

A day without new
knowledge is a lost day.

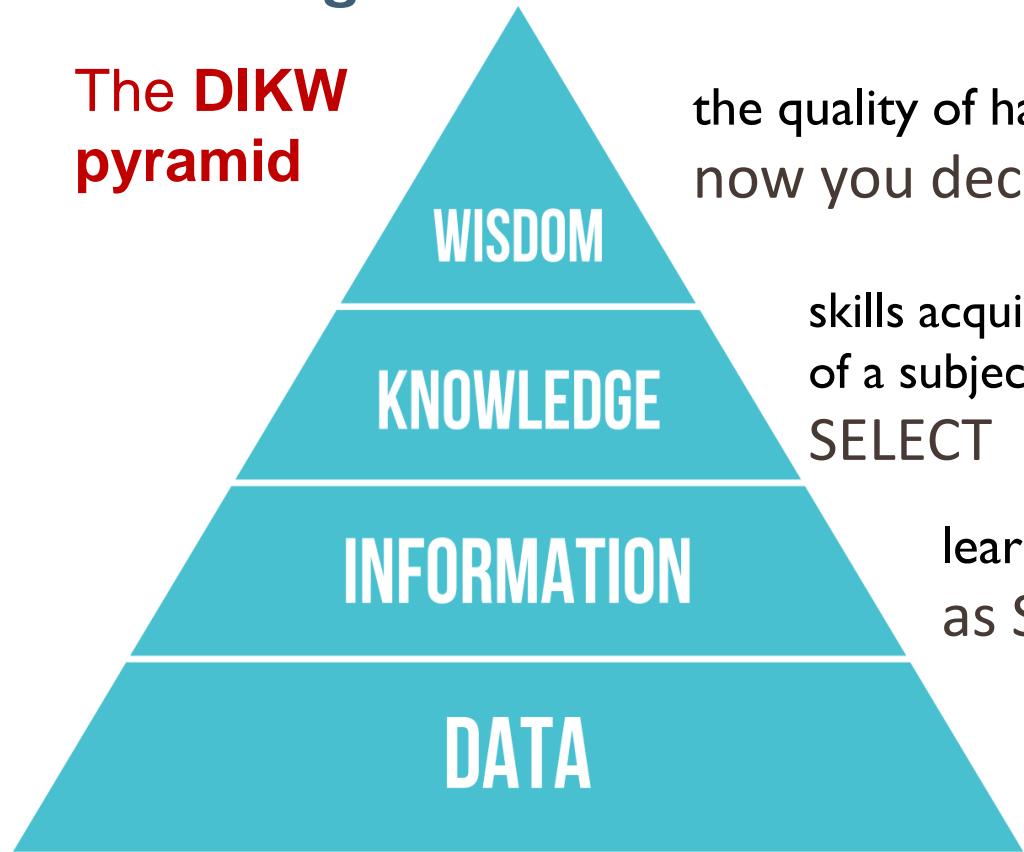
Database Technologies – MySQL

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

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

DIKW Model describes how the data can be processed and transformed into **information**, **knowledge**, and **wisdom**.

The **DIKW** pyramid



the quality of having experience, knowledge, and good judgement.
now you decide when to use and how to use(**wisdom**)

skills acquired through education, it can be theoretical or practical understanding
of a subject.
SELECT potential (**knowledge**)

learned about something or someone.
as SELECT (symbol: σ) (**information**)

Sigma(σ) (**data**)

Let's take another example.

wisdom

- Our employees Ben, Jo, and Tom are young.
- Our employees Ben, Jo, and Tom are in 20's
- Toy is going to retire next year.
-

knowledge

Age of employees:

$R = \{ \text{Ben is 25 yrs. Old}, \text{Jo is 29 yrs. Old}, \text{Kim is 45 yrs. Old}, \text{Tom is 23 yrs. Old}, \text{Toy is 60 yrs. Old}, \dots \}$

Information

Now we arrange the data and make some sense and create information.

set A is **Age**, set B is **Name**

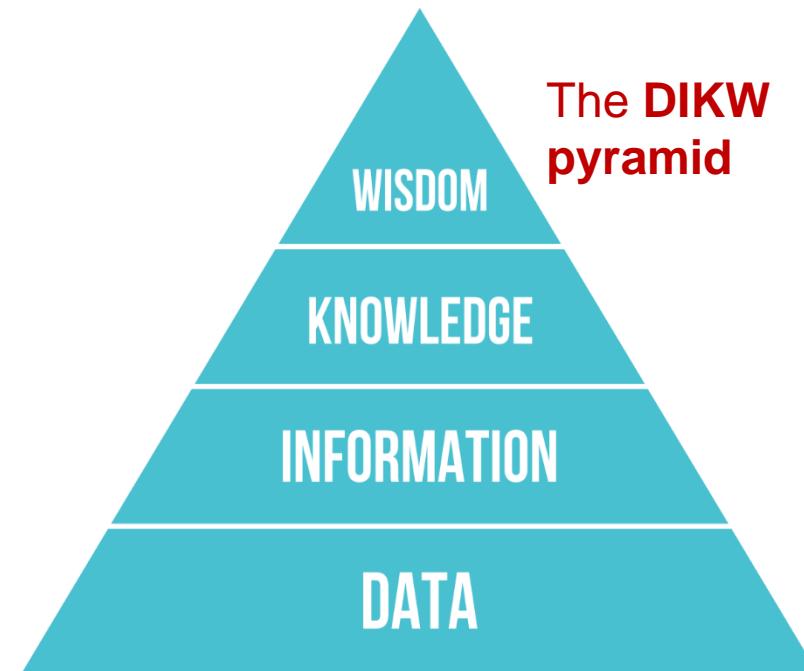
Age – { 25, 29, 45, 23, 60, 51, 35, }

Name – { Ben, Jo, Kim, Tom, Toy, Sam, Don, }

data

set A – { 25, 29, 45, 23, 60, 51, 35, }

set B – { Ben, Jo, Kim, Tom, Toy, Sam, Don, }



Class Room

Session 1

Introduction

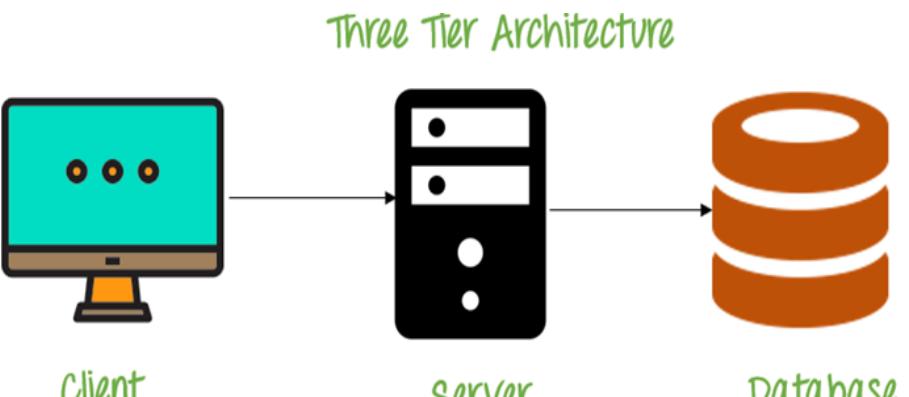
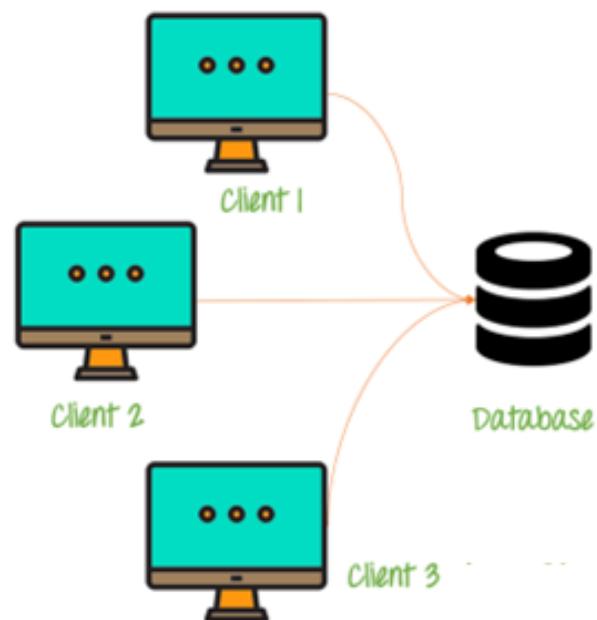
- If anyone who wants to develop a good application then he should have the knowledge three major components.

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 }



Single Tier Architecture



Introduction

- A layer refers to pieces of software that are logically separated, but typically live within the same process and machine.
- A tier, instead, refers to pieces of software that live in distinct processes or AppDomains or machines.
- A tier refers to physical separation; a layer is about logical separation.

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, etc.)

Cultural means: the ideas, customs, and social behaviour of a particular people or society..

Introduction

4 Important Roles of Database in Industry.

- It is needed for data access within the company.
- It is needed to maintain strong relationships between data.
- This system allows newer(latest) and better updates.
- It helps to search data in a better manner.

What is Relation and Relationship?

Remember:

- A **reference** is a relationship between two tables where the values in one table refer to the values in another table.
- 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.

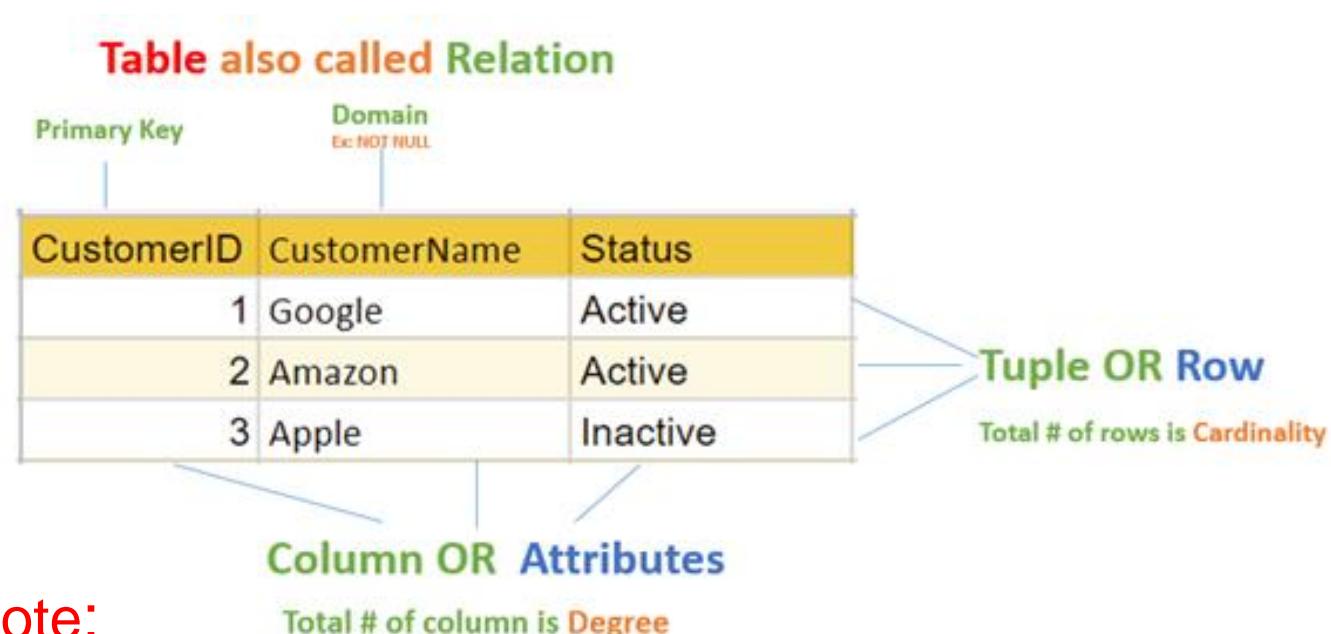
Relationship: In database, relationship is that how the two entities are **connected** to each other, i.e. what kind of relationship type they hold between them.

Primary/Foreign key is used to specify this relationship.

Remember:

Foreign Key is also know as

- referential constraint
- referential integrity constraint. (Referential integrity constraint is the state of a database in which all values of all foreign keys are valid.)



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

```
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];
```

file-oriented system File Anomalies

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
```

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

file-oriented system

File Anomalies

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
```

file-oriented system

A **flat file** database is a database that stores data in a plain text **file** (e.g. ***.txt**, ***.csv** format). Each line of the text **file** holds one record, with fields separated by delimiters, such as **commas** or **tabs**.

1 rajan MG Road Pune MH 34500

2 rahul patil SSG Lane Pune MH 54000

3 suraj raj k Deccan Gymkhana Pune MH 22000

4, S M Kumar, Mg Road Pune MH, 32000

5, S M Kumar, Mg Road, Pune, MH, 32000

1,raj,k,1984-06-12,raj.kumar@gmail.com

2,om,,1969-10-25,om123@gmail.com

3,rajes,kumar,1970-10-25,

4,rahul,patil,1982-10-31,rahul.patil@gmail.com

5,ketan,,,ruhan.bagde@gmail.com

The Zen of Python,

Beautiful is better than ugly.

Explicit is better than implicit.

Simple is better than complex.

Complex is better than complicated.

Flat is better than nested.

Sparse is better than dense.

Readability counts.

Special cases aren't special enough to break the rules.

Although practicality beats purity.

Errors should never pass silently.

Unless explicitly silenced.

In the face of ambiguity, refuse the temptation to guess.

There should be one-- and preferably only one --obvious way to do it.

Although that way may not be obvious at first unless you're Dutch.

Now is better than never.

Although never is often better than *right* now.

If the implementation is hard to explain, it's a bad idea.

If the implementation is easy to explain, it may be a good idea.

Namespaces are one honking great idea -- let's do more of those!

advantages of file-oriented system

The biggest advantage of file-based storage is that anyone can understand the system.

Advantage of File-oriented system

- **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.

Disadvantage of File-oriented system

- **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 customers 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.
- **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.
- **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.

A **database application** is a computer program whose primary purpose is entering and retrieving information.

What is database?

A major purpose of a database system is to provide users with an **abstract view** of the data.

abstract means existing in thought or as an idea but not having a physical or concrete existence.



what is database?

A database is a system to **organize**, **store** and **retrieve** large amounts of data easily, which is stored in **one** or **more data files** by **one** or **more users**.

Each database is a collection of tables, which are called **relations**, hence the name "**relational database**".



Relation Schema: A relation schema represents name of the relation with its attributes.

- e.g. student (roll_no int, name varchar, address varchar, phone varchar and age int) is relation schema for STUDENT

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.



ORACLE

PostgreSQL



SYBASE

IBM **DB2.**

Difference between File System and DBMS

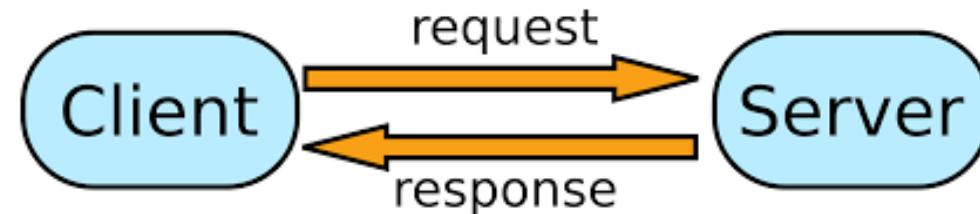
File Management System	Database Management System
• File System is easy-to-use system to store data which require less security and constraints.	• Database Management System is used when security constraints are high.
• Data Redundancy is more in File System.	• Data Redundancy is less in Database Management System.
• Data Inconsistency is more in File System.	• Data Inconsistency is less in Database Management System.
• Centralization is hard to get when it comes to File System.	• Centralization is achieved in Database Management System.
• User locates the physical address of the files to access data in File System.	• In Database Management System, user is unaware of physical address where data is stored.
• Security is low in File System.	• Security is high in Database Management System.
• File System stores unstructured data. "unstructured data" may include documents, audio, video, images, etc.	• Database Management System stores structured data.

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.

difference between dbms and rdbms

DBMS	RDBMS
<ul style="list-style-type: none">• Data is stored as file.	<ul style="list-style-type: none">• Data is stored as tables.
<ul style="list-style-type: none">• There is no relationship between data in DBMS.	<ul style="list-style-type: none">• Data is present in multiple tables which can be related to each other.
<ul style="list-style-type: none">• DBMS has no support for distributed databases.	<ul style="list-style-type: none">• RDBMS supports distributed databases.
<ul style="list-style-type: none">• Normalization cannot be achieved.	<ul style="list-style-type: none">• Normalization can be achieved.
<ul style="list-style-type: none">• DBMS supports single user at a time.	<ul style="list-style-type: none">• RDBMS supports multiple users at a time.
<ul style="list-style-type: none">• Data Redundancy is common in DBMS.	<ul style="list-style-type: none">• Data Redundancy can be reduced in RDBMS.
<ul style="list-style-type: none">• DBMS provides low level of security during data manipulation.	<ul style="list-style-type: none">• RDBMS has high level of security during data manipulation.

Codd's Rules

Rule 1: Information Rule

The data stored in a database, may it be user data or metadata, must be a value of some table cell. Everything in a database must be stored in a table format.

Rule 2: Guaranteed Access Rule

Every single data is guaranteed to be accessible with a combination of table-name, primary-key (row value), and attribute-name (column value).

Rule 3: Systematic Treatment of NULL Values

The NULL values in a database must be given a systematic and uniform treatment. This is a very important rule because a NULL can be interpreted as one the following – data is missing, data is not known, or data is not applicable.

Rule 4: Active Online Catalog

The structure description of the entire database must be stored in an online catalog, known as **data dictionary**, which can be accessed by authorized users.

Rule 5: Comprehensive Data Sub-Language Rule

A database can only be accessed using a language having linear syntax that supports data definition, data manipulation, and transaction management operations. This language can be used directly or by means of some application. If the database allows access to data without any help of this language, then it is considered as a violation.

Rule 6: View Updating Rule

All the views of a database, which can theoretically be updated, must also be updatable by the system.

Rule 7: High-Level Insert, Update, and Delete Rule

A database must support high-level insertion, updation, and deletion. This must not be limited to a single row, that is, it must also support union, intersection and minus operations to yield sets of data records.

Rule 8: Physical Data Independence

The data stored in a database must be independent of the applications that access the database. Any change in the physical structure of a database must not have any impact on how the data is being accessed by external applications.

Rule 9: Logical Data Independence

The logical data in a database must be independent of its user's view (application). Any change in logical data must not affect the applications using it. For example, if two tables are merged or one is split into two different tables, there should be no impact or change on the user application. This is one of the most difficult rule to apply.

Rule 10: Integrity Independence

A database must be independent of the application that uses it. All its integrity constraints can be independently modified without the need of any change in the application. This rule makes a database independent of the front-end application and its interface.

Rule 11: Distribution Independence

The end-user must not be able to see that the data is distributed over various locations. Users should always get the impression that the data is located at one site only. This rule has been regarded as the foundation of distributed database systems.

Rule 12: Non-Subversion Rule

If a system has an interface that provides access to low-level records, then the interface must not be able to subvert the system and bypass security and integrity constraints.

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**.

- **Tables** – In relational model, relations are saved in the form of Tables. A table has rows and columns.
- **Attribute** – Attributes are the properties that define a relation. **e.g.** (**roll_no, name, address, phone and age**)
- **Tuple** – 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) with its attribute (column) names.
e.g. **student(prn, name, address, phone, DoB, age, hobby, email, status)** is relation schema for student relation.
- **Attribute domain** – An attribute domain specifies the data type, format, constraints of a column, and defines the range of values that are valid for that column.

Remember:

- In database management systems, **NULL** 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 a 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.



ACID

ACID properties of transactions

Atomicity. In a transaction involving two or more separate pieces of information, either all of the pieces are committed or none are.

For example, in an application that transfers funds from one account to another, the atomicity property ensures that, if a debit is made successfully from one account, the corresponding credit is made to the other account.

Consistency. A transaction either creates a new and valid state of data, or, if any failure occurs, returns all data to its state before the transaction was started.

For example, in an application that transfers funds from one account to another, the consistency property ensures that the total value of funds in both the accounts is the same at the start and end of each transaction.

Isolation. A transaction in process and not yet committed must remain isolated from any other transaction.

For example, If multiple users attempt to transfer money at the same time, the transactions should be isolated from one another to prevent conflicts or inconsistencies. Each transaction should be treated as if it is the only transaction being executed at that time.

Durability. Committed data is saved by the system such that, even in the event of a failure and system restart, the data is available in its correct state.

For example, in an application that transfers funds from one account to another, the durability property ensures that the changes made to each account will not be reversed.

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.

In relation to a database , an entity is a

- Person(student, teacher, employee, department, ...)
- Place(classroom, building, ...) --a particular position or area
- Thing(computer, lab equipment, ...) --an object that is not named
- 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.

What is Entity Type?

entity type

The entities that have the **common attributes** is called an **entity type**.

Each entity type in the database is described by a **name** and **a list of attributes**.

e.g. an entity Person is an entity type that has *Age*, *Name* and *Address* attributes.

Eg.

Entity TYPE

Person (Age, Name, Address, ...)

Entity

17 , Sharmin, Paud Road, ...

When you are designing attributes for your entities, **you will sometimes find that an attribute does not have a value**. For example, you might want an attribute for a person's middle name, but you can't require a value because some people have no middle name. For these, you can define the attribute so that it can contain null values.

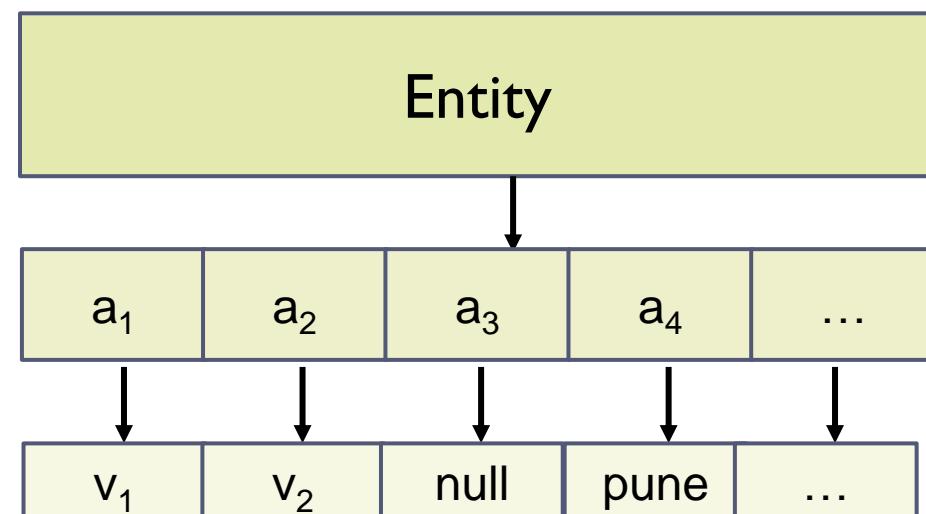
In database management systems, **null** is used to represent missing or unknown data in a table column.

What is an Attribute?

Attributes are the properties that define a relation.

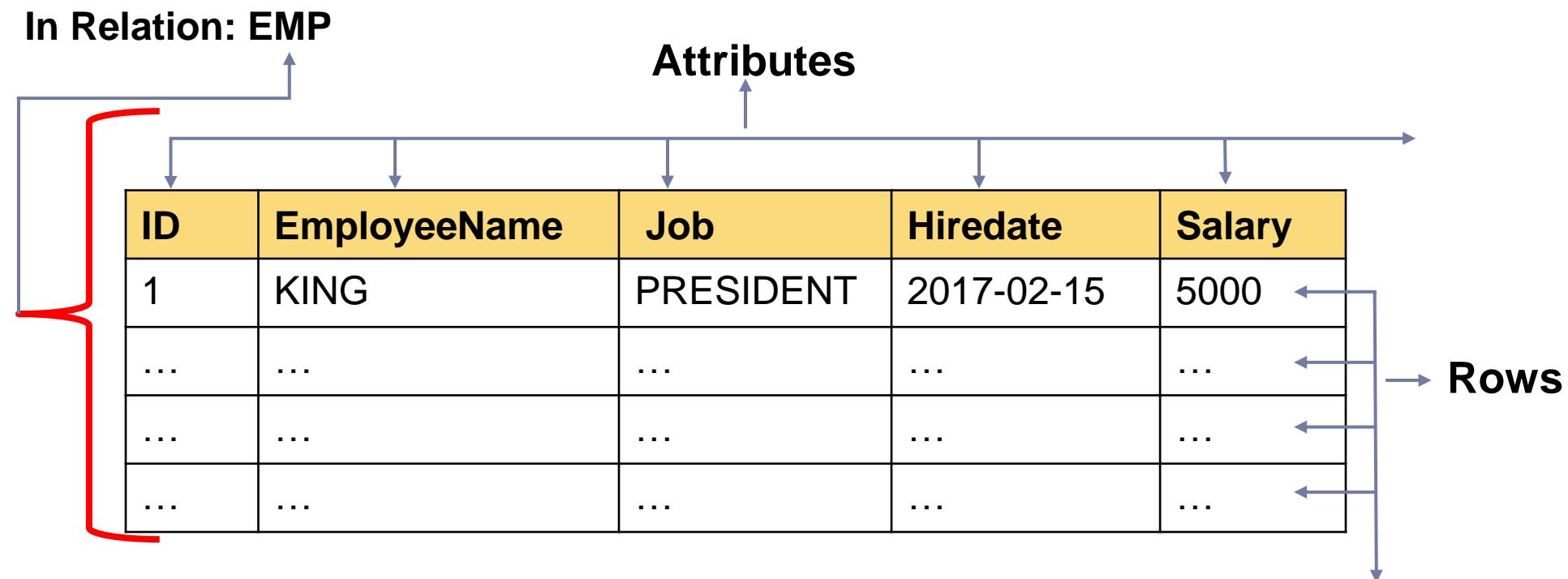
e.g. student(ID, firstName, middleName, lastName, city)

In some cases, you might not want a specific attribute to contain a null value, but you don't want to require that the user or program always provide a value. In this case, a default value might be appropriate. **A default value is a value that applies to an attribute if no other valid value is available.**



A table has rows and columns

In RDBMS, a table organizes data in rows and columns. The **COLUMNS** are known as **ATTRIBUTES / FIELDS** whereas the **ROWS** are known as **RECORDS / TUPLE**.



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 (Can't be divided further)	--VS--	Composite Attribute (Can be divided further)
• Single Value Attribute (Only One value)	--VS--	Multi Valued Attribute (Multiple values)
• Stored Attribute (Only One value)	--VS--	Derived Attribute (Virtual)
• Complex Attribute (Composite & Multivalued)		

- **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 has only single value is known as single valued attribute.
e.g. manufactured part can have only one serial number, voter card, blood group, price, quantity, branch 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.

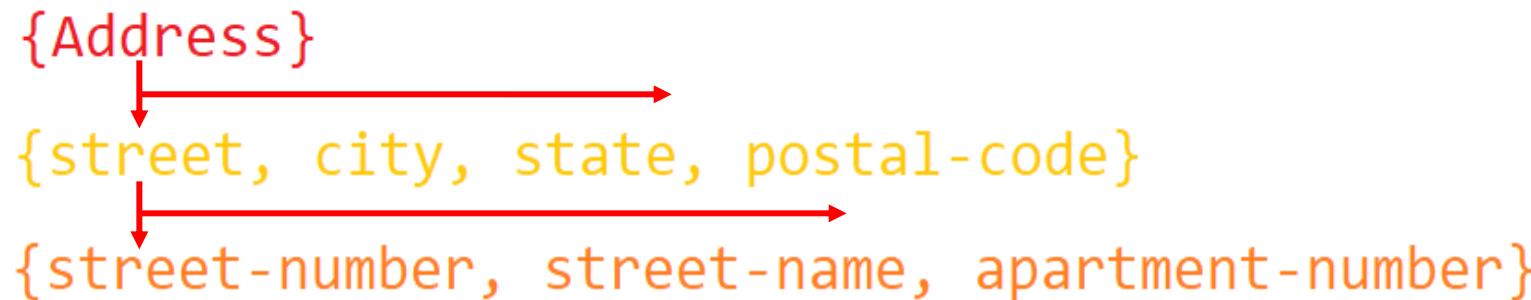
Composite VS Multi Valued Attribute

composite / multi valued attributes

Composite Attribute

Person Entity

- *Name* attribute: (firstName, middleName, and lastName)
- *PhoneNumber* attribute: (countryCode, cityCode, and phoneNumber)



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@yahoo.com, ...]

What is an Prime, Non-Prime
Attribute?

Prime attribute (*Entity integrity*)

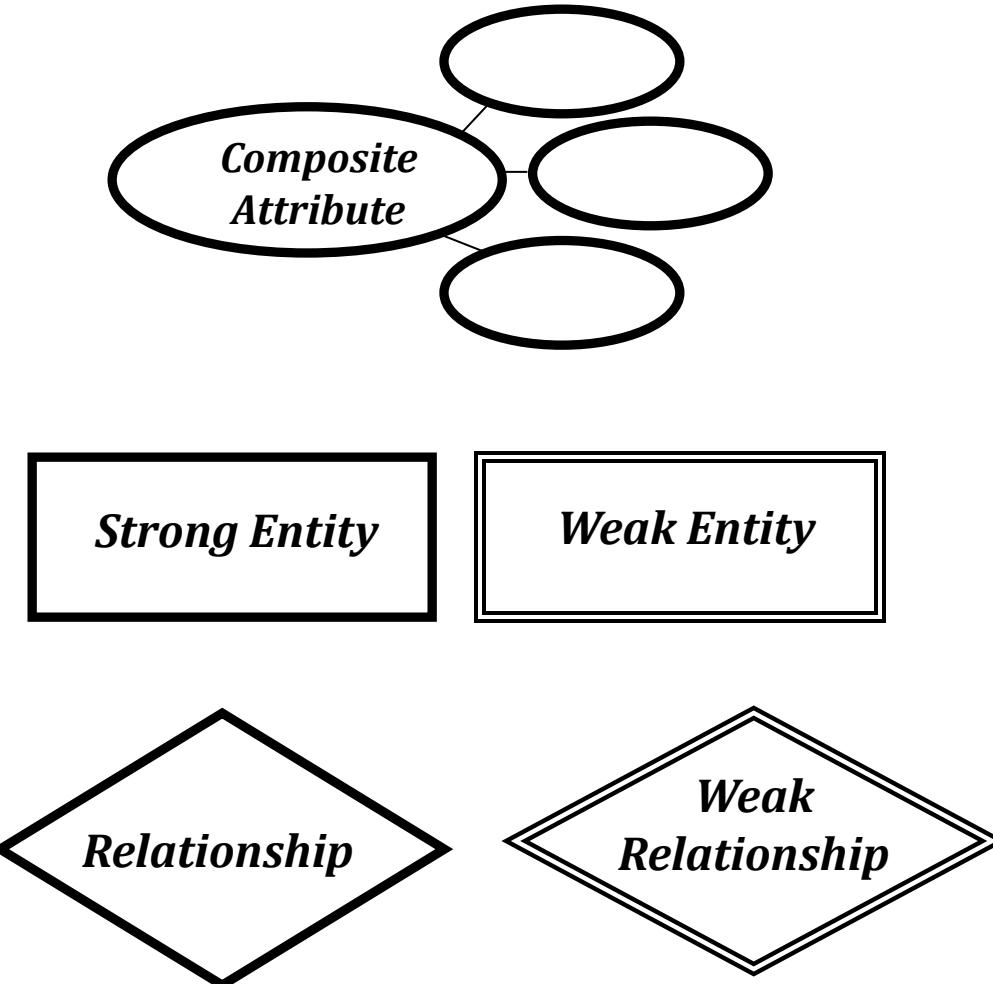
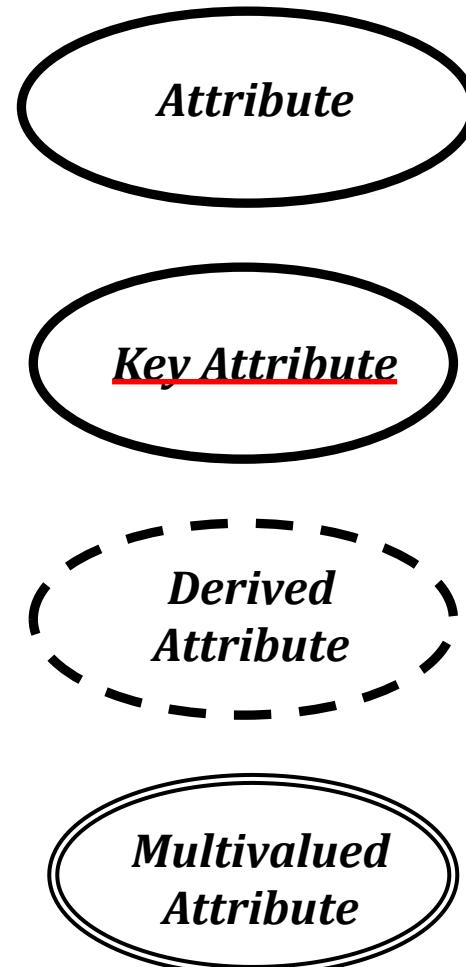
An attribute, which is a **part of the prime-key** (candidate key), is known as a prime attribute.

Non-prime attribute

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

Entity Relationship Diagram Symbols

entity relationship diagram symbols



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

participation constraints

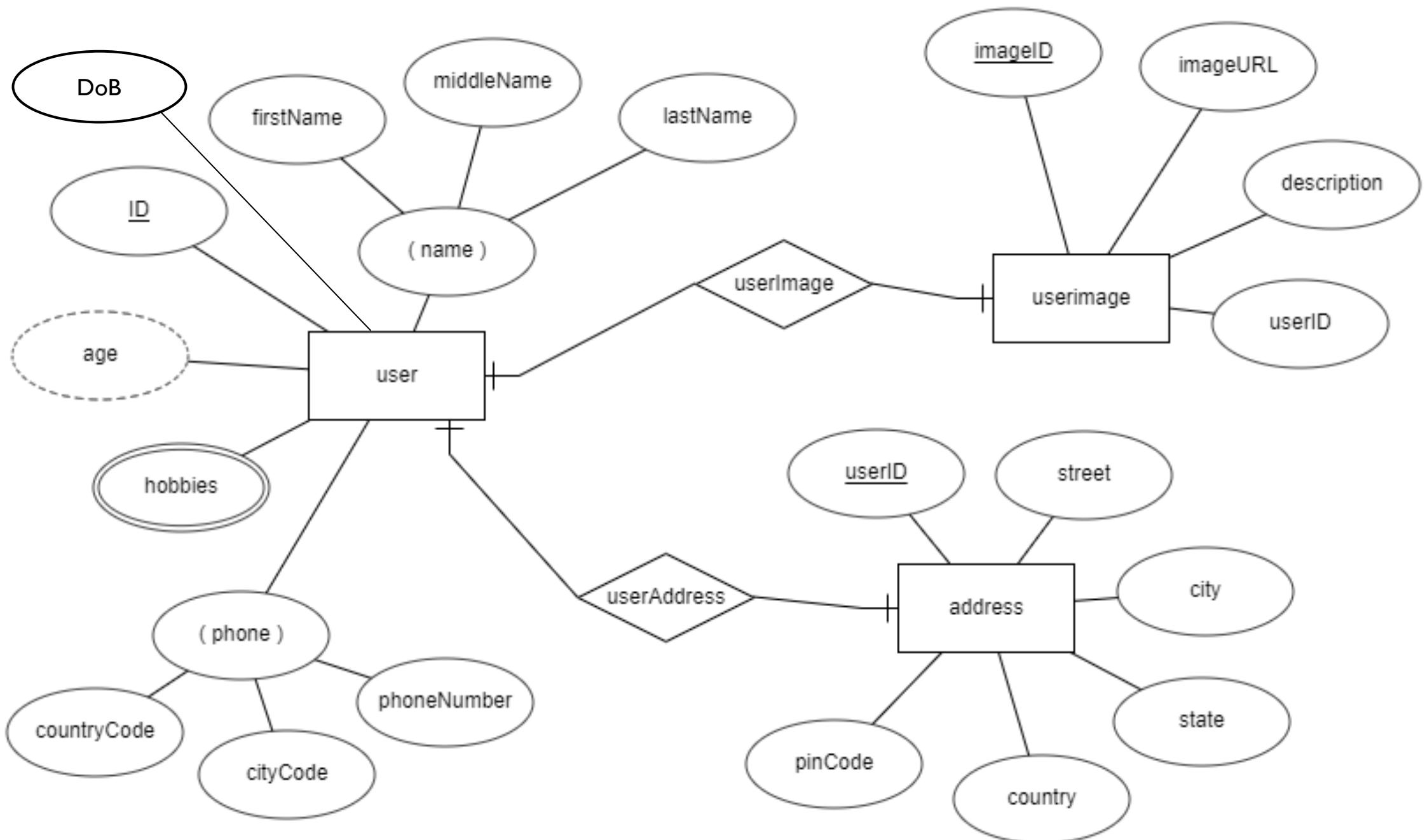
An entity may participate in a relation either totally or partially.

Total participation means that every entity is involved in the relationship, e.g., each student must be guided by a professor (there are no students who are not guided by any professor). This kind of relation is represented as a double line.

Partial participation means that not all entities are involved in the relationship, e.g., not every professor guides a student (there are professors who don't). A partial participation is represented by a single line.



entity relationship diagram



What is a degree, cardinality, domain and union in database?

What is a degree, cardinality, domain 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 $d(R)$.
- **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*.
- **Domain:** Total range of accepted values for an attribute of the relation **is called the domain of the attribute.** (**Data Type(size)**)
- **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 $d(R)$** .
 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 in the table. There are primarily two types of integrity constraints that help us in ensuring the uniqueness of each row, namely, UNIQUE 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 relationship then it should always reference a corresponding value in the second table $t_1[\text{FK}] = t_2[\text{PK}]$ or it should be null.
- **Domain integrity:** A domain is a set of values of the same type. For example, we can specify if a particular column can hold null values or not, if the values have to be unique or not, the data type or size of values that can be entered in the column, the default values for the column, etc..

Degrees of relationship

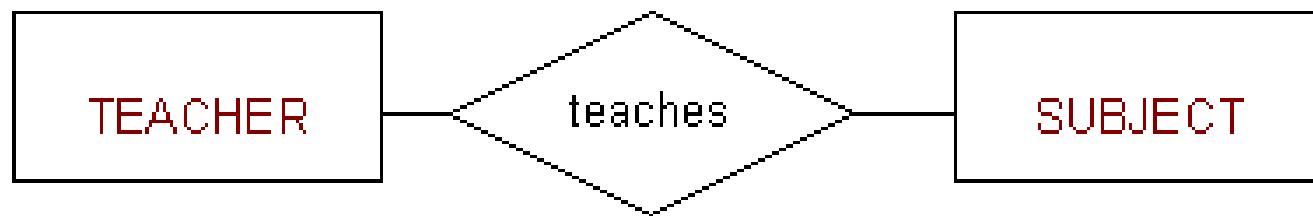
In DBMS, a **degree of relationship** represents the number of entity types that associate in a relationship.

1. Unary
2. Binary
3. Ternary
4. N-ary

relationships - binary

The three most common relationships in ER models are **Binary**, **Unary**, and **Ternary**

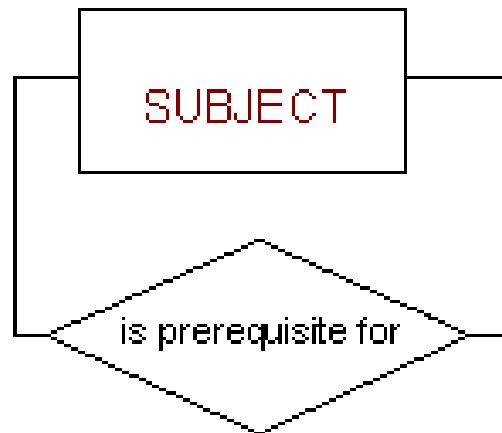
A ***binary relationship*** is when two entities participate and is the most common relationship.



relationships - unary

The three most common relationships in ER models are **Binary**, **Unary**, and **Ternary**

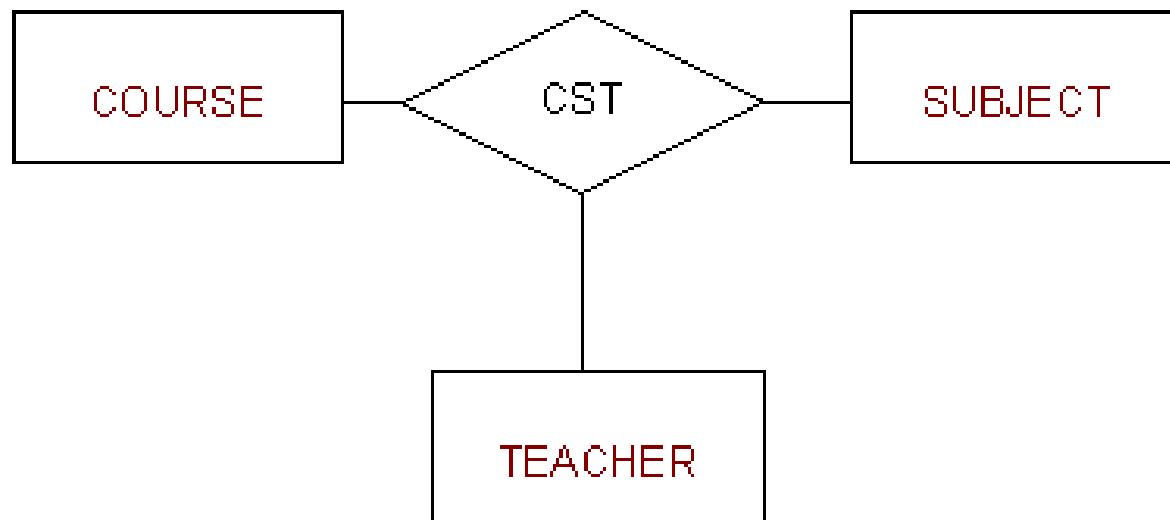
A *unary relationship* is when both participants in the relationship are the same entity.



relationships - ternary

The three most common relationships in ER models are **Binary**, **Unary**, and **Ternary**

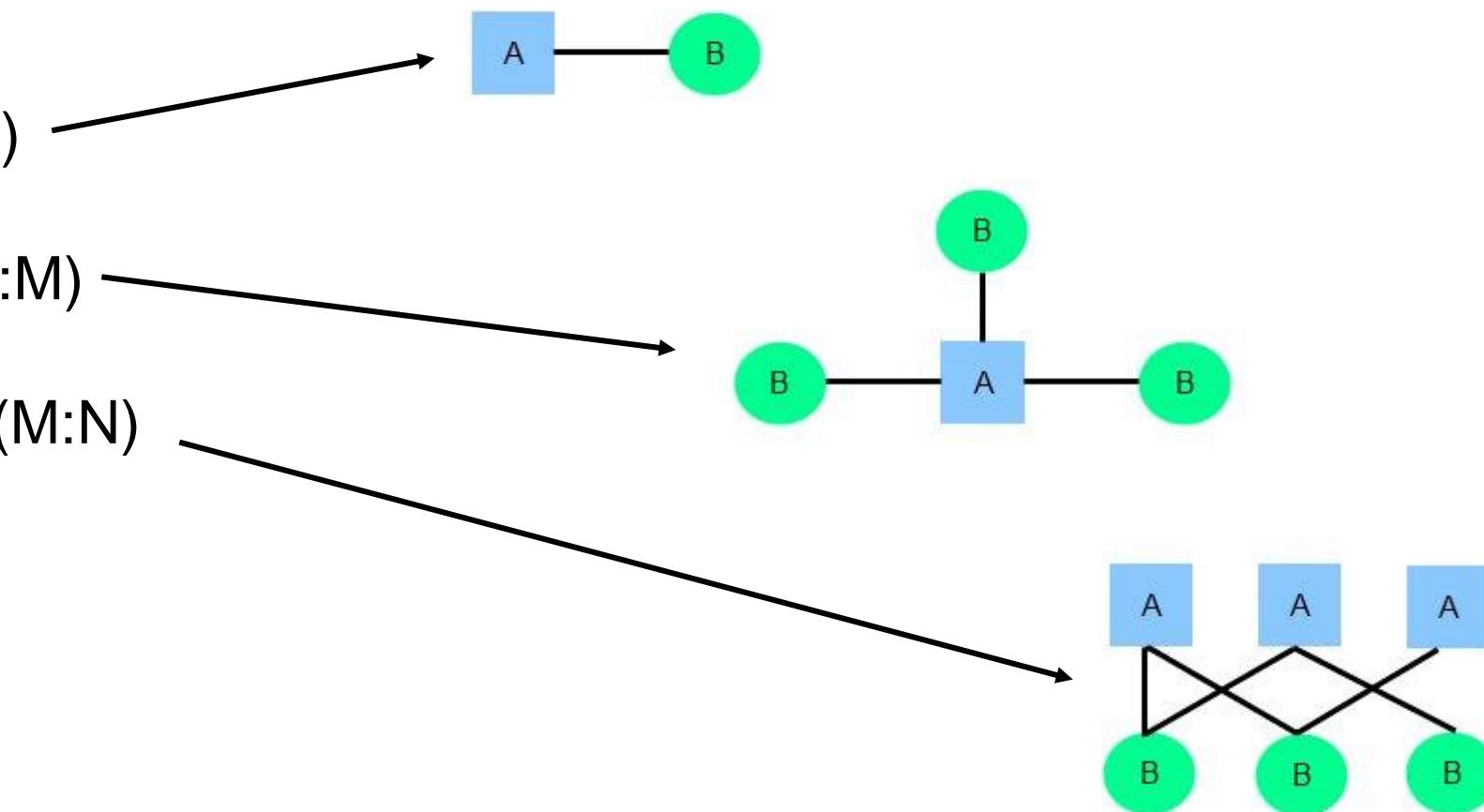
A **ternary relationship** is when three entities participate in the relationship.



Common relationships

Common relationship

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



- ONE patient is allocated ONE bed
- ONE bed is occupied by ONLY ONE patient

relationships



One



Many



One (and only one)



Zero or one



One or many

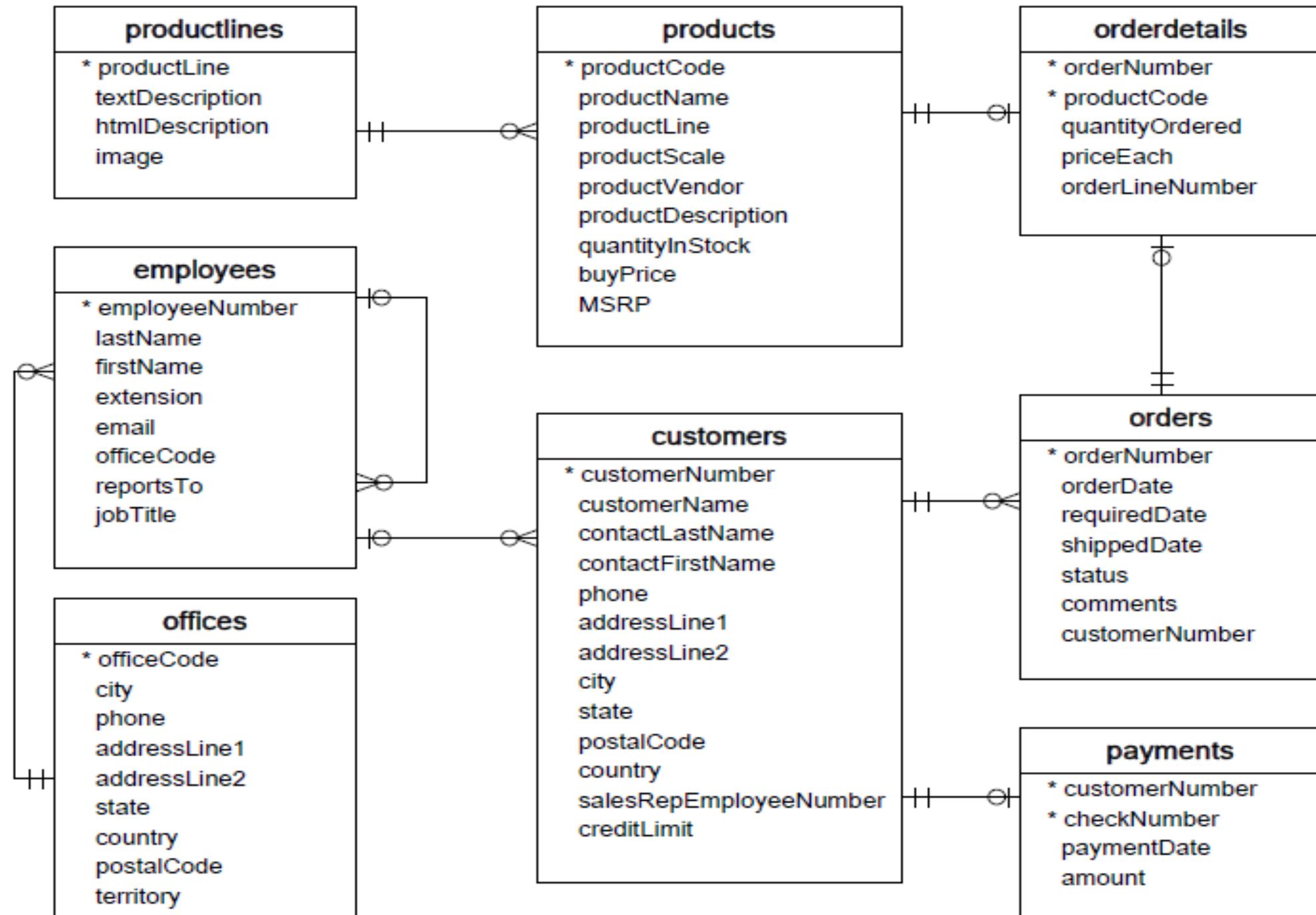


Zero or many

One and ONLY One (||) Min & Max only One

relationships

Notation	Meaning	Example
—	Relationship	<pre> classDiagram class Student class University Student "Enrolls" --> University </pre>
+	One	<pre> classDiagram class Student class StudentIDNumber Student "+" --> "Has" StudentIDNumber </pre>
-->	Many	<pre> classDiagram class Student class Class Student --> "Attends" Class </pre>
++	One and ONLY One	<pre> classDiagram class Student class Chair Student "++" --> "Uses" Chair </pre>
—o+	Zero or One	<pre> classDiagram class Student class SSN Student "—o+" --> "+o—" "Has" SSN </pre>
-->	One or Many	<pre> classDiagram class Instructor class Class Instructor --> "Teaches" Class </pre>
—o-->	Zero or Many	<pre> classDiagram class Classroom class Chair Classroom "—o-->" --> "<--o—" "Has" Chair </pre>

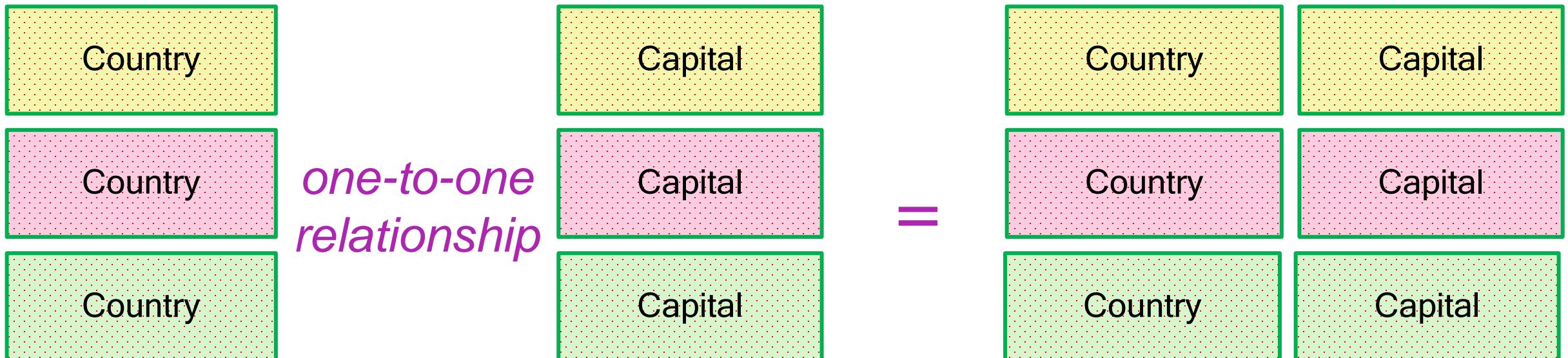


one-to-one relationship

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.

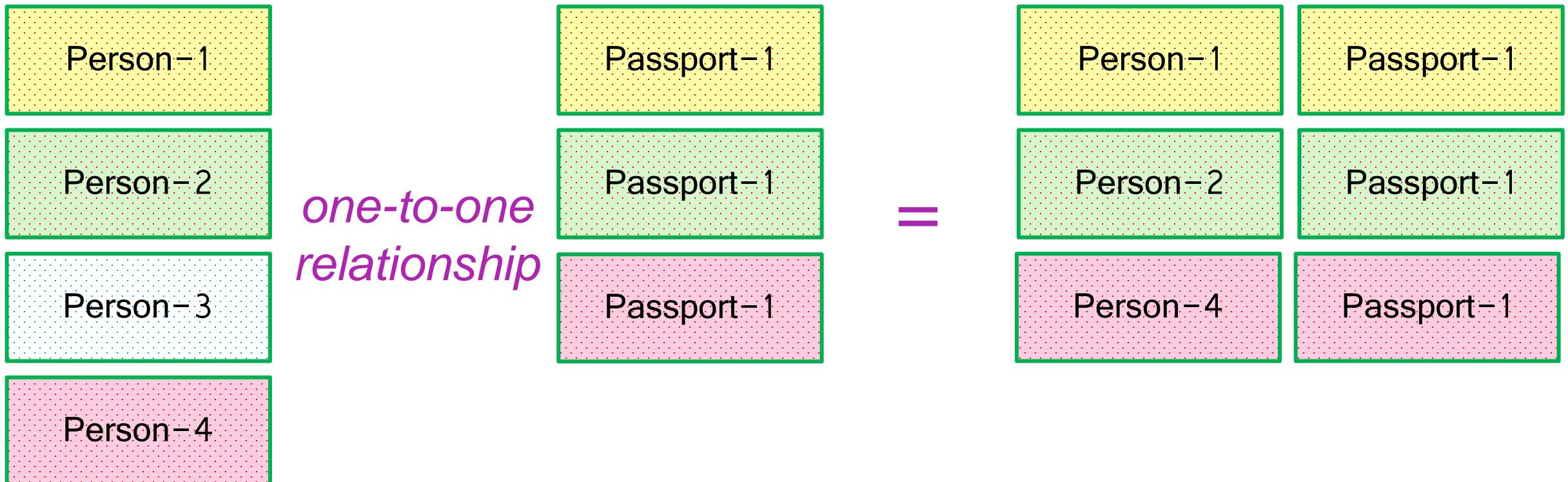
A *one-to-one* relationship is a type of cardinality that refers to the relationship between two entities R and S in which one element of entity R may only be linked to zero/one element of entity S , and vice versa.



one-to-one relationship

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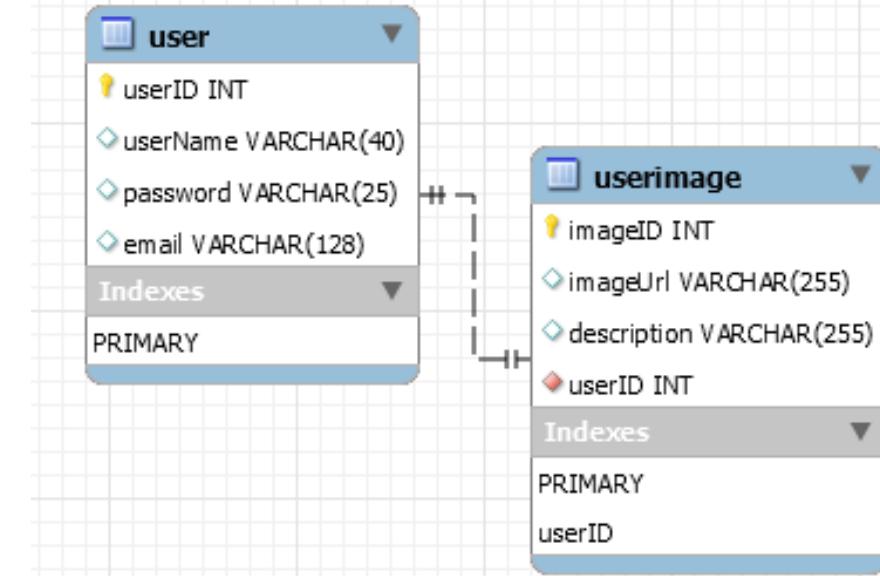


how to create one-to-one relationship

```
CREATE TABLE user (
    userID INT PRIMARY KEY,
    userName VARCHAR(40),
    password VARCHAR(25),
    email VARCHAR(128)
);
```

```
CREATE TABLE userImage (
    imageID INT PRIMARY KEY,
    imageUrl VARCHAR(255),
    description VARCHAR(255),
    userID INT NOT NULL UNIQUE,
    FOREIGN KEY(userID) REFERENCES user(userID)
);
```

	userID	userName	password	email
▶	1	Ramesh	*****	ramesh@gmail.com
	2	Rajan	*****	rajan.hotmail.com
	3	Kumar	*****	kumer112@yahooomail.com
	4	Suraj	*****	suran@gmail.com
●	NULL	NULL	NULL	NULL

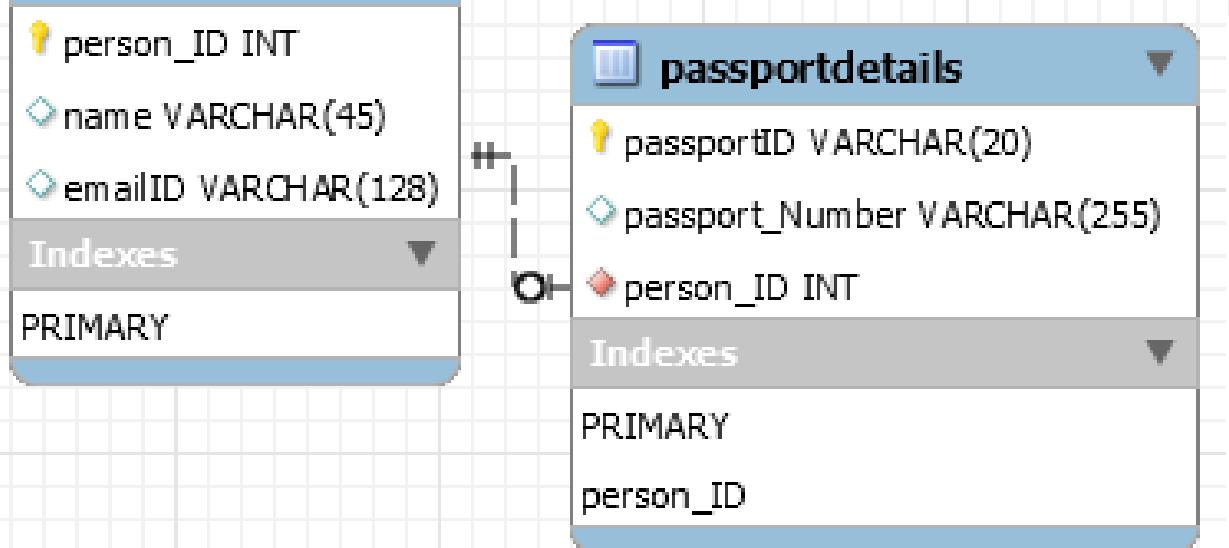
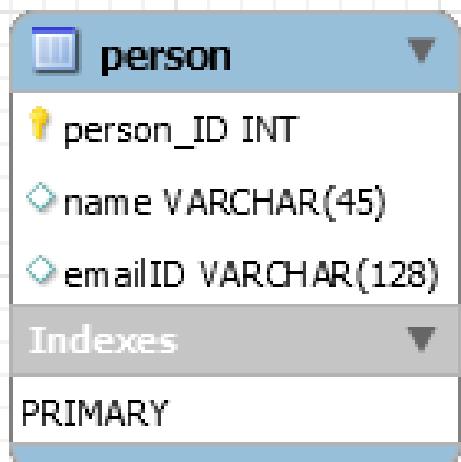


	imageID	imageUrl	description	userID
▶	1001	c:/images/img1.jpeg	For passport	1
	1002	c:/images/img2.jpeg	For Voter Card	2
	1003	c:/images/img3.jpeg	For AADHAR Card	3
	1004	c:/images/img4.jpeg	For Licence	4
●	NULL	NULL	NULL	NULL

how to create one-to-one relationship

```
CREATE TABLE person (
    person_ID INT PRIMARY KEY ,
    name VARCHAR(45),
    emailID VARCHAR(128)
);
```

	person_ID	name	emailID
▶	1	Ramesh	ramesh@gmail.com
	2	Rajan	rajan.hotmail.com
	3	Kumar	kumer112@yahoo.com
●	4	Suraj	suran@gmail.com
	NULL	NULL	NULL



```
CREATE TABLE passportDetails (
    passportID VARCHAR(20) PRIMARY KEY,
    passport_Number VARCHAR(255),
    person_ID INT UNIQUE,
    FOREIGN KEY(person_ID) REFERENCES person(person_ID)
);
```

	passportID	passport_Number	person_ID
▶	IN-zx001	IN-XAJS1028S	1
	IN-zx002	IN-XBDH1738S	2
	IN-zx003	IN-XCKE1933S	3
●	NULL	NULL	NULL

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 rows 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 rows 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*

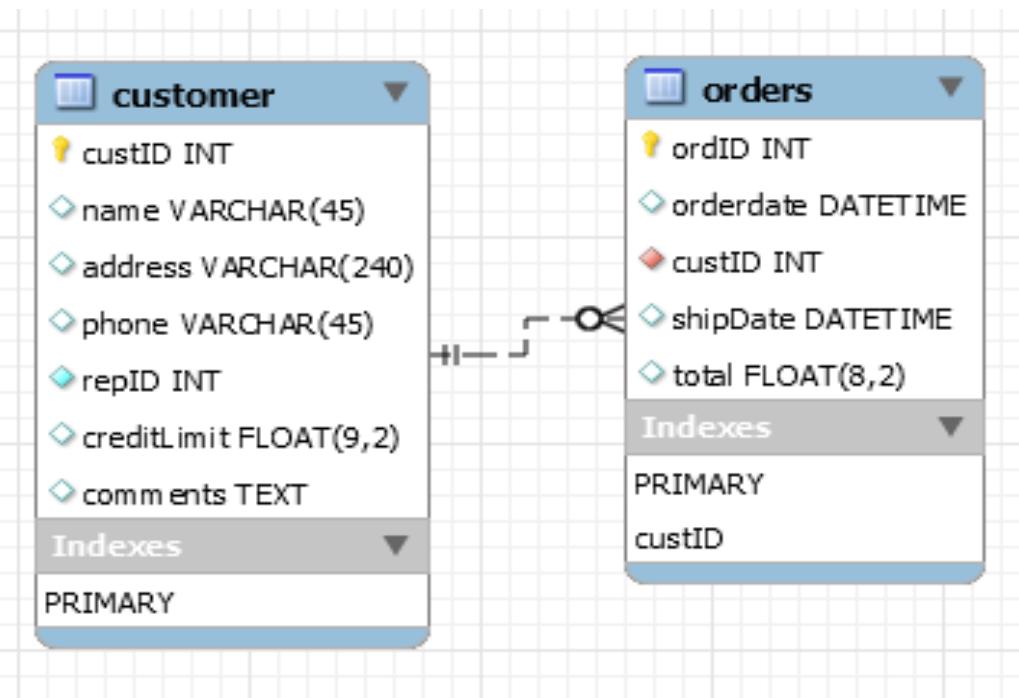
Invoice_Item-1
Invoice_Item-1
Invoice_Item-2
Invoice_Item-1
Invoice_Item-2
Invoice_Item-2
Invoice_Item-1
Invoice_Item-1

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

how to create one-to-many relationship

```
CREATE TABLE customer (
    custID INT PRIMARY KEY,
    name VARCHAR(45),
    address VARCHAR(240),
    phone VARCHAR(45),
    repID INT NOT NULL,
    creditLimit FLOAT(9,2),
    comments TEXT,
    constraint custid_zero CHECK(custID > 0)
);
```

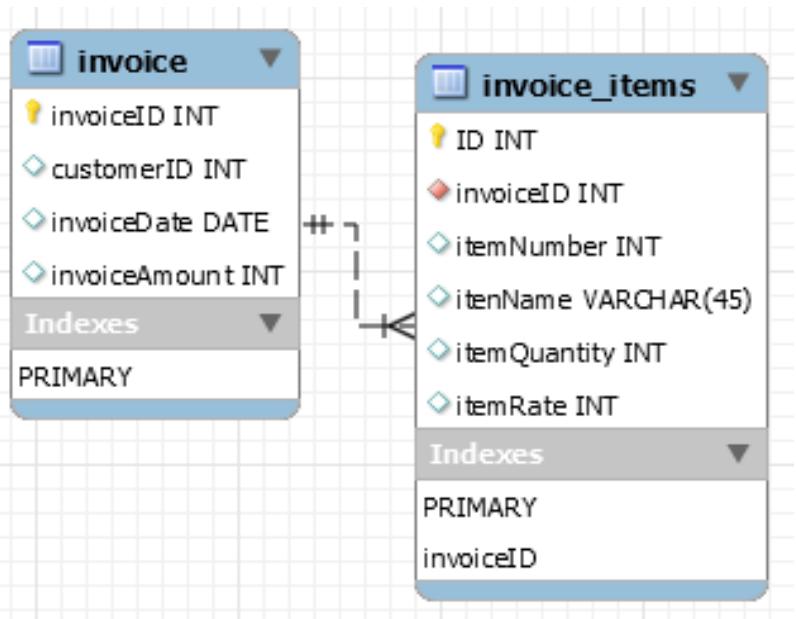
```
CREATE TABLE orders (
    ordID INT PRIMARY KEY,
    orderdate DATETIME,
    custID INT,
    shipDate DATETIME,
    total FLOAT(8,2),
    FOREIGN KEY(custID) REFERENCES customer(custID),
    constraint total_greater_zero CHECK(total >= 0)
);
```



how to create one-to-many relationship

```
CREATE TABLE invoice (
    invoiceID INT PRIMARY KEY,
    customerID INT,
    invoiceDate DATE,
    invoiceAmount INT
);
```

	invoiceID	customerID	invoiceDate	invoiceAmount
▶	1	235	2020-01-13	1750
	2	235	2020-02-28	5000
	3	778	2020-03-10	2000
	4	778	2020-03-16	2300
*	HULL	HULL	HULL	HULL



```
CREATE TABLE invoice_items (
    invoiceID INT,
    itemID INT,
    itenName VARCHAR(45),
    itemQuantity INT,
    itemRate INT,
    PRIMARY KEY(invoiceID, itemID),
    FOREIGN KEY(invoiceID) REFERENCES invoice(invoiceID)
);
```

```
CREATE TABLE invoice_items (
    invoiceID INT NOT NULL,
    itemID INT NOT NULL,
    itenName VARCHAR(45),
    itemQuantity INT,
    itemRate INT,
    UNIQUE(invoiceID, itemID),
    FOREIGN KEY(invoiceID) REFERENCES invoice(invoiceID)
);
```

many-to-one relationship

```

CREATE TABLE users (
    userID INT,
    loginID INT,
    userName VARCHAR(45),
    PRIMARY KEY(loginID, userID),
    constraint fk_users_login_loginID1 FOREIGN KEY(loginID)
        REFERENCES login(loginID)
);

```

```

CREATE TABLE users (
    userID INT NOT NULL,
    loginID INT NOT NULL,
    userName VARCHAR(45),
    UNIQUE(loginID, userID),
    constraint fk_users_login_loginID2 FOREIGN KEY(loginID)
        REFERENCES login(loginID)
);

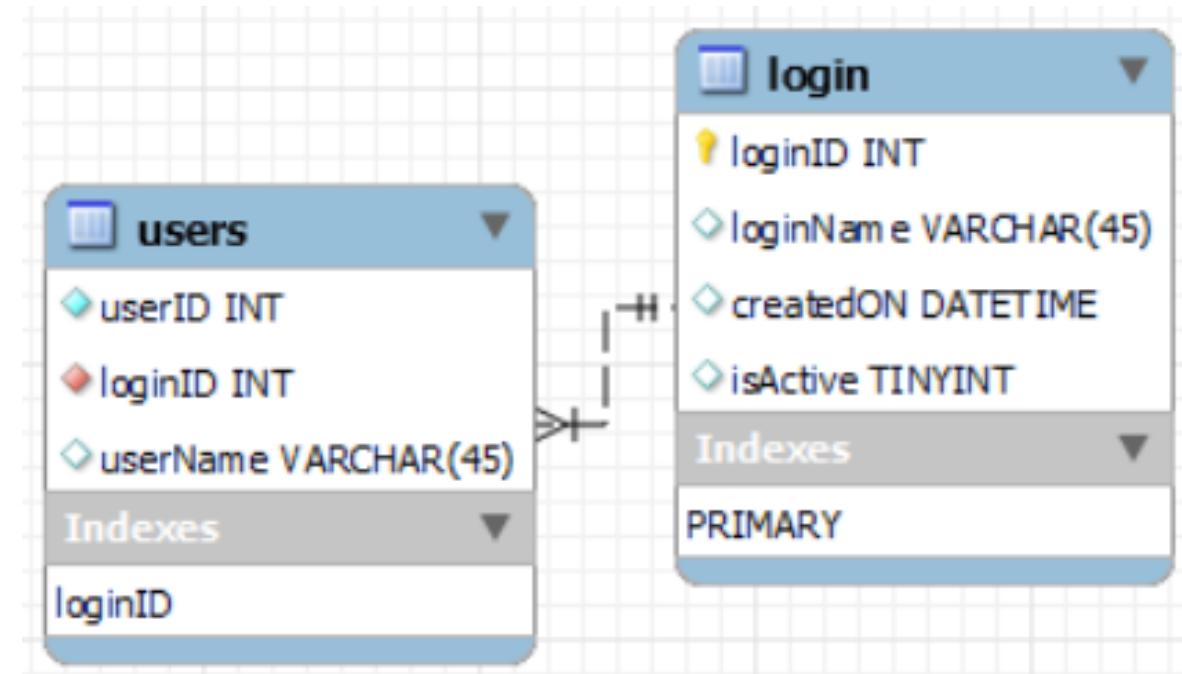
```

```

CREATE TABLE login (
    loginID INT,
    loginName VARCHAR(45),
    createdON DATETIME,
    isActive TINYINT,
    PRIMARY KEY(loginID)
);

```

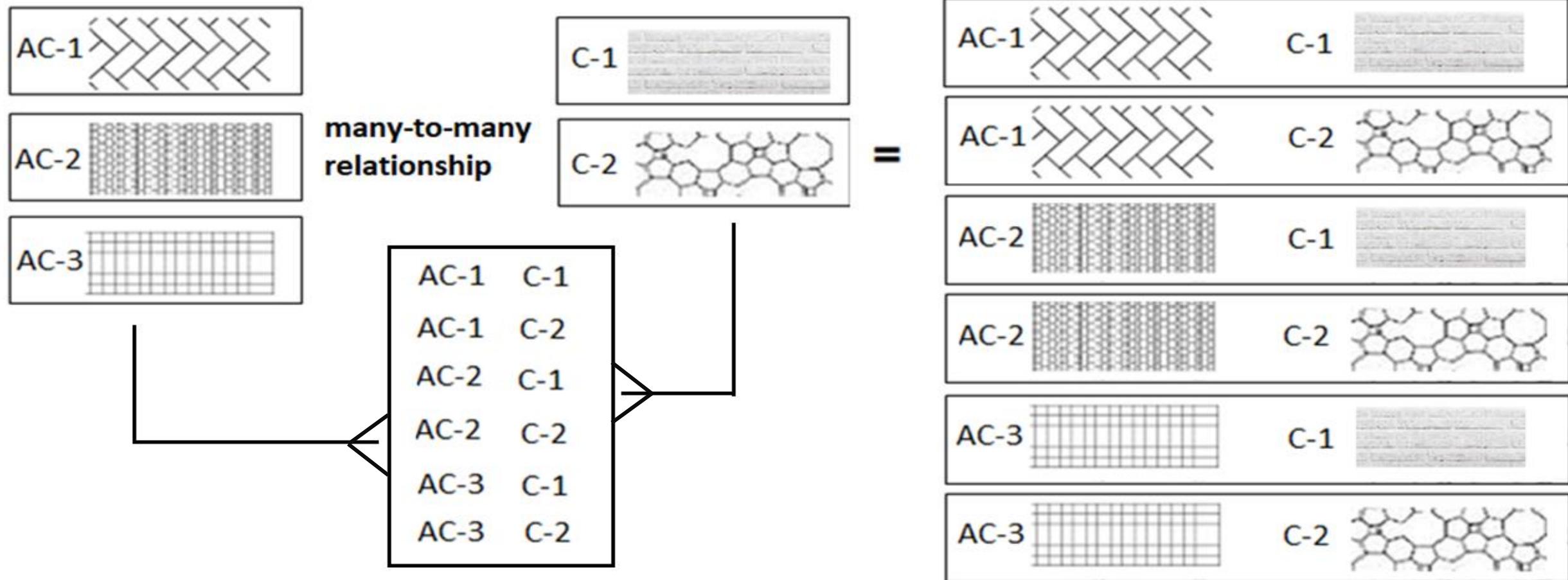
many-to-one relationship



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.



how to create many-to-many relationship

```
CREATE TABLE item (
```

```
    ID INT PRIMARY KEY,
```

```
    name VARCHAR(45),
```

```
    description TEXT
```

```
);
```

```
CREATE TABLE orders (
```

```
    ID INT PRIMARY KEY,
```

```
    orderdate DATETIME,
```

```
    custID INT NOT NULL,
```

```
    shipDate DATETIME,
```

```
    total FLOAT(8,2),
```

```
    constraint total_greater_zero CHECK(total >= 0)
```

```
);
```

```
CREATE TABLE orders_has_item (
```

```
    orders_ID INT NOT NULL,
```

```
    item_ID INT NOT NULL,
```

```
    PRIMARY KEY(orders_ID, item_ID),
```

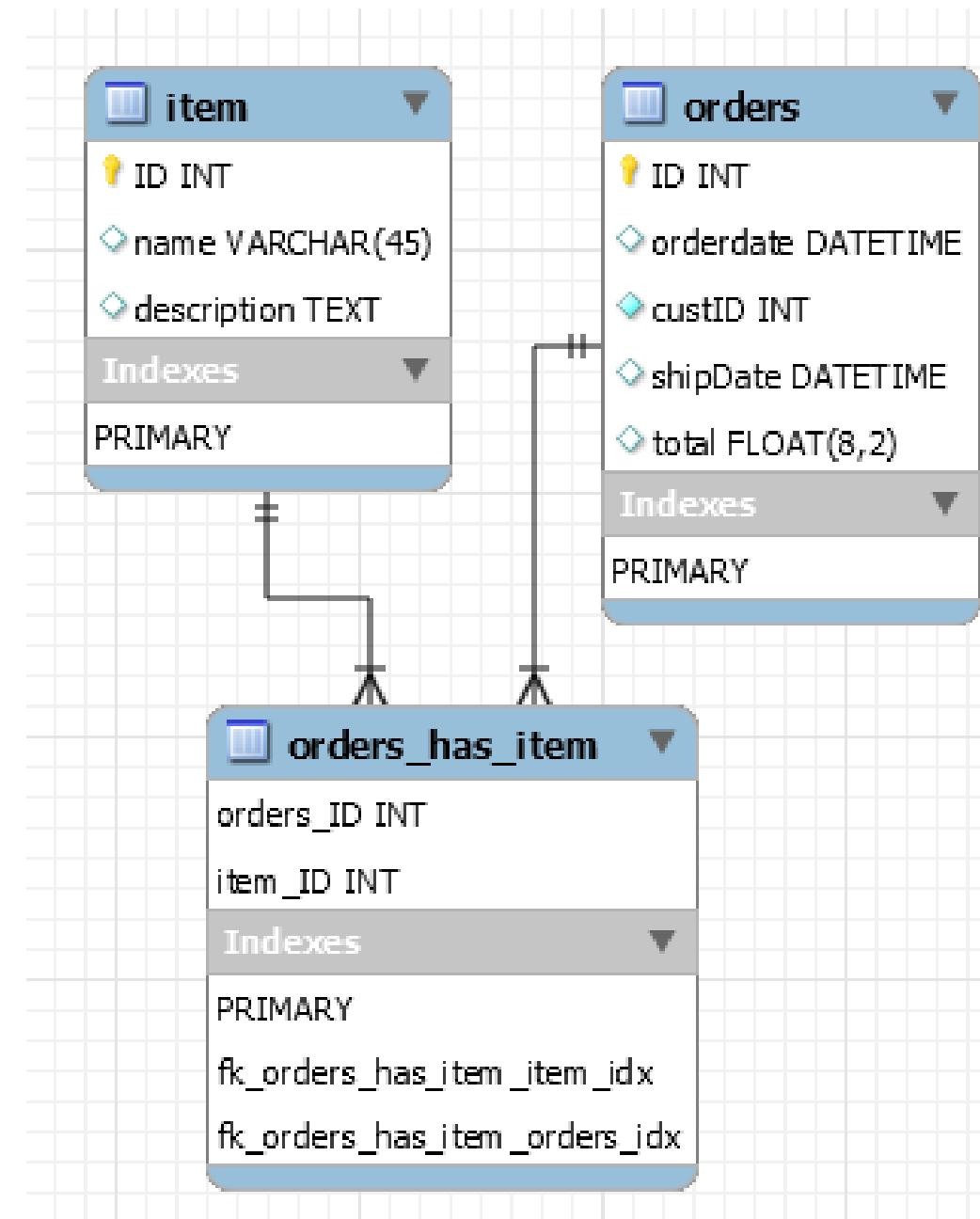
```
    constraint fk_orders_has_item_orders FOREIGN KEY(orders_ID)
```

```
        REFERENCES orders(ID),
```

```
    constraint fk_orders_has_item_item1 FOREIGN KEY(item_ID)
```

```
        REFERENCES item(ID)
```

```
);
```

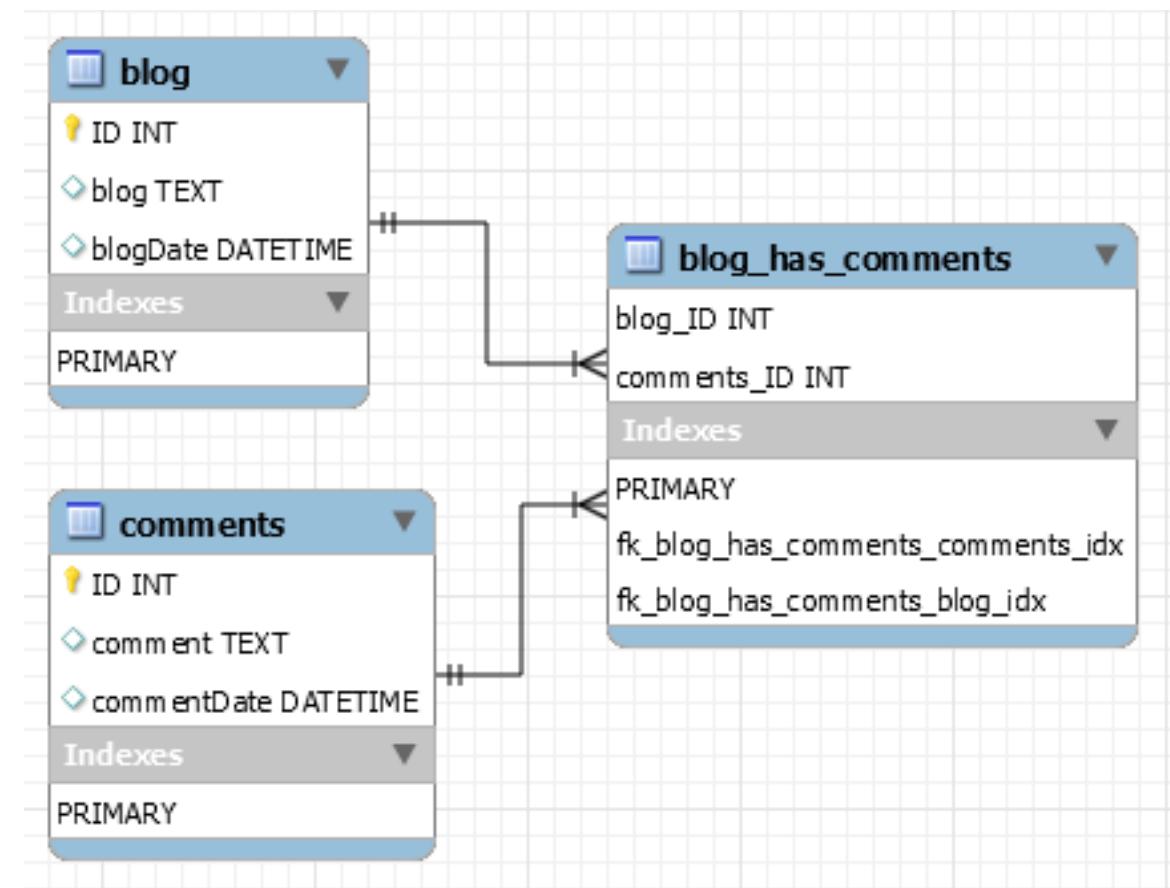


how to create many-to-many relationship

```
CREATE TABLE blog (
    ID INT PRIMARY KEY,
    blog TEXT,
    blogDate DATETIME
);
```

```
CREATE TABLE comments (
    ID INT PRIMARY KEY,
    comment TEXT,
    commentDate DATETIME
);
```

```
CREATE TABLE blog_has_comments (
    blog_ID INT,
    comments_ID INT,
    PRIMARY KEY(blog_ID, comments_ID),
    constraint fk_blog_has_comments_blog FOREIGN KEY(blog_ID) REFERENCES blog(ID),
    constraint fk_blog_has_comments_comments FOREIGN KEY(comments_ID) REFERENCES comments(ID)
);
```



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?

Remember:

what is sql?

- EXPLICIT or IMPLICIT commit will commit the data.

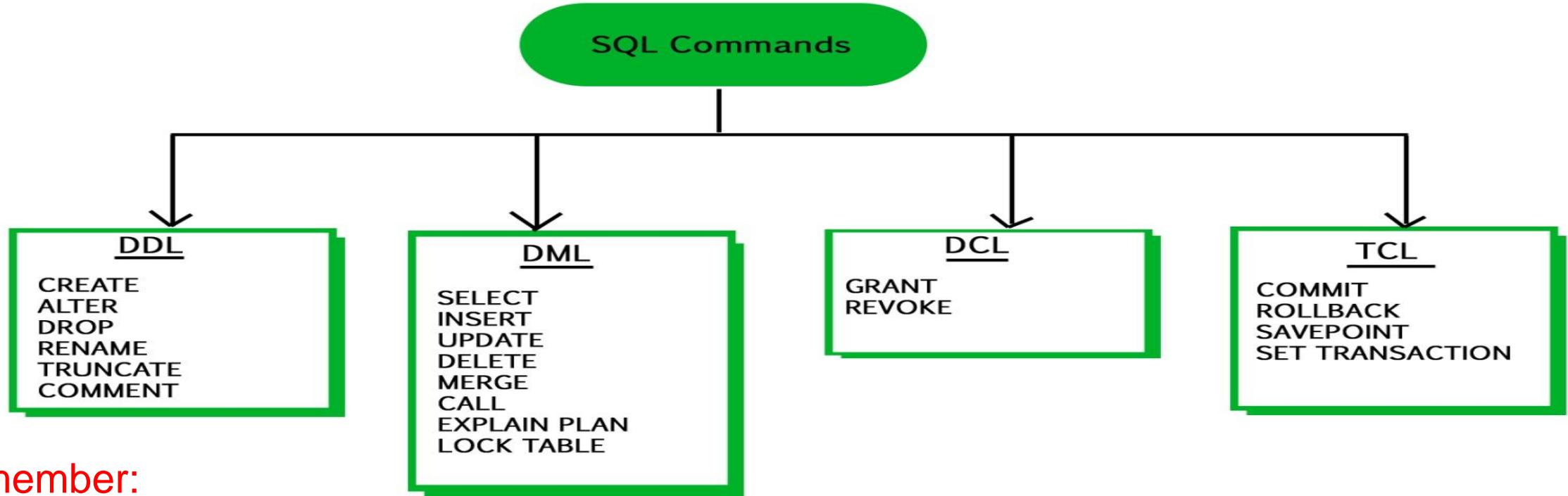
SQL (Structured Query Language) is a database language designed and developed for managing data in relational database management systems (RDBMS). SQL is common language for all Relational Databases.



Remember:

what is sql?

- An EXPLICIT commit happens when we execute an SQL "COMMIT" command.
- An IMPLICIT commits occur without running a "COMMIT" command.



Remember:

- A **NULL** value is not treated as a **blank** or **0**. Null or NULL is a special marker used in Structured Query Language to indicate that a data value does not exist or missing or unknown in the database.
- **Degree $d(R)$** : Total no. of attributes/columns present in a relation/table is called degree of the relation and is denoted by $d(R)$.
- **Cardinality $|R|$** : Total no. of tuples present in a relation or Rows present in a table, is called cardinality of a relation and is denoted by $|R|$.

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.

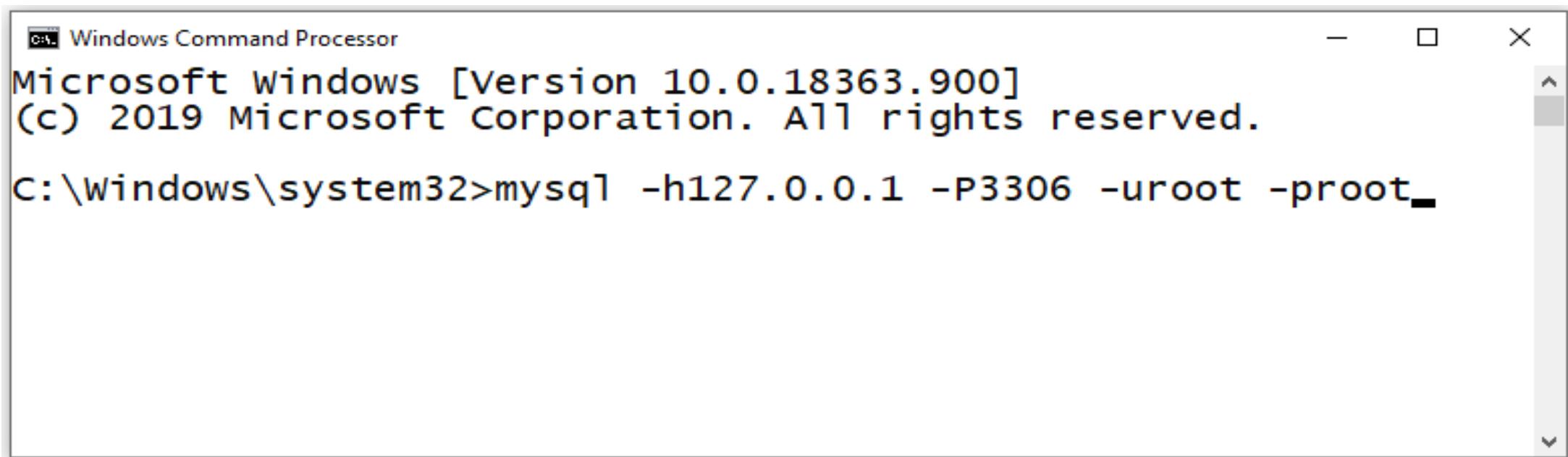
Reconnect to the server	<code>\r</code>
Execute a system shell command	<code>!</code>
Exit mysql	<code>\q</code>
Change your mysql prompt.	<code>prompt str or \R str</code>

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]



A screenshot of a Windows Command Processor window titled "Windows Command Processor". The window displays the following text:

```
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_-
```

- Before MySQL version 5.5, MyISAM is the default storage engine.
- From version 5.5, MySQL uses InnoDB as the default storage engine.

STORAGE ENGINES

A storage engine is a software module that a database management system uses to create, read, update data from a database. There are two types of storage engines in MySQL: **transactional** and **non-transactional**.

Storage Engine	File on disk
MEMORY	Data is not stored on the disk
InnoDB	.ibd (data and index)
MyISAM	MYD (data), .MYI (index)
CSV	.CSV (data), CSM (metadata)

SHOW ENGINES Syntax

For MySQL 5.5 and later, the default storage engine is *InnoDB*. The default storage engine for MySQL prior to version 5.5 was *MyISAM*.

SHOW [STORAGE] ENGINES

SHOW ENGINES displays status information about the server's storage engines. This is particularly useful for checking whether a storage engine is supported, or to see what the default engine is.

INFORMATION_SCHEMA.ENGINES

- `show engines;`
- `show STORAGE engines;`

INFORMATION_SCHEMA provides access to database metadata, information about the MySQL server such as the name of a database or table, the data type of a column, or access privileges.



ENGINES

- `show engines;`
- `show STORAGE engines;`

```
mysql> show engines;
```

Engine	Support	Comment	Transactions	XA	Savepoints
MEMORY	YES	Hash based, stored in memory, useful for temporary tables	NO	NO	NO
MRG_MYISAM	YES	Collection of identical MyISAM tables	NO	NO	NO
CSV	YES	CSV storage engine	NO	NO	NO
FEDERATED	NO	Federated MySQL storage engine	NULL	NULL	NULL
PERFORMANCE_SCHEMA	YES	Performance Schema	NO	NO	NO
MyISAM	YES	MyISAM storage engine	NO	NO	NO
InnoDB	DEFAULT	Supports transactions, row-level locking, and foreign keys	YES	YES	YES
BLACKHOLE	YES	/dev/null storage engine (anything you write to it disappears)	NO	NO	NO
ARCHIVE	YES	Archive storage engine	NO	NO	NO

```
9 rows in set (0.00 sec)
```

```
mysql> ■
```

- `SET DEFAULT_STORAGE_ENGINE = MyISAM;`

MEMORY tables are visible to another client, but
TEMPORARY tables are not visible to another client.

ENGINES

- **InnoDB** is the most widely used storage engine with transaction support. It is the only engine which provides foreign key referential integrity constraint. Oracle recommends using InnoDB for tables except for specialized use cases.
- **MyISAM** is the original storage engine. It is a fast storage engine. It does not support transactions. MyISAM provides table-level locking. It is used mostly in Web and data warehousing.
- **Memory** storage engine creates tables in memory. It is the fastest engine. It provides table-level locking. It does not support transactions. Memory storage engine is ideal for creating temporary tables or quick lookups. The data is lost when the database is re-started.
- **CSV** stores data in CSV files. It provides great flexibility because data in this format is easily integrated into other applications.

ENGINES

- MEMORY tables are visible to another client, but
- TEMPORARY tables are not visible to another client.

In the case of InnoDB, it is used to store the tables in tablespace whereas, in the case of MyISAM, it stores each MyISAM table in a separate file.

In my.ini do this changes.

```
[mysqld]
innodb_file_per_table = 1
```

Tablespace: A data file that can hold data for one or more InnoDB tables and associated indexes.

- a. System tablespace
- b. File per tablespace
- c. General tablespace

Note:- By default, InnoDB contains only one tablespace called the System tablespace whose identifier is 0

SHOW DATABASES

SHOW DATABASES Syntax

SHOW {DATABASES | SCHEMAS} [LIKE 'pattern' | WHERE *expr*]

SHOW SCHEMAS is a synonym for SHOW DATABASES.

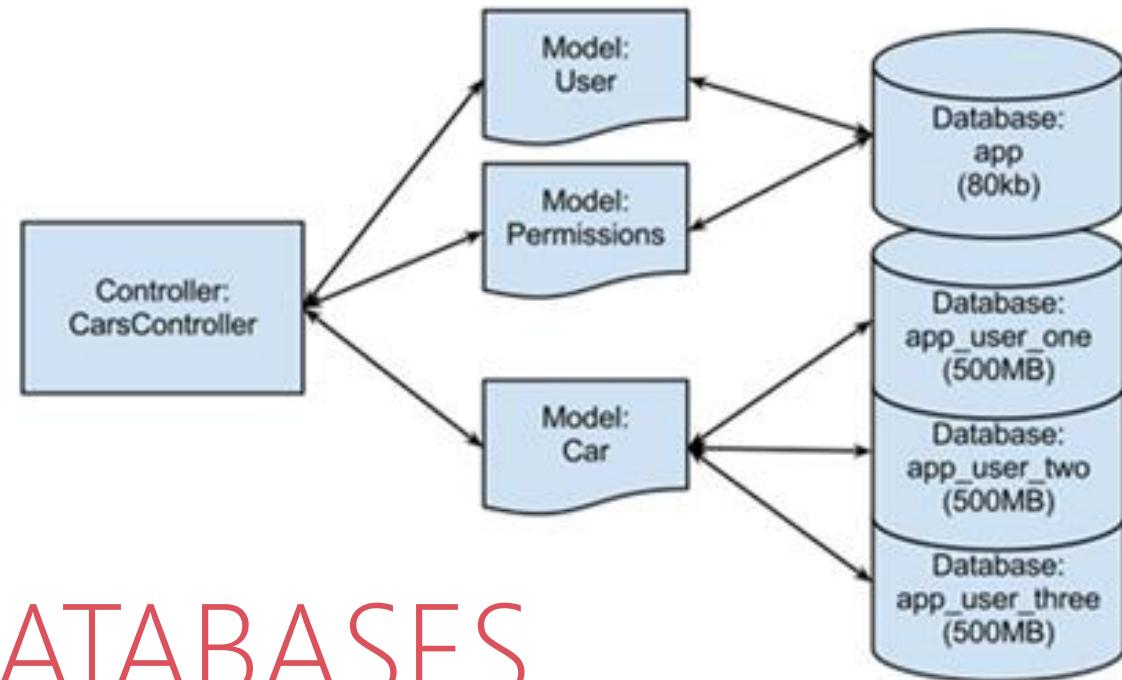
SHOW DATABASES;

SHOW SCHEMAS;

SHOW DATABASES LIKE 'U%';

SHOW SCHEMAS LIKE 'U%';

NULL means “no database is selected”. Issue the **USE dbName** command to select the database.



USE DATABASES

The **USE db_name** statement tells MySQL to use the db_name database as the default (current) database for subsequent statements. The database remains the default until the end of the session or another **USE** statement is issued.

USE DATABASES Syntax

`USE db_name`

`\U db_name`

Note:

- USE, does not require a semicolon.
- USE must be followed by a database name.

`USE db1`

`\U db1`

CREATE DATABASE
ALTER DATABASE

create / alter database

CREATE DATABASE creates a database with the given name. To use this statement, you need the CREATE privilege for the database.

```
CREATE {DATABASE | SCHEMA} [IF NOT EXISTS] db_name  
ALTER {DATABASE | SCHEMA} [db_name] READ ONLY [=] { 0 | 1}
```

CREATE SCHEMA is a synonym for **CREATE DATABASE**.

- `CREATE DATABASE db1;`
- `CREATE DATABASE IF NOT EXISTS db1;`

- `ALTER DATABASE db1 READ ONLY = 0; // is in read write mode.`
- `ALTER DATABASE db1 READ ONLY = 1; // is in read only mode.`

Note:

- It is **not** possible to Create, Alter, Drop any object, and Write (Insert, Update, and Delete rows) in a read-only database.
- TEMPORARY tables; it is possible to create, alter, drop, and write (Insert, Update, and Delete rows) to TEMPORARY tables in a read-only database.

DROP DATABASE

If the default database is dropped, the default database is unset (the DATABASE() function returns NULL).

drop database

DROP DATABASE drops all tables in the database and deletes the database. Be very careful with this statement! To use DROP DATABASE, you need the DROP privilege on the database.

`DROP {DATABASE | SCHEMA} [IF EXISTS] db_name`

DROP SCHEMA is a synonym for **DROP DATABASE**.

`DROP DATABASE db1;`

`DROP DATABASE IF EXISTS db1;`

Information Functions

Use these function with SELECT statement

information function

- **FOUND_ROWS()** - For a SELECT with a LIMIT clause, the number of rows that would be returned were there no LIMIT clause

e.g.

- `SELECT * FROM emp;`
- `SELECT FOUND_ROWS();`

- **LAST_INSERT_ID()** - Value of the AUTOINCREMENT column for the last INSERT
- **ROW_COUNT()** - The number of rows updated.

e.g.

- `SELECT * FROM emp;`
- `SELECT ROW_COUNT();`

- **DATABASE()** - Return the default (current) database name

e.g.

- `SELECT DATABASE();`

- **SCHEMA()** - Synonym for DATABASE()

information function

- **CURRENT_USER()**, **CURRENT_USER** - The authenticated user name and host name
- **USER()** - The user name and host name provided by the client

e.g.

- `SELECT USER();`

- **SESSION_USER()** - Synonym for **USER()**
- **SYSTEM_USER()** - Synonym for **USER()**
- **VERSION()** - Return a string that indicates the MySQL server version

e.g.

- `SELECT VERSION();`

- **CONNECTION_ID()** - Return the connection ID (thread ID) for the connection

```
mysqlshow [options] [db_name [tbl_name [col_name]]]
```

mysqlshow.exe

The mysqlshow client can be used to quickly see which databases exist, their tables, or a table's columns or indexes

mysqlshow.exe

mysqlshow – Get Quick Info On MySQL DB, Table, Column and Indexes

[Display available databases]

- C:\> mysqlshow -hlocalhost -P3306 -uroot -proot

[Display all tables in a database]

- C:\> mysqlshow -hlocalhost -P3306 -uroot -proot db1

[Display tables along with number of columns in a database]

- C:\> mysqlshow -hlocalhost -P3306 -uroot -proot db1 -v

[Display total number of columns and rows of all tables in a database]

- C:\> mysqlshow -hlocalhost -P3306 -uroot -proot db1 -v -v

mysqlshow.exe

mysqlshow – Get Quick Info On MySQL DB, Table, Column and Indexes

[Display all columns of a table]

- C:\> mysqlshow -hlocalhost -P3306 -uroot -proot db1 emp

[Display details about a specific column from a table]

- C:\> mysqlshow -hlocalhost -P3306 -uroot -proot db1 emp empno

[Display both indexes and columns of a table]

- C:\> mysqlshow -hlocalhost -P3306 -uroot -proot db1 emp -k

Source Command

source command

You can execute an SQL script file using the **source command** or **\. command**

`\. file_name`

`source file_name`

- `\. 'D:\mysqldemobld7.sql'`
- `SOURCE 'D:\mysqldemobld7.sql'`
- `SOURCE //infoserver1/infodomain1/Everyone/DBT/mysqldemobld7.sql`

SHOW COLUMNS

EMP & DEPT Table structure

```
mysql> show columns from emp;
```

Field	Type	Null	Key	Default	Extra
EMPNO	int	NO	PRI	NULL	
ENAME	varchar(12)	YES		NULL	
GENDER	char(1)	YES		NULL	
JOB	varchar(20)	YES	MUL	NULL	
MGR	int	YES	MUL	NULL	
HIREDATE	date	YES		NULL	
SAL	int	YES		NULL	
COMM	int	YES		NULL	
DEPTNO	int	NO	MUL	NULL	
BONUSID	int	YES		NULL	
USER NAME	varchar(20)	YES		NULL	
PWD	varchar(20)	YES		NULL	
PHONE	varchar(45)	YES		NULL	
isActive	tinyint(1)	YES		NULL	

```
14 rows in set (0.00 sec)
```

```
mysql> show columns from dept;
```

Field	Type	Null	Key	Default	Extra
DEPTNO	int	NO	PRI	NULL	
DNAME	varchar(12)	YES		NULL	
LOC	varchar(10)	YES		NULL	
PWD	varchar(20)	YES		NULL	
STARTEDON	varchar(10)	YES		NULL	

```
5 rows in set (0.00 sec)
```

SHOW COLUMNS Syntax

```
SHOW [FULL] {COLUMNS | FIELDS} {FROM | IN} tbl_name [{FROM | IN}  
db_name] [LIKE 'pattern' | WHERE expr]
```

- SHOW COLUMNS FROM emp;
- SHOW COLUMNS IN emp;
- SHOW FULL COLUMNS FROM emp; # WITH PRIVILEGES
- SHOW COLUMNS FROM emp FROM dbName;
- SHOW COLUMNS FROM user01.emp;
- SHOW COLUMNS FROM emp LIKE 'E%'; # STARTING WITH E
- SHOW COLUMNS FROM emp WHERE FIELD IN ('ename'); # ONLY ENAME COLUMN

SHOW TABLES

SHOW TABLES Syntax

```
SHOW [FULL] TABLES [{FROM | IN} db_name] [LIKE 'pattern' | WHERE expr]
```

- SHOW TABLES;
- SHOW FULL TABLES; // WITH TABLE TYPE
- SHOW TABLES FROM USER01;
- SHOW TABLES WHERE TABLES_IN_USER01 LIKE 'E%' OR TABLES_IN_USER01 LIKE 'B%';
- SHOW TABLES WHERE TABLES_IN_USER01 IN ('EMP');

SHOW TABLES STATUS

SHOW TABLES STATUS Syntax

SHOW TABLE STATUS [{FROM | IN} *db_name*] [LIKE '*pattern*' | WHERE *expr*]

- SHOW TABLE STATUS;
- SHOW TABLE STATUS FROM user01;
- SHOW TABLE STATUS IN user01;
- SHOW TABLE STATUS LIKE 'emp';

SHOW VARIABLES

shows the values of MySQL system variables.

SHOW VARIABLES Syntax

SHOW [GLOBAL | SESSION] VARIABLES [LIKE '*pattern*' | WHERE *expr*]

```
SET SQL_SAFE_UPDATES = 0;  
SET SQL_SAFE_UPDATES = false;
```

Enable/Disable :- 1 (true) / 0 (false)

explain analyze

explain

The DESCRIBE and EXPLAIN statements are synonyms. In practice, the DESCRIBE keyword is more often used to obtain information about table structure, whereas EXPLAIN is used to obtain a query execution plan.

```
{EXPLAIN | DESCRIBE | DESC}  
tbl_name [col_name]
```

- `DESC emp;`
- `DESC emp ename;`
- `DESCRIBE emp;`
- `EXPLAIN emp;`
- `EXPLAIN emp empno;`

EXPLAIN works with SELECT, DELETE, INSERT, REPLACE, and UPDATE statements.

explain

The DESCRIBE and EXPLAIN statements are synonyms. In practice, the DESCRIBE keyword is more often used to obtain information about table structure, whereas EXPLAIN is used to obtain a query execution plan.

```
{EXPLAIN | DESCRIBE | DESC}  
{explainable_stmt}
```

```
explainable_stmt: {  
    SELECT statement  
    | DELETE statement  
    | INSERT statement  
    | REPLACE statement  
    | UPDATE statement  
}
```

- EXPLAIN ANALYZE SELECT * FROM emp;
- EXPLAIN ANALYZE SELECT * FROM emp **where** empno = 7788;
- EXPLAIN ANALYZE SELECT * FROM emp INNER JOIN dept USING(deptno);

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 ');`

example of text, blob, and longblob

Try Out

- `CREATE TABLE movies(_id INT AUTO_INCREMENT PRIMARY KEY, description TEXT, img1 BLOB, img2 LONGBLOB);`
- `INSERT INTO movies VALUE(default, load_file("d:/movie1.txt") , load_file("d:/img1.jpg") , load_file("d:/img2.jpg"));`
- `INSERT INTO movies VALUE(default, load_file("d:/movie2.txt") , load_file("d:/img1.jpg") , load_file("d:/img2.jpg"));`
- `INSERT INTO movies VALUE(default, load_file("d:\\movie3.txt") , load_file("d:\\\\img1.jpg") , load_file("d:\\\\img2.jpg"));`
- `SELECT * FROM movies;`

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 $\geq D$

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

```
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)

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

datatype – enum

- 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 '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.

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

datatype – enum

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

- A SET column can have a maximum of **64** distinct members.
- 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');`

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

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_definition*, ...)

[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:

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;

default value

The DEFAULT specifies a default value for the column.

- BLOB, TEXT, GEOMETRY or JSON column can't have a default value.
e.g. `CREATE TABLE temp(c1 TEXT DEFAULT('PUNE'));`

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
);`

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
▶	postID	int	YES		NULL	
▶	postTitle	varchar(255)	YES		NULL	
▶	postDate	datetime	YES		CURRENT_TIMESTAMP	DEFAULT_GENERATED
▶	deleted	int	YES		NULL	

	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 t (`
 `c1 INT,`
 `c2 INT DEFAULT 1,`
 `c3 INT DEFAULT 3,`
 `);`
- `INSERT INTO t VALUES();`
- `INSERT INTO t VALUES(-1, DEFAULT, DEFAULT);`
- `INSERT INTO t VALUES(-2, DEFAULT(c2), DEFAULT(c3));`
- `INSERT INTO t VALUES(-3, DEFAULT(c3), DEFAULT(c2));`

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

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 give you the error.
- Inserting a string into a string column that exceeds the column maximum length. Data too long for column error will be raised.
- Inserting data into a column that does not exist, then Unknown column error will raise.

- **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] ...)] [ (col_name, ...) ] {  
VALUES | VALU E } ( { expr | DEFAULT }, ... ), ( ... ), ... [ 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 rows into an existing table. The INSERT ... VALUES

```
INSERT [IGNORE] [INTO] tbl_name [PARTITION (partition_name [, partition_name] ...)] [ (col_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');`

insert rows using select

insert ... select

With INSERT ... SELECT, you can quickly insert many rows into a table from one or many tables.

`INSERT [INTO] tbl_name [(col_name, ...)] SELECT ...`

- `INSERT INTO dept(deptno) SELECT 1 + 1;`
- `INSERT INTO dept(deptno) SELECT deptno FROM dept;`
- `INSERT INTO dept SELECT * FROM dept;`
- `INSERT INTO dept(SELECT MAX(deptno) + 1, 'HRD', 'BARODA', 'r57px33px' FROM dept);`
- `set @x := 40;`
- `INSERT INTO dept VALUES (@x := @x + 1 , 'HRD', 'BARODA', 'r57px33px');`
- `set @x := (SELECT MAX(deptno) FROM dept);`
- `INSERT INTO dept VALUES (@x := @x + 1 , 'HRD', 'BARODA', 'r57px33px');`

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



Table DEPARTMENTS

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

Projection
Selection

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

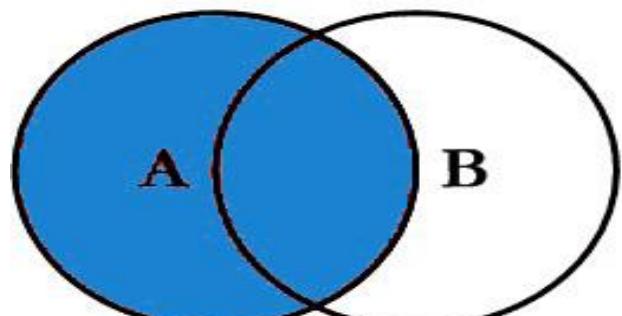


S

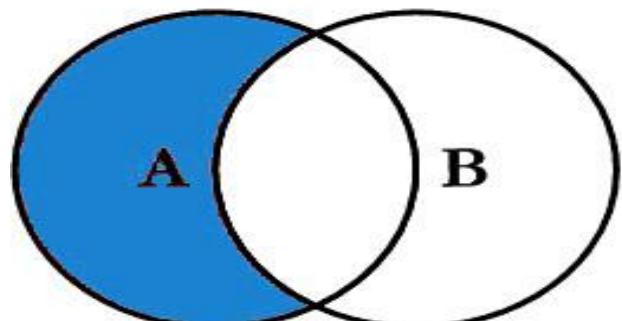
DEPTNO	DNAME	LOC
10	HRD	PUNE
20	SALES	BARODA
40	PURCHASE	SURAT



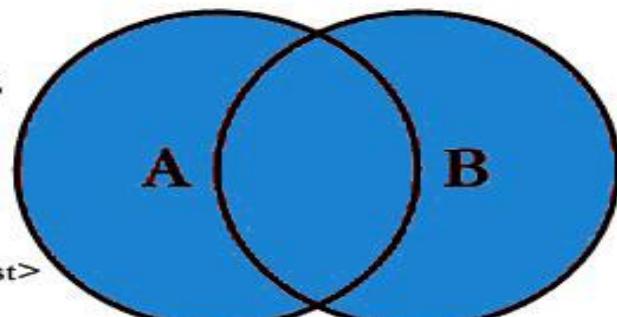
SQL JOINS



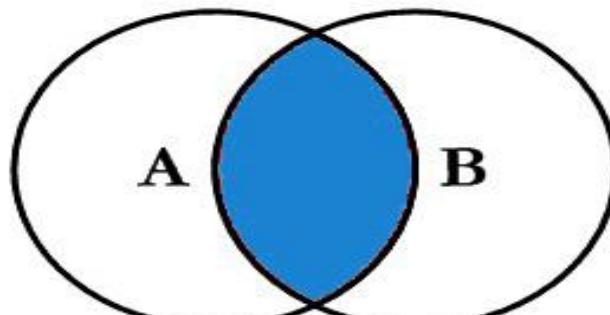
```
SELECT <select_list>  
FROM TableA A  
LEFT JOIN TableB B  
ON A.Key = B.Key
```



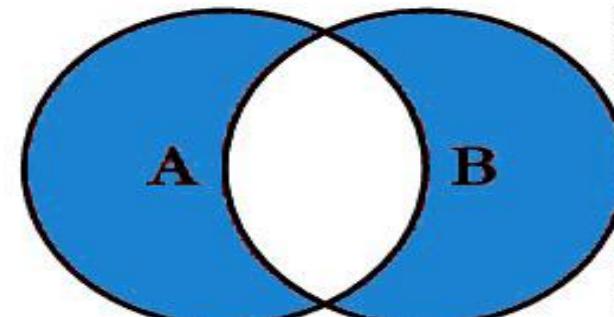
```
SELECT <select_list>  
FROM TableA A  
LEFT JOIN TableB B  
ON A.Key = B.Key  
WHERE B.Key IS NULL
```



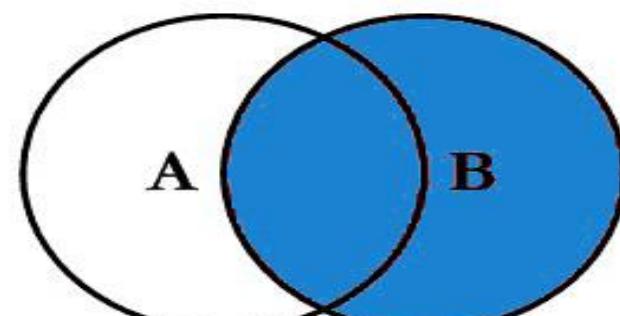
```
SELECT <select_list>  
FROM TableA A  
FULL OUTER JOIN TableB B  
ON A.Key = B.Key
```



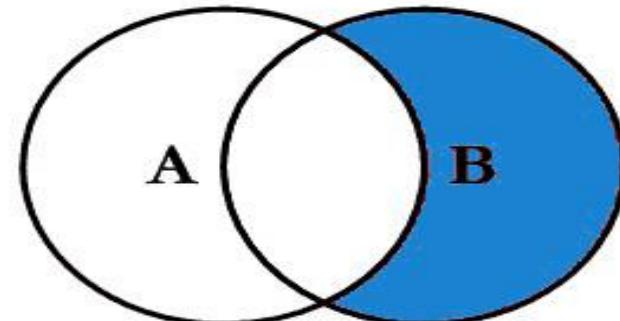
```
SELECT <select_list>  
FROM TableA A  
INNER JOIN TableB B  
ON A.Key = B.Key
```



```
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  
RIGHT 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>

column-list
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.

Note:

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

Here c1 column is a Primary Key

- `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.

UPDATE can violate.

Important:

- TODO

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]
[ORDER BY . . .]
[LIMIT row_count]
```

- `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`

[`PARTITION` (`partition_name [, partition_name] ...`)]

[`WHERE` `where_condition`]

[`ORDER BY` ...]

[`LIMIT` `row_count`]

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.`

auto_increment

The **auto_increment** specifies a **auto_increment** value for the column.

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

	Field	Type	Null	Key	Default	Extra
▶	postID	int	NO	PRI	NULL	auto_increment
	postTitle	varchar(255)	YES		NULL	
	postDate	datetime	YES		CURRENT_TIMESTAMP	DEFAULT_GENERATED
	deleted	int	YES		NULL	

- `CREATE TABLE comments (commentID INT AUTO_INCREMENT PRIMARY KEY, comment TEXT, commentDate DATETIME DEFAULT NOW(), deleted INT);`

	Field	Type	Null	Key	Default	Extra
▶	commentID	int	NO	PRI	NULL	auto_increment
	comment	text	YES		NULL	
	commentDate	datetime	YES		CURRENT_TIMESTAMP	DEFAULT_GENERATED
	deleted	int	YES		NULL	

- `CREATE TABLE animals(id INT NOT NULL AUTO_INCREMENT, breed INT, PRIMARY KEY (id, breed)); //valid`
- `CREATE TABLE animals(id NT NOT NULL, breed INT AUTO_INCREMENT, PRIMARY KEY (id, breed)); //invalid`

auto_increment

- **auto_increment_increment** – is the incremental value, controls the interval between successive column values.
 - **auto_increment_offset** – determines the starting value for the AUTO_INCREMENT field; this value is used for the first record inserted into the table.
-
- `SET @@auto_increment_offset=5;`
 - `SET @@auto_increment_increment=10;`
 - `ALTER TABLE temp AUTO_INCREMENT = 0;`

Remember:

- If value of `auto_increment_offset` set is greater than that of `auto_increment_increment`, the value of `auto_increment_offset` is ignored.

auto_increment

NO_AUTO_VALUE_ON_ZERO affects handling of *AUTO_INCREMENT* columns. Normally, you generate the next sequence number for the column by inserting either NULL or 0 into it.

NO_AUTO_VALUE_ON_ZERO suppresses this behaviour for 0 so that only NULL generates the next sequence number.

- *SET sql_mode = '';*
- *SET sql_mode = 'NO_AUTO_VALUE_ON_ZERO';*

- **CREATE TABLE ... LIKE ...**, the destination table *preserves generated column information* from the original table.
- **CREATE TABLE ... SELECT ...**, the destination table *does not preserves generated column information* from the original table.

generated column

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.

- `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`

`);`

	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

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

Note:

- Virtual column cannot be converted to stored column.
 - `CREATE TABLE product1(`
 `productCode INT,`
 `quantityInStock INT,`
 `buyPrice INT,`
 `stockValue FLOAT GENERATED ALWAYS AS (quantityInStock * buyPrice) VIRTUAL`
`);`
 - `ALTER TABLE product1 MODIFY stockValue FLOAT (12, 2); // error: We are trying to convert virtual column [`
 `GENERATED ALWAYS AS] to stored column by not giving GENERATED ALWAYS AS`
- Then What→ give
- `ALTER TABLE product1 MODIFY stockValue FLOAT (12, 2) GENERATED ALWAYS AS (quantityInStock * buyPrice) VIRTUAL ;`

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

Note:

- **Stored column cannot be converted to virtual column.**
- `CREATE TABLE product1(`
`productCode INT,`
`quantityInStock INT,`
`buyPrice INT,`
`stockValue FLOAT`
`);`
- `ALTER TABLE product1 MODIFY stockValue FLOAT GENERATED ALWAYS AS (quantityInStock * buyPrice) VIRTUAL; //`
error: We are trying to convert stored column to virtual column by giving GENERATED ALWAYS AS

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
);
```

- `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;`

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

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;`

a1 INT(10) zerofill	0	0	0	0	0	0	1	5	0	0	length(ID1) -> 10
a2 INT(10)							3	6	7	5	length(ID2) -> 4

zerofill value

When you select a column with the type ZEROFILL it pads the displayed value of the field with zeros up to the display width specified in the column definition.

Note:

- ZEROFILL attribute is use for numeric datatype.
- If you specify ZEROFILL for a column, MySQL automatically adds the **UNSIGNED** attribute to the column.

zerofill column

col_name data_type **ZEROFILL**

```
CREATE TABLE employee (
    ID INT ZEROFILL AUTO_INCREMENT PRIMARY KEY,
    firstName VARCHAR(40),
    salary INT,
    commission INT,
    total INT DEFAULT(salary + commission)
);
```

- `INSERT INTO employee VALUES(NULL, 'ram', 4700, NULL, default);`
- `INSERT INTO employee VALUES(0, 'pankaj', 3400, 400 , default);`
- `INSERT INTO employee VALUES(100, 'rajan', 3200, NULL , default);`
- `INSERT INTO employee VALUES(NULL, 'ninad', 2600, 0, default);`
- `INSERT INTO employee VALUES(0, 'omkar', 4500, 300, default);`
- `INSERT INTO employee VALUES (-200, 'rahul', 3000, 300 , default);`

- `SELECT * FROM employee;`
- `SELECT ID, LENGTH(ID), salary, LENGTH(salary) FROM employee;`

zerofill column

- `CREATE TABLE account (`
 `accountNumber INT ZEROFILL PRIMARY KEY,`
 `balance FLOAT,`
 `openingBalance FLOAT,`
 `accountName VARCHAR(45),`
 `customerID INT,`
 `openingDate DATE`
`);`

	Field	Type	Null	Key	Default	Extra
▶	accountNumber	int(10) unsigned zerofill	NO	PRI	NULL	
	balance	float	YES		NULL	
	openingBalance	float	YES		NULL	
	accountName	varchar(45)	YES		NULL	
	customerID	int	YES		NULL	
	openingDate	date	int	YES	NULL	

Note:

- If you specify ZEROFILL for a numeric column, MySQL automatically adds the **UNSIGNED** attribute to the column.

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:

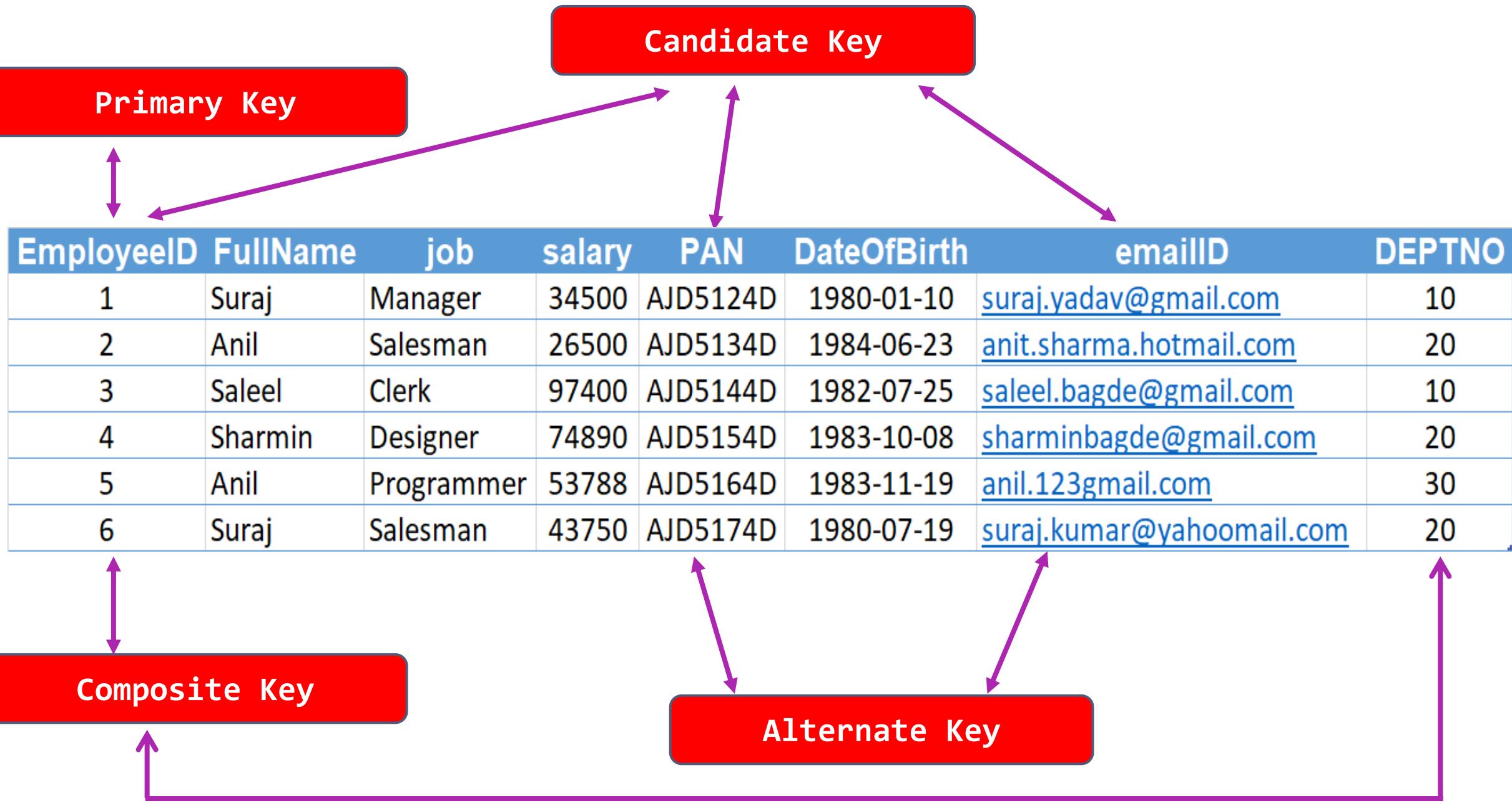
- a table with a foreign key that references another table's primary key is **MUL**.
- If more than one of the Key values applies to a given column of a table, Key displays the one with the highest priority, in the order **PRI**, **UNI**, and **MUL**.
- If a table has a PRIMARY KEY or UNIQUE NOT NULL 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?

$r = \text{Employee}(\text{EmployeeID}, \text{FullName}, \text{job}, \text{salary}, \text{PAN}, \text{DateOfBirth}, \text{emailID}, \text{deptno})$

- **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.
- 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.**

PRIMARY KEY constraint

Choosing a primary key is one of the most important steps in good database design. A primary key is a column that serves a special purpose. 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:- The InnoDB table uses a clustered index for optimizing the speed of most common lookups (SELECT statement) and DML operations like INSERT, UPDATE, and DELETE command. Clustered indexes sort and store the data rows in the table based on their key values that can be sorted in only one way. If the table column contains a primary key or unique key, MySQL creates a clustered index named PRIMARY based on that specific column.

Non-Clustered Index:- The indexes other than PRIMARY indexes (i.e. clustered indexes) called a non-clustered index. The non-clustered indexes are also known as secondary indexes. The non-clustered index and table data are both stored in different places. It is not sorted (ordering) the table data.

- `CREATE TABLE test(c1 INT, c2 INT, c3 INT, c4 INT,c5 INT, c6 INT, c7 INT, c8 INT, c9 INT, c10 INT, c11 INT, c12 INT, c13 INT, c14 INT, c15 INT, c16 INT, c17 INT, c18 INT, c19 INT, c20 INT, PRIMARY KEY (c1, c2, c3, c4, c5, c6, c7, c8, c9, c10, c11, c12, c13, c14, c15, c16, c17, c18)); // error`

constraints – add primary key

col_name data_type PRIMARY KEY

The following example creates tables with **PRIMARY KEY** column.

- `CREATE TABLE users (
 ID INT PRIMARY KEY,
 userName VARCHAR(25),
 password VARCHAR(25),
 email VARCHAR(255)
);`
- `CREATE TABLE supplier (
 supplier_id INT,
 supplier_name VARCHAR(50),
 contact_name VARCHAR(50),
 constraint pk_supplier_id PRIMARY KEY(supplier_id)
);`
- `CREATE TABLE purchase_orders (
 po_number INT,
 vendor_id INT NOT NULL,
 po_status INT NOT NULL,
 PRIMARY KEY(po_number)
);`
- `CREATE TABLE person (
 ID INT NOT NULL UNIQUE,
 lastName VARCHAR(45),
 firstName VARCHAR(45),
 age INT,
 email VARCHAR(255)
);`

constraints – add composite primary key

The following example creates tables with **COMPOSITE PRIMARY KEY** column.

- `CREATE TABLE salesDetails (
 customerID INT,
 productID INT,
 timeID INT,
 qty INT,
 salesDate DATE,
 salesAmount INT,
 PRIMARY KEY(customerID , productID, timeID)
) ;`

customerID	productID	timeID	quantity	salesDate	salesAmount
Cust-001	PRD-1	D1-T1	100	•••••	25,00,000
Cust-001	PRD-1	D2-T1	100	••••••	25,00,000
Cust-001	PRD-2	D1-T1	200	••••••	50,00,000
Cust-002	PRD-1	D1-T1	100	••••••	25,00,000
Cust-004	PRD-1	D1-T1	100	••••••	25,00,000
Cust-004	PRD-2	D3-T1	200	••••••	50,00,000

constraints – add composite primary key

The following example creates tables with **COMPOSITE PRIMARY KEY** column.

- `CREATE TABLE payments (paymentID INT, orderID INT, amount INT, bankDetails VARCHAR(255), PRIMARY KEY(paymentID , orderID));`
- `CREATE TABLE order_product (orderID INT, productID INT, qty INT, rate INT, constraint pk_orderID_productID PRIMARY KEY(orderID, productID));`

Try It

```
CREATE TABLE try(c1 INT, c2 INT, c3 INT, c4 INT, c5 INT, c6 INT  
,c7 INT, c8 INT, c9 INT, c10 INT,c11 INT,c12 INT, c13 INT, c14 INT,  
c15 INT, c16 INT,c17 INT, c18 INT, c19 INT, c20 INT, c21 INT, c22  
INT, c23 INT, c24 INT, c25 INT, c26 INT, c27 INT, c28 INT, c29 INT ,  
c30 INT, c31 INT, c32 INT, c33 INT, PRIMARY KEY(c1, c2, c3, c4,  
c5, c6, c7, c8, c9, c10, c11, c12, c13, c14, c15, c16, c17));
```

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

Add Primary Key using Alter

constraints – add primary key using alter

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

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

- `CREATE TABLE vendors (`
 `vendor_id INT,`
 `vendor_name VARCHAR(25),`
 `address VARCHAR(255)`
`);`
- `ALTER TABLE vendors ADD PRIMARY KEY(vendor_id);`
- `ALTER TABLE vendors ADD constraint pk_vendor_id PRIMARY KEY(vendor_id);`

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

Drop Primary Key

constraints – drop primary key

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

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

- `CREATE TABLE vendors (
 vendor_id INT,
 vendor_name VARCHAR(25),
 address VARCHAR(255)
)`

```
ALTER TABLE vendors DROP PRIMARY KEY;
```

Remember:

- A unique key can be NULL.
- 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 contacts (ID INT, first_name VARCHAR(50), last_name VARCHAR(50), phone VARCHAR(15), UNIQUE(phone));`
- `CREATE TABLE brands (ID INT, brandName VARCHAR(30), constraint uni_brandName UNIQUE(brandName));`
- `SHOW INDEX FROM clients;`

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

Add Unique Key using Alter

constraints – add unique key using alter

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

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

- `CREATE TABLE shop (`
 `ID INT,`
 `shop_name VARCHAR(30)`
`);`
- `ALTER TABLE shop ADD UNIQUE(shop_name);`
- `ALTER TABLE shop ADD constraint uni_shop_name UNIQUE(shop_name);`

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

Drop Unique Key

constraints – drop unique key

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

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

- `SELECT table_name, constraint_name, constraint_type
FROM information_schema.table_constraints WHERE
constraint_schema = 'z' AND table_name IN ('A', 'B');`
- `ALTER TABLE users DROP INDEX <COLUMN_NAME>;`
- `ALTER TABLE users DROP INDEX U_USER_ID; #CONSTRAINT NAME`
- `CREATE TABLE users (
 ID INT PRIMARY KEY,
 userName VARCHAR(40),
 password VARCHAR(255),
 email VARCHAR(255) UNIQUE KEY
) ;`
- `CREATE TABLE users (
 ID INT PRIMARY KEY,
 userName VARCHAR(40),
 password VARCHAR(255),
 email VARCHAR(255),
 constraint uni_email UNIQUE KEY(email)
) ;`
- `ALTER TABLE users DROP INDEX email;`
- `ALTER TABLE users DROP INDEX uni_email;`

```
[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	CourseDuration	CourseName
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.

Remember:

alter, drop – (primary key/foreign key)

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:

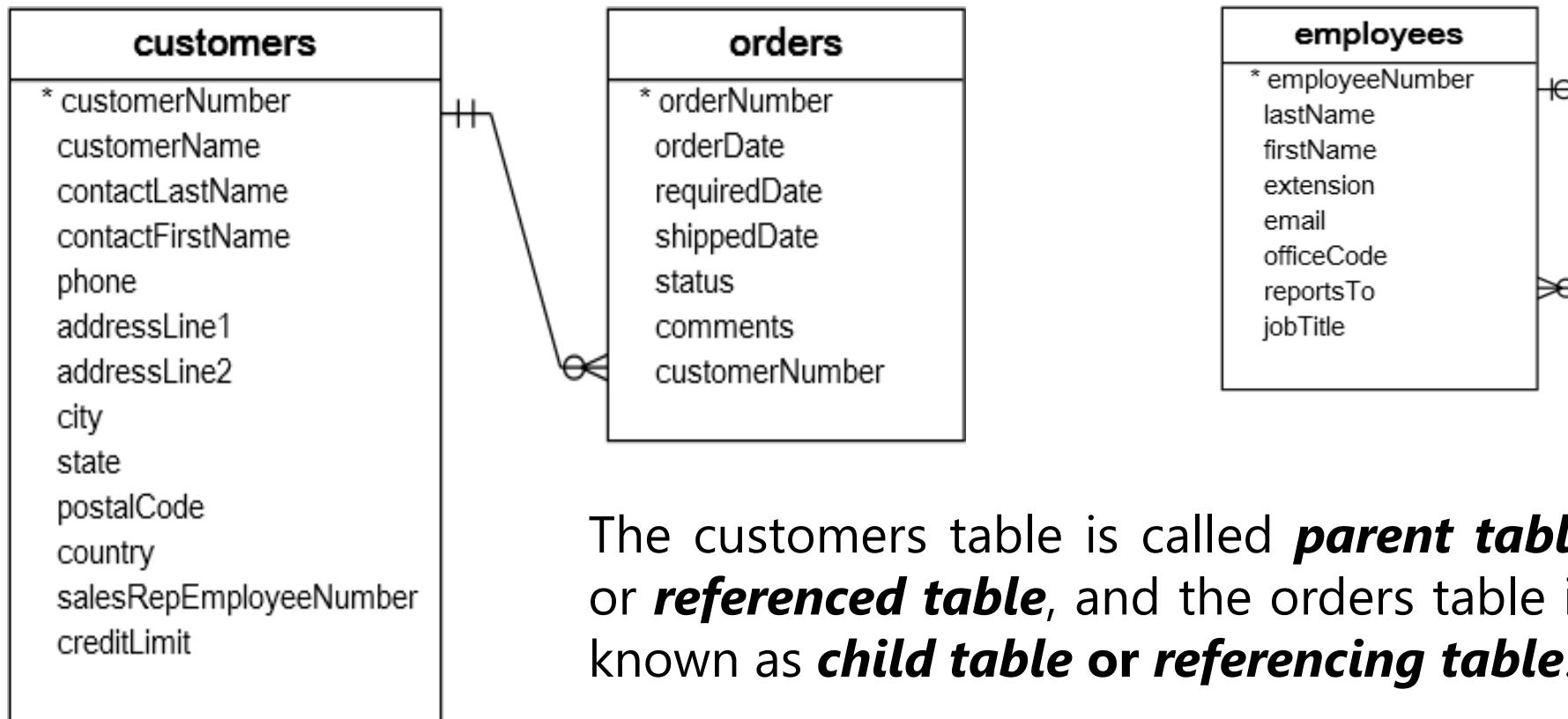
- If we try to modify datatype of RollNo in Student or Student_Course table with VARCHAR, it will not allow.
- If we try to apply auto_increment to RollNo in Student table, it will not allow
- If we try to drop RollNo column from Student table , it will not allow.

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.

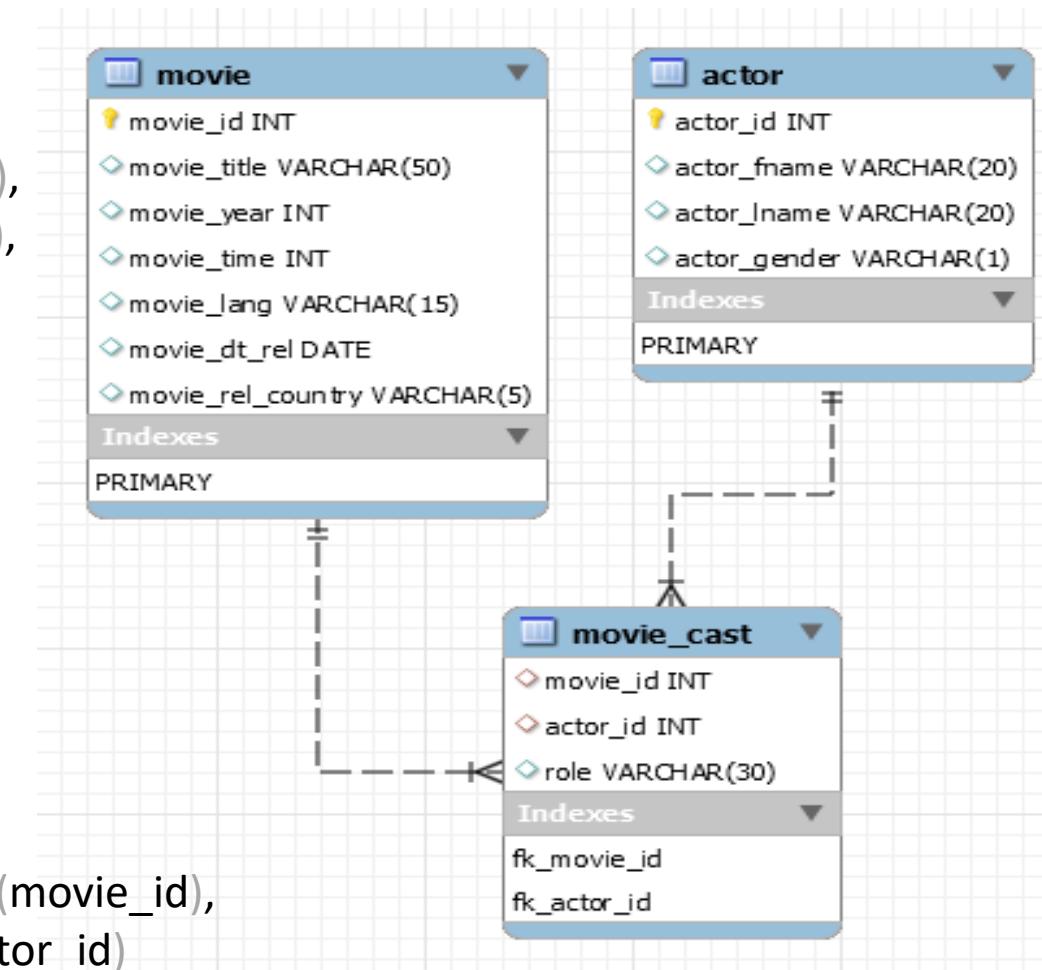


The **customers** table is called ***parent table*** or ***referenced table***, and the **orders** table is known as ***child table* or *referencing table***.

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.

- `CREATE TABLE movie (movie_id INT PRIMARY KEY, movie_title VARCHAR(50), movie_year INT, movie_time INT, movie_lang VARCHAR(15), movie_dt_rel DATE, movie_rel_country VARCHAR(5));`
- `CREATE TABLE actor (actor_id INT PRIMARY KEY, actor_fname VARCHAR(20), actor_lname VARCHAR(20), actor_gender VARCHAR(1));`
- `CREATE TABLE movie_cast (movie_id INT, actor_id INT, role VARCHAR(30), constraint fk_movie_id FOREIGN KEY(movie_id) REFERENCES movie(movie_id), constraint fk_actor_id FOREIGN KEY(actor_id) REFERENCES actor(actor_id));`



QUESTION – *find foreign key columns*

The following example find **Foreign Key** columns.

- `CREATE TABLE owner (
 owner_id INT PRIMARY KEY,
 first_name VARCHAR(50),
 last_name VARCHAR(50),
 email VARCHAR(255)
);`
- `CREATE TABLE shop (
 shop_id INT,
 owner_id INT,
 shop_name VARCHAR(30)
);`
- `CREATE TABLE brands (
 brand_id INT PRIMARY KEY,
 brand_name VARCHAR(30) UNIQUE
);`
- `CREATE TABLE contacts (
 contact_id INT PRIMARY KEY,
 owner_id INT,
 contact_number VARCHAR(15)
);`
- `CREATE TABLE shop_brand (
 ID INT PRIMARY KEY,
 shop_id INT,
 brand_id INT
);`

```
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,
    constraint fk_userID FOREIGN KEY(userID) REFERENCES users(ID)
) ;
```

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

constraints – foreign key

- [ON DELETE *reference_option*]
- [ON UPDATE *reference_option*]

Cascaded FOREIGN KEY actions do not activate triggers.

reference_option: RESTRICT | CASCADE | SET NULL | NO ACTION | SET DEFAULT

Remember:

- When an UPDATE or DELETE operation affects a key value in the parent table that has matching rows in the child table, the result depends on the referential action specified using ON UPDATE and ON DELETE sub clauses of the FOREIGN KEY clause.
- ON DELETE or ON UPDATE that is not specified, the default action is always RESTRICT.

constraints – foreign key

Remember:

- CASCADE: DELETE or UPDATE the row from the parent table, and automatically DELETE or UPDATE the matching rows in the child table. Both ON DELETE CASCADE and ON UPDATE CASCADE are supported.
- SET NULL: DELETE or UPDATE the row from the parent table, and set the foreign key column or columns in the child table to NULL. Both ON DELETE SET NULL and ON UPDATE SET NULL clauses are supported.

```
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) ON DELETE CASCADE ON UPDATE CASCADE
);
```

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

on delete / on update – foreign key

SET NULL: Delete or update the row from the parent table and set the foreign key column or columns in the child table to NULL. If you specify a SET NULL action, make sure that you have not declared the columns in the child table as NOT NULL.

RESTRICT: Rejects the delete or update operation for the parent table. Specifying RESTRICT (or NO ACTION) is the same as omitting the ON DELETE or ON UPDATE clause.

NO ACTION: Is equivalent to RESTRICT. The MySQL Server rejects the delete or update operation for the parent table if there is a related foreign key value in the referenced table.

SET DEFAULT: This action is recognized by the MySQL parser, but both InnoDB and NDB reject table definitions containing ON DELETE SET DEFAULT or ON UPDATE SET DEFAULT clauses.

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)
);
```

constraints – check

col_name data_type CHECK(expr)

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

```
CREATE TABLE users (
    ID INT PRIMARY KEY,
    startDate DATE,
    endDate DATE,
    constraint chk_endDate CHECK(endDate > startDate + INTERVAL 7 day)
);
```

- `SELECT * FROM check_constraints WHERE CONSTRAINT_SCHEMA = 'z';`

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

Add 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 (condition)
```

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

The check constraint defined on a table must refer to only columns in that table. It can not refer to columns in other tables.

- `CREATE TABLE test (CHECK(c3 > (c1 + c2)), c1 INT, c2 INT, c3 INT);`
- `CREATE TABLE test (c1 INT, c2 INT, c3 INT, CHECK(c3 > (c1 + c2)));`
- `CREATE TABLE test (CHECK(c3 > (c1 + c2)), PRIMARY KEY(c1), c1 INT, c2 INT, c3 INT);`
- `CREATE TABLE test (a INT CHECK (a >= 0),b INT CHECK (b >= 0), CHECK ( a + b <= 10));`
  
- `ALTER TABLE test ADD constraint chk_id CHECK(ID > 10);`
- `ALTER TABLE test DROP CHECK chk_id;`

## *check with (in, like, and between)*

The **CHECK** constraint using **IN**, **LIKE**, and **BETWEEN**.

```
CREATE TABLE users (
 ID INT PRIMARY KEY,
 userName VARCHAR(40),
 password VARCHAR(255) CHECK(LENGTH(password) > 5),
 email VARCHAR(255),
 country VARCHAR(255) CHECK(country LIKE ('I%') OR country LIKE ('U%')),
 ratings INT CHECK(ratings BETWEEN 1 and 5 OR ratings BETWEEN 12 and 25),
 isActive BOOL CHECK(isActive IN (1, 0)),
 startDate DATE,
 endDate DATE,
 constraint chk_endDate CHECK(endDate > startDate + INTERVAL 7 day)
);
```

# 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 |
|---|----------|--------------|------|-----|---------|-------|
| ▶ | vehideID | 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    |                |

# modify column

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

`alter_specification`

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

- `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 |
|---|----------|--------------|------|-----|---------|-------|
| ▶ | vehideID | int          | NO   | PRI | HULL    |       |
|   | year     | int          | YES  |     | HULL    |       |
|   | make     | varchar(100) | YES  |     | HULL    |       |
|   | model    | varchar(100) | NO   |     | HULL    |       |
|   | color    | varchar(50)  | YES  |     | HULL    |       |
|   | note     | varchar(255) | YES  |     | HULL    |       |

## modify column

- `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 |
|---|----------|--------------|------|-----|---------|-------|
| ▶ | vehideID | int          | NO   | PRI | HULL    |       |
|   | year     | smallint     | NO   |     | HULL    |       |
|   | make     | varchar(150) | NO   |     | HULL    |       |
|   | model    | varchar(100) | NO   |     | HULL    |       |
|   | color    | varchar(20)  | NO   |     | HULL    |       |
|   | note     | varchar(255) | YES  |     | HULL    |       |

- `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));`
- `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	
	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	

	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 stores 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 csv(

```
    ID INT not null,  
    ename VARCHAR(10) not null,  
    job VARCHAR(10) not null,  
    sal INT not null) ENGINE = CSV;
```

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

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

create table with blackhole engine

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

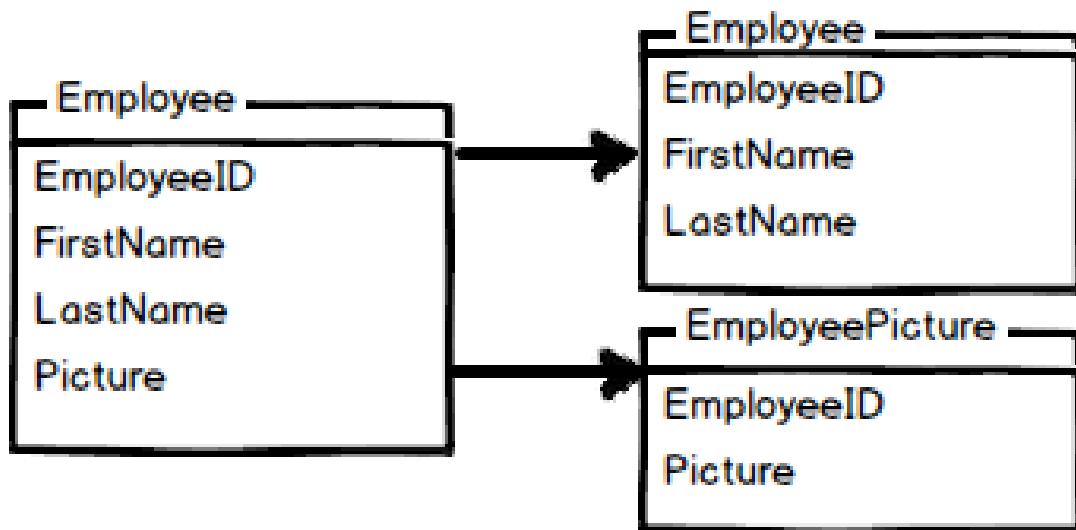
Partitioning separates data into logical units.

table partitioning

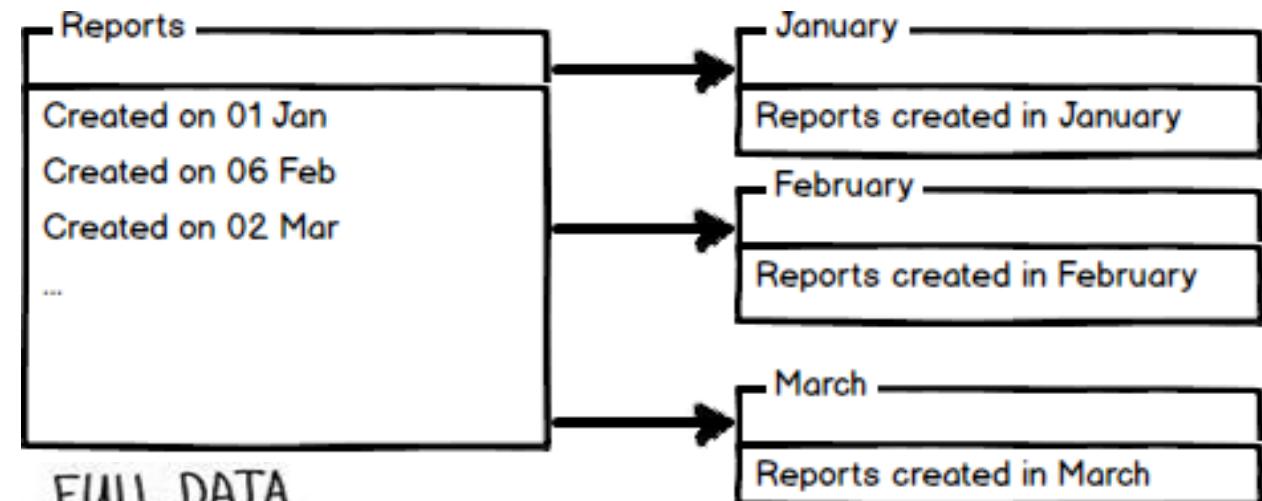
What is a database table partitioning?

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 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

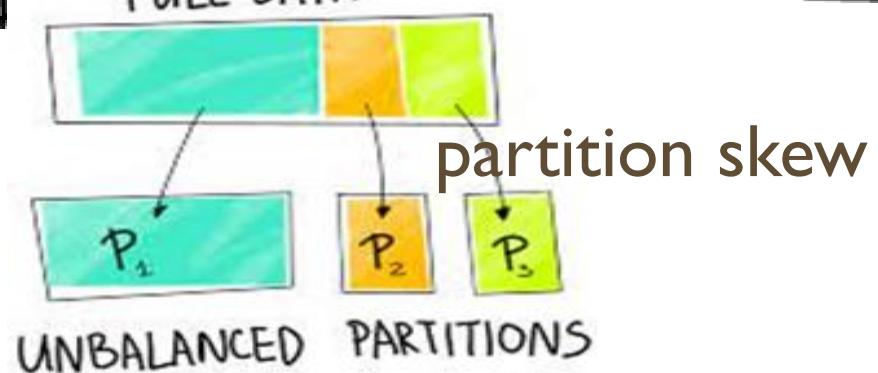


table partitioning

Original Table

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

Vertical Partitions

VP1

CUSTOMER ID	FIRST NAME	LAST NAME
1	TAEKO	OHNUKI
2	O.V.	WRIGHT
3	SELDAA	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	SELDAA	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.

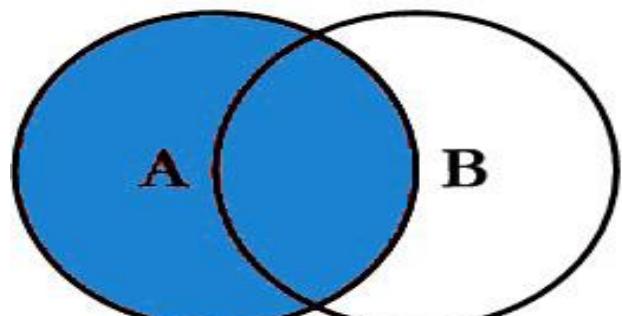
R

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

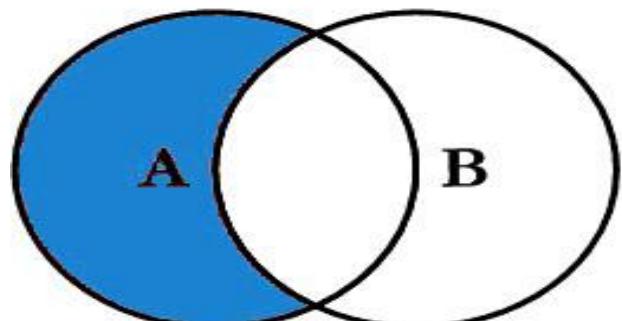
S

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

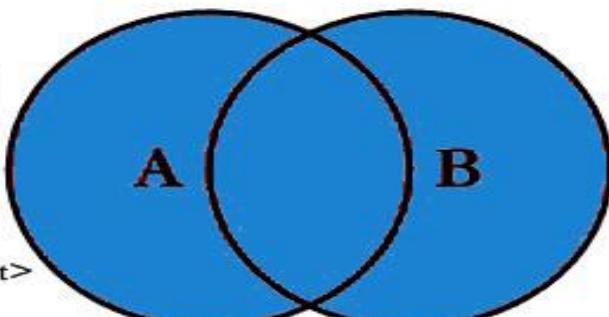
SQL JOINS



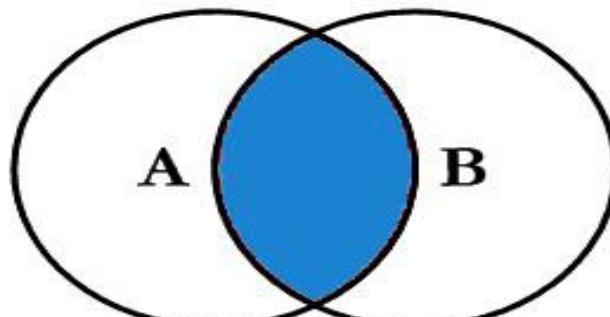
```
SELECT <select_list>  
FROM TableA A  
LEFT JOIN TableB B  
ON A.Key = B.Key
```



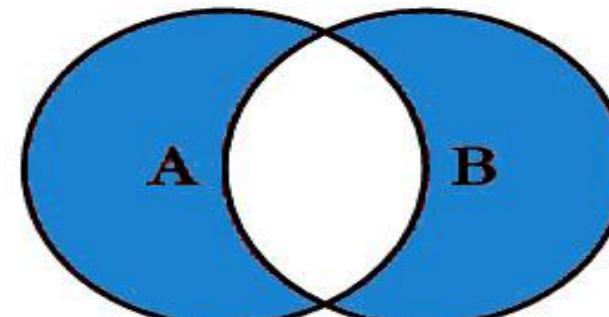
```
SELECT <select_list>  
FROM TableA A  
LEFT JOIN TableB B  
ON A.Key = B.Key  
WHERE B.Key IS NULL
```



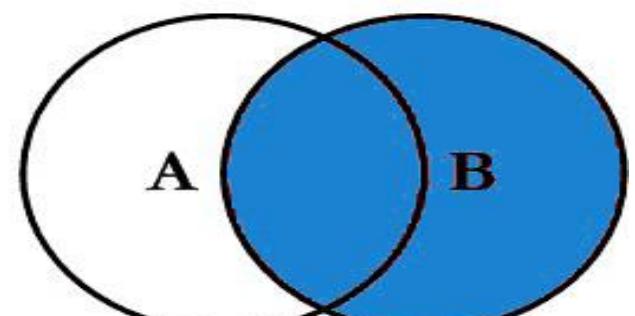
```
SELECT <select_list>  
FROM TableA A  
FULL OUTER JOIN TableB B  
ON A.Key = B.Key
```



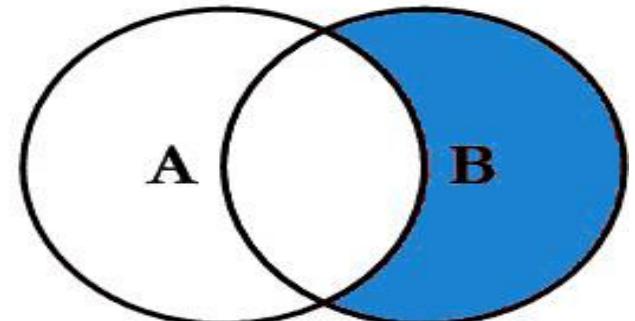
```
SELECT <select_list>  
FROM TableA A  
INNER JOIN TableB B  
ON A.Key = B.Key
```



```
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  
RIGHT 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>

column-list
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 A1 [ AS ] alias_name, A2 [ AS ] alias_name, . . . , AN 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

| 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 and numbers to strings as necessary." This means that in order to compare a string to a number, it tries to parse a number from the start of the string. In this case there is no number there, so it converts to 0, and $0 = 0$ is true.

select statement - expressions

Column EXPRESSIONS

SELECT A_1, A_2, A_3, 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;
- Note:**
If any expression evaluated with NULL, returns NULL.
- SELECT 2 + NULL ;
 - SELECT 2 * NULL ;
 - SELECT 2 - NULL ;
 - SELECT 2 / NULL ;

Note:

In SQL, the same name can be used for two (or more) attributes as long as the attributes are in different relations. If this is the case, and a multi-table query refers to two or more attributes with the same name, we must ***qualify*** the attribute name with the relation name to prevent ambiguity. This is done by prefixing the relation name to the attribute name and separating the two by a period (.).

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 (`)

- NULL value does not occupy space in memory.
- NULL value is independent of data type.
- NULL can be written in any lettercase.

null-to-null comparisons

- SELECT NULL = NULL, NULL IS NULL; // Output will be NULL and 1
- SELECT NULL = NULL, NULL IS NOT NULL; // Output will be NULL and 0

the null value

The **NULL** value is special. It means "**NO VALUE**" or "**UNKNOWN VALUE**".

Remember:

- You cannot compare two "**UNKNOWN VALUE**" the way you compare two "**KNOWN VALUE**" to each other.
 - If you attempt to use **NULL** with the usual arithmetic comparison operators, the result is **NULL** (*undefined*).
 - Instead of using `=`, `<>`, or `!=` to test for equality or inequality with **NULL** values, use **IS NULL** or **IS NOT NULL**
 - MySQL specific `<=>` comparison operator is used for **NULL**-to-**NULL** comparisons.
-

```
SELECT * FROM EMP WHERE COMM <=> NULL
```

Note:

The result of (FALSE AND UNKNOWN) is FALSE, whereas the result of (FALSE OR UNKNOWN) is UNKNOWN.

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;`

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;`

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()**.

## *sysdate(), now(), curdate(), curtime()*

NOW() returns a constant time that indicates the time at which the statement began to execute. (Within a stored function or trigger, NOW() returns the time at which the function or triggering statement began to execute.) This differs from the behavior for SYSDATE(), which returns the exact time at which it executes.

- [SELECT SYSDATE\(\)](#)
- [SELECT NOW\(\)](#)
- [SELECT CURDATE\(\)](#)
- [SELECT CURTIME\(\)](#)

***Result in something like this:***

**SYSDATE()**  
2017-02-11 10:22:31

**NOW()**  
2017-02-11 10:22:31

**CURDATE()**  
2017-02-11

**CURTIME()**  
10:22:31

```
mysql> SELECT NOW(), SLEEP(7), NOW();
mysql> SELECT SYSDATE(), SLEEP(7), SYSDATE();
```

The DATE() function extracts the date value from a date or datetime expression.

### DATE(expr)

- `SELECT DATE("2017-06-15 09:34:21");`
- `SELECT NOW(), DATE(NOW());`

#### Note:

- Returns NULL if expression is not a date or a datetime value.
- `SELECT hiredate, DAYNAME(hiredate), IF(DAYNAME(hiredate)='Saturday', hiredate + INTERVAL 2 DAY,  
IF(DAYNAME(hiredate)='Sunday', hiredate + INTERVAL 1 DAY, IF(DAYNAME(hiredate)='Monday', hiredate + INTERVAL 7  
DAY, IF(DAYNAME(hiredate)='Tuesday', hiredate + INTERVAL 6 DAY, IF(DAYNAME(hiredate)='Wednesday', hiredate +  
INTERVAL 5 DAY, IF(DAYNAME(hiredate)='Thursday', hiredate + INTERVAL 4 DAY, IF(DAYNAME(hiredate)='Friday', hiredate +  
INTERVAL 3 DAY, 'TODO')))))) R1 FROM emp;`

## + 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    |               |                                    |

## + 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 hiredate, DAYNAME(hiredate), IF(DAYNAME(hiredate) = 'Saturday', hiredate + INTERVAL 2 DAY,  
IF(DAYNAME(hiredate) = 'Sunday', hiredate + INTERVAL 1 DAY, IF(DAYNAME(hiredate) = 'Monday', hiredate + INTERVAL 7  
DAY, IF(DAYNAME(hiredate) = 'Tuesday', hiredate + INTERVAL 6 DAY, IF(DAYNAME(hiredate) = 'Wednesday', hiredate +  
INTERVAL 5 DAY, IF(DAYNAME(hiredate) = 'Thursday', hiredate + INTERVAL 4 DAY, IF(DAYNAME(hiredate) = 'Friday',  
hiredate + INTERVAL 3 DAY, 'TODO')))))) R1 FROM emp;`

*adddate()*

# **ADDDATE()** is a synonym for **DATE\_ADD()**

`ADDDATE(date, INTERVAL expr unit)` / `DATE_ADD (date, INTERVAL expr unit)`

- `SELECT NOW(), ADDDATE(NOW(), INTERVAL 1 DAY);`
- `SELECT NOW(), ADDDATE(NOW(), 1);`

| unit Value | ExpectedexprFormat |
|------------|--------------------|
| SECOND     | SECONDS            |
| MINUTE     | MINUTES            |
| HOUR       | HOURS              |
| DAY        | DAYS               |
| WEEK       | WEEKS              |
| MONTH      | MONTHS             |
| QUARTER    | QUARTERS           |
| YEAR       | YEARS              |

# SUBDATE() is a synonym for DATE\_SUB()

SUBDATE(date, INTERVAL expr unit) / DATE\_SUB (date, INTERVAL expr unit)

- SELECT NOW(), SUBDATE(NOW(), INTERVAL 1 DAY);
- SELECT NOW(), SUBDATE(NOW(), 1);

| unit Value | ExpectedexprFormat |
|------------|--------------------|
| SECOND     | SECONDS            |
| MINUTE     | MINUTES            |
| HOUR       | HOURS              |
| DAY        | DAYS               |
| WEEK       | WEEKS              |
| MONTH      | MONTHS             |
| QUARTER    | QUARTERS           |
| YEAR       | YEARS              |

# *addtime()*

ADDTIME() adds expr2 to expr1 and returns the result. expr1 is a time or datetime expression, and expr2 is a time expression.

## ADDTIME(expr1, expr2)

- `SELECT NOW(), ADDTIME(NOW(), '1:1:1') # 'HH:MM:SS'`
- `SELECT NOW(), ADDTIME(NOW(), '2 2:10:5') # 'DAY HH:MM:SS'`
- Adding 15 seconds.  
`SELECT NOW(), ADDTIME(NOW(), "15") AS Updated_time;`
- Adding 10 minutes.  
`SELECT NOW(), ADDTIME(NOW(), "00:10:00") AS Updated_time;`
- Adding 2 hours.  
`SELECT NOW(), ADDTIME(NOW(), "2:00:00") AS Updated_time;`
- Adding 10 hours 30 minute 25 second and 100000 Microseconds.  
`SELECT NOW(), ADDTIME(NOW(), "10:30:25.100000") AS Updated_time;`
- Adding 1 day 2 hours 30 minute 25 second.  
`SELECT NOW(), ADDTIME(NOW(), "1 2:30:25") AS Updated_time;`

=

## subtime()

SUBTIME() returns expr1 – expr2 expressed as a value in the same format as expr1. expr1 is a time or datetime expression, and expr2 is a time expression.

### SUBTIME(expr1, expr2)

- `SELECT NOW(), SUBTIME(NOW(), '1:1:1'); # 'HH:MM:SS'`
- `SELECT NOW(), SUBTIME(NOW(), '2 1:1:1'); # 'DAY HH:MM:SS'`
- Subtract 15 seconds.  
`SELECT NOW(), SUBTIME(NOW(), "15") AS Updated_time;`
- Subtract 10 minutes.  
`SELECT NOW(), SUBTIME(NOW(), "00:10:00") AS Updated_time;`
- Subtract 2 hours.  
`SELECT NOW(), SUBTIME(NOW(), "2:00:00") AS Updated_time;`
- Subtract 10 hours 30 minute 25 second and 100000 Microseconds.  
`SELECT NOW(), SUBTIME(NOW(), "10:30:25.100000") AS Updated_time;`
- Subtract 1 day 2 hours 30 minute 25 second.  
`SELECT NOW(), SUBTIME(NOW(), "1 2:30:25") AS Updated_time;`

# 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`

## *period\_diff()*

MySQL PERIOD\_DIFF() returns the difference between two periods. Periods should be in the same format i.e. YYYYMM or YYMM.

`PERIOD_DIFF(Period1, Period2);`

- `SELECT PERIOD_DIFF(201701, 201601);`
- `SELECT PERIOD_DIFF(EXTRACT (YEAR_MONTH FROM NOW()), EXTRACT(YEAR_MONTH FROM hiredate)) AS R1 FROM emp;`

# *datetime functions*

| Syntax           | Result                                                                                                                                     |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| DAY(date)        | DAY() is a <b>synonym for DAYOFMONTH()</b> .                                                                                               |
| 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                                                                                      |
|---------------------------------------|---------------------------------------------------------------------------------------------|
| <code>WEEKDAY(date)</code>            | Returns the weekday index for date (0 = Monday, 1 = Tuesday, ... 6 = Sunday).               |
| <code>WEEKOFYEAR(date)</code>         | Returns the calendar week of the date as a number in the range from 1 to 53.                |
| <code>QUARTER(date)</code>            | Returns the quarter of the year for date, in the range 1 to 4.                              |
| <code>HOUR(time)</code>               | Returns the hour for time. The range of the return value is 0 to 23 for time-of-day values. |
| <code>MINUTE(time)</code>             | Returns the minute for time, in the range 0 to 59.                                          |
| <code>SECOND(time)</code>             | Returns the second for time, in the range 0 to 59.                                          |
| <code>DATEDIFF(expr1, expr2)</code>   | Returns the number of days between two dates or datetimes.                                  |
| <code>STR_TO_DATE(str, format)</code> | 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                                   |
|---------|-----------------------------------------------|
| %l      | 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.<br><b>e.g.</b> <ul style="list-style-type: none"><li>• <code>SELECT ASCII(ename) FROM emp;</code></li></ul>                                                                                                                                                                                                                                                                                                                            |
| 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. <b>NULL values are skipped.</b><br><b>e.g.</b> <ul style="list-style-type: none"><li>• <code>SELECT CHAR(65, 66, 67); / SELECT CAST(CHAR(65 66, 67) AS CHAR);</code></li></ul>                                                                                                                                                                                                                                                     |
| CONCAT(str1, str2, ...)       | Returns the string that results from concatenating the arguments. CONCAT() <b>returns NULL if any argument is NULL.</b><br><b>e.g.</b> <ul style="list-style-type: none"><li>• <code>SELECT CONCAT('Mr. ', ename) FROM emp;</code></li><li>• <code>SELECT CONCAT('My', NULL, 'SQL');</code> #op will be NULL</li></ul>                                                                                                                                                                                                                                                           |
| 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.<br><b>e.g.</b> <ul style="list-style-type: none"><li>• <code>SELECT ELT(1, 'Bank', 'Of', 'India', 'Kothrud', 'Pune');</code></li><li>• <code>SELECT ELT(1, ename, job, sal) FROM emp;</code></li><li>• <code>SELECT hiredate, ELT(MONTH(hiredate),'Winter', 'Winter', 'Spring', 'Spring', 'Spring', 'Summer', 'Summer', 'Summer', 'Autumn', 'Autumn', 'Autumn', 'Winter') R1 FROM emp;</code></li></ul> |

# *string functions*

| Syntax                              | Result                                                                                                                                                                 |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>STRCMP(expr1, expr2)</code>   | <code>STRCMP()</code> 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. |
| <code>LCASE(str)</code>             | Returns lower case string. <code>LCASE()</code> is a synonym for <code>LOWER()</code> .                                                                                |
| <code>UCASE(str)</code>             | Returns upper case string. <code>UCASE()</code> is a synonym for <code>UPPER()</code> .                                                                                |
| <code>LENGTH(str)</code>            | Returns the length of the string.                                                                                                                                      |
| <code>LPAD(str, len, padstr)</code> | Returns the string str, left-padded with the string padstr to a length of len characters.                                                                              |
| <code>RPAD(str, len, padstr)</code> | Returns the string str, right-padded with the string padstr to a length of len characters.                                                                             |
| <code>REPEAT(str, count)</code>     | 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                                                                                     |
|------------------------------|--------------------------------------------------------------------------------------------|
| <code>LEFT(str, len)</code>  | Returns the leftmost len characters from the string str, or NULL if any argument is NULL.  |
| <code>RIGHT(str, len)</code> | Returns the rightmost len characters from the string str, or NULL if any argument is NULL. |
| <code>LTRIM(str)</code>      | Returns the string str with leading space characters removed.                              |
| <code>RTRIM(str)</code>      | Returns the string str with trailing space characters removed.                             |
| <code>TRIM(str)</code>       | Returns the string str with leading and trailing space characters removed.                 |
| <code>BINARY</code> 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.<br><i>e.g.</i> <ul style="list-style-type: none"><li>• <code>SELECT REPLACE('Hello', 'l', 'x');</code></li></ul> |
| REVERSE(str)                   | Returns the string str with the order of the characters reversed.                                                                                                                                                                                                                         |
| SUBSTR(str, pos, len)          | <b>SUBSTR() is a synonym for SUBSTRING().</b><br><i>e.g.</i> <ul style="list-style-type: none"><li>• <code>SELECT SUBSTR ('This is the test by IWAY', 6);</code></li><li>• <code>SELECT SUBSTR ('This is the test by IWAY', -4, 4);</code></li></ul>                                      |
| 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)));`

# *string functions*

- `SELECT * FROM emp WHERE LEFT(ename, 1) IN ('a', 'e', 'o', 'i', 'u');`
- `SELECT * FROM emp WHERE REGEXP_LIKE(ename, '(a|e|i|o|u)');`
- `SELECT * FROM emp WHERE REGEXP_LIKE(ename, '^ (a|m)'); //starts with`
- `SELECT * FROM emp WHERE REGEXP_LIKE(ename, '(n|r)$'); //ends with`
- `SELECT "abc,,abc,,,,bc,,,,,abc" ; / SELECT REPLACE(REPLACE(REPLACE("abc,,abc,,,,bc,,,,,abc", ",","."),".",""),".","")) R1 ;`

mathematical functions

# *mathematical functions*

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

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

## *mathematical functions*

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**

## **modifiers**

`SELECT [ALL / DISTINCT / DISTINCTROW] identifier.* / identifier.A1 [ [as] alias_name], identifier.A2 [ [as] alias_name], identifier.A3 [ [as] alias_name], expression1 [ [as] alias_name], expression2 [ [as] alias_name] ...`

- [ `FROM <identifier.r1> [as] alias_name], <identifier.r2> [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], ... }` } ]

## **select statement**

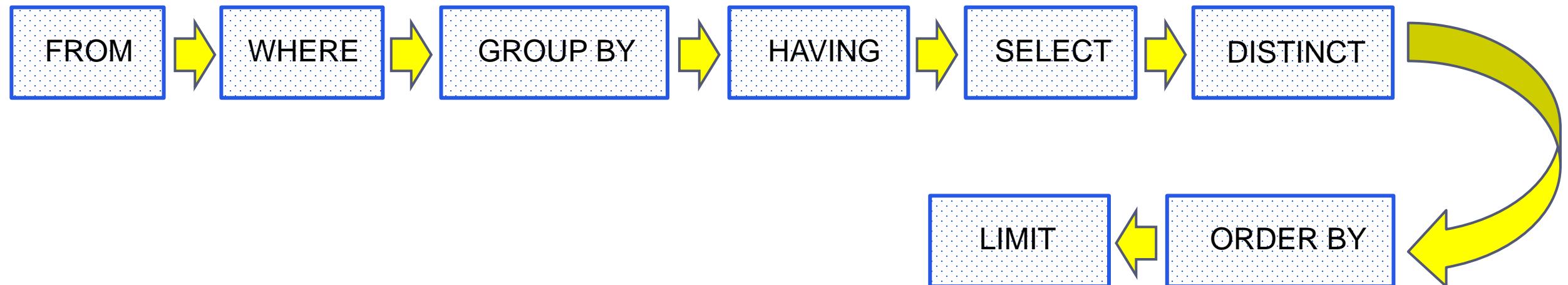
### **Remember:**

- **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



select statement... execution



# 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

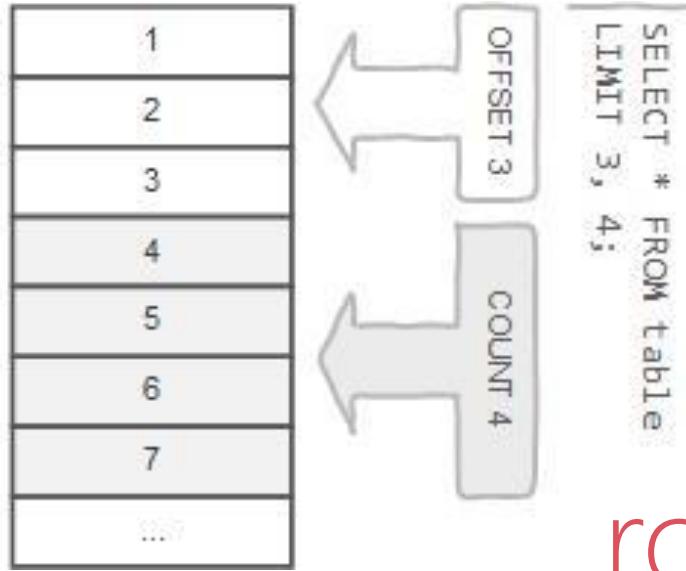
# UUID() / UUID\_SHORT()

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;`

```
SELECT * FROM table;
```



## 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.
-

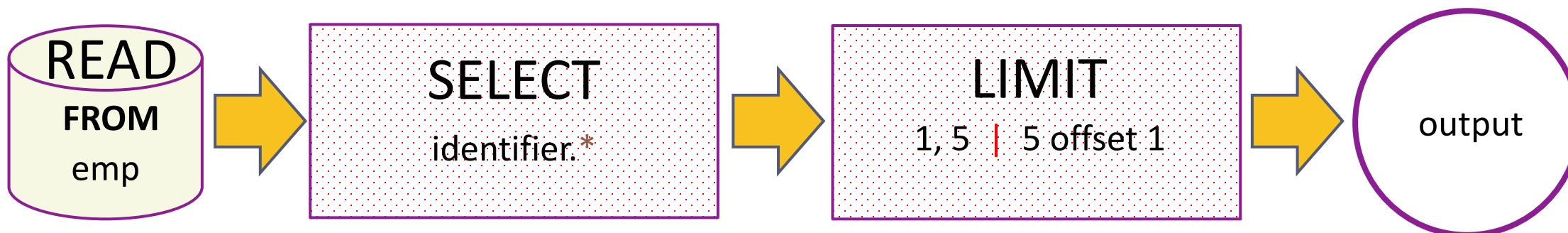
## *select - limit*

`SELECT A1, A2, A3, ... 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;`

## *select - limit*

This variable is used to return the maximum number of rows from SELECT statements. Its default value is unlimited. But if you changed the limit then SELECT statement returns the rows equals to the value.

`SQL_SELECT_LIMIT = { value | DEFAULT }`

This variable does not apply to SELECT statement that executed in the stored procedures or functions.

- `SET SQL_SELECT_LIMIT = 2;`
- `SET SQL_SELECT_LIMIT = DEFAULT;`
- `SELECT * FROM emp;`

Nulls by default occur at the top, but you can use *IsNull* to assign default values, that will put it in the position you require. . The *ISNULL()* function tests whether an expression is NULL. If expression is a NULL value, the *ISNULL()* function returns 1. Otherwise, it returns 0.

- `SELECT id AS 'a' FROM tbl_name ORDER BY `a`;`
- `SELECT id AS 'a' FROM tbl_name ORDER BY 'a';`

## 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 A1, A2, A3, An FROM r
[ORDER BY {A1, A2, A3, ... | expr | position} [ASC | DESC], ...]
```

"Ordered by attributes  $A_1, A_2, A_3 \dots$ "

- 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  $A_3$

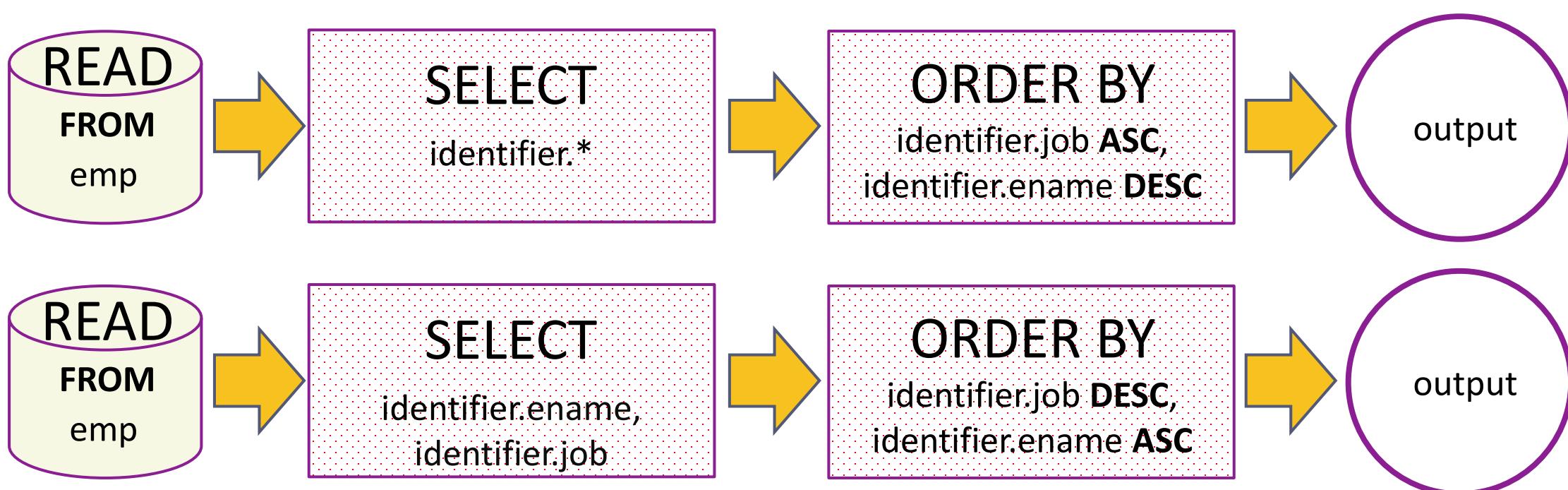
- `SELECT * FROM r ORDER BY key_part1, key_part2;` // optimizer does not use the index.
- `SELECT key_part1, key_part2 FROM r ORDER BY key_part1, key_part2;` // optimizer uses the index.

# *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 { $A_1, A_2, A_3, \dots$  | expr | position} [ASC | DESC], ...]



# *select - order by*

When doing an ORDER BY, NULL values are presented **first** if you do ORDER BY ... ASC

- `SELECT * FROM emp ORDER BY comm ASC;`

# *select - order by*

When doing an ORDER BY, NULL values are presented last if you do ORDER BY ... DESC.

- `SELECT * FROM emp ORDER BY comm DESC;`

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

*select - order by*

[ORDER BY { $A_1, A_2, A_3, \dots$  | 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  $A_1, A_2, A_3, \dots$  FROM  $r_1, r_2, r_3, \dots$  [ 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  $(v_1, v_2, \dots, v_n)$  to denote a tuple of arity (attribute)  $n$  containing values  $v_1, v_2, \dots, v_n$ .

**WHERE  $(a_1, a_2) \leq (b_1, b_2)$**

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

## Comparison Functions and Operators

|                               |                                                                                        |
|-------------------------------|----------------------------------------------------------------------------------------|
| LEAST(value1, value2, ...)    | With two or more arguments, returns the smallest argument.                             |
| GREATEST(value1, value2, ...) | With two or more arguments, returns the largest argument.                              |
| (expr, [expr] ...)            | Multiple columns in expr. (sub-query returning multiple columns to compare)            |
| COALESCE(value, ...)          | Returns the first non-NULL value in the list, or NULL if there are no non-NULL values. |

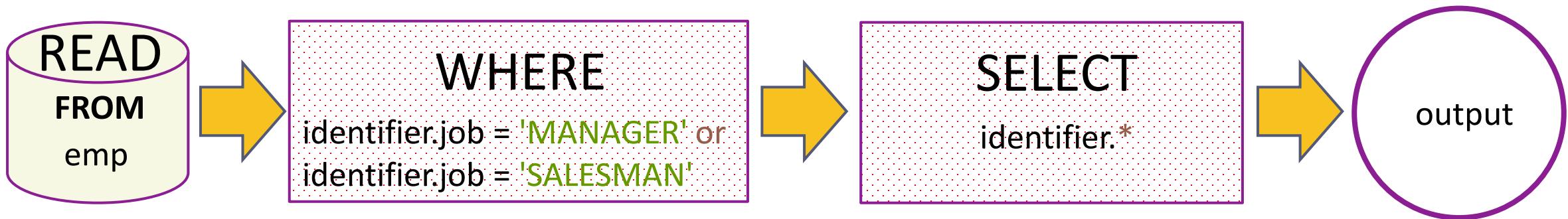
- SELECT GREATEST(10, 20, 30), # 30  
LEAST(10, 20, 30); # 10
- SELECT GREATEST(10, null, 30), # null  
LEAST(10, NULL, 30); # null
- SELECT \* FROM emp WHERE (deptno, pwd) = (SELECT deptno, pwd FROM dept WHERE deptno = 30);

Remember:

- If any argument is NULL, the both functions return NULLs immediately without doing any comparison..

# 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    | a12recppm  | 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  $A_1, A_2, A_3, \dots$  FROM  $r_1, r_2, r_3, \dots$  [ WHERE  $P$  ]`

What will be the output of the following statement?

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

- `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;
- 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 |
|   | 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  |

|   | 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**. **non-zero** 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;`

|   | <code>id</code> | <code>title</code> | <code>completed</code> |
|---|-----------------|--------------------|------------------------|
| ▶ | 2               | Task2              | 1                      |
|   | 4               | Task4              | 1                      |
|   | 8               | Task8              | 1                      |
|   | 9               | Task9              | 12                     |
|   | 10              | Task10             | 58                     |
|   | 11              | Task11             | 1                      |
|   | 13              | Task13             | 1                      |
|   | NULL            | NULL               | NULL                   |

|   | <code>id</code> | <code>title</code> | <code>completed</code> |
|---|-----------------|--------------------|------------------------|
| ▶ | 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;`

|   | <code>id</code> | <code>title</code> | <code>completed</code> |
|---|-----------------|--------------------|------------------------|
| ▶ | 1               | Task1              | 0                      |
|   | 3               | Task3              | 0                      |
|   | 7               | Task7              | 0                      |
|   | 12              | Task12             | 0                      |
|   | NULL            | NULL               | NULL                   |

## *select – boolean*

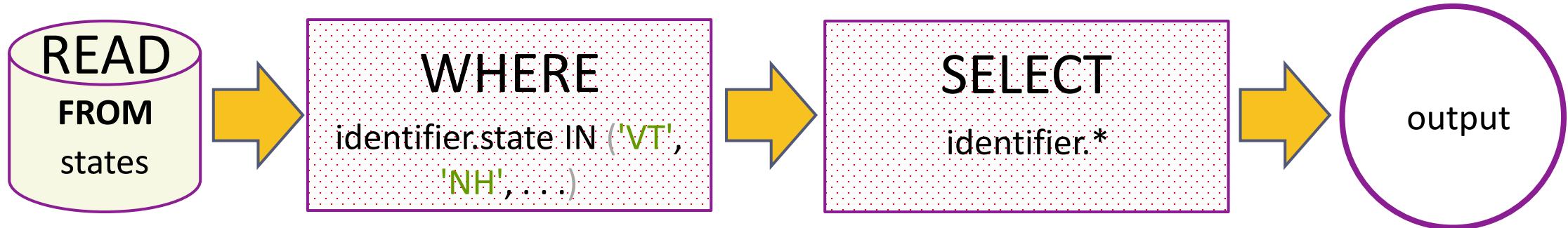
- BOOL and BOOLEAN are synonym of TINYINT(1)

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);`



#### 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 r1 WHERE (`

`state = 'VT' OR  
 state = 'NH' OR  
 state = 'ME' OR  
 state = 'MA' OR  
 state = 'CT' OR  
 state = 'RI'`



- `SELECT ... FROM r1 WHERE state IN ('VT', 'NH', 'ME', 'MA', 'CT', 'RI');`
- `SELECT ... FROM r1 WHERE state IN (SELECT ...);`

`);`

**A IN (B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, etc.)**    A is found in the list (B<sub>1</sub>, B<sub>2</sub>, etc.)

## 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)"

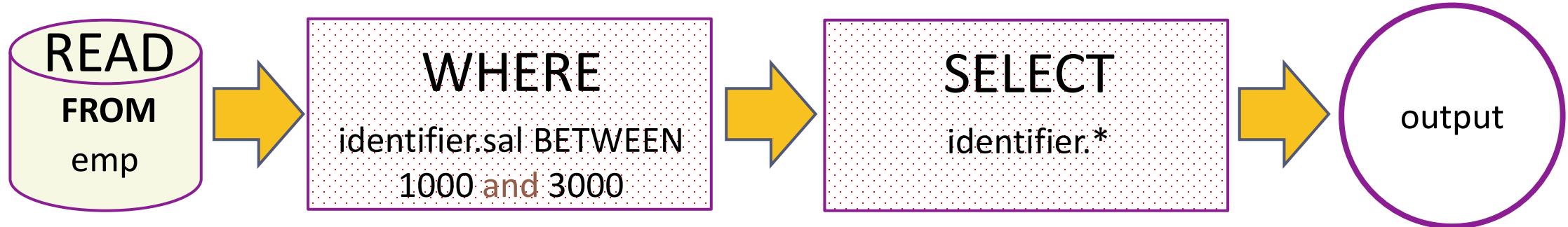
## Remember:

in

- 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)`



#### 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 ( $\geq$ ) and less than or equal to ( $\leq$ ) to substitute the BETWEEN operator.
- 

Note:

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

e.g.

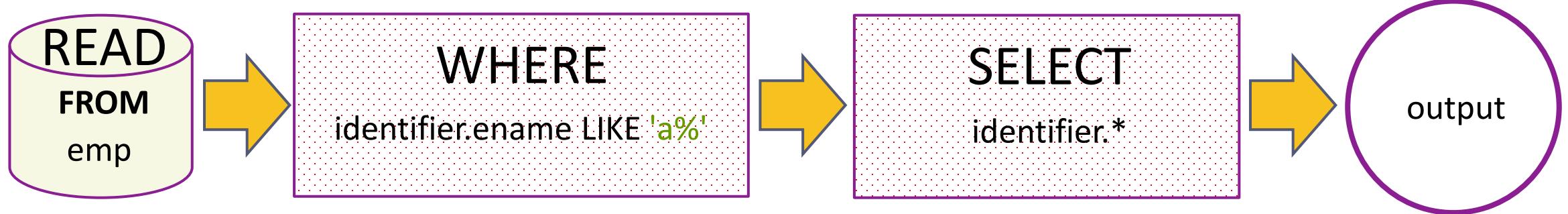
SELET empno, ename, job, hiredate, sal, comm, deptno, isactive FROM emp WHERE sal BETWEEN 1000 AND NULL;

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

*between*

- SELECT empno, ename, job, hiredate, sal, comm, deptno, isactive FROM emp WHERE sal BETWEEN 1000 AND 3000;

|   | empno | ename  | job      | hiredate   | sal     | comm    | deptno | isactive |
|---|-------|--------|----------|------------|---------|---------|--------|----------|
| ▶ | 7421  | THOMAS | CLERK    | 1981-07-19 | 1750.00 | NULL    | 10     | 0        |
|   | 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        |
|   | 7788  | SCOTT  | ANALYST  | 1982-12-09 | 3000.00 | NULL    | 20     | 1        |
|   | 7844  | TURNER | SALESMAN | 1981-09-08 | 1500.00 | 0.00    | 30     | 1        |
|   | 7876  | ADAMS  | CLERK    | 1983-01-12 | 1100.00 | NULL    | 20     | 1        |
|   | 7902  | FORD   | ANALYST  | 1981-12-03 | 3000.00 | NULL    | 20     | 0        |
|   | 7920  | GRASS  | SALESMAN | 1980-02-14 | 2575.00 | 2700.00 | 30     | 1        |



#### 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.
  - \_ matches exactly one 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.
-

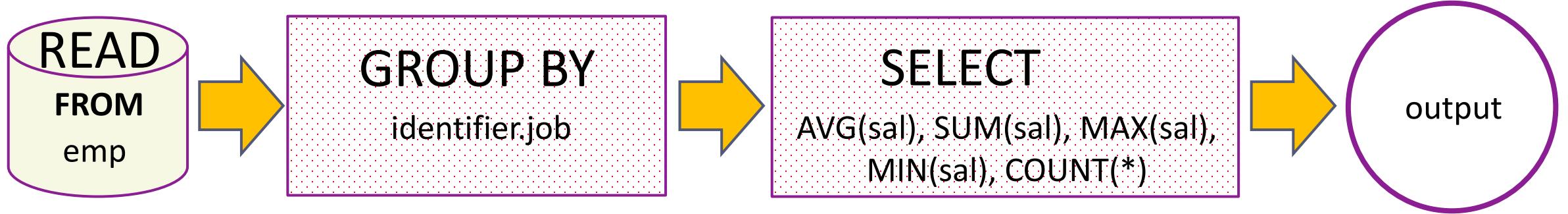
like

- SELECT empno, ename, job, hiredate, sal, comm, deptno, isactive FROM emp WHERE ename LIKE 'a%';

|   | empno | ename  | job      | hiredate   | sal     | comm    | deptno | isactive |
|---|-------|--------|----------|------------|---------|---------|--------|----------|
| ▶ | 7415  | AARAV  | CLERK    | 1981-12-31 | 3350.00 | NULL    | 10     | 0        |
|   | 7499  | ALLEN  | SALESMAN | 1981-02-20 | 1600.00 | 300.00  | 30     | 1        |
|   | 7876  | ADAMS  | CLERK    | 1983-01-12 | 1100.00 | NULL    | 20     | 1        |
|   | 7945  | AARUSH | SALESMAN | 1980-02-14 | 1350.00 | 2700.00 | 30     | 0        |
|   | 7949  | ALEX   | MANAGER  | 1982-01-24 | 1250.00 | 500.00  | 30     | 1        |

## 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;`



## 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(*) / COUNT(colNM)`

- `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.

## TODO

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

- 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;`

## TODO

### SUM([DISTINCT] expr)

- 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;`

## TODO

### SUM([DISTINCT] expr)

- 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;`
  
- `SELECT custId, type, amount, CASE type WHEN 'd' THEN amount WHEN 'c' THEN amount * -1 END amount FROM transactions;`

## TODO

### `MAX([DISTINCT] expr)`

- 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;`

## TODO

### `MIN([DISTINCT] expr)`

- 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;`

### TODO

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

- 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 functions*

TODO

COUNT([DISTINCT] *expr*)

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;

Things to... Remember:

*aggregate functions*

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 deptno, GROUP_CONCAT(ename) FROM emp group BY deptno;`
  
- `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;`

```
SELECT DISTINCT COUNT(JOB) FROM EMP
```

```
SELECT COUNT(DISTINCT JOB) FROM EMP
```

- `SET SQL_MODE = '';`
- `SET SQL_MODE = 'ONLY_FULL_GROUP_BY';`



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

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;
```

## *select - group by*

- Columns selected for output can be referred to in ORDER BY and GROUP BY clauses using column names, column aliases, or column positions. Column positions are integers and begin with 1
- If you use GROUP BY, output rows are sorted according to the GROUP BY columns as if you had an ORDER BY for the same columns. To avoid the overhead of sorting that GROUP BY produces, add ORDER BY NULL.
- If a query includes GROUP BY but you want to avoid the overhead of sorting the result, you can suppress sorting by specifying ORDER BY NULL.

For example:

- `SELECT job, COUNT(*) FROM emp GROUP BY job ORDER BY NULL;`
- `SELECT * FROM emp ORDER BY FIELD (job, 'MANAGER', 'SALESMAN');`

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

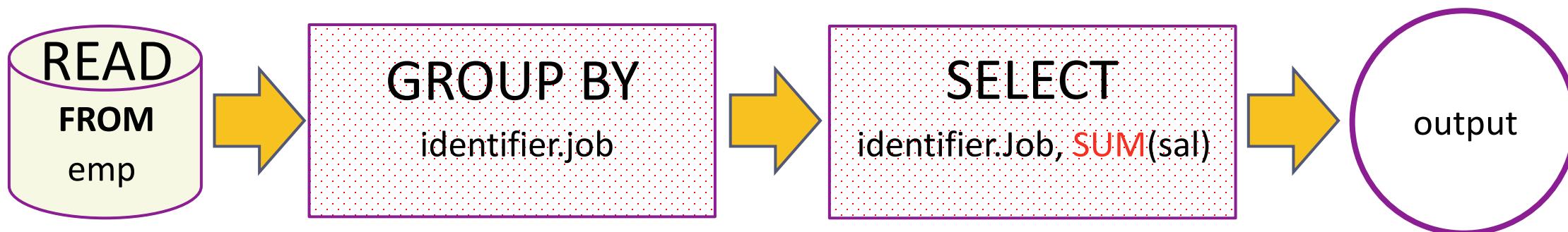
**select - group by**

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

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

[GROUP BY { $G_1, G_2, \dots$  | 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    |

- SET *SQL\_MODE* = '';
- SET *SQL\_MODE* = 'ONLY\_FULL\_GROUP\_BY';

*select - group by*

Examples:

- SELECT job, sal + 1001 FROM emp GROUP BY job;
- SELECT job, COUNT(job) FROM emp GROUP BY COUNT(job); # error
- SELECT job, sal + 1001 FROM emp GROUP BY sal + 1001;
- SELECT LENGTH(ename) R1 FROM emp GROUP BY R1;
- SELECT job, SUM(sal) FROM emp GROUP BY job WITH ROLLUP;
- SELECT COALESCE (job, 'Total'), SUM(sal) FROM emp GROUP BY job WITH ROLLUP;

## 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';` \*
  - **HAVING** is merged with **WHERE** if you do not use GROUP BY or Aggregate Functions (COUNT(), . . .)
- \* **ERROR: Unknown column '...'**  
**in 'having clause'**

## *select - having*

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

[GROUP BY { $G_1, G_2, \dots$  | expr | position}, ... [WITH ROLLUP]]

[HAVING having\_condition ]

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



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

When WHERE and HAVING clause are used together in a SELECT query with aggregate function, WHERE clause is applied first on individual rows and only rows which pass the condition is included for creating groups. Once group is created, HAVING clause is used to filter groups based upon condition specified.

difference between where and  
having clause

# *where and having clause*

## Remember:

- **WHERE** clause can be used with - **SELECT**, **UPDATE**, and **DELETE** statements, whereas **HAVING** clause can only be used with the **SELECT** statement.
  - **WHERE** clause filters rows before aggregation (GROUPING), whereas, **HAVING** clause filters groups, after the aggregations are performed.
  - **WHERE** is used before the ‘**GROUP BY**’ clause if required and **HAVING** is used after the ‘**GROUP BY**’ clause.
  - Aggregate functions (**SUM**, **MIN**, **MAX**, **AVG** and **COUNT**) cannot be used in the **WHERE** clause, unless it is in a sub query contained in a **WHERE** or **HAVING** clause, whereas, aggregate functions can be used in **HAVING** clause.
- 

## Note:

- The **WHERE** clause acts as a pre-filter whereas **HAVING** clause acts as a post-filter.

# *where vs having*

**WHERE**

**Vs**

**HAVING**

| <b>WHERE</b>                                                                        | <b>HAVING</b>                                                          |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Implemented in row operations.                                                      | Implemented in column operations.                                      |
| Single row                                                                          | Summarized row or group or rows.                                       |
| It only fetches the data from particular rows or table according to the condition.  | It only fetches the data from grouped data according to the condition. |
| Aggregate Functions cannot appear in WHERE clause.                                  | Aggregate Functions Can appear in HAVING clause.                       |
| Used with SELECT and other statements such as UPDATE, DELETE or either one of them. | Used with SELECT statement only.                                       |
| Pre-filter                                                                          | Post-filter                                                            |
| GROUP BY Comes after WHERE.                                                         | GROUP BY Comes before HAVING.                                          |

window function

# window function

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

- `RANK() OVER(PARTITION BY expr [, expr] ... ORDER BY expr [ASC|DESC] [, expr [ASC|DESC]] ... )`
- `DENSE_RANK() OVER(PARTITION BY expr [, expr] ... ORDER BY expr [ASC|DESC] [, expr [ASC|DESC]] ... )`
- `ROW_NUMBER() OVER([ PARTITION BY expr [, expr] ... ORDER BY expr [ASC|DESC] [, expr [ASC|DESC]] ... ] )`

## 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

- `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);`
  
- `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;`

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;`

`SELECT VARIABLE_NAME , VARIABLE_VALUE FROM  
PERFORMANCE_SCHEMA.USER_VARIABLES_BY_THREAD;`

# *user-defined variables*

## Note:

- User variables are intended to provide data values. They cannot be used directly in an SQL statement as an identifier or as part of an identifier.

e.g.

```
SET @v1 = 'ENAME'; #WHERE ENAME IS COLUMN NAME.
SELECT @v1 FROM emp;
```

# rownum

```
mysql> SELECT * FROM (SELECT @cnt := @cnt + 1 "R1", emp.* FROM emp, (SELECT @cnt := 0) T1) T2 WHERE "R1" > @cnt - 7;
```

## select - rownum

```
mysql> SET @rank = 0;
mysql> SELECT @row := @row + 1 as rownum , emp.* FROM emp;
mysql> SELECT @row := @row + 1 as rownum , emp.* FROM emp, (SELECT @row := 0) as E;
mysql> SELECT @row := @row + 1 ,E.* FROM (SELECT job, sal FROM emp GROUP BY job ORDER BY SAL DESC) E , (SELECT @row := 0) EE;
```

| ROWNUM | EMPNO | ENAME  | JOB       | MGR  | HIREDATE            | SAL     | COMM    | DEPTNO | BONUSID | USER_NAME | PWD        |
|--------|-------|--------|-----------|------|---------------------|---------|---------|--------|---------|-----------|------------|
| 1      | 7839  | KING   | PRESIDENT | NULL | 1981-11-17 00:00:00 | 5000.00 | NULL    | 10     | 1       | KING      | r50mom     |
| 2      | 7698  | BLAKE  | MANAGER   | 7839 | 1981-05-01 00:00:00 | 2850.00 | NULL    | 30     | 1       | BLAKE     | sales@2017 |
| 3      | 7782  | CLARK  | MANAGER   | 7839 | 1981-06-09 00:00:00 | 2450.00 | NULL    | 10     | 3       | CLARK     | r50mom     |
| 4      | 7566  | JONES  | MANAGER   | 7839 | 1981-04-02 00:00:00 | 2975.00 | NULL    | 20     | 4       | JONES     | a12recmom  |
| 5      | 7654  | MARTIN | SALESMAN  | 7698 | 1981-09-28 00:00:00 | 1250.00 | 1400.00 | 30     | 6       | MARTIN    | sales@2017 |
| 6      | 7499  | ALLEN  | SALESMAN  | 7698 | 1981-02-20 00:00:00 | 1600.00 | 300.00  | 30     | 4       | ALLEN     | sales@2017 |
| 7      | 7844  | TURNER | SALESMAN  | 7698 | 1981-09-08 00:00:00 | 1500.00 | 0.00    | 30     | 5       | TURNER    | sales@2017 |
| 8      | 7900  | JAMES  | CLERK     | 7698 | 1981-12-03 00:00:00 | 950.00  | NULL    | 30     | 2       | JAMES     | sales@2017 |
| 9      | 7521  | WARD   | SALESMAN  | 7698 | 1981-02-22 00:00:00 | 1250.00 | 500.00  | 30     | 1       | WARD      | sales@2017 |
| 10     | 7902  | FORD   | ANALYST   | 7566 | 1981-12-03 00:00:00 | 3000.00 | NULL    | 20     | 4       | FORD      | a12recmom  |

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

## Remember:

- A subquery must be enclosed in parentheses.
- Use single-row operators with single-row subqueries, and use multiple-row operators with multiple-row subqueries.
- If a subquery (inner query) returns a null value to the outer query, the outer query will not return any rows when using certain comparison operators in a **WHERE** clause.
- If **ORDER BY** occurs within a subquery and also is applied in the outer query, the outermost **ORDER BY** takes precedence.
- If **LIMIT** occurs within a subquery and also is applied in the outer query, the outermost **LIMIT** takes precedence.

# sub-queries

A subquery is a **SELECT** statement within another statement.

## Note:

- You may use comparison operators such as **<>**, **<**, **>**, **<=**, and **>=** with a single row subquery.
- Multiple row subquery returns one or more rows to the outer SQL statement. You may use the **IN**, **ANY**, or **ALL** operator in outer query to handle a subquery that returns multiple rows.

A subquery is a **SELECT** statement within another statement.

## subqueries

**Remember:**

A subquery may occur in:

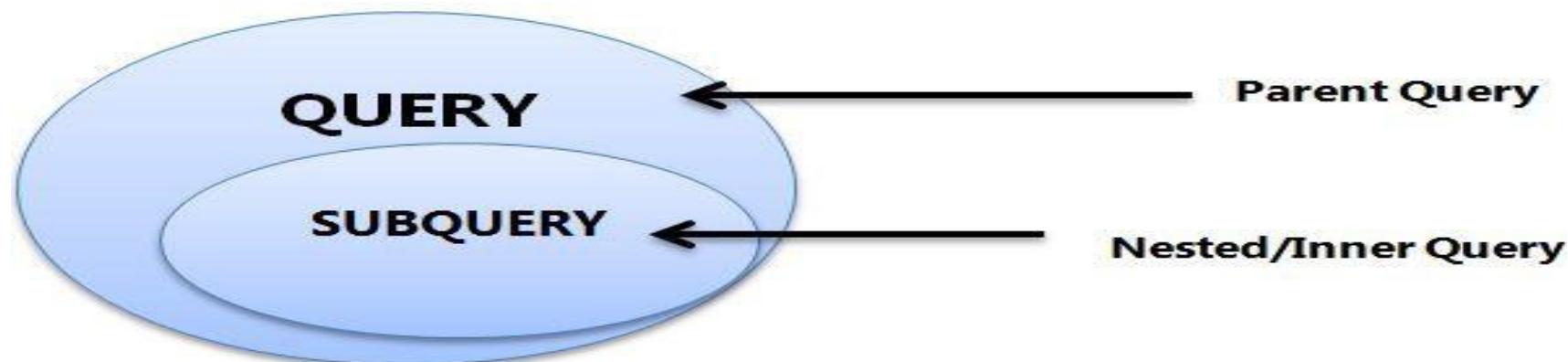
- a **SELECT** clause
- a **FROM** clause
- a **WHERE** clause
- a **HAVING** clause

- **INSERT ... SELECT ...**
- **UPDATE ... SELECT ...**
- **DELETE ... SELECT ...**
- **CREATE TABLE ... AS SELECT ...**
- **CREATE VIEW ... AS SELECT ...**
- **DECLARE CURSOR ... AS SELECT ...**
- **EXPLAIN SELECT ...**

**Note:**

A subquery's outer statement can be any one of:

- **SELECT**
- **INSERT**
- **UPDATE**
- **DELETE**
- **CREATE**



## *single row subqueries*

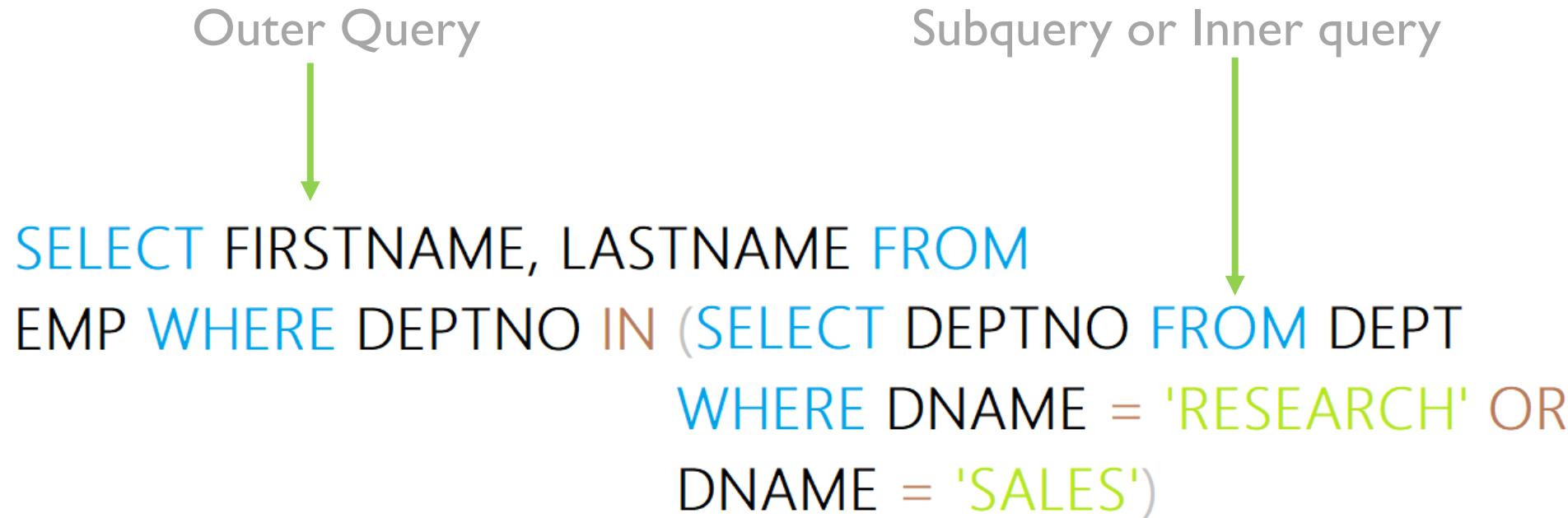
A single row subquery returns **zero or one row** to the outer SQL statement. You can place a subquery in a **WHERE** clause, a **HAVING** clause, or a **FROM** clause of a SELECT statement.

Outer Query  
↓  
`SELECT FIRSTNAME, LASTNAME FROM  
EMP WHERE DEPTNO = (SELECT DEPTNO FROM EMP  
WHERE DNAME = 'SALES')`

Subquery or Inner query  
↓

## *multiple row and column subqueries*

A multiple row subquery returns **one or more rows** to the outer SQL statement. You may use the **IN**, **ANY**, or **ALL** operator in outer query to handle a subquery that returns multiple rows.



## *subqueries with insert*

TODO

`INSERT INTO table_name [(column1 [, column2 ])] (subquery)`

`INSERT INTO EMPLOYEE`  SELECT \* FROM EMP

`INSERT INTO EMPLOYEE (FIRSTNAME, LASTNAME)`  
SELECT FIRSTNAME, LASTNAME  FROM EMP

## *subqueries with update*

TODO

`UPDATE table_name SET column_name = (subquery) [WHERE (subquery)]`

## *subqueries with delete*

TODO

`DELETE FROM table_name [ WHERE (subquery) ]`

# *types of subqueries*

- The Subquery as Scalar Operand – **SELECT** clause
- Comparisons using Subqueries – **WHERE / HAVING** clause (*Single row subquery*)
- Subqueries in the **FROM Clause** – **INLINE VIEWS** (*Derived Tables*)
- Subqueries with ALL, ANY, IN, or SOME – **WHERE / HAVING** clause (*Multiple row subquery*)
- Subqueries with EXISTS or NOT EXISTS

WITH var(param) as (SELECT) [CET] Common Table Expressions

**WITH** a(p1, p2, p3, p4) **AS** (SELECT \* FROM dept) **SELECT** p1, p2, p3, p4 **FROM** a;

the subquery as scalar operand

# *the subquery as scalar operand*

TODO

`SELECT A1, A2, A3, (subquery) as A4, ... FROM r`

**Remember:**

- A scalar subquery is a subquery that returns **exactly one column value from one row**.
- A scalar subquery is a simple operand, and you can use it almost anywhere a single column value is legal.

**Note:**

- If the subquery returns 0 rows then the value of scalar subquery expression is **null**.
- if the subquery returns more than one row then MySQL returns an **error**.

**Think:**

- `SELECT (SELECT 1, 2); #error`
- `SELECT (SELECT ename, sal FROM emp); #error`
- `SELECT (SELECT * FROM emp); #error`
- `SELECT (SELECT NULL + 1);`
- `SELECT ename, (SELECT dname FROM dept WHERE emp.deptno = dept.deptno) R1 FROM emp ;`

## *the subquery as scalar operand*

e.g.

- `SELECT (SELECT stdprice FROM price WHERE prodid = 100890 AND enddate IS NOT NULL) AS "Standard Price",  
(SELECT minprice FROM price WHERE prodid = 100890 AND enddate IS NOT NULL) AS "Minimum Price";`

|  | Standard Price | Minimum Price |
|--|----------------|---------------|
|  | 54.00          | 40.50         |

- `SELECT (SELECT stdprice FROM price WHERE prodid = 100890 AND enddate IS NOT NULL) - (SELECT minprice  
FROM price WHERE prodid = 100890 AND enddate IS NOT NULL) AS "Price Difference";`

|  | Price Difference |
|--|------------------|
|  | 13.50            |

subquery in the from clause

# *subqueries in the from clause*

TODO

`SELECT A1, A2, A3, (subquery) as A4, ... FROM (subquery) [AS] name, ...`

Note:

- Every table in a FROM clause must have a name, therefore the [AS] name clause is mandatory.
- `SET @x := 0;`  
`SELECT * FROM (SELECT @x := @x + 1 as R1, emp.* FROM emp) DT WHERE R1 = 5;`
- `SELECT * FROM (SELECT @cnt := @cnt + 1 R1, MOD(@cnt,2) R2, emp.* FROM emp, (SELECT @cnt:=0) DT1 ) DT2 WHERE R2 = 0;`
- `SELECT MIN(R1) FROM (SELECT COUNT(job) R1 FROM emp GROUP BY job) DT;`
- `SELECT MAX(R1) FROM (SELECT COUNT(*) R1 FROM actor_movie GROUP BY actorid) DT`

|  |                |
|--|----------------|
|  | <b>MAX(R1)</b> |
|  | 5              |

- `SELECT AVG(SUM(column1)) FROM t1 GROUP BY column1; //ERROR`
- `SELECT AVG(sum_column1)`  
`FROM (SELECT SUM(column1) AS sum_column1`  
`FROM t1 GROUP BY column1) AS t1;`

comparisons using subquery

# *comparisons using subqueries*

TODO

Comparison Operators like : =, !=/ <>, >, >=, <, <= , <=>

`SELECT A1, A2, A3, (subquery) as A4, ... FROM r WHERE p = (subquery)`

**Remember:**

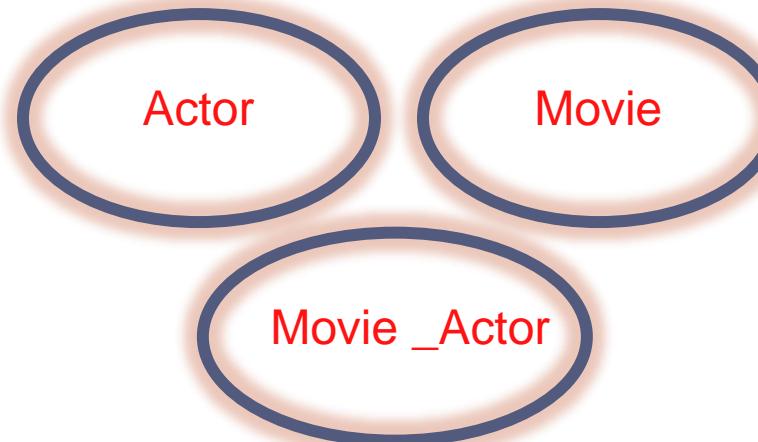
- A subquery can be used before or after any of the comparison operators.
  - The subquery can return **at most one value**.
  - The value can be the result of an arithmetic expression or a function.
- 
- `SELECT * FROM emp WHERE deptno = (SELECT 5 + 5);`
  - `SELECT * FROM emp WHERE sal = (SELECT MAX(sal) FROM emp);`
  - `SELECT MAX(sal) FROM emp WHERE sal < (SELECT MAX(sal) FROM emp);`
  - `SELECT * FROM emp WHERE sal > (SELECT sal FROM emp GROUP BY sal ORDER BY sal DESC limit 3, 1) ORDER BY sal DESC;`

**Following statements will raise an error.**

- `SELECT * FROM emp WHERE deptno = (SELECT deptno FROM dept WHERE deptno IN(10, 20));`

## *comparisons using subqueries*

movie : (movieid, name, release\_date)  
actor : (actorid, name)  
actor\_movie : (actorid, movieid)



- `SELECT a.actorid, a.name FROM actor a, actor_movie am WHERE a.actorid = am.actorid GROUP BY am.actorid HAVING COUNT(*) = (SELECT MAX(R1) FROM (SELECT COUNT(*) "R1" FROM actor_movie GROUP BY actorid) M);`

|  | actorid | name          |
|--|---------|---------------|
|  | 2       | Akshay Kumar  |
|  | 3       | Salman Khan   |
|  | 7       | Madhuri Dixit |

## Remember:

- When used with a subquery, the word IN is an alias for =ANY
- NOT IN is not an alias for <>ANY, but for <>ALL

subquery with in, all, any, some

# *subqueries with in, all, any, some*

- *operand comparison\_operator ANY (subquery)* The word SOME is an alias for ANY.
- *operand IN (subquery)*
- *operand comparison\_operator SOME (subquery)*
- *operand comparison\_operator ALL (subquery)*
- The **ANY** keyword, which must follow a comparison operator, means return TRUE if the comparison is TRUE for ANY of the values in the column that the subquery returns.
- The word **ALL**, which must follow a comparison operator, means return TRUE if the comparison is TRUE for ALL of the values in the column that the subquery returns.
- **IN** and **=ANY** are **not synonyms** when used with an expression list. **IN** can take an expression list, but **= ANY** cannot.
- `SELECT * FROM emp WHERE deptno IN (5 + 5, 10 + 10);`
- `SELECT * FROM emp WHERE job =ANY (SELECT job FROM emp WHERE deptno IN(10, 20)) ;`
- `SELECT * FROM emp WHERE deptno =ANY (10, 20); //error`



# *subqueries with in, all, any, some*

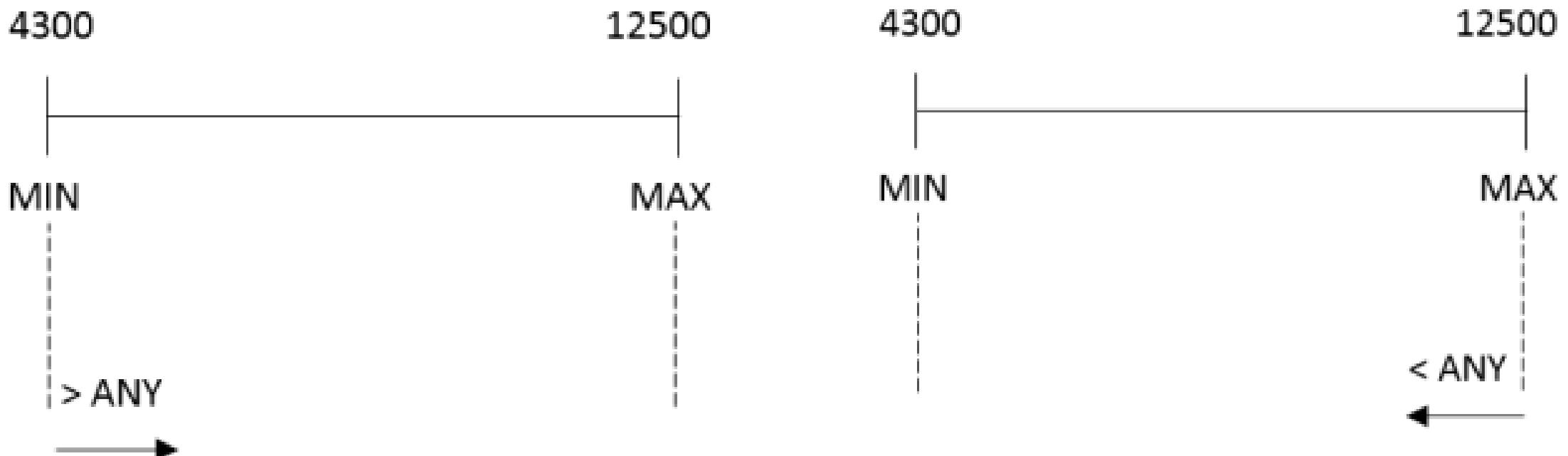
TODO

SELECT  $A_1, A_2, A_3, (\text{subquery})$  as  $A_4, \dots$  FROM  $(\text{subquery})$  [AS] Alias WHERE  $p$  IN  $(\text{subquery})$   
SELECT  $A_1, A_2, A_3, (\text{subquery})$  as  $A_4, \dots$  FROM  $(\text{subquery})$  [AS] Alias WHERE  $p$  ANY  $(\text{subquery})$   
SELECT  $A_1, A_2, A_3, (\text{subquery})$  as  $A_4, \dots$  FROM  $(\text{subquery})$  [AS] Alias WHERE  $p$  ALL  $(\text{subquery})$

- Remember:
- `SELECT * FROM emp WHERE deptno = SELECT deptno FROM dept WHERE dname = 'SALES'; // error`
- `SELECT * FROM emp WHERE deptno IN SELECT deptno FROM dept WHERE dname = 'SALES'; // error`
- `SELECT * FROM emp WHERE deptno IN SELECT * FROM dept WHERE dname = 'SALES'; // error`

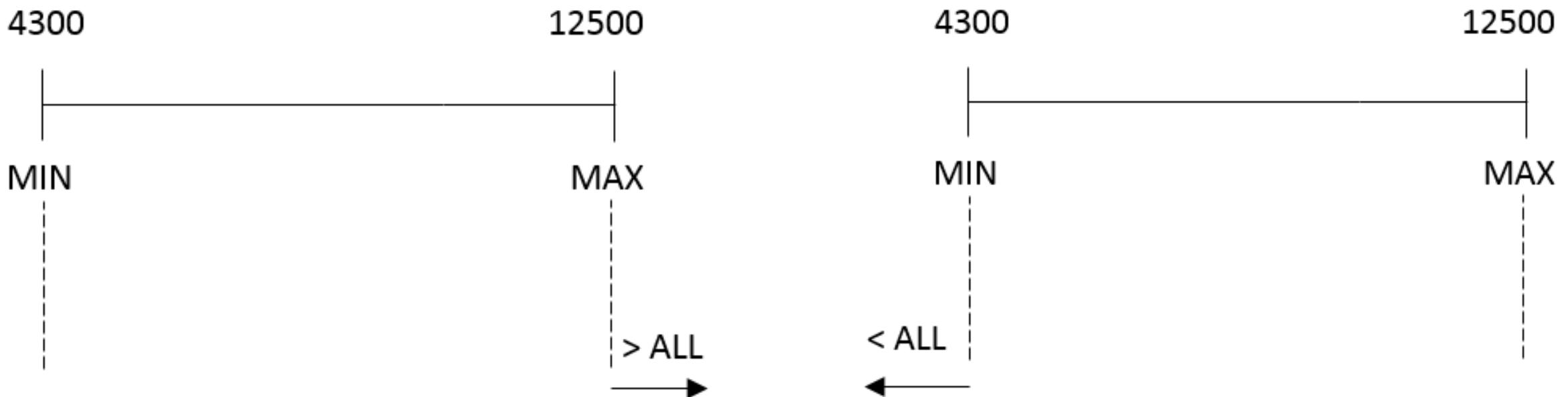
## *any / some*

- "`x = ANY (...)`": The value must match one or more values in the list to evaluate to TRUE.
- "`x != ANY (...)`": The value must not match one or more values in the list to evaluate to TRUE.
- "`x > ANY (...)`": The value must be greater than the smallest value in the list to evaluate to TRUE.
- "`x < ANY (...)`": The value must be smaller than the biggest value in the list to evaluate to TRUE.
- "`x >= ANY (...)`": The value must be greater than or equal to the smallest value in the list to evaluate to TRUE.
- "`x <= ANY (...)`": The value must be smaller than or equal to the biggest value in the list to evaluate to TRUE.



*all*

- " $x = \text{ALL}(\dots)$ ": The value must match all the values in the list to evaluate to TRUE.
- " $x \neq \text{ALL}(\dots)$ ": The value must not match any values in the list to evaluate to TRUE.
- " $x > \text{ALL}(\dots)$ ": The value must be greater than the biggest value in the list to evaluate to TRUE.
- " $x < \text{ALL}(\dots)$ ": The value must be smaller than the smallest value in the list to evaluate to TRUE.
- " $x \geq \text{ALL}(\dots)$ ": The value must be greater than or equal to the biggest value in the list to evaluate to TRUE.
- " $x \leq \text{ALL}(\dots)$ ": The value must be smaller than or equal to the smallest value in the list to evaluate to TRUE.



*all*

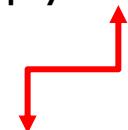
The expression is TRUE, if table T2 is empty.

`SELECT * FROM EMP WHERE DEPTNO >ALL (SELECT C1 FROM T2) //`

This statement will return all rows from EMP table.



empty table



## *subqueries with in, all, any, some*

You can use a subquery after a comparison operator, followed by the keyword IN, ALL, ANY, or SOME.

- `SELECT * FROM emp WHERE deptno IN (SELECT deptno FROM emp WHERE deptno = 10 OR deptno = 20);`
- `SELECT * FROM emp WHERE sal >ALL (SELECT sal FROM emp WHERE ename = 'ADAMS' OR ename = 'TURNER');`
- `SELECT * FROM emp WHERE sal >ANY (SELECT sal FROM emp WHERE ename = 'ADAMS' OR ename = 'TURNER');`
- `SELECT * FROM emp WHERE sal >SOME (SELECT sal FROM emp WHERE ename = 'ADAMS' OR ename = 'TURNER');`
- `SELECT * FROM server WHERE id =ANY (SELECT id FROM runningserver);`
- `SELECT * FROM server WHERE id <ALL (SELECT id FROM runningserver);`
- `SELECT * FROM server WHERE id <ANY (SELECT id FROM runningserver);`

```
SELECT * FROM d1 WHERE c1 not in (SELECT min(c1) FROM d1 GROUP BY deptno, dname, loc, walletid) ORDER BY deptno;
```

row subquery

## *row subqueries*

Scalar or column Subqueries return a single value or a column of values. A row subquery is a subquery variant that returns a single row and can thus return more than one column value. You can use = , >, <, >=, <=, <>, !=, <=>

1. `SELECT * from EMP where deptno, 1 = (SELECT deptno, 1 from DEPT where deptno=10);`
2. `SELECT * FROM emp WHERE ROW (deptno, 1) = (SELECT deptno, 1 FROM dept WHERE deptno = 10);`

- `SELECT * FROM emp WHERE EXISTS (SELECT 1);`

subquery with exists or not exists

## *subqueries with exists or not exists*

The EXISTS operator tests for the existence of rows in the results set of the subquery. If a subquery row value is found, EXISTS subquery returns TRUE and in this case NOT EXISTS subquery will return FALSE.

**SELECT  $A_1, A_2, A_3, A_4, \dots$  FROM  $r$  WHERE [NOT] EXISTS (subquery)**

The records will be displayed from outer SELECT statement....

- **SELECT \* FROM emp WHERE EXISTS (SELECT \* FROM dept WHERE emp.deptno = dept.deptno);**
- **SELECT \* FROM dept WHERE NOT EXISTS (SELECT deptno FROM emp WHERE emp.deptno = dept.deptno);**
- **SELECT \* FROM emp m WHERE EXISTS (SELECT \* FROM emp e WHERE e.mgr = m.empno);**
- **SELECT \* FROM emp m WHERE NOT EXISTS (SELECT \* FROM emp e WHERE e.mgr = m.empno);**
- **SELECT \* FROM dept WHERE deptno IN (SELECT \* FROM emp WHERE emp.deptno = dept.deptno);**
- **SELECT \* FROM dept WHERE deptno NOT IN (SELECT \* FROM emp WHERE emp.deptno = dept.deptno);**
- **SELECT \* FROM emp f WHERE NOT EXISTS (SELECT \* FROM emp m WHERE f.deptno = m.deptno AND gender = 'm');**
- **SELECT \* FROM emp m WHERE NOT EXISTS (SELECT true FROM emp f WHERE m.deptno = f.deptno AND f.gender = 'f');**

correlated subquery

# *correlated subqueries*

A correlated subquery (**also known as a synchronized subquery**) is a subquery that uses values from the outer query. The subquery is evaluated once for each row processed by the outer query.

Following query find all employees who earn more than the average salary in their department.

- `SELECT * FROM emp e WHERE sal > (SELECT AVG(sal) FROM emp WHERE e.deptno = emp.deptno) ORDER BY deptno;`
- `SELECT ename, sal, job FROM emp WHERE sal > (SELECT AVG(sal) FROM emp E WHERE e.job = emp.job);`
- `SELECT job, MAX(sal) FROM emp WHERE sal < (SELECT MAX(sal) FROM emp E WHERE emp.job = e.job GROUP BY e.job) GROUP BY job;`
- `SELECT DISTINCTROW deptno FROM emp WHERE EXISTS (SELECT deptno FROM dept WHERE emp.deptno = dept.deptno); (Intersect)`
- `SELECT DISTINCTROW deptno FROM DEPT WHERE NOT EXISTS (SELECT deptno FROM emp WHERE emp.deptno = dept.deptno);`

Write query to find all employees who have same salary.

- `SELECT e1.* FROM emp e1 WHERE sal IN (SELECT e2.sal FROM emp e2 WHERE e1.sal = e2.sal AND e1.empno <> e2.empno);`

IS NULL  
NULL

joins

*joins*

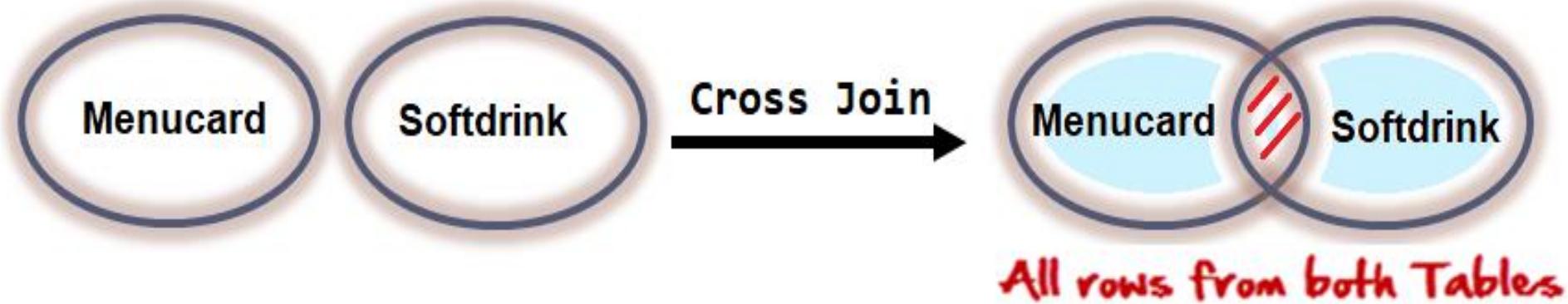
**JOINS** are used to **retrieve data from multiple tables.**

**JOIN** is performed whenever **two or more tables** are joined in a SQL statement.

*joins*

## Type of JOINS

- Cartesian or Product Join – Cross Join
- Equijoin – Inner Join
- Natural Join
- Simple Join
- Outer Join – Right Outer Join, Left Outer Join
- Self Join



## cartesian or product join

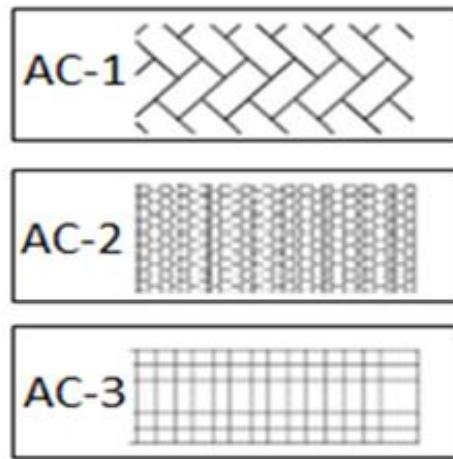
- **Cartesian/Product means** Number of Rows present in Table 1 Multiplied by Number of Rows present in Table 2.
- **Cross Join in MySQL** does not require any common column to **join** two table.

The result of  $R(A_1, A_2, \dots, A_n) \times S(B_1, B_2, \dots, B_m)$  is a relation Q with degree  $n + m$  attributes  $Q(A_1, A_2, \dots, A_n, B_1, B_2, \dots, B_m)$ , in that order.

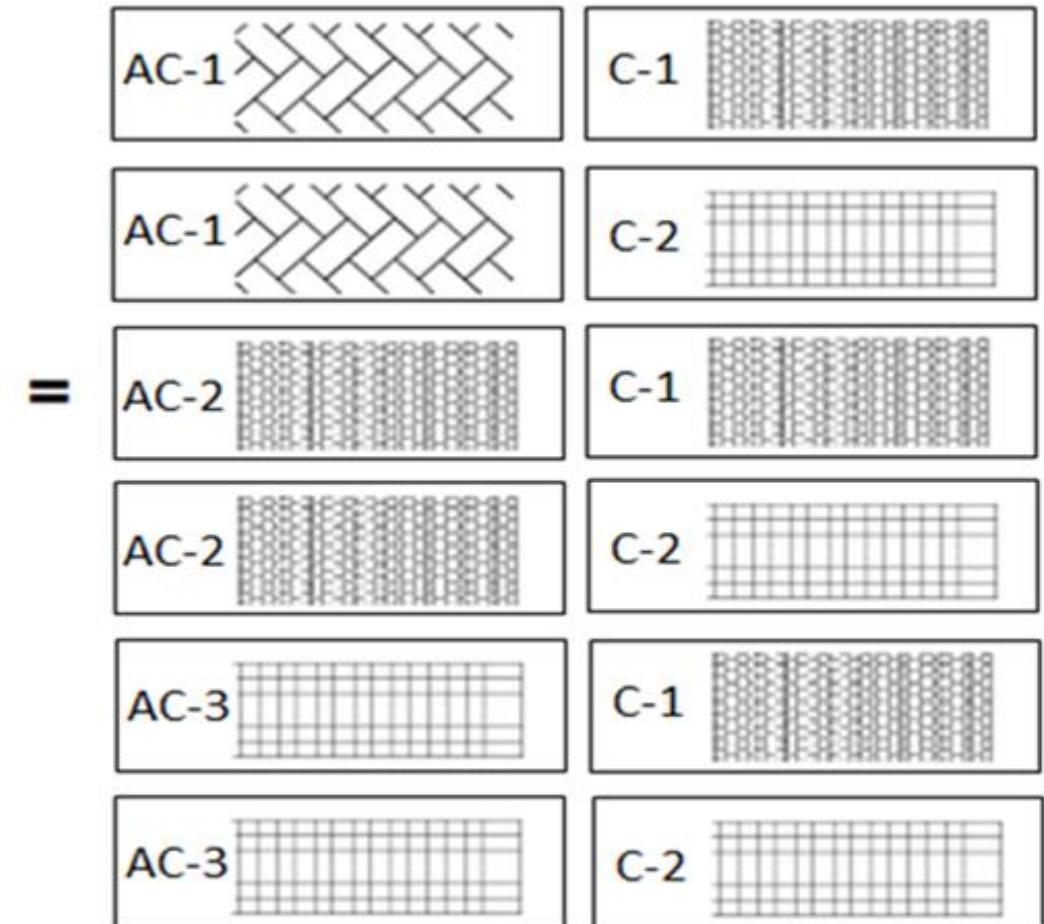
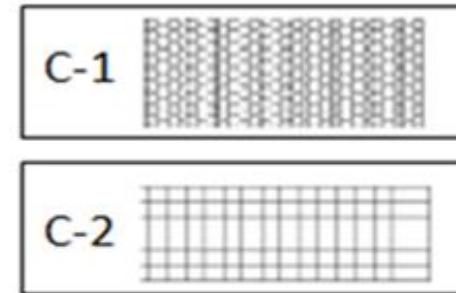
$$\begin{aligned} \text{Degree } d(R \times S) &= d(R) + d(S). \\ \text{Cardinality } |R \times S| &= |R| * |S| \end{aligned}$$

## *joins - cartesian or product*

The CROSS JOIN gets a row from the first table ( $r_1$ ) and then creates a new row for every row in the second table ( $r_2$ ). It then does the same for the next row for in the first table ( $r_1$ ) and so on.



CROSS JOIN



## *joins - cartesian or product*

Cartesian or Product joins are joins without a join condition. Each row of one table is combined with each row of another table. The result is referred to as a Cartesian product.

`SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1, r_2, \dots$`

$$r_1 = \{1, 2\}$$

$$r_2 = \{a, b, c\}$$

$$r_1 \times r_2$$

$$R = \{ (1, a),$$

$$(2, a),$$

$$(1, b),$$

$$(2, b),$$

$$(1, c),$$

$$(2, c) \}$$

$$r_1 = \{1, 2, 3\}$$

$$r_2 = \{a, b\}$$

$$r_1 \times r_2$$

$$R = \{ (1, a),$$

$$(1, b),$$

$$(2, a),$$

$$(2, b),$$

$$(3, a),$$

$$(4, b) \}$$

$$r_1 = \{1, 2\}$$

$$r_2 = \{a, b, \text{null}\}$$

$$r_1 \times r_2$$

$$R = \{ (1, a),$$

$$(2, a),$$

$$(1, b),$$

$$(2, b),$$

$$(1, \text{null}),$$

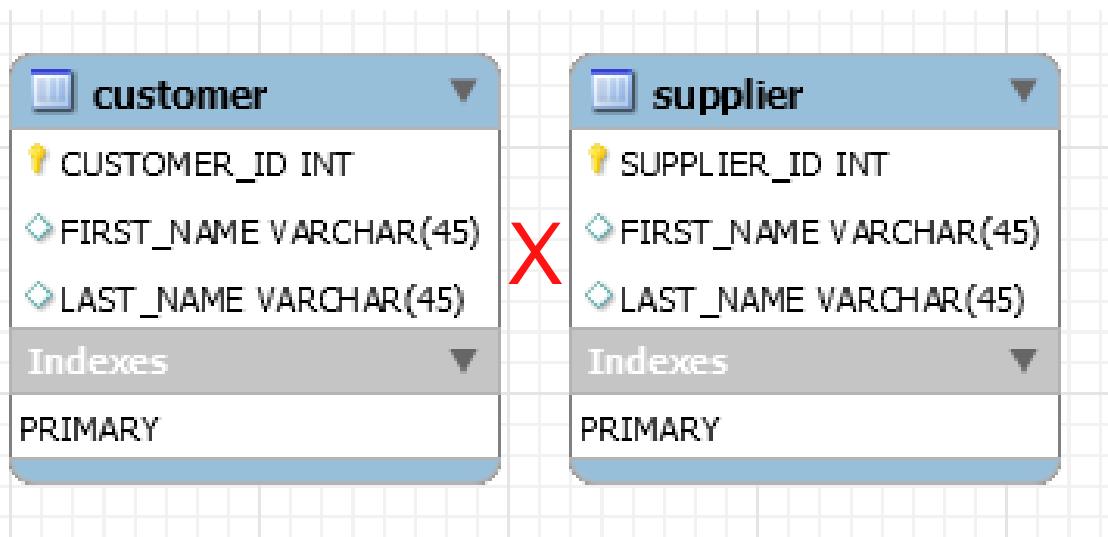
$$(2, \text{null}) \}$$

- Warehouse/product
- Product/sales\_channel
- Cards

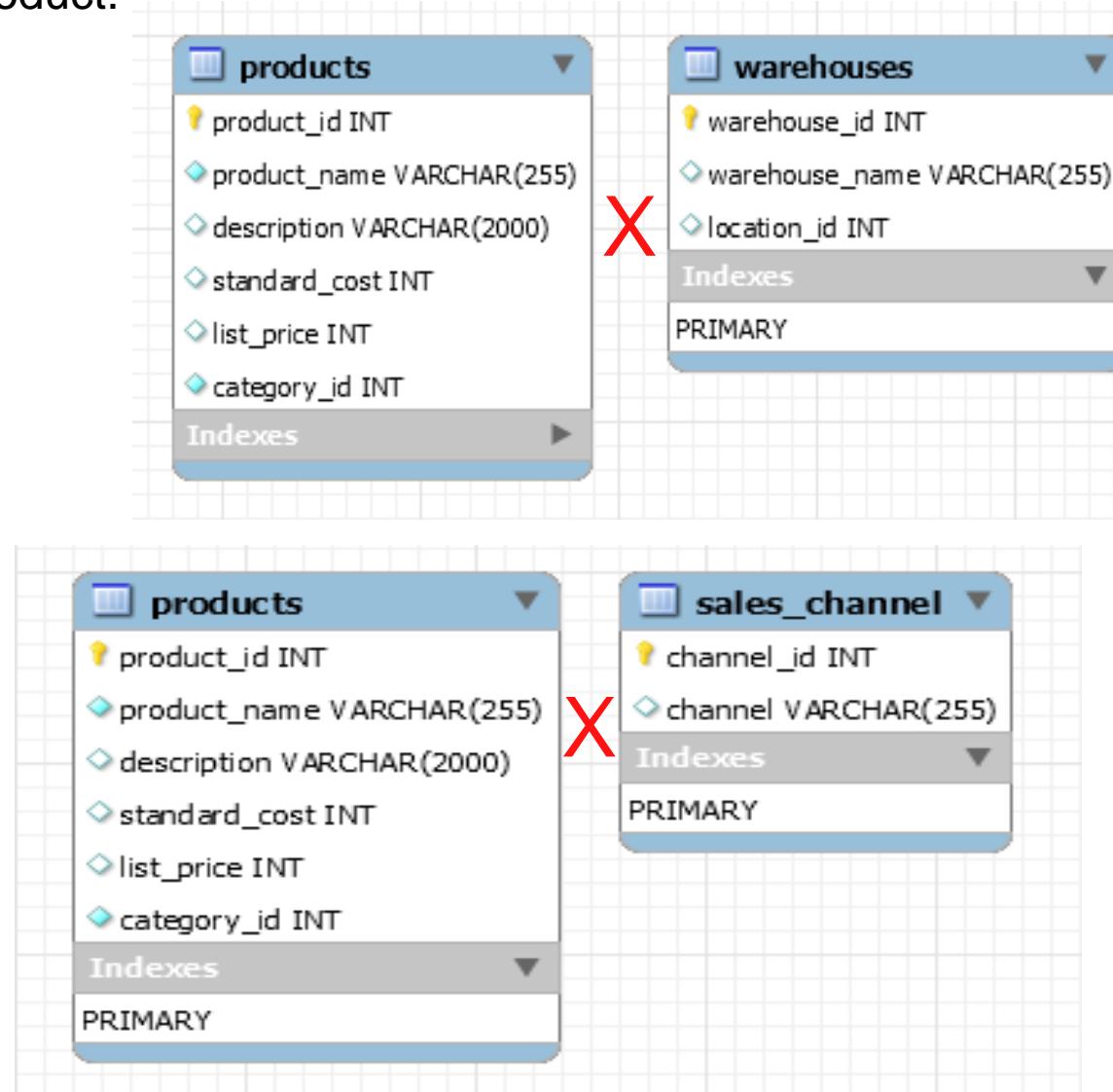
# *joins - cartesian or product*

Cartesian or Product joins are joins without a join condition. Each row of one table is combined with each row of another table. The result is referred to as a Cartesian product.

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1, r_2, \dots$**



- Warehouse/product
- Product/sales\_channel
- Cards



# joins - cartesian or product

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1, r_2, \dots$**

- **SELECT \* FROM menucard, softdrink;**

|   | ID | NAME                         | RATE |
|---|----|------------------------------|------|
| ▶ | 1  | Extra Long Cheeseburger      | 100  |
|   | 2  | Double Stacker               | 125  |
|   | 3  | Double Cheeseburger          | 100  |
|   | 4  | Hamburger                    | 85   |
|   | 5  | Classic Grilled Dog          | 95   |
|   | 6  | Chili Cheese Grilled Dog     | 115  |
|   | 7  | Flame Grilled Chicken Burger | 135  |
|   | 8  | Original Chicken Sandwich    | 55   |
|   | 9  | McALLO TIKKI                 | 45   |
|   | 10 | Veg Maharaja Mac             | 75   |
|   | 11 | Big Spicy Chicken Wrap       | 100  |
|   | 12 | McVeggie Schezwan            | 85   |

|   | ID | NAME                | RATE |
|---|----|---------------------|------|
| ▶ | 1  | Coca-Cola           | 45   |
|   | 2  | Mello Yello         | 75   |
|   | 3  | Diet Coke           | 60   |
|   | 4  | Frozen Fanta Cherry | 65   |
|   | 5  | Iced Tea            | 35   |

|   | ID | NAME                    | RATE | ID | NAME                | RATE |
|---|----|-------------------------|------|----|---------------------|------|
| ▶ | 1  | Extra Long Cheeseburger | 100  | 1  | Coca-Cola           | 45   |
|   | 1  | Extra Long Cheeseburger | 100  | 2  | Mello Yello         | 75   |
|   | 1  | Extra Long Cheeseburger | 100  | 3  | Diet Coke           | 60   |
|   | 1  | Extra Long Cheeseburger | 100  | 4  | Frozen Fanta Cherry | 65   |
|   | 1  | Extra Long Cheeseburger | 100  | 5  | Iced Tea            | 35   |
|   | 2  | Double Stacker          | 125  | 1  | Coca-Cola           | 45   |
|   | 2  | Double Stacker          | 125  | 2  | Mello Yello         | 75   |
|   | 2  | Double Stacker          | 125  | 3  | Diet Coke           | 60   |
|   | 2  | Double Stacker          | 125  | 4  | Frozen Fanta Cherry | 65   |
|   | 2  | Double Stacker          | 125  | 5  | Iced Tea            | 35   |
|   | 3  | Double Cheeseburger     | 100  | 1  | Coca-Cola           | 45   |
|   | 3  | Double Cheeseburger     | 100  | 2  | Mello Yello         | 75   |
|   | 3  | Double Cheeseburger     | 100  | 3  | Diet Coke           | 60   |
|   | 3  | Double Cheeseburger     | 100  | 4  | Frozen Fanta Cherry | 65   |
|   | 3  | Double Cheeseburger     | 100  | 5  | Iced Tea            | 35   |
|   | 4  | Hamburger               | 85   | 1  | Coca-Cola           | 45   |
|   | 4  | Hamburger               | 85   | 2  | Mello Yello         | 75   |
|   | 4  | Hamburger               | 85   | 3  | Diet Coke           | 60   |
|   | 4  | Hamburger               | 85   | 4  | Frozen Fanta Cherry | 65   |
|   | 4  | Hamburger               | 85   | 5  | Iced Tea            | 35   |

# joins - cartesian or product

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1, r_2, \dots$**

- **SELECT mnu.name, sftdrink.name, mnu.rate, sftdrink.rate, mnu.rate + sftdrink.rate as "Total" FROM menocard mnu, softdrink sftdrink;**

|   | ID | NAME                         | RATE |
|---|----|------------------------------|------|
| ▶ | 1  | Extra Long Cheeseburger      | 100  |
|   | 2  | Double Stacker               | 125  |
|   | 3  | Double Cheeseburger          | 100  |
|   | 4  | Hamburger                    | 85   |
|   | 5  | Classic Grilled Dog          | 95   |
|   | 6  | Chili Cheese Grilled Dog     | 115  |
|   | 7  | Flame Grilled Chicken Burger | 135  |
|   | 8  | Original Chicken Sandwich    | 55   |
|   | 9  | McALLO TIKKI                 | 45   |
|   | 10 | Veg Maharaja Mac             | 75   |
|   | 11 | Big Spicy Chicken Wrap       | 100  |
|   | 12 | McVeggie Schezwan            | 85   |

|   | ID | NAME                | RATE |
|---|----|---------------------|------|
| ▶ | 1  | Coca-Cola           | 45   |
|   | 2  | Mello Yello         | 75   |
|   | 3  | Diet Coke           | 60   |
|   | 4  | Frozen Fanta Cherry | 65   |
|   | 5  | Iced Tea            | 35   |

|   | name                    | name                | rate | rate | Total |
|---|-------------------------|---------------------|------|------|-------|
| ▶ | Extra Long Cheeseburger | Coca-Cola           | 100  | 45   | 145   |
|   | Extra Long Cheeseburger | Mello Yello         | 100  | 75   | 175   |
|   | Extra Long Cheeseburger | Diet Coke           | 100  | 60   | 160   |
|   | Extra Long Cheeseburger | Frozen Fanta Cherry | 100  | 65   | 165   |
|   | Extra Long Cheeseburger | Iced Tea            | 100  | 35   | 135   |
|   | Double Stacker          | Coca-Cola           | 125  | 45   | 170   |
|   | Double Stacker          | Mello Yello         | 125  | 75   | 200   |
|   | Double Stacker          | Diet Coke           | 125  | 60   | 185   |
|   | Double Stacker          | Frozen Fanta Cherry | 125  | 65   | 190   |
|   | Double Stacker          | Iced Tea            | 125  | 35   | 160   |
|   | Double Cheeseburger     | Coca-Cola           | 100  | 45   | 145   |
|   | Double Cheeseburger     | Mello Yello         | 100  | 75   | 175   |
|   | Double Cheeseburger     | Diet Coke           | 100  | 60   | 160   |
|   | Double Cheeseburger     | Frozen Fanta Cherry | 100  | 65   | 165   |
|   | Double Cheeseburger     | Iced Tea            | 100  | 35   | 135   |
|   | Hamburger               | Coca-Cola           | 85   | 45   | 130   |
|   | Hamburger               | Mello Yello         | 85   | 75   | 160   |
|   | Hamburger               | Diet Coke           | 85   | 60   | 145   |
|   | Hamburger               | Frozen Fanta Cherry | 85   | 65   | 150   |
|   | Hamburger               | Iced Tea            | 85   | 35   | 120   |
|   | Classic Grilled Dog     | Coca-Cola           | 95   | 45   | 140   |
|   | Classic Grilled Dog     | Mello Yello         | 95   | 75   | 170   |
|   | Classic Grilled Dog     | Diet Coke           | 95   | 60   | 155   |

# *joins - cartesian or product*

- SELECT name, COUNT(\*) "Total Employees", rate \* COUNT(\*) "Total Cost" FROM emp, softdrink GROUP BY name;

|  | NAME                | TOTAL EMPLOYEES | TOTAL COST |
|--|---------------------|-----------------|------------|
|  | Coca-Cola           | 30              | 1350       |
|  | Diet Coke           | 30              | 1800       |
|  | Frozen Fanta Cherry | 30              | 1950       |
|  | Iced Tea            | 30              | 1050       |
|  | Mello Yello         | 30              | 2250       |

## *joins – cross join*

The CROSS JOIN produced a result set which is the product of rows of two associated tables when no WHERE clause is used with CROSS JOIN. In this join, the result set appeared by multiplying each row of the first table with all rows in the second table if no condition introduced with CROSS JOIN.

`SELECT A1, A2, A3, ... FROM r1 CROSS JOIN r2, ...`

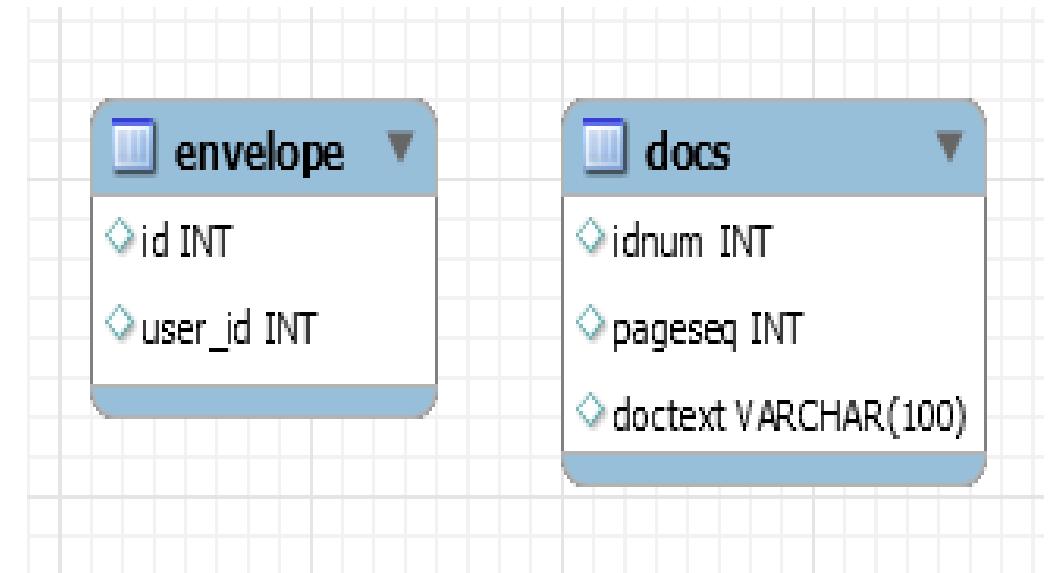
**envelope Table**

|   | <b>id</b> | <b>user_id</b> |
|---|-----------|----------------|
| ▶ | 1         | 1              |
|   | 2         | 2              |
|   | 3         | 3              |

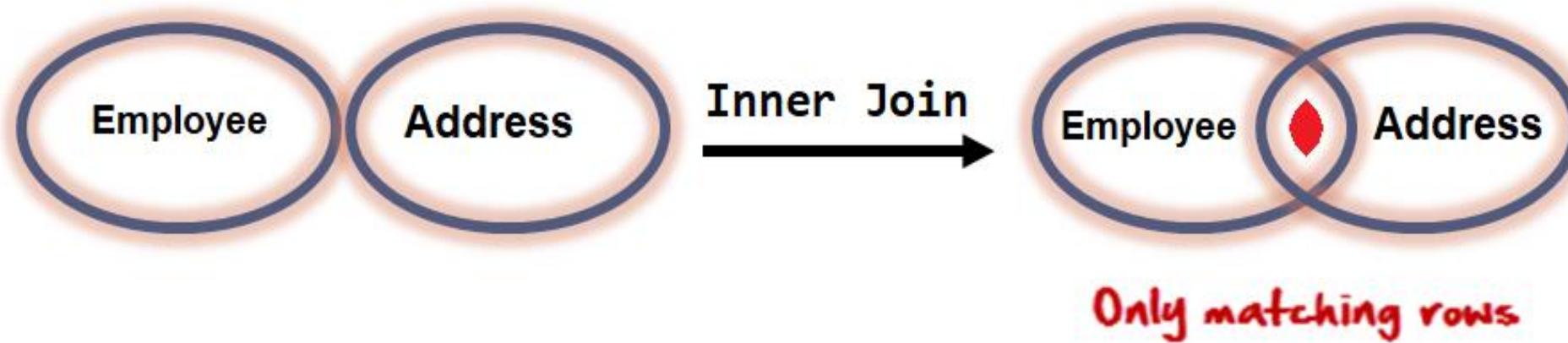
**docs Table**

|   | <b>idnum</b> | <b>pageseq</b> | <b>doctext</b> |
|---|--------------|----------------|----------------|
| ▶ | 1            | 5              | NULL           |
|   | 2            | 6              | NULL           |
|   | HULL         | 0              | NULL           |

- `SELECT * FROM envelope CROSS JOIN docs;`



|   | <b>id</b> | <b>user_id</b> | <b>idnum</b> | <b>pageseq</b> | <b>doctext</b> |
|---|-----------|----------------|--------------|----------------|----------------|
| ▶ | 1         | 1              | 1            | 5              | NULL           |
|   | 2         | 2              | 1            | 5              | NULL           |
|   | 3         | 3              | 1            | 5              | NULL           |
|   | 1         | 1              | 2            | 6              | NULL           |
|   | 2         | 2              | 2            | 6              | NULL           |
|   | 3         | 3              | 2            | 6              | NULL           |
|   | 1         | 1              | HULL         | 0              | NULL           |
|   | 2         | 2              | HULL         | 0              | NULL           |
|   | 3         | 3              | HULL         | 0              | NULL           |



## equi join

An **equi join / Inner Join** is a join with a join condition containing an equality operator.

An equijoin returns only those rows that have equivalent values for the specified columns. Rows that match remain in the result, those that don't are rejected. The match condition is commonly called the **join condition**. **equi join / Inner Join** returns rows when there is at least one match in both tables.

The result of  $R(A_1, A_2, \dots, A_n) \bowtie_{\text{join condition}} S(B_1, B_2, \dots, B_m)$  is a relation  $Q$  with degree  $n + m$  attributes  $Q(A_1, A_2, \dots, A_n, B_1, B_2, \dots, B_m)$ , **in that order**.  $Q$  has one tuple for each combination of tuples—one from  $R$  and one from  $S$ —whenever the combination satisfies the join condition.

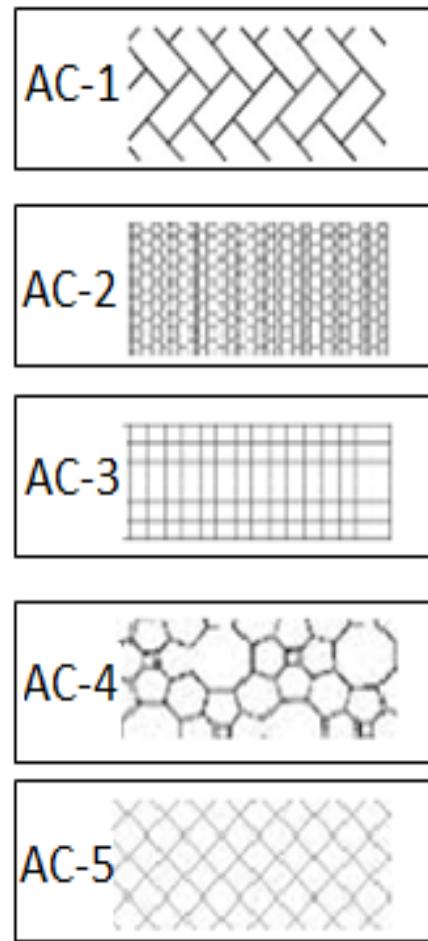
| employeeID | Name     | deptNo                                                                               |
|------------|----------|--------------------------------------------------------------------------------------|
| 1          | Saleel   | 10  |
| 2          | Sharmin  | 20  |
| 3          | Vrushali | 10  |

| deptNo | Name       |
|--------|------------|
| 10     | Sales      |
| 20     | Accounting |
| 30     | Manager    |

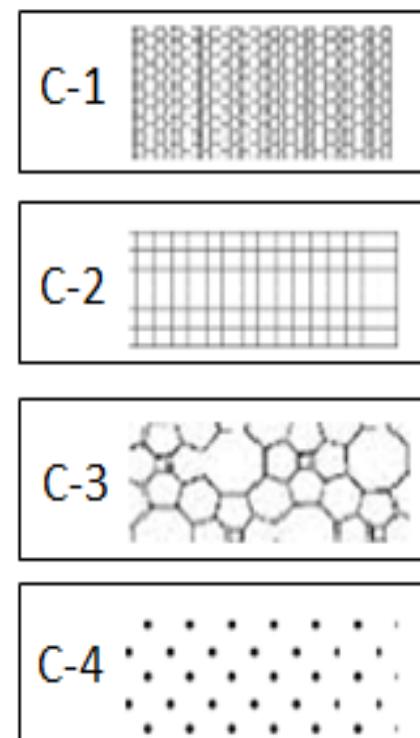
| employeeID | Name     | deptNo | deptNo | Name       |
|------------|----------|--------|--------|------------|
| 1          | Saleel   | 10     | 10     | Sales      |
| 2          | Sharmin  | 20     | 20     | Accounting |
| 3          | Vrushali | 10     | 10     | Sales      |

## *equi join example*

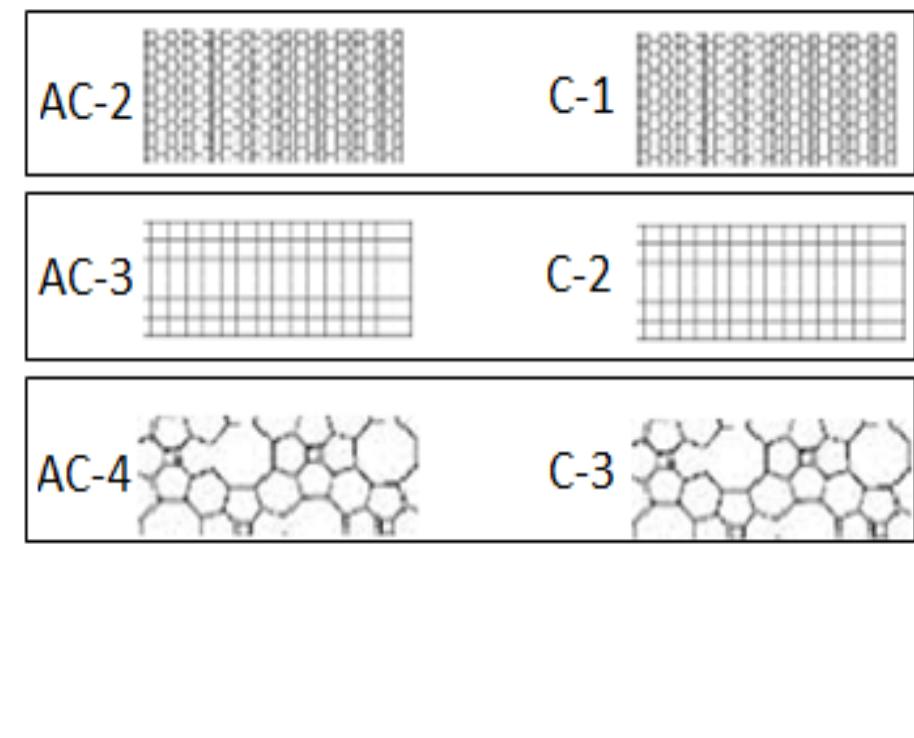
The following table illustrates the inner join of two tables  $r_1(\text{AC-1}, \text{AC-2}, \text{AC-3}, \text{AC-4}, \text{AC-5})$  and  $r_2(\text{C-1}, \text{C-2}, \text{C-3}, \text{C-4})$ . The result includes rows: (2,A), (3,B), and (4,C) as they have the same patterns.



**INNER JOIN**



=



## *joins – equi join*

EQUI JOIN performs a JOIN against equality or matching column(s) values of the associated tables. An equal sign (=) is used as comparison operator in the where clause to refer equality.

SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1, r_2$  WHERE  $r_1.A_1 = r_2.A_1$

$r_1 = \{ 1, 2, 3, 4 \}$

$r_2 = \{ (1, a), (2, b), (1, c), (3, d), (2, e), (1, f) \}$

$r_1 = r_2$

$R = \{(1,1,a),$   
 $(2,2,b),$   
 $(1,1,c),$   
 $(3,3,d),$   
 $(2,2,e),$   
 $(1,1,f)\}$

**Remember:**

A general join condition is of the form <condition> AND <condition> AND ... AND <condition>, where each <condition> is of the form  $A_i \theta B_j$ ,  **$A_i$  is an attribute of R,  $B_j$  is an attribute of S.**

# *joins – equi join*

- `SELECT * FROM emp , dept WHERE emp.deptno = dept.deptno;`

|   | EMPNO | ENAME   | JOB       | MGR  | HIREDATE   | SAL        | COMM    | DEPTNO | BONUSID | USER NAME | PWD        | isActive | DEPTNO | DNAME      | LOC        | PWD        |        |
|---|-------|---------|-----------|------|------------|------------|---------|--------|---------|-----------|------------|----------|--------|------------|------------|------------|--------|
| ▶ | 7369  | SMITH   | CLERK     | 7902 | 1980-12-17 | 800.00     | NULL    | 20     | 2       | SMITH     | a12recmpm  | 0        | 20     | RESEARCH   | DALLAS     | a12recmpm  |        |
|   | 7415  | AARAV   | CLERK     | 7902 | 1981-12-31 | 3350.00    | NULL    | 10     | NULL    | AARAV     | NULL       | 0        | 10     | ACCOUNTING | NEW YORK   | r50mpm     |        |
|   | 7421  | THOMAS  | CLERK     | 7920 | 1981-07-19 | 1750.00    | NULL    | 10     | 1       | THOMAS    | r50mpm     | 0        | 10     | ACCOUNTING | NEW YORK   | r50mpm     |        |
|   | 7499  | ALLEN   | SALESMAN  | 7698 | 1981-02-20 | 1600.00    | 300.00  | 30     | 4       | ALLEN     | sales@2017 | 1        | 30     | SALES      | CHICAGO    | sales@2017 |        |
|   | 7521  | WARD    | SALESMAN  | 7698 | 1981-02-22 | 1250.00    | 500.00  | 30     | 1       | WARD      | sales@2017 | 1        | 30     | SALES      | CHICAGO    | sales@2017 |        |
|   | 7566  | JONES   | MANAGER   | 7839 | 1981-04-02 | 2975.00    | NULL    | 20     | 4       | JONES     | a12recmpm  | 1        | 20     | RESEARCH   | DALLAS     | a12recmpm  |        |
|   | 7654  | MARTIN  | SALESMAN  | 7698 | 1981-09-28 | 1250.00    | 1400.00 | 30     | 6       | MARTIN    | sales@2017 | 1        | 30     | SALES      | CHICAGO    | sales@2017 |        |
|   | 7698  | BLAKE   | MANAGER   | 7839 | 1981-05-01 | 2850.00    | NULL    | 30     | 1       | BLAKE     | sales@2017 | 1        | 30     | SALES      | CHICAGO    | sales@2017 |        |
|   | 7782  | CLARK   | MANAGER   | 7839 | 1981-06-09 | 2450.00    | NULL    | 10     | 3       | CLARK     | r50mpm     | 1        | 10     | ACCOUNTING | NEW YORK   | r50mpm     |        |
|   | 7788  | SCOTT   | ANALYST   | 7566 | 1982-12-09 | 3000.00    | NULL    | 20     | 3       | SCOTT     | a12recmpm  | 1        | 20     | RESEARCH   | DALLAS     | a12recmpm  |        |
|   | 7839  | KING    | PRESIDENT | NULL | 1981-11-17 | 5000.00    | NULL    | 10     | 1       | KING      | r50mpm     | 1        | 10     | ACCOUNTING | NEW YORK   | r50mpm     |        |
|   | 7844  | TURNER  | SALESMAN  | 7698 | 1981-09-08 | 1500.00    | 0.00    | 30     | 5       | TURNER    | sales@2017 | 1        | 30     | SALES      | CHICAGO    | sales@2017 |        |
|   | 7876  | ADAMS   | CLERK     | 7788 | 1983-01-12 | 1100.00    | NULL    | 20     | 1       | ADAMS     | a12recmpm  | 1        | 20     | RESEARCH   | DALLAS     | a12recmpm  |        |
|   | 7900  | JAMES   | CLERK     | 7698 | 1981-12-03 | 950.00     | NULL    | 30     | 2       | JAMES     | sales@2017 | 1        | 30     | SALES      | CHICAGO    | sales@2017 |        |
|   | 7902  | FORD    | ANALYST   | 7566 | 1981-12-03 | 3000.00    | NULL    | 20     | 4       | FORD      | a12recmpm  | 0        | 20     | RESEARCH   | DALLAS     | a12recmpm  |        |
|   | 7919  | HOFFMAN | MANAGER   | 7566 | 1982-03-24 | 4150.00    | NULL    | 30     | 3       | HOFFMAN   | sales@2017 | 1        | 30     | SALES      | CHICAGO    | sales@2017 |        |
|   | 7920  | GRASS   | SALESMAN  | 7919 | 1980-02-14 | 2575.00    | 2700.00 | 30     | 5       | GRASS     | sales@2017 | 1        | 30     | SALES      | CHICAGO    | sales@2017 |        |
|   | 7934  | MILLER  | CLERK     | 7    | 7919       | 1982-01-23 | 1300.00 | NULL   | 10      | 2         | MILLER     | r50mpm   | 0      | 10         | ACCOUNTING | NEW YORK   | r50mpm |

Remember:

- `SELECT * FROM emp, dept WHERE emp.deptno = dept.deptno AND dname = 'accounting';`
- `SELECT * FROM emp, dept WHERE (emp.deptno, dname) = (dept.deptno, 'accounting');`

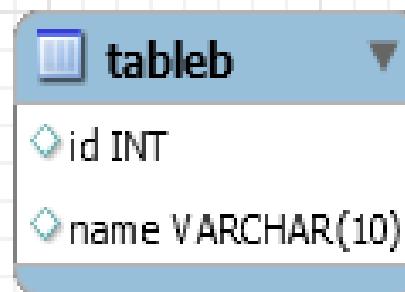
tableA Table

|   | id   | name |
|---|------|------|
| ▶ | 5    | aa   |
|   | 1    | a    |
|   | 2    | b    |
|   | 3    | y    |
|   | NONE | d    |
|   | 5    | NONE |
|   | 1    | NONE |
|   | 1    | b    |
|   | 8    | a    |

tableB Table

|   | id   | name |
|---|------|------|
| ▶ | 1    | a    |
|   | 2    | x    |
|   | 4    | b    |
|   | NONE | c    |
|   | 6    | NONE |
|   | NONE | NONE |
|   | 7    | z    |
|   | 2    | NONE |
|   | 5    | z    |
|   | 9    | u    |

## joins – equi join



- `SELECT * FROM tableA , tableB WHERE tableA.id = tableB.id;`

|   | id | name | id | name |
|---|----|------|----|------|
| ▶ | 1  | a    | 1  | a    |
|   | 1  | NONE | 1  | a    |
|   | 1  | b    | 1  | a    |
|   | 2  | b    | 2  | x    |
|   | 2  | b    | 2  | NONE |
|   | 5  | aa   | 5  | z    |
|   | 5  | NONE | 5  | z    |

- `SELECT * FROM tableA , tableB WHERE tableA.name = tableB.name;`

|   | id | name | id | name |
|---|----|------|----|------|
| ▶ | 1  | a    | 1  | a    |
|   | 8  | a    | 1  | a    |
|   | 2  | b    | 4  | b    |
|   | 1  | b    | 4  | b    |

## ON Contrition

- When this join condition gets applied none of the columns of the relation will get eliminated in the result set.
- In order to apply this join condition, on any two tables they need not to have any common column.

on condition and using attribute

## USING Attribute Contrition

- When all the common columns are used in the join predicate then the result would be same as Natural join.
- In the result set of the join the duplicates of the columns used in the predicate gets eliminated.
- It should not have a qualifier(table name or Alias) in the referenced columns.

### Note:

- **ON** clause is optional, If not given then **INNER JOIN** works like **CROSS JOIN**.

## *joins – on & using clause example*

### The ON clause

The ON clause is used to join tables where the column names don't match in both tables.

```
SELECT * FROM EMP
INNER JOIN DEPT
ON EMP.DEPTNO = DEPT.ID
```

JOINING CONDITION



### The USING clause

The USING clause is used if several columns share the same name but you don't want to join using all of these common columns. **The columns listed in the USING clause can't have any qualifiers in the statement.**

```
SELECT * FROM EMP
INNER JOIN DEPT
USING(DEPTNO)
```

JOINING CONDITION →



# inner join

The inner join is one of the most commonly used joins in SQL. The inner join clause allows you to query data from two or more related tables.

INNER JOIN returns rows when there is at least one match in both tables.

## *joins – inner join*

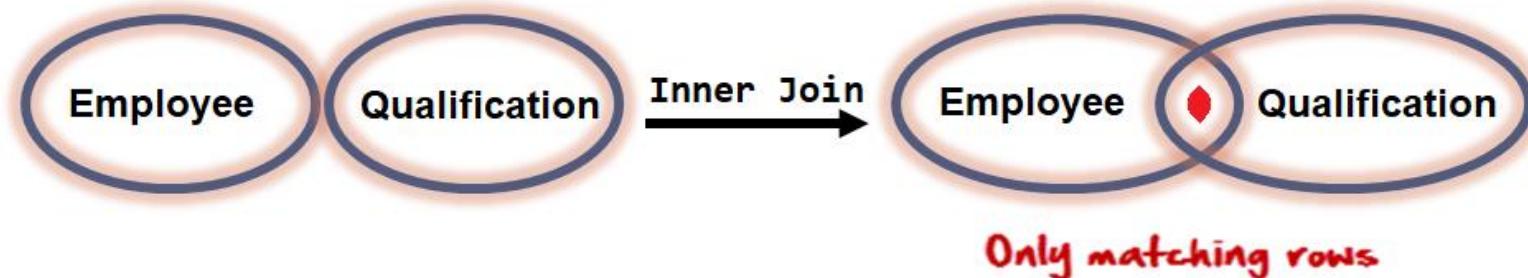
The INNER JOIN selects all rows from both participating tables as long as there is a match between the columns. An SQL INNER JOIN is same as JOIN clause, combining rows from two or more tables.

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1$  [INNER] JOIN  $r_2$  ON  $r_1.A_1 = r_2.A_1$**

- **SELECT \* FROM employee emp INNER JOIN qualification quali ON emp.id = quali.employeeid;**

| ID | FIRSTNAME | LASTNAME | GENDER | HIREDATE   | ID | EMPLOYEEID | NAME  | Stream     | ADMISSIONYEAR | INSTITUTE  | UNIVERSITY              | YEAROFPASSING | PERCENTAGE | GRADE |
|----|-----------|----------|--------|------------|----|------------|-------|------------|---------------|------------|-------------------------|---------------|------------|-------|
| 1  | Denis     | Murphy   | M      | 1964-06-12 | 1  | 1          | 10    | General    | 1957-08-02    | Alabama    | Stanford University     | 1958          | 62.00      | D     |
| 1  | Denis     | Murphy   | M      | 1964-06-12 | 2  | 1          | 12    | Science    | 1959-06-22    | Alaska     | Harvard University      | 1960          | 56.00      | D     |
| 1  | Denis     | Murphy   | M      | 1964-06-12 | 3  | 1          | BE    | IT         | 1960-06-12    | Arizona    | Harvard University      | 1964          | 75.00      | B     |
| 2  | Jenny     | Ross     | F      | 1964-10-25 | 4  | 2          | 10    | General    | 1957-01-19    | Alaska     | University of Chicago   | 1958          | 67.00      | C     |
| 2  | Jenny     | Ross     | F      | 1964-10-25 | 5  | 2          | 12    | Commerce   | 1959-10-23    | New York   | Yale University         | 1960          | 67.00      | C     |
| 2  | Jenny     | Ross     | F      | 1964-10-25 | 6  | 2          | B.Com | Accounting | 1960-06-12    | Arkansas   | Yale University         | 1964          | 69.00      | C     |
| 3  | David     | Ross     | M      | 1964-10-25 | 7  | 3          | 10    | General    | 1957-11-25    | Arizona    | Yale University         | 1958          | 86.00      | A     |
| 3  | David     | Ross     | M      | 1964-10-25 | 8  | 3          | 12    | Science    | 1959-02-17    | California | California University   | 1960          | 57.00      | D     |
| 3  | David     | Ross     | M      | 1964-10-25 | 9  | 3          | BE    | IT         | 1960-06-12    | Florida    | University of Florida   | 1964          | 85.00      | A     |
| 4  | Fred      | NULL     | M      | 1965-10-31 | 10 | 4          | 10    | General    | 1958-03-19    | Idaho      | Pennsylvania University | 1959          | 89.00      | A     |
| 4  | Fred      | NULL     | M      | 1965-10-31 | 11 | 4          | 12    | Commerce   | 1960-05-21    | New Ham... | Yale University         | 1961          | 96.00      | A+    |
| 4  | Fred      | NULL     | M      | 1965-10-31 | 12 | 4          | ----- | -----      | -----         | -----      | -----                   | -----         | -----      | ----- |
| 5  | Helen     | Taylor   | F      | 1965-01-10 | 13 | 5          | ----- | -----      | -----         | -----      | -----                   | -----         | -----      | ----- |

ON clause is optional, If not given then INNER JOIN works like CROSS JOIN



INNER JOIN returns rows when there is at least one match in both tables.

## *joins – inner join*

The INNER JOIN selects all rows from both participating tables as long as there is a match between the columns. An SQL INNER JOIN is same as JOIN clause, combining rows from two or more tables.

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1$  [INNER] JOIN  $r_2$  ON  $r_1.A_1 = r_2.A_1$**

- **SELECT \* FROM customer INNER JOIN ord USING (custid);**

| CUSTID | NAME            | ADDRESS          | CITY         | STATE | ZIP   | AREA | PHONE    | REPID | CREDITLIMIT | COMMENTS                              | ORDID | ORDERDATE           | COMMPLAN | SHIPDATE            | STA         |
|--------|-----------------|------------------|--------------|-------|-------|------|----------|-------|-------------|---------------------------------------|-------|---------------------|----------|---------------------|-------------|
| 106    | SHAPE UP        | 908 SEQUOIA      | PALO ALTO    | CA    | 94301 | 415  | 364-9777 | 7521  | 6000.00     | Support intensive. Orders small a...  | 601   | 1986-05-01 00:00:00 | A        | 1986-05-30 00:00:00 | In Pro      |
| 102    | VOLLYRITE       | 9722 HAMILTON    | BURLINGAME   | CA    | 95133 | 415  | 644-3341 | 7654  | 7000.00     | Company doing heavy promotion ...     | 602   | 1986-06-05 00:00:00 | B        | 1986-06-20 00:00:00 | On Hold     |
| 102    | VOLLYRITE       | 9722 HAMILTON    | BURLINGAME   | CA    | 95133 | 415  | 644-3341 | 7654  | 7000.00     | Company doing heavy promotion ...     | 603   | 1986-06-05 00:00:00 | NULL     | 1986-06-05 00:00:00 | Canceled    |
| 106    | SHAPE UP        | 908 SEQUOIA      | PALO ALTO    | CA    | 94301 | 415  | 364-9777 | 7521  | 6000.00     | Support intensive. Orders small a...  | 604   | 1986-06-15 00:00:00 | A        | 1986-06-30 00:00:00 | Resolved    |
| 106    | SHAPE UP        | 908 SEQUOIA      | PALO ALTO    | CA    | 94301 | 415  | 364-9777 | 7521  | 6000.00     | Support intensive. Orders small a...  | 605   | 1986-07-14 00:00:00 | A        | 1986-07-30 00:00:00 | Disputed    |
| 100    | JOCKSPORTS      | 345 VIEWRIDGE    | BELMONT      | CA    | 96711 | 415  | 598-6609 | 7844  | 5000.00     | Very friendly people to work with ... | 606   | 1986-07-14 00:00:00 | A        | 1986-07-30 00:00:00 | Shipped     |
| 104    | EVERY MOUNTAIN  | 574 SURRY RD.    | CUPERTINO    | CA    | 93301 | 408  | 996-2323 | 7499  | 10000.00    | Customer with high market share ...   | 607   | 1986-07-18 00:00:00 | C        | 1986-07-18 00:00:00 | In Progress |
| 104    | EVERY MOUNTAIN  | 574 SURRY RD.    | CUPERTINO    | CA    | 93301 | 408  | 996-2323 | 7499  | 10000.00    | Customer with high market share ...   | 608   | 1986-07-25 00:00:00 | C        | 1986-07-25 00:00:00 | Shipped     |
| 100    | JOCKSPORTS      | 345 VIEWRIDGE    | BELMONT      | CA    | 96711 | 415  | 598-6609 | 7844  | 5000.00     | Very friendly people to work with ... | 609   | 1986-08-01 00:00:00 | B        | 1986-08-15 00:00:00 | On Hold     |
| 101    | TKB SPORT SHOP  | 490 BOLI RD.     | REDWOOD CITY | CA    | 94061 | 415  | 368-1223 | 7521  | 10000.00    | Rep called 5/8 about change in or...  | 610   | 1987-01-07 00:00:00 | A        | 1987-01-08 00:00:00 | In Progress |
| 102    | VOLLYRITE       | 9722 HAMILTON    | BURLINGAME   | CA    | 95133 | 415  | 644-3341 | 7654  | 7000.00     | Company doing heavy promotion ...     | 611   | 1987-01-11 00:00:00 | B        | 1987-01-11 00:00:00 | Shipped     |
| 104    | EVERY MOUNTAIN  | 574 SURRY RD.    | CUPERTINO    | CA    | 93301 | 408  | 996-2323 | 7499  | 10000.00    | Customer with high market share ...   | 612   | 1987-01-15 00:00:00 | C        | 1987-01-20 00:00:00 | Canceled    |
| 108    | NORTH WOODS ... | 98 LONE PINE ... | HIBBING      | MN    | 55649 | 612  | 566-9123 | 7844  | 8000.00     | NULL                                  | 613   | 1987-02-01 00:00:00 | NULL     | 1987-02-01 00:00:00 | Shipped     |
| 102    | VOLLYRITE       | 9722 HAMILTON    | BURLINGAME   | CA    | 95133 | 415  | 644-3341 | 7654  | 7000.00     | Company doing heavy promotion ...     | 614   | 1987-02-01 00:00:00 | NULL     | 1987-02-05 00:00:00 | In Progress |
| 107    | WOMENS SPORTS   | VALCO VILLAGE    | SUNNYVALE    | CA    | 93301 | 408  | 967-4398 | 7499  | 10000.00    | First sporting goods store geared ... | 615   | 1987-02-01 00:00:00 | NULL     | 1987-02-06 00:00:00 | In Progress |
| 103    | JUST TENNIS     | HILLVIEW MALL    | BURLINGAME   | CA    | 97544 | 415  | 677-9312 | 7521  | 3000.00     | Contact rep about new line of ten...  | 616   | 1987-02-03 00:00:00 | NULL     | 1987-02-10 00:00:00 | Resolved    |
| 105    | K + T SPORTS    | 3476 EL PASEO    | SANTA CLARA  | CA    | 91003 | 408  | 376-9966 | 7844  | 5000.00     | Tends to order large amounts of ...   | 617   | 1987-02-05 00:00:00 | NULL     | 1987-03-03 00:00:00 | Shipped     |
| 102    | VOLLYRITE       | 9722 HAMILTON    | BURLINGAME   | CA    | 95133 | 415  | 644-3341 | 7654  | 7000.00     | Company doing heavy promotion ...     | 618   | 1987-02-15 00:00:00 | A        | 1987-03-06 00:00:00 | On Hold     |
| 104    | EVERY MOUNTAIN  | 574 SURRY RD.    | CUPERTINO    | CA    | 93301 | 408  | 996-2323 | 7499  | 10000.00    | Customer with high market share ...   | 619   | 1987-02-22 00:00:00 | NULL     | 1987-02-04 00:00:00 | In Progress |
| 100    | JOCKSPORTS      | 345 VIEWRIDGE    | BELMONT      | CA    | 96711 | 415  | 598-6609 | 7844  | 5000.00     | Very friendly people to work with ... | 620   | 1987-03-12 00:00:00 | NULL     | 1987-03-12 00:00:00 | Canceled    |
| 100    | JOCKSPORTS      | 345 VIEWRIDGE    | BELMONT      | CA    | 96711 | 415  | 598-6609 | 7844  | 5000.00     | Very friendly people to work with ... | 621   | 1987-03-15 00:00:00 | A        | 1987-01-01 00:00:00 | Shipped     |

ON clause is optional, If not given then INNER JOIN works like CROSS JOIN



In general, the join condition for NATURAL JOIN is constructed by equating each pair of join attributes that have the same name in the two relations and combining these conditions with AND.

# natural join

The NATURAL JOIN is such a join that performs the same task as an INNER JOIN. NATURAL JOIN does not use any comparison operator. We can perform a NATURAL JOIN only if there is at least one common attribute that exists between two relations. In addition, the attributes must have the same name. When this join condition gets applied always the duplicates of the common columns get eliminated from the result.

## Remember:

The standard definition of NATURAL JOIN requires that the two join attributes (or each pair of join attributes) have the same name in both relations. **If this is not the case, a renaming operation is applied first.**

e.g.

- `SELECT * FROM r NATURAL JOIN (SELECT a1 AS c1, a2 FROM s) t1;`

Joins two tables based on common column names. Hence one must confirm the common columns before using a NATURAL JOIN

## *joins – natural join*

The **NATURAL JOIN** is such a join that performs the same task as an **INNER JOIN**.

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1$  NATURAL [INNER] JOIN  $r_2$  NATURAL [INNER] JOIN  $r_3 \dots$**

- **SELECT \* FROM emp NATURAL JOIN dept;**
- The associated tables have one or more pairs of identically column-names.
- The columns must be of the same name.
- The columns datatype may differ.
- Don't use ON / USING clause in a NATURAL JOIN.
- When this join condition gets applied always the duplicates of the common columns get eliminated from the result.

A **NATURAL JOIN** can be used with a **LEFT OUTER** join, or a **RIGHT OUTER** join.

If the column-names are not same, then NATURAL JOIN will work as CROSS JOIN.

**SELECT \* FROM EMP  
NATURAL JOIN DEPT**

# INNER

Vs

# NATURAL

## *inner join vs natural join*

| INNER JOIN                                                                                                                                                                                                                                                                                                          | NATURAL JOIN                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Inner Join joins two table on the basis of the column which is explicitly specified in the ON clause.                                                                                                                                                                                                               | Natural Join joins two tables based on same attribute name.                                                                           |
| In Inner Join, The resulting table will contain all the attribute of both the tables including duplicate columns also                                                                                                                                                                                               | In Natural Join, The resulting table will contain all the attributes of both the tables but keep only one copy of each common column  |
| In Inner Join, only those records will return which exists in both the tables                                                                                                                                                                                                                                       | Same as Inner Join                                                                                                                    |
| <b>SYNTAX:</b> <ul style="list-style-type: none"><li>• <code>SELECT * FROM r<sub>1</sub> INNER JOIN r<sub>2</sub> ON r<sub>1</sub>.A<sub>1</sub> = r<sub>2</sub>.A<sub>1</sub>;</code></li><li>• <code>SELECT * FROM r<sub>1</sub> INNER JOIN r<sub>2</sub> USING(A<sub>1</sub>, [A<sub>2</sub>]);</code></li></ul> | <b>SYNTAX:</b> <ul style="list-style-type: none"><li>• <code>SELECT * FROM r<sub>1</sub> NATURAL JOIN r<sub>2</sub>;</code></li></ul> |

# simple join

TODO

## *joins – simple join*

The SIMPLE JOIN is such a join that performs the same task as an INNER JOIN.

SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1$  SIMPLE JOIN  $r_2$  USING ( $A_1, \dots$ )

- SELECT \* FROM emp SIMPLE JOIN dept USING(deptno)

```
SELECT * FROM EMP
SIMPLE JOIN DEPT
USING(DEPTNO)
```

↑  
JOINING CONDITION

The ON clause is required for a left or right outer join.

The LEFT OUTER JOIN operation keeps every tuple in the first, or left, relation R in  $R \bowtie S$ , if no matching tuple is found in S, then the attributes of S in the join result are filled or padded with NULL values.

The RIGHT OUTER JOIN keeps every tuple in the second, or right, relation S in the result of  $R \bowtie S$ , if no matching tuple is found in R, then the attributes of R in the join result are filled or padded with NULL values.

## outer joins

In an outer join, along with rows that satisfy the matching criteria, we also include some or all rows that do not match the criteria.

```
CREATE TABLE r1 (id INT, c1 VARCHAR(10));
```

```
CREATE TABLE r2 (id INT, c1 VARCHAR(10));
```

```
INSERT INTO r1 VALUES (4,'AC-1'), (1,'AC-2'),(2,'AC-3'),(3,'AC-4'),(5,'AC-5');
```

```
INSERT INTO r2 VALUES (1,'C-1'), (2,'C-2'),(3,'C-3'),(7,'C-4');
```

Suppose, we want to join two tables: r1 and r2. SQL left outer join returns all rows in the left table (r1) and all the matching rows found in the right table (r2). It means the result of the SQL left join always contains the rows in the left table. . **If no matching rows found in the right table, NULL are displayed.**

## left outer joins

$$r_1 = \{1, 2, 3, 4\}$$

$$r_2 = \{(1, a), (2, b), (1, c), (3, d), (2, e), (1, f), (5, z)\}$$

$r_1$  left join  $r_2$

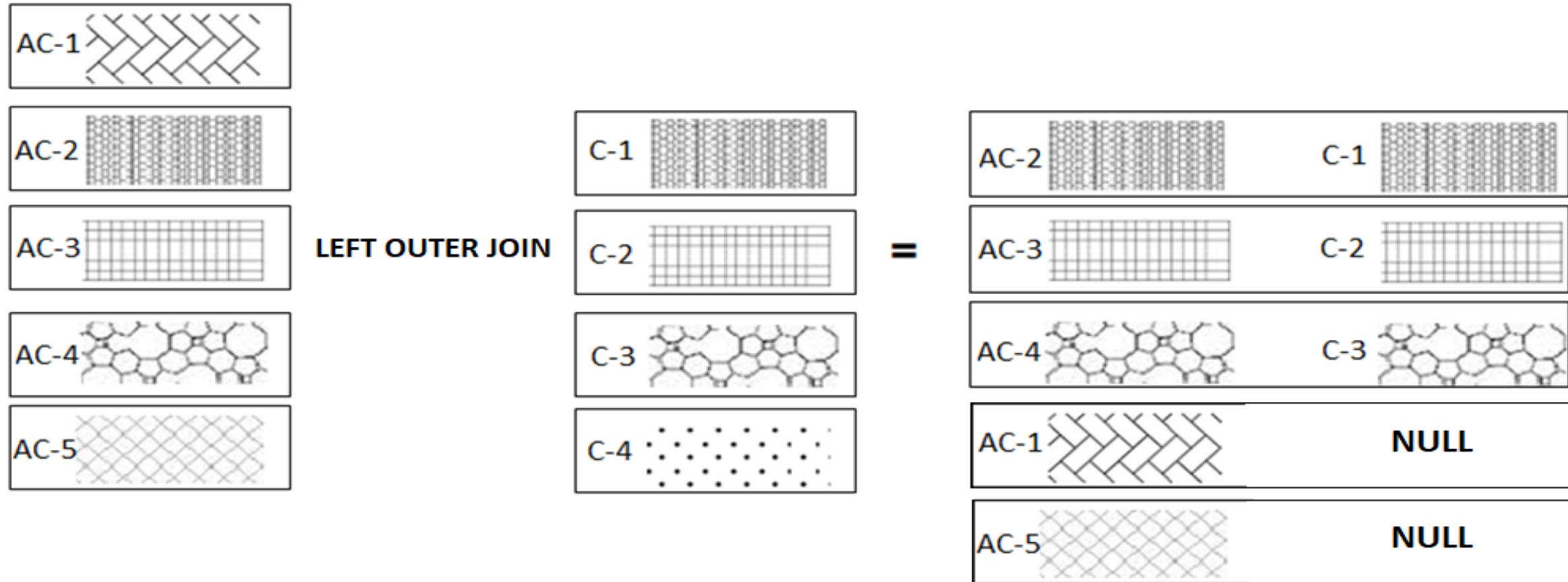
$$R = \{(1, 1, a), (2, 2, b), (1, 1, c), (3, 3, d), (2, 2, e), (1, 1, f), (4, \text{NULL}, \text{NULL})\}$$

```
SELECT * FROM r1 LEFT JOIN r2 ON r1.c1 = r2.c1;
```

|   | c1 | c1   | c2   |
|---|----|------|------|
| 1 | 1  | 1    | a    |
| 2 | 2  | 2    | b    |
| 1 | 1  |      | c    |
| 3 | 3  | 3    | d    |
| 2 |    | 2    | e    |
| 1 | 1  |      | f    |
| 4 |    | NULL | NULL |

## *joins – left outer join*

The following example shows the LEFT JOIN of two tables  $r_1(\text{AC-1}, \text{AC-2}, \text{AC-3}, \text{AC-4}, \text{AC-5})$  and  $r_2(\text{C-1}, \text{C-2}, \text{C-3}, \text{C-4})$ . The LEFT JOIN will match rows from the  $r_1$  table with the rows from  $r_2$  table using patterns:



## *joins – left outer join*

The **LEFT JOIN** keyword returns all rows from the left table ( $r_1$ ), with the matching rows in the right table ( $r_2$ ).  
**The result is NULL in the right side when there is no match.**

```
SELECT A1, A2, A3, ... FROM r1 LEFT [OUTER] JOIN r2 ON r1. A1 = r2. A1
```

```
SELECT * FROM orders ord LEFT OUTER JOIN employee emp ON emp.id = ord.employeeid;
```



# joins – left outer join

- `SELECT * FROM student LEFT OUTER JOIN student_order ON student.id = student_order.studentid ;`

|  | ID | namefirst | namelast | DOB        | emailID                  | ID   | studentID | orderdate  | amount |
|--|----|-----------|----------|------------|--------------------------|------|-----------|------------|--------|
|  | 6  | lala      | prasad   | 1980-12-01 | lala.prasad@gmail.com    | 26   | 6         | 2019-02-02 | 280    |
|  | 6  | lala      | prasad   | 1980-12-01 | lala.prasad@gmail.com    | 30   | 6         | 2019-07-10 | 750    |
|  | 7  | sharmin   | bagde    | 1986-12-14 | sharmin.bagde@gmail.com  | 10   | 7         | 2019-10-10 | 2500   |
|  | 7  | sharmin   | bagde    | 1986-12-14 | sharmin.bagde@gmail.com  | 33   | 7         | 2019-06-23 | 945    |
|  | 8  | vrushali  | bagde    | 1984-12-29 | vrushali.bagde@gmail.com | 21   | 8         | 2019-01-12 | 4500   |
|  | 8  | vrushali  | bagde    | 1984-12-29 | vrushali.bagde@gmail.com | 40   | 8         | 2019-01-12 | 650    |
|  | 9  | vasant    | khande   | 1992-10-26 | vasant.khande@gmail.com  | NULL | NULL      | NULL       | NULL   |
|  | 10 | nitish    | patil    | 1990-10-26 | nitish.patil@gmail.com   | 11   | 10        | 2019-11-11 | 150    |
|  | 10 | nitish    | patil    | 1990-10-26 | nitish.patil@gmail.com   | 22   | 10        | 2019-11-02 | 650    |
|  | 10 | nitish    | patil    | 1990-10-26 | nitish.patil@gmail.com   | 34   | 10        | 2019-01-19 | 225    |
|  | 11 | neel      | save     | 1975-10-30 | neel.save@gmail.com      | NULL | NULL      | NULL       | NULL   |
|  | 12 | deep      | save     | 1986-11-30 | deep.save@gmail.com      | 5    | 12        | 2019-05-03 | 655    |
|  | 12 | deep      | save     | 1986-11-30 | deep.save@gmail.com      | 6    | 12        | 2019-05-04 | 1000   |
|  | 12 | deep      | save     | 1986-11-30 | deep.save@gmail.com      | 28   | 12        | 2019-02-02 | 45     |
|  | 12 | deep      | save     | 1986-11-30 | deep.save@gmail.com      | 29   | 12        | 2019-01-12 | 190    |
|  | 13 | nrupali   | save     | 1981-12-01 | nrupali.save@gmail.com   | 13   | 13        | 2019-11-02 | 655    |
|  | 13 | nrupali   | save     | 1981-12-01 | nrupali.save@gmail.com   | 36   | 13        | 2019-01-12 | 180    |
|  | 14 | supriya   | karnik   | 1983-12-15 | supriya.karnik@gmail.com | 12   | 14        | 2019-07-21 | 340    |
|  | 14 | supriya   | karnik   | 1983-12-15 | supriya.karnik@gmail.com | 35   | 14        | 2019-10-10 | 325    |
|  | 15 | bandish   | karnik   | 1987-12-30 | bandish.karnik@gmail.com | NULL | NULL      | NULL       | NULL   |
|  | 16 | sangita   | karnik   | 1990-12-01 | sangita.karnik@gmail.com | NULL | NULL      | NULL       | NULL   |
|  | 17 | sangita   | menon    | 1989-10-26 | sangita.menon@gmail.com  | NULL | NULL      | NULL       | NULL   |
|  | 18 | rahul     | shah     | 1982-06-12 | rahul.shah@gmail.com     | NULL | NULL      | NULL       | NULL   |

## *joins – left outer join*

The **LEFT JOIN** keyword returns all rows from the left table ( $r_1$ ), with the matching rows in the right table ( $r_2$ ).  
**The result is NULL in the right side table when there is no match.**

```
SELECT A1, A2, A3, ... FROM r1 LEFT [OUTER] JOIN r2 ON r1. A1 = r2. A1 WHERE r2. A1 IS NULL
```

```
SELECT * FROM orders ord LEFT OUTER JOIN employee emp ON emp.id = ord.employeeid WHERE emp.id IS NULL;
```



# joins – left outer join

- `SELECT * FROM student LEFT OUTER JOIN student_order ON student.id = student_order.studentid WHERE student_order.studentID IS NULL;`

|   | ID | namefirst | namelast | DOB        | emailID                  | ID   | studentID | orderdate | amount |
|---|----|-----------|----------|------------|--------------------------|------|-----------|-----------|--------|
| ▶ | 3  | ulka      | joshi    | 1970-10-25 | ulka.joshi@gmail.com     | NULL | NULL      | NULL      | NULL   |
|   | 9  | vasant    | khande   | 1992-10-26 | vasant.khande@gmail.com  | NULL | NULL      | NULL      | NULL   |
|   | 11 | neel      | save     | 1975-10-30 | neel.save@gmail.com      | NULL | NULL      | NULL      | NULL   |
|   | 15 | bandish   | karnik   | 1987-12-30 | bandish.karnik@gmail.com | NULL | NULL      | NULL      | NULL   |
|   | 16 | sangita   | karnik   | 1990-12-01 | sangita.karnik@gmail.com | NULL | NULL      | NULL      | NULL   |
|   | 17 | sangita   | menon    | 1989-10-26 | sangita.menon@gmail.com  | NULL | NULL      | NULL      | NULL   |
|   | 18 | rahul     | shah     | 1982-06-12 | rahul.shah@gmail.com     | NULL | NULL      | NULL      | NULL   |
|   | 19 | bhavin    | patel    | 1983-11-13 | bhavin.patel@gmail.com   | NULL | NULL      | NULL      | NULL   |
|   | 20 | kaushal   | patil    | 1982-07-30 | kaushal.patil@gmail.com  | NULL | NULL      | NULL      | NULL   |
|   | 21 | pankaj    | gandhi   | 1982-07-30 | pankaj.gandhi@gmail.com  | NULL | NULL      | NULL      | NULL   |
|   | 22 | rajan     | patel    | 1982-07-30 | rajan.patel@gmail.com    | NULL | NULL      | NULL      | NULL   |
|   | 23 | bhavin    | patel    | 1982-07-30 | bhavin.patel@gmail.com   | NULL | NULL      | NULL      | NULL   |
|   | 24 | mukesh    | bhavsar  | 1982-07-30 | mukesh.bhavsar@gmail.com | NULL | NULL      | NULL      | NULL   |
|   | 25 | dilu      | khande   | 1982-07-30 | dilu.khande@gmail.com    | NULL | NULL      | NULL      | NULL   |
|   | 26 | sonam     | khan     | 1972-05-13 | sonam.khan@gmail.com     | NULL | NULL      | NULL      | NULL   |
|   | 27 | rohit     | patil    | 1976-12-31 | rohit.patil@gmail.com    | NULL | NULL      | NULL      | NULL   |
|   | 28 | raj       | bubber   | 1982-02-28 | raj.bubber@gmail.com     | NULL | NULL      | NULL      | NULL   |
|   | 29 | sharmin   | patil    | 1999-11-10 | sharmin.patil@gmail.com  | NULL | NULL      | NULL      | NULL   |

## *joins – left outer join*

The **LEFT JOIN** keyword returns all rows from the left table ( $r_1$ ), with the matching rows in the right table ( $r_2$ ).  
**The result is NULL in the right side table when there is no match.**

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1$  LEFT [OUTER] JOIN  $r_2$  USING ( $A_1, \dots$ )**

- **SELECT \* FROM emp LEFT OUTER JOIN dept USING(deptno);**

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1$  NATURAL LEFT [OUTER ] JOIN  $r_2$**

- **SELECT \* FROM emp NATURAL LEFT OUTER JOIN dept;**

Suppose, we want to join two tables: r1 and r2. Right outer join returns all rows in the right table (r1) and all the matching rows found in the left table (r2). It means the result of the SQL right join always contains the rows in the right table. . If no matching rows found in the left table, NULL are displayed.

## right outer joins

$$r_1 = \{1, 2, 3, 4\}$$

$$r_2 = \{(1, a), (2, b), (1, c), (3, d), (2, e), (1, f), (5, z)\}$$

$r_1$  right join  $r_2$

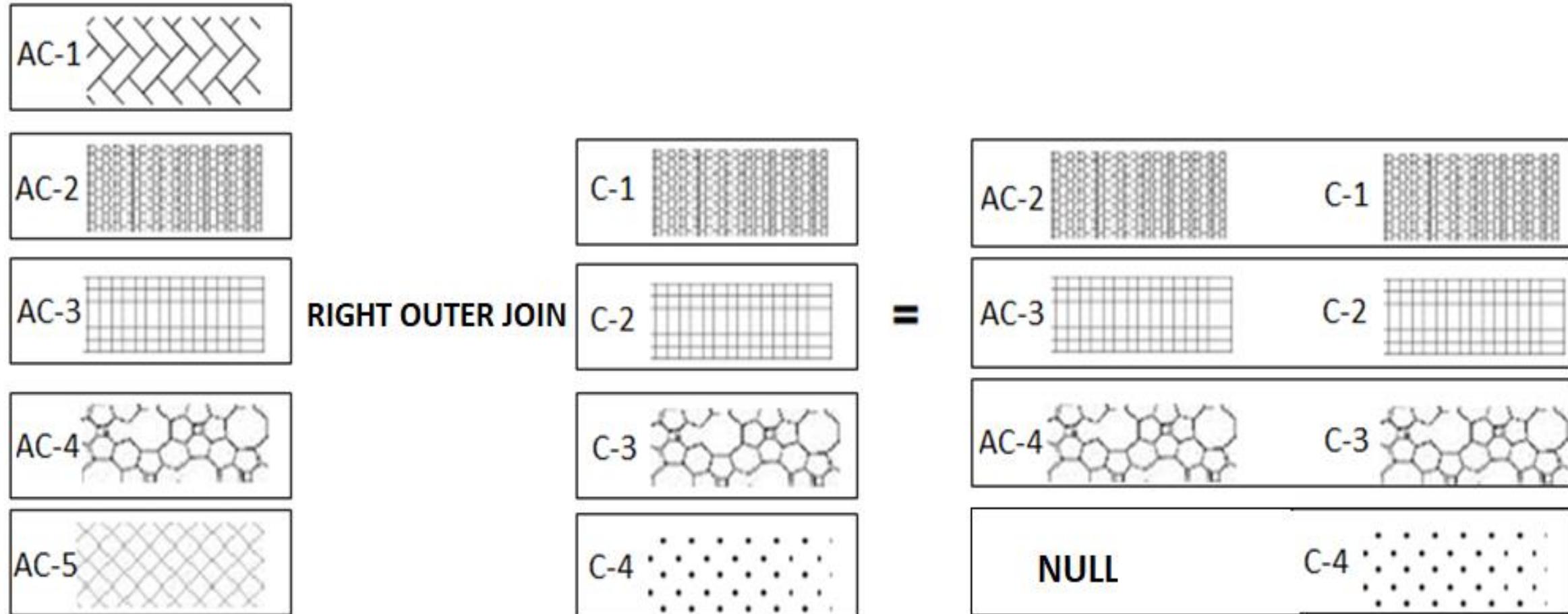
$$R = \{(1, 1, a), (1, 1, c), (1, 1, f), (2, 2, b), (2, 2, e), (3, 3, d), (\text{NULL}, 5, z)\}$$

`SELECT * FROM r1 RIGHT JOIN r2 ON r1.c1 = r2.c1;`

|      | c1 | c1 | c2 |
|------|----|----|----|
| 1    | 1  | 1  | a  |
| 1    | 1  | 1  | c  |
| 1    | 1  | 1  | f  |
| 2    | 2  | 2  | b  |
| 2    | 2  | 2  | e  |
| 3    | 3  | 3  | d  |
| NULL |    | 5  | z  |

## *joins – right outer join*

The following example shows the RIGHT OUTER JOIN of two tables  $r_1(\text{AC-1}, \text{AC-2}, \text{AC-3}, \text{AC-4}, \text{AC-5})$  and  $r_2(\text{C-1}, \text{C-2}, \text{C-3}, \text{C-4})$ . The RIGHT JOIN will match rows from the  $r_1$  table with the rows from  $r_2$  table using patterns:



## *joins – right outer join*

The **RIGHT JOIN** keyword returns all rows from the right table ( $r_2$ ), with the matching rows in the left table ( $r_1$ ).  
**The result is NULL in the left side table when there is no match.**

```
SELECT A1, A2, A3, ... FROM r1 RIGHT [OUTER] JOIN r2 ON r1.A1 = r2.A1
```

```
SELECT * FROM orders ord RIGHT OUTER JOIN employee emp ON emp.id = ord.employeeid;
```



# joins – right outer join

- `SELECT * FROM student RIGHT OUTER JOIN student_order ON student.id = student_order.studentid;`

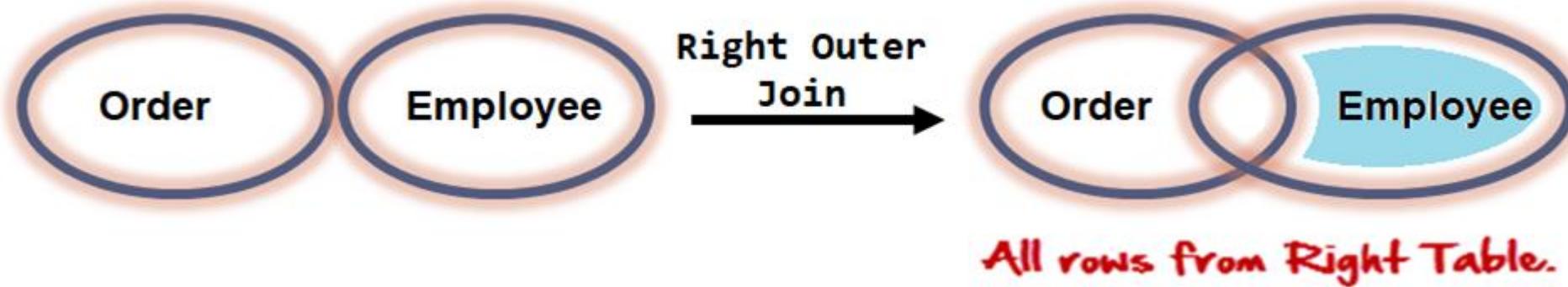
|  | ID | namefirst | namelast | DOB        | emailID                  | ID | studentID | orderdate  | amount |
|--|----|-----------|----------|------------|--------------------------|----|-----------|------------|--------|
|  | 6  | lala      | prasad   | 1980-12-01 | lala.prasad@gmail.com    | 7  | 6         | 2019-11-11 | 4000   |
|  | 1  | saleel    | bagde    | 1986-12-14 | saleel.bagde@gmail.com   | 8  | 1         | 2019-07-19 | 1270   |
|  | 5  | ruhan     | bagde    | 1984-01-12 | ruhan.bagde@gmail.com    | 9  | 5         | 2019-04-07 | 2000   |
|  | 7  | sharmin   | bagde    | 1986-12-14 | sharmin.bagde@gmail.com  | 10 | 7         | 2019-10-10 | 2500   |
|  | 10 | nitish    | patil    | 1990-10-26 | nitish.patil@gmail.com   | 11 | 10        | 2019-11-11 | 150    |
|  | 14 | supriya   | karnik   | 1983-12-15 | supriya.karnik@gmail.com | 12 | 14        | 2019-07-21 | 340    |
|  | 13 | nrupali   | save     | 1981-12-01 | nrupali.save@gmail.com   | 13 | 13        | 2019-11-02 | 655    |
|  | 4  | rahul     | patil    | 1982-10-31 | rahul.patil@gmail.com    | 14 | 4         | 2019-01-12 | 1000   |
|  |    |           |          |            |                          | 15 | NULL      | 2019-04-07 | 4000   |
|  |    |           |          |            |                          | 16 | NULL      | 2019-10-10 | 1270   |
|  |    |           |          |            |                          | 17 | NULL      | 2019-11-11 | 4588   |
|  |    |           |          |            |                          | 18 | NULL      | 2019-07-21 | 1200   |
|  |    |           |          |            |                          | 19 | NULL      | 2019-11-02 | 125    |
|  |    |           |          |            |                          | 20 | NULL      | 2019-01-12 | 350    |
|  | 8  | vrushali  | bagde    | 1984-12-29 | vrushali.bagde@gmail.com | 21 | 8         | 2019-01-12 | 4500   |
|  | 10 | nitish    | patil    | 1990-10-26 | nitish.patil@gmail.com   | 22 | 10        | 2019-11-02 | 650    |
|  | 4  | rahul     | patil    | 1982-10-31 | rahul.patil@gmail.com    | 23 | 4         | 2019-10-19 | 700    |

## *joins – right outer join*

The **RIGHT JOIN** keyword returns all rows from the right table ( $r_2$ ), with the matching rows in the left table ( $r_1$ ).  
**The result is NULL in the left side table when there is no match.**

```
SELECT A1, A2, A3, ... FROM r1 RIGHT [OUTER] JOIN r2 ON r1.A1 = r2.A1 WHERE r1.A1 IS NULL
```

```
SELECT * FROM orders ord RIGHT OUTER JOIN employee emp ON emp.id = ord.employeeid WHERE ord.employeeid IS NULL;
```



# *joins – right outer join*

- `SELECT * FROM student RIGHT OUTER JOIN student_order ON student.id = student_order.studentid WHERE student.ID IS NULL;`

|   | ID   | namefirst | namelast | DOB  | emailID |  | ID | studentID | orderdate  | amount |
|---|------|-----------|----------|------|---------|--|----|-----------|------------|--------|
| ▶ | NULL | NULL      | NULL     | NULL | NULL    |  | 15 | NULL      | 2019-04-07 | 4000   |
|   | NULL | NULL      | NULL     | NULL | NULL    |  | 16 | NULL      | 2019-10-10 | 1270   |
|   | NULL | NULL      | NULL     | NULL | NULL    |  | 17 | NULL      | 2019-11-11 | 4588   |
|   | NULL | NULL      | NULL     | NULL | NULL    |  | 18 | NULL      | 2019-07-21 | 1200   |
|   | NULL | NULL      | NULL     | NULL | NULL    |  | 19 | NULL      | 2019-11-02 | 125    |
|   | NULL | NULL      | NULL     | NULL | NULL    |  | 20 | NULL      | 2019-01-12 | 350    |

## *joins – right outer join*

The **RIGHT JOIN** keyword returns all rows from the right table ( $r_2$ ), with the matching rows in the left table ( $r_1$ ).  
**The result is NULL in the left side table when there is no match.**

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1$  RIGHT [OUTER] JOIN  $r_2$  USING ( $A_1, \dots$ )**

**SELECT \* FROM emp RIGHT OUTER JOIN dept USING(deptno);**

**SELECT  $A_1, A_2, A_3, \dots$  FROM  $r_1$  NATURAL RIGHT [OUTER ] JOIN  $r_2$**

**SELECT \* FROM emp NATURAL RIGHT OUTER JOIN dept;**

# LEFT JOIN

Vs

# RIGHT JOIN

## *left join vs right join*

| LEFT OUTER JOIN                                                                                                                                                                                           | RIGHT OUTER JOIN                                                                                                                                                                                          | FULL OUTER JOIN                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| All the tuples of the left table remain in the result.<br><br>The tuples of left table that does not have a matching tuple in right table are extended with NULL value for attributes of the right table. | All the tuples of the right table remain in the result.<br><br>The tuples of right table that does not have a matching tuple in left table are extended with NULL value for attributes of the left table. | All the tuples from left as well as right table remain in the result.<br><br>The tuples of left as well as the right table that does not have the matching tuples in the right and left table respectively are extended with NULL value for attributes of the right and left tables. |

TODO

self joins

TODO

## *joins – self join*

A **SELF JOIN** is a join in which a table is joined with itself (which is also called Unary relationships), especially when the table has a FOREIGN KEY which references its own PRIMARY KEY.

```
SELECT rx.A1, rx.A2, ry.A1, ry.A2, ... FROM r1 rx, r1 ry WHERE rx.A1 = ry.A1
```

```
SELECT distinct e1.* FROM emp e1 , emp e2 WHERE e1.sal = e2.sal AND e1.empno != e2.empno ORDER BY e1.sal;
```

```
SELECT C1 FROM T1 UNION SELECT C1 FROM T2
ORDER BY C1
```

(UNION ALL, EXCEPT ALL, INTERSECT ALL)

```
(SELECT C1 FROM T1 ORDER BY C1) UNION
(SELECT C1 FROM T2 ORDER BY C1)
```

```
SELECT C1 FROM T1 ORDER BY C1 UNION
SELECT C1 FROM T2 ORDER BY C1 //ERROR
```

# set operation in sql

**Set operators** are used to join the results of two (or more) SELECT statements.

There are set union (**UNION**), set difference (**EXCEPT**), and set intersection (**INTERSECT**) operations. The relations resulting from these set operations are sets of tuples; that is, duplicate tuples are eliminated from the result.

## Remember:

- The result set column names are taken from the column names of the first SELECT statement.
- SELECT statement should have the same data type. (Not in MySQL)
- UNION: To apply ORDER BY or LIMIT to an individual SELECT, place the clause inside the parentheses that enclose the SELECT.

e.g. (SELECT ...) UNION (SELECT ...)

- `CREATE TABLE Facebook (`  
    `ID INT PRIMARY KEY,`  
    `name VARCHAR(45),`  
    `location VARBINARY(45)`  
`);`
- `CREATE TABLE LinkedIn (`  
    `ID INT PRIMARY KEY,`  
    `name VARCHAR(45),`  
    `location VARBINARY(45)`  
`);`

```
SELECT name FROM students
UNION
SELECT name FROM contacts;
```

*/\* Fetch the union of queries \*/*

```
SELECT name FROM students
UNION ALL
SELECT name FROM contacts;
```

*/\* Fetch the union of queries with duplicates \*/*

```
SELECT name FROM students
EXCEPT
SELECT name FROM contacts;
```

*/\* Fetch names from students \*/  
/\* that aren't present in contacts \*/*

```
SELECT name FROM students
INTERSECT
SELECT name FROM contacts;
```

*/\* Fetch names from students \*/  
/\* that are present in contacts as well \*/*

# union

## syntax

```
SELECT ... UNION [ALL | DISTINCT]
SELECT ... [UNION [ALL | DISTINCT]
SELECT ...]
```

- `SELECT DISTINCT * FROM duplicate;`
- `SELECT * FROM duplicate UNION SELECT * FROM duplicate;`
- `SELECT deptno, dname, loc, walletid FROM (SELECT ROW_NUMBER()
OVER(PARTITION BY deptno) R1, duplicate.* FROM duplicate) T1 WHERE R1=1;`

## Note:

- It is used to combine two or more result sets (SELECT statements) into a single set
  - it removes duplicate rows between the various SELECT statements.
  - each SELECT statement within the UNION operator must have the same number of fields in the result sets.
  - default behaviour for UNION is that duplicate rows are removed from the result.
- 
- `(SELECT deptno FROM emp LIMIT 1) UNION (SELECT deptno FROM dept LIMIT 1);`
  - `SELECT 'EMP' as 'Table Name', COUNT(*) FROM emp UNION SELECT 'DEPT', COUNT(*) FROM dept UNION SELECT 'BONUS', COUNT(*) FROM bonus;`
  - `SELECT COUNT(*) FROM customer UNION SELECT COUNT(*) FROM ord;`
  - `SELECT * FROM emp WHERE deptno NOT IN (SELECT deptno FROM emp m WHERE m.deptno NOT IN (SELECT deptno FROM emp f WHERE gender = 'F')) UNION SELECT deptno FROM emp m WHERE m.deptno NOT IN (SELECT deptno FROM emp f WHERE gender = 'M'));`

*union*

books

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | DS         | Hardcover | 950  |
|   | 1      | DS         | Hardcover | 950  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

newbooks

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | Redis      | Paperback | 850  |
|   | 1      | Redis      | Paperback | 850  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

Output

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | DS         | Hardcover | 950  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 1      | Redis      | Paperback | 850  |

*Duplicate rows  
not repeated  
in result set*

- `SELECT * FROM books UNION SELECT * FROM newbooks;`

Note:

The following statement will give an error

- `SELECT bookName, type FROM books ORDER BY bookname  
UNION  
SELECT bookName, type FROM newbooks;`

*union all*

books

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | DS         | Hardcover | 950  |
|   | 1      | DS         | Hardcover | 950  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

newbooks

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | Redis      | Paperback | 850  |
|   | 1      | Redis      | Paperback | 850  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

Output

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | DS         | Hardcover | 950  |
|   | 1      | DS         | Hardcover | 950  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 1      | Redis      | Paperback | 850  |
|   | 1      | Redis      | Paperback | 850  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

### Note:

- It is used to combine two or more result sets into a single set, including duplicates.
- `SELECT * FROM books UNION ALL SELECT * FROM newbooks;`
- `SELECT * FROM emp UNION ALL SELECT * FROM emp;`
- `SELECT bookname, COUNT(*) FROM (SELECT bookname FROM books UNION ALL SELECT bookname FROM newbooks) b GROUP BY bookname;`

Duplicate rows  
are repeated  
in result set

It is used to combine two result sets and returns the data which are common in both the result set.

## *intersect / intersect all*

books

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | DS         | Hardcover | 950  |
|   | 1      | DS         | Hardcover | 950  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

newbooks

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | Redis      | Paperback | 850  |
|   | 1      | Redis      | Paperback | 850  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

Output

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 2      | JavaScript | Paperback | 700  |

Output

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

An INTERSECT query returns the intersection of 2 or more data sets. If a record exists in both data sets, it will be included in the INTERSECT results.

- `SELECT * FROM books INTERSECT SELECT * FROM newbooks;`
- `SELECT * FROM books INTERSECT ALL SELECT * FROM newbooks;`
- `SELECT bookName, type FROM books WHERE EXISTS ( SELECT bookname, type FROM newbooks WHERE books.bookName = newbooks.bookName);`
- `SELECT bookName, type FROM books WHERE bookName IN (SELECT bookName FROM newbooks);`

It is used to combine two result sets and returns the data from the first result set which is not present in the second result set.

*except / except all*

books

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | DS         | Hardcover | 950  |
|   | 1      | DS         | Hardcover | 950  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

newbooks

|   | bookID | bookName   | Type      | Cost |
|---|--------|------------|-----------|------|
| ▶ | 1      | Redis      | Paperback | 850  |
|   | 1      | Redis      | Paperback | 850  |
|   | 2      | JavaScript | Paperback | 700  |
|   | 2      | JavaScript | Paperback | 700  |

Output

|   | bookID | bookName | Type      | Cost |
|---|--------|----------|-----------|------|
| ▶ | 1      | DS       | Hardcover | 950  |

Output

|   | bookID | bookName | Type      | Cost |
|---|--------|----------|-----------|------|
| ▶ | 1      | DS       | Hardcover | 950  |
|   | 1      | DS       | Hardcover | 950  |

An EXCEPT returns rows from first dataset, which are not available in the second dataset.

- `SELECT * FROM books EXCEPT SELECT * FROM newbooks;`
- `SELECT * FROM books EXCEPT ALL SELECT * FROM newbooks;`
  
- `SELECT bookName, type FROM books WHERE NOT EXISTS (SELECT bookName, type FROM newbooks WHERE books.bookName = newbooks.bookName);`
- `SELECT bookName, type FROM newbooks WHERE NOT EXISTS (SELECT bookName, type FROM books WHERE books.bookName = newbooks.bookName);`

Note:

*except*

- There is no **MINUS** operator in MySQL, you can easily simulate this type of query using either the **EXCEPT** , **NOT IN** clause or the **NOT EXISTS** clause.

1. `SELECT * FROM books /* Fetch everything from books */  
 EXCEPT /* that are not present in newbooks */  
 SELECT * FROM newbooks;`

2. `SELECT * FROM newbooks /* Fetch everything from newbooks */  
 EXCEPT /* that are not present in books */  
 SELECT * FROM books;`

create table ... like statement

## *create table ... like*

Use CREATE TABLE ... LIKE to create an empty table based on the definition of another table, including any column attributes and indexes defined in the original table.

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

- LIKE works only for base tables, not for VIEWS.
- You cannot execute CREATE TABLE or CREATE TABLE ... LIKE while a LOCK TABLES statement is in effect.
- `CREATE TABLE e LIKE emp;`

MEMORY tables are visible to another client, but  
TEMPORARY tables are not visible to another client.

*create temporary table ... like  
statement*

## *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;
```

- LIKE works only for base tables, not for VIEWS.
- You cannot execute CREATE TABLE or CREATE TABLE ... LIKE while a LOCK TABLES statement is in effect.

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.

```
CREATE TEMPORARY TABLE e like emp;
```

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 table ... select statement

## *create table ... select*

You can create one table from another by adding a SELECT statement at the end of the CREATE TABLE statement.

```
CREATE TABLE new_tbl [AS] SELECT * FROM orig_tbl;
```

You cannot use FOR UPDATE as part of the SELECT in a statement such as CREATE TABLE new\_table  
SELECT ... FROM old\_table .... FOR UPDATE.

If you attempt to do so, the statement fails.

- CREATE TABLE e **SELECT \* FROM emp;**
- CREATE TABLE e as **SELECT \* FROM emp;**
- CREATE TABLE e (ID INT) **SELECT \* FROM emp;**
- CREATE TABLE e as **SELECT 1+1, ename FROM emp;**
- CREATE TABLE e as **SELECT 1+1 "R1", ename FROM emp;**
- CREATE TABLE e as **SELECT \* FROM emp WHERE 1=2;**

### Note:

- By default, this statement does not copy all column attributes such as AUTO\_INCREMENT

- `SET autocommit = { 0 | 1 }` 0 - disable; 1 - enable
  - show variables like 'auto%';
  - `SELECT @@AUTOCOMMIT;`

Turning the autocommit off globally. Open **my.ini** file and add the following statement.

[mysqld]

`autocommit = 0`

After adding the line re-start the MySQL server.

## commit and rollback

Remember:

- When you **UPDATE** or **DELETE** a row, that row is automatically locked for other users.
- ROW LOCKING IS AUTOMATIC IN MYSQL AND ORACLE.
- When you **UPDATE** or **DELETE** a row, that row becomes READ ONLY for other users.
- Other users can **SELECT** from that table; they will view the old data before your changes.
- Other users can **INSERT** rows into that table.
- Other users can **UPDATE** or **DELETE** "other" rows of that table.
- No other user can **UPDATE** or **DELETE** your locked row, till you have issued a Rollback or Commit.
- To lock the rows manually you require **SELECT** statement with a **FOR UPDATE** clause.
- **LOCKS ARE AUTOMATICALLY RELEASED WHEN YOU ROLLBACK OR COMMIT.**

# *commit and rollback*

To undo MySQL statements you use the ROLLBACK statement. To write the changes into the database within a transaction, you use the COMMIT statement.

START TRANSACTION

[transaction\_characteristic]

transaction\_characteristic:

| READ WRITE  
| READ ONLY

## Note:

- It is important to note that MySQL automatically commits the changes to the database by default.
- START TRANSACTION READ ONLY;
- INSERT INTO dept VALUES (60, 'HRD', 'Pune' );
- COMMIT

## *commit and rollback*

To undo MySQL statements you use the ROLLBACK statement. To write the changes into the database within a transaction, you use the COMMIT statement.

BEGIN [WORK]  
COMMIT [WORK]  
SAVEPOINT *identifier*  
ROLLBACK [WORK] TO [SAVEPOINT] *identifier*  
SET autocommit = {0 | 1}

### Note:

- It is important to note that MySQL automatically commits the changes to the database by default.
  - BEGIN WORK
  - INSERT INTO dept VALUES (60, 'HRD', 'Pune' );
  - ROLLBACK / COMMIT WORK
- 
- SAVEPOINT pt0;
  - INSERT INTO dept VALUES (60, 'HRD', 'Pune' );
  - SAVEPOINT pt1;
  - INSERT INTO dept VALUES (61, 'HRD', 'baroda' );
  - ROLLBACK TO SAVEPOINT pt1;

select .... for update

## *select - for update*

Sets a shared mode lock on any rows that are read. Other sessions can read the rows, but cannot modify them until your transaction commits. If any of these rows were changed by another transaction that has not yet committed, your query waits until that transaction ends and then uses the latest values.

- `SELECT * FROM emp FOR UPDATE;`

# truncate table

## Remember:

- DROP and TRUNCATE are DDL commands, whereas DELETE is a DML command.
  - DELETE operations can be rolled back, while DROP and TRUNCATE operations cannot be rolled back.
  - The TRUNCATE TABLE statement removes all the data/rows of a table and resets the auto-increment value to zero.
-

## *truncate table*

Logically, TRUNCATE TABLE is similar to a DELETE statement that deletes all rows, or a sequence of DROP TABLE and CREATE TABLE statements.

`TRUNCATE [TABLE] tbl_name`

### Remember:

- Truncate operations drop and re-create the table, which is much faster than deleting rows one by one.
  - Truncate operations cause an implicit commit, and so cannot be rolled back.
  - Truncate does not cause ON DELETE triggers to fire.
  - Truncate cannot be performed for parent-child foreign key relationships.
  - Truncate retains Identity and reset to the seed (**start value**) value.
  - Cannot truncate a table referenced in a foreign key constraint.
  - Any AUTO\_INCREMENT value is reset to its start value.
-

**DELETE****Vs TRUNCATE***delete vs truncate*

| <b>DELETE</b>                                                                      | <b>TRUNCATE</b>                                             |
|------------------------------------------------------------------------------------|-------------------------------------------------------------|
| You can specify the tuple that you want to delete.                                 | It deletes all the tuples from a relation.                  |
| DELETE is a Data Manipulation Language command.                                    | TRUNCATE is a Data Definition Language command.             |
| DELETE command can have WHERE clause.                                              | TRUNCATE command do not have WHERE clause.                  |
| DELETE command activates the trigger applied on the table and causes them to fire. | TRUNCATE command does not activate the triggers to fire.    |
| DELETE command eliminate the tuples one-by-one.                                    | TRUNCATE delete the entire data page containing the tuples. |
| DELETE command lock the row/tuple before deleting it.                              | TRUNCATE command lock data page before deleting table data. |
| DELETE command acts slower as compared to TRUNCATE.                                | TRUNCATE is faster as compared to DELETE.                   |
| DELETE records transaction log for each deleted tuple.                             | TRUNCATE record transaction log for each deleted data page. |
| DELETE command can be followed either by COMMIT or ROLLBACK.                       | TRUNCATE command can't be ROLLBACK.                         |

# DROP

# Vs TRUNCATE

## *drop vs truncate*

| <b>DROP</b>                                                           | <b>TRUNCATE</b>                                                               |
|-----------------------------------------------------------------------|-------------------------------------------------------------------------------|
| The DROP command is used to remove table definition and its contents. | Whereas the TRUNCATE command is used to delete all the rows from the table.   |
| In the DROP command, VIEW of table does not exist.                    | In the TRUNCATE command, VIEW of table exist.                                 |
| In the DROP command, integrity constraints will be removed.           | In the TRUNCATE command, integrity constraints will not be removed.           |
| In the DROP command, INDEX associated to the table will be removed.   | In the TRUNCATE command, INDEX associated to the table will not be removed.   |
| In the DROP command, TRIGGER associated to the table will execute.    | In the TRUNCATE command, TRIGGER associated to the table will not execute.    |
| In the DROP command, TRIGGER associated to the table will be removed. | In the TRUNCATE command, TRIGGER associated to the table will be not removed. |
|                                                                       |                                                                               |
|                                                                       |                                                                               |

# rename table

Change the table name.

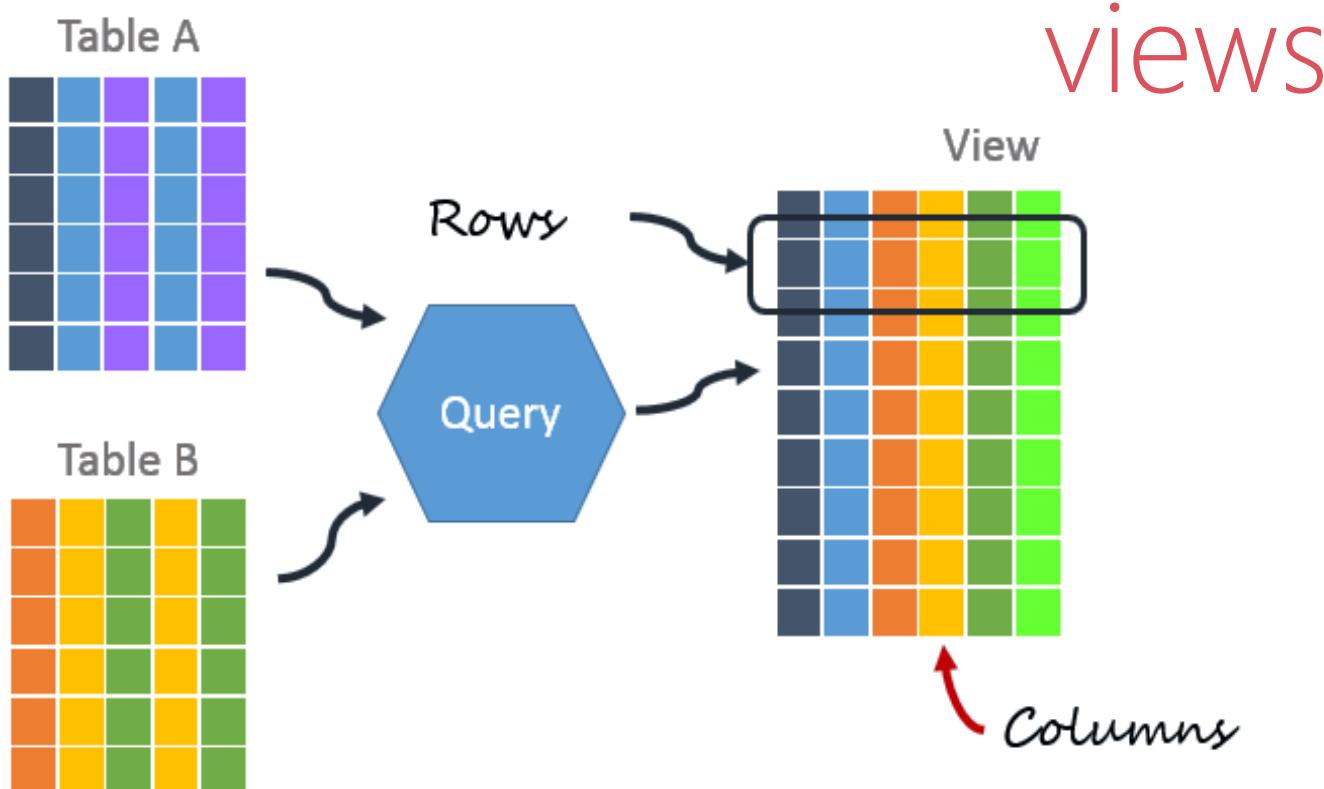
`RENAME TABLE old_tbl_name TO new_tbl_name`

- `RENAME TABLE emp TO employee;`

A **VIEW** in SQL as a logical subset of data from one or more tables. Views are used to restrict data access. A **VIEW** contains no data of its own but its like window through which data from tables can be viewed or changed. The table on which a View is based are called BASE Tables.

There are 2 types of Views in SQL:

- **Simple View** : Simple views can only contain a single base table.
- **Complex View** : Complex views can be constructed on more than one base table. In particular, complex views can contain: join conditions, a group by clause, a order by clause.



## Theater

| ID | Name | Address |
|----|------|---------|
| 1  | A    | B       |
| 2  | C    | D       |
| 3  | E    | F       |
| 4  | G    | H       |

## Opera

| ID | Name | Address |
|----|------|---------|
| 1  | I    | J       |
| 2  | K    | L       |
| 3  | M    | N       |
| 4  | O    | P       |

## Cinema

| ID | Name | Address |
|----|------|---------|
| 1  | R    | S       |
| 2  | T    | U       |
| 3  | V    | W       |
| 4  | X    | Y       |

view

## Executed View

| ID | Name | Address |
|----|------|---------|
| 1  | A    | B       |
| 2  | C    | D       |
| 3  | E    | F       |
| 4  | G    | H       |
| 5  | I    | J       |
| 6  | K    | L       |
| 7  | M    | N       |
| 8  | O    | P       |
| 9  | R    | S       |
| 10 | T    | U       |
| 11 | V    | W       |
| 12 | X    | Y       |

SELECT ID, Name, Address **FROM** theater

**UNION**

SELECT ID, Name, Address **FROM** opera

**UNION**

SELECT ID, Name, Address **FROM** cinema;

## Remember:

- it can be described as **virtual/derived** table which derived its data from one or more than one base table.
- View names may appear in a query in any place where a relation name may appear.
- it is stored in the database.
- it can be created using tables of same database or different database.
- it is used to implement the security mechanism in the SQL.
- It can have max 64 char (view name).

view

## Rules:

- If a VIEW is defined as `SELECT *` on a table, new columns added to the base table later do not become part of the VIEW, and columns dropped from the base table will result in an error when selecting from the VIEW.
- A VIEW must have unique column names with no duplicates, just like a base table. By default, the names of the columns retrieved by the `SELECT` statement are used for the VIEW column names.
- The VIEW definition cannot refer to a TEMPORARY table, and you cannot create a TEMPORARY VIEW.
- You cannot associate a TRIGGER with a VIEW.
  - `DESC dept;`
  - `CREATE VIEW v1 AS SELECT * FROM dept;`
  - `DROP TABLE dept;`
  - `DESC v1;`

## Note:

- If we drop the BASE TABLE, the VIEW will not be dropped.

- A VIEW definition (structure) is not permanently stored as part of the database.

Try this

Uses of a View: A good database should contain views due to the following reasons:

- **Restricting data access** – Views provide an additional level of table security by restricting access to a predetermined set of rows and columns of a table.
- **Hiding data complexity** – A view can hide the complexity that exists in multiple tables join.
- **Simplify commands for the user** – Views allow the user to select information from multiple tables without requiring the users to actually know how to perform a join.
- **Store complex queries** – Views can be used to store complex queries.
- **Rename Columns** – Views can also be used to rename the columns without affecting the base tables provided the number of columns in view must match the number of columns specified in select statement. Thus, renaming helps to hide the names of the columns of the base tables.
- **Multiple view facility** – Different views can be created on the same table for different users.

## Views are not updatable in the following cases:

- A table in the FROM clause is reference by a subquery in the WHERE statement.
- There is a subquery in the SELECT clause.
- The SQL statement defining the view joins tables.
- One of the tables in the FROM clause is a non-updatable view.
- The SELECT statement of the view contains an aggregate function such as SUM(), COUNT(), MAX(), MIN(), and so on.
- The keywords DISTINCT, GROUP BY, HAVING clause, LIMIT clause, UNION, or UNION ALL appear in the defining SQL statement.

# *difference between simple and complex view*

| SIMPLE VIEW                                                                                                                              | COMPLEX VIEW                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Contains only one base table or is created from only one table, it may include WHERE clause and ORDER BY clause.                         | Contains more than one base tables or is created from more than one tables.                                               |
| We cannot use group functions like MAX(), COUNT(), etc.                                                                                  | We can use group functions.                                                                                               |
| Does not contain groups of data.                                                                                                         | It can contain groups of data.                                                                                            |
| DML operations could be performed through a simple view.                                                                                 | DML operations could not always be performed through a complex view.                                                      |
| INSERT, DELETE and UPDATE are directly possible on a simple view.                                                                        | We cannot apply INSERT, DELETE and UPDATE on complex view directly.                                                       |
| Simple view does not contain group by, having clause, limit clause, distinct, pseudo column like rownum, columns defined by expressions. | It can contain group by, having clause, limit clause, distinct, pseudocolumn like rownum, columns defined by expressions. |
| Does not include NOT NULL columns from base tables.                                                                                      | NOT NULL columns that are not selected by simple view can be included in complex view.                                    |

## *create view*

The select\_statement is a SELECT statement that provides the definition of the view. The select\_statement can select from base tables or other views.

```
CREATE [OR REPLACE] VIEW view_name [(column_list)]
AS select_statement [WITH CHECK OPTION]
```

UPDATE AND DELETE on VIEW (with check option given on view) will work only when the DATA MATCHES IN WHERE CLAUSE.

- CREATE VIEW v1 as **SELECT \* FROM** dept;
- CREATE VIEW v1(A<sub>1</sub>, A<sub>2</sub>) as **SELECT** deptno, dname **FROM** dept;
- CREATE or REPLACE VIEW v1 as **SELECT \* FROM** dept **WITH CHECK OPTION**;

```
desc INFORMATION_SCHEMA.VIEWS;
```

licence table

create view

|   | ID   | customerID | licenceClass | licenceType                                                           | licenceNumber | ValidFrom | ValidTo | agentID |
|---|------|------------|--------------|-----------------------------------------------------------------------|---------------|-----------|---------|---------|
| ▶ | 1    | 1          | LMV          | Light motor vehicles including motorcars, jeeps, taxis, delivery vans | RQFY8GZNDF9E  | *****     | *****   | 1       |
|   | 2    | 2          | LMV          | Light motor vehicles including motorcars, jeeps, taxis, delivery vans | ZFVHYH40AHGS  | *****     | *****   | 2       |
|   | 3    | 1          | HMV          | Heavy Motor Vehicles                                                  | 20CMZQ6ERXJ4  | *****     | *****   | 3       |
|   | 4    | 2          | HMV          | Heavy Motor Vehicles                                                  | DNIE1K9R5BG6  | *****     | *****   | 1       |
|   | 5    | 3          | LMV          | Light motor vehicles including motorcars, jeeps, taxis, delivery vans | Y3CNWQ6MKPCG  | *****     | *****   | 2       |
|   | 6    | 3          | HMV          | Heavy Motor Vehicles                                                  | Y6DC2IRD2EWZ  | *****     | *****   | 1       |
|   | 7    | 4          | HGMV         | Heavy Goods Motor Vehicle                                             | 2EFFSXY040AW  | *****     | *****   | 3       |
|   | 8    | 5          | HMV          | Heavy Motor Vehicles                                                  | GC1BMW KCTVQ4 | *****     | *****   | 2       |
|   | 9    | 6          | LMV          | Light motor vehicles including motorcars, jeeps, taxis, delivery vans | 2148PC50IR3P  | *****     | *****   | 1       |
|   | 10   | 7          | HPMV         | Heavy passenger motor vehicle/Heavy transport vehicle                 | N4NODNCFJENP  | *****     | *****   | 2       |
|   | 11   | 8          | HGMV         | Heavy Goods Motor Vehicle                                             | EBPW9M34FKOI  | *****     | *****   | 2       |
|   | 12   | 9          | HPMV         | Heavy passenger motor vehicle/Heavy transport vehicle                 | 940MGEL4HO00  | *****     | *****   | 3       |
|   | 13   | 10         | LMV          | Light motor vehicles including motorcars, jeeps, taxis, delivery vans | JWRDAETHDU5Z  | *****     | *****   | 1       |
|   | 14   | 11         | HGMV         | Heavy Goods Motor Vehicle                                             | Z95XCS7W9NAU  | *****     | *****   | 2       |
|   | 15   | 12         | HGMV         | Heavy Goods Motor Vehicle                                             | 1YJ12NQX8HAJ  | *****     | *****   | 1       |
|   | 16   | 13         | LMV          | Light motor vehicles including motorcars, jeeps, taxis, delivery vans | 1XMTETH8E6JS  | *****     | *****   | 1       |
|   | 17   | 14         | HPMV         | Heavy passenger motor vehicle/Heavy transport vehicle                 | 0WEMMTPVTBPM  | *****     | *****   | 2       |
| * | NULl | NULl       | NULl         | NULl                                                                  | NULl          | NULl      | NULl    | NULl    |

# all are Simple View

- CREATE or REPLACE VIEW agent1\_view AS SELECT \* FROM licence WHERE agentID = 1 ORDER BY validTo;
- CREATE or REPLACE VIEW agent2\_view AS SELECT \* FROM licence WHERE agentID = 2;
- CREATE or REPLACE VIEW agent3\_view AS SELECT \* FROM licence WHERE agentID = 3;

create user and grant/revoke  
privileges

## *create user*

TODO

`CREATE USER [IF NOT EXISTS] 'user_name' @'localhost' IDENTIFIED BY 'password'`

`SET PASSWORD FOR 'user_name'@'localhost' = 'auth_string'`

`DROP USER [IF EXISTS] 'user_name' @'localhost'`

- `CREATE USER 'saleel'@'localhost' IDENTIFIED BY 'saleel';`
- `SET PASSWORD FOR 'saleel'@'localhost' = 'sharmin';`
- `DROP USER 'saleel'@'localhost';`

# *grant/revoke privileges*

TODO

`GRANT priv_type ON object_type TO 'user_name'@'localhost'`

`REVOKE priv_type ON object_type FROM 'user_name'@'localhost'`

| Privilege        | Privilege |
|------------------|-----------|
| ALL [PRIVILEGES] | SELECT    |
| CREATE           | INSERT    |
| ALTER            | UPDATE    |
| DROP             | DELETE    |
| EXECUTE          |           |

- `GRANT ALL PRIVILEGES ON db1.* TO 'saleel'@'localhost';`
- `GRANT ALL PRIVILEGES ON *.* TO 'saleel'@'localhost';`
  
- `GRANT INSERT, UPDATE ON emp TO 'saleel';`
- `REVOKE INSERT, UPDATE ON emp FROM 'saleel';`

Try Out

*create view*

```
CREATE TABLE customer (
 ID INT PRIMARY KEY ,
 name VARCHAR(50),
 description TEXT
);
```

```
CREATE TABLE orders (
 orderID INT ,
 customerID INT,
 orderDate DATE,
 amount INT,
 constraint fk_customerID FOREIGN KEY(customerID) REFERENCES customer(ID));
```

```
INSERT INTO customer VALUES (1, 'saleel', 'description Text 1'), (2, 'vrushali', 'description Text 2'), (3, 'sharmin', 'description Text 3'), (4, 'ruhan', 'description Text 4');
```

```
INSERT INTO orders VALUES(1, 1, NOW(), 3000), (2, 1, NOW(), 1000), (3, 2, NOW(), 100), (4, 2, NOW(), 300), (5, 2, NOW(), 200);
```

- CREATE or REPLACE VIEW v1 AS SELECT \* FROM customer, orders WHERE ID = customerID;
  - CREATE or REPLACE VIEW v2 AS SELECT customer.\* FROM customer, orders WHERE ID = customerID;
  - CREATE or REPLACE VIEW v3 AS SELECT orders.\* FROM customer, orders WHERE ID = customerID;
- // We may get Error: Can not insert into join view 'db5.v1'
- ```
• INSERT INTO v1(ID, name, description, orderID, customerID, orderdate, amount) VALUES (10,'S10','D1', 10, 1, NOW(), 111); // Error: Can not modify more than one base table through a join view 'db5.v1'
```
- // We may get Error: Can not insert into join view 'db5.v2' without fields list.
- INSERT INTO v1(ID, name, description) VALUES(1, 'neel', 'description Text 5');
 - INSERT INTO v1(orderID, customerID, orderDate, amount) VALUES(1, 1, now(), 7000);
 - INSERT INTO v2(ID, name, description) VALUES(5, 'neel', 'description Text 5');
 - INSERT INTO v3(orderID, customerID, orderdate, amount) VALUES(6, 1, NOW(), 200);

SHOW CREATE VIEW Syntax

`SHOW CREATE VIEW view_name`

`show create VIEW v1;`

`SHOW [FULL] TABLES [{ FROM | IN } db_name]
[LIKE 'pattern' | WHERE expr]`

`show full tables where table_type like 'VIEW';`

alter / drop view

This statement changes the definition of a view, which must exist.

```
ALTER VIEW view_name [(column_list)]
    AS select_statement
    [WITH CHECK OPTION]
```

e.g.

- `ALTER VIEW studentview AS SELECT namefirst, namelast, emailid FROM student;`

`DROP VIEW` removes one or more views.

```
DROP VIEW [IF EXISTS]
    view_name [, view_name, ...]
```

e.g.

- `DROP VIEW studentview;`
- `DROP VIEW studentid10view, studentviewwithcheck;`
- `DROP VIEW studentTotalMarksView, studentAddressView;`

MySQL indexes (PRIMARY KEY, UNIQUE, INDEX, and FULLTEXT) are stored in B-trees.

index

- it is a schema object.
- it is used by the server to speed up the retrieval of rows.
- it reduces disk I/O(input/output) process.
- it helps to speed up select queries where clauses, but it slows down data input, with the update and the insert statements.
- it can be created or dropped with no effect on the data.
- multiple columns index may consist of up to 16 columns.

Indexes are used to find rows with specific column values quickly. Without an index, MySQL must begin with the first row and then read through the entire table to find the relevant rows. If the table has an index for the columns in question, MySQL can quickly determine the position (**from the index file**) to seek to in the middle of the data file without having to look at all the data. This is much faster than reading every row sequentially.

- To find the rows matching a WHERE clause quickly.
- If the table has a multiple-column index, any leftmost prefix of the index can be used by the optimizer to look up rows. For example, if you have a three-column index on (col1, col2, col3), you have indexed search capabilities on (col1), (col1, col2), and (col1, col2, col3).

Note:

- Index name can have max 64 char.
- It is not possible to create an INDEX on a VIEW.
- If we drop the BASE TABLE, the INDEX will be dropped automatically.

create index

Indexes are used to find rows with specific column values quickly.

```
CREATE [UNIQUE] INDEX index_name  
ON tbl_name (index_col_name, ...)
```

e.g.

- `CREATE INDEX indexOnName ON emp(ename);`
- `CREATE INDEX indexOnUniversity ON student_qualifications(university);`
- `CREATE UNIQUE INDEX uniqueIndexOnName ON emp(ename);`

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 **unique key**, MySQL creates a clustered index.
- Data retrieval is faster than non-cluster 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.
- The non-clustered index and table data are both stored in different places.
- It is not sorted (ordering) the table data.
- Extra space is required to store logical structure
- Data update is faster than clustered index

SHOW INDEX Syntax

To get the index of a table, you specify the table name after the FROM keyword. The statement will return the index information associated with the table in the current database.

```
SHOW { INDEX | INDEXES | KEYS }
```

```
  { FROM | IN } tbl_name
```

```
  [{ FROM | IN } db_name]
```

```
  [WHERE expr]
```

e.g.

- SHOW INDEX FROM emp;
- SHOW INDEX FROM student_qualifications;

SHOW INDEX returns table index information.

drop index

DROP INDEX drops the index named index_name from the table tbl_name.

DROP INDEX index_name ON tbl_name

e.g.

- **DROP INDEX indexOnName ON emp;**
- **DROP INDEX indexOnUniversity ON student_qualifications;**
- **DROP INDEX uniqueIndexOnName ON emp;**

select ... into

An INTO clause should not be used in a nested SELECT because such a SELECT must return its result to the outer context.

select ... into

The SELECT ... INTO form of SELECT enables a query result to be stored in variables or written to a file.

`SELECT ... INTO var_list`

`SELECT ... INTO OUTFILE`

`SELECT ... INTO DUMPFILE`

- Selects column values and stores them into variables.
- Writes the selected rows to a file. Column and line terminators can be specified to produce a specific output format.
- Writes a single row to a file without any formatting.

select ... into var_list

select ... into var_list

The SELECT ... INTO form of SELECT enables a query result to be stored in variables or written to a file.

`SELECT ... INTO var_list`

- The selected values are assigned to the variables.
- The number of variables must match the number of columns.
- The query should return a single row.
- If the query returns no rows, a warning with error code 1329 occurs (No data), and the variable values remain unchanged.
- If the query returns multiple rows, error 1172 occurs (Result consisted of more than one row).
- The statement may retrieve multiple rows, you can use LIMIT 1 to limit the result set to a single row.

select ... into var_list

The SELECT ... INTO form of SELECT enables a query result to be stored in variables or written to a file.

`SELECT ... INTO var_list`

- `SET @x = 0;`
`SET @y = null;`
`SELECT empno, ename INTO @x, @y FROM emp WHERE empno = 7788;`
- `SET @x = 0;`
`SET @y = null;`
`SELECT MAX(sal), MIN(sal) INTO @x, @y FROM emp WHERE empno = 7788;`

variable_name	value
secure_file_priv	C:/ProgramData/MySQL/MySQL Server 8.0/Uploads

In this example, I can only read files from the / Uploads / directory.

select ... into outfile

If not working then do changes in *my.ini* file.

```
secure_file_priv = ""  
SHOW VARIABLES LIKE "secure_file_priv";
```

select ... into outfile

Writes the selected rows to a file. Column and line terminators can be specified to produce a specific output format.

SELECT ... INTO OUTFILE

- `SELECT identifier.* FROM emp INTO OUTFILE "/tmp/emp.csv";`
 - `SELECT identifier.* FROM emp INTO OUTFILE "/tmp/emp.txt";`
 - `SELECT identifier.* FROM emp INTO OUTFILE "/tmp/emp.csv" FIELDS TERMINATED BY ',';`
 - `SELECT identifier.* FROM emp INTO OUTFILE "/tmp/emp.csv" FIELDS TERMINATED BY ',';`
 - `SELECT identifier.* FROM emp INTO OUTFILE "/tmp/emp.csv" FIELDS TERMINATED BY ',' LINES TERMINATED by '\n';`
 - `SELECT identifier.* FROM emp INTO OUTFILE "/tmp/emp.csv" FIELDS TERMINATED BY ',' OPTIONALLY ENCLOSED BY '\"'
LINES TERMINATED BY '\n';`
 - `SELECT "DEPT", "DNAME", "LOC", "PWD", "STARTEDON" UNION SELECT * FROM dept;`
-
- `TABLE emp INTO OUTFILE "/tmp/emp.csv";`
 - `TABLE emp INTO OUTFILE "/tmp/emp.txt";`

select ... into dumpfile

select ... into dumpfile

If you use INTO DUMPFILE instead of INTO OUTFILE, MySQL writes only one row into the file, without any column or line termination and without performing any escape processing. This is useful if you want to store a BLOB value in a file.

SELECT ... INTO DUMPFILE

- `SELECT identifier.* FROM emp WHERE empno = 7788 INTO DUMPFILE "/tmp/emp.txt";`

- mysql dump -uroot -p db1 >> d:\bk.sql
 - mysql dump -u[username] -p[password] --all-databases > d:\db_backup.sql
 - mysql dump -P 3306 -h 192.168.100.26 -usaleel -psaleel db_name > db_backup.sql
 - mysql dump -P 3306 -h 192.168.100.26 -usaleel -psaleel db_name table_name > db_backup.sql
 - mysql dump -P 3306 -h 192.168.100.26 -usaleel -psaleel db_name table_name --WHERE ="deptno=10" > db_backup.sql
 - mysql dump -P 3306 -h 192.168.100.26 -usaleel -psaleel db_name table_name --WHERE ="job='manager'" > db_backup.sql
 - mysql dump --column-statistics=0 -P 3306 -h 192.168.100.26 -usaleel -psaleel db_name > db_backup.sql
 - mysql -P 3306 -h 192.168.100.74 -uroot -p root db2 < d:\ backup_fileName.sql
 - mysql -P 3306 -h 192.168.100.74 -uroot -p root < d:\ backup_fileName.sql db2
-

snapshots

To create a raw data snapshot of MyISAM tables, you can use standard copy tools such as cp or copy, a remote copy tool such as scp or rsync, an archiving tool such as zip or tar, or a file system snapshot tool such as dump, providing that your MySQL data files exist on a single file system. If you are replicating only certain databases, copy only those files that relate to those tables.

CountryName,CapitalName,CapitalLatitude,CapitalLongitude,CountryCode,ContinentName,remark
Somaliland,Hargeisa,9.55,44.05,NULL,Africa,
South Georgia and South Sandwich Islands,King Edward Point,-54.283333,-36.5,GS,Antarctica,
French Southern and Antarctic Lands,Port-aux-Français,-49.35,70.216667,TF,Antarctica,
Palestine,Jerusalem,31.7666667,35.233333,PS,Asia,
Aland Islands,Mariehamn,60.116667,19.9,AX,Europe,
Nauru,Yaren,-0.5477,166.920867,NR,Australia,
Saint Martin,Marigot,18.0731,-63.0822,MF,North America,
Tokelau,Atafu,-9.166667,-171.833333,TK,Australia,
Western Sahara,El-Aaiún,27.153611,-13.203333,EH,Africa,

load data infile "D:\abc1.csv" into table a fields terminated by ","
ignore 1 rows (id,name,@dt) SET dt =
STR_TO_DATE(@dt,"%d-%m-%Y");

import .csv / .tsv file

```
CREATE TABLE countries (
    CountryName VARCHAR(45),
    CapitalName VARCHAR(45),
    CapitalLatitude VARCHAR(45),
    CapitalLongitude VARCHAR(45),
    CountryCode VARCHAR(45),
    ContinentName VARCHAR(45),
    remark VARCHAR(45)
);
```

```
LOAD DATA INFILE 'path/file-name.csv' INTO TABLE countries
FIELDS TERMINATED BY ',' or FIELDS TERMINATED BY '\t'
LINES TERMINATED BY '\n'
IGNORE 1 ROWS;
```

- ```
SELECT "DEPT", "DNAME", "LOC", "PWD", "STARTEDON" UNION
SELECT * FROM dept;
```

## *Import .CSV file with dateFormat*

moduleId,moduleName,duration,startedON

```
1,OracleCR,6 months,23-10-2022
2,PIG,2 months,12-10-2022
3,Neo4j,4 months,20-10-2022
4,Cassandra,7 months,03-10-2022
5,HIVE,3 months,09-10-2022
6,MongoDB,2 months,25-10-2022
7,Redis,1 months,06-10-2022
```

```
CREATE TABLE module (
moduleId INT,
moduleName VARCHAR(45),
duration VARCHAR(45),
startedON DATE
);
```

```
LOAD DATA INFILE 'path/file-name.csv' INTO TABLE module
FIELDS TERMINATED BY ','
LINES TERMINATED BY '\n'
IGNORE 1 ROWS
(moduleId,modulename,moduleDuration,@startedOn)
SET startedOn = STR_TO_DATE(@startedOn,'%d-%m-%Y')
;
```

# cluster

A cluster comprises multiple interconnected computers or servers that appear as if they are one server to end users and applications.

# data dictionary

A data dictionary contains metadata i.e data about the database. The data dictionary is very important as it contains information such as what is in the database, who is allowed to access it, where is the database physically stored etc. The users of the database normally don't interact with the data dictionary, it is only handled by the database administrators.

The data dictionary in general contains information about the following –

- Names of all the database tables and their schemas.
- Details about all the tables in the database, such as their owners, their security constraints, when they were created etc.
- Physical information about the tables such as where they are stored and how.
- Table constraints such as primary key attributes, foreign key information etc.
- Information about the database views that are visible.

# *data dictionary - information\_schema*

## Data Dictionary

INFORMATION\_SCHEMA.COLUMNS

INFORMATION\_SCHEMA.TABLES

INFORMATION\_SCHEMA.TABLE\_CONSTRAINTS

INFORMATION\_SCHEMA.STATISTICS

INFORMATION\_SCHEMA.KEY\_COLUMN\_USAGE

INFORMATION\_SCHEMA.ROUTINES

INFORMATION\_SCHEMA.PARAMETERS

INFORMATION\_SCHEMA.TRIGGERS

**Class Room**

# **Session 1**

# pl/sql

PL/SQL is a procedural language extension to Structured Query Language (SQL). The purpose of PL/SQL is to combine database language and procedural programming language.

## Note:

- Statements that return a **result set** can be used within a STORED PROCEDURE but **not** within a STORED FUNCTION. This prohibition includes **SELECT** statements that do not have an **INTO var\_list** clause.
- DDL statements, such as **CREATE**, **ALTER**, and **DROP** etc. are permits STORED PROCEDURES, (**but not in** STORED FUNCTIONS).
- ERROR 1314 (0A000): USE command is not allowed in stored procedures
- Stored PROCEDURES and FUNCTIONS name can have max 64 char.

## create procedure and create function

- GRANT EXECUTE ON [ PROCEDURE | FUNCTION ] object\_name **TO** user;
- REVOKE EXECUTE ON [ PROCEDURE | FUNCTION ] object\_name **FROM** user;
- SHOW **CREATE PROCEDURE** <routine\_name>
- SHOW **CREATE FUNCTION** <routine\_name>

# *stored procedure and function*

These statements create stored routines. By default, a routine is associated with the default database. To associate the routine explicitly with a given database, specify the name as db\_name.sp\_name when you create it.

`CREATE PROCEDURE sp_name ([proc_parameter[,...]])`

`proc_parameter:`

`[ IN | OUT | INOUT ] param_name type`

`CREATE FUNCTION sp_name ([func_parameter[,...]])`

`RETURNS type`

`DETERMINISTIC`

`DROP PROCEDURE IF EXISTS procedurename;`  
delimiter \$\$

`CREATE PROCEDURE procedurename()`  
`begin`

`statements.....`

`end $$`

`delimiter ;`

`SELECT * FROM information_schema.parameters  
WHERE SPECIFIC_NAME = 'pro1';`

`desc mysql.proc`

`DROP FUNCTION IF EXISTS functionname;  
delimiter $$  
CREATE FUNCTION functionname() RETURNS INT  
DETERMINISTIC  
begin  
statements.....  
return (something);  
end $$  
delimiter ;`

**Parameter:** Is an unknown thing. Means it exists but don't know it.

e.g. Blood sugar it exists but we don't know it.

*proc\_parameter - out | inout param-name type*

TODO.

`CREATE PROCEDURE sp_name ([proc_parameter[,...]])`

`proc_parameter:`

`[ IN | OUT | INOUT ] param_name type`

### Note:

- For each **OUT** or **INOUT** parameter, pass a user-defined variable in the **CALL** statement that invokes the **PROCEDURE**. So that you can obtain its value when the **PROCEDURE** returns.
- If you are calling the **PROCEDURE** from within another stored **PROCEDURE** or **FUNCTION**, you can also pass a routine parameter or local routine variable as an **OUT** or **INOUT** parameter.

A parameter is a variable in a method definition. When a method is called, the arguments are the data you pass into the method's parameters. Parameter is variable in the declaration of function. Argument is the actual value of this variable that gets passed to function.

## difference between arguments and parameters?

- **Parameter** is variable in the declaration of *procedure* or a *function*.
- **Argument** is the actual value of this variable that gets passed to a *procedure* or a *function*.

# *stored procedure and function*

Parameter List

```
CREATE PROCEDURE EMPLOYEE(ID INT)
BEGIN
 SELECT * FROM EMP WHERE EMPNO = ID;
END;
```

Argument List

```
CALL EMPLOYEE(7788);
```

difference between stored  
procedure and function?

## *stored procedure and function*

- A FUNCTION always returns a value using the return statement. PROCEDURE may return one or more values through OUT parameter(s) or may not return any at all.
- FUNCTIONS are normally used for computations whereas PROCEDURES are normally used for executing business logic.
- A FUNCTION returns 1 value only. PROCEDURE can return multiple values (max 1024).
- A FUNCTION can be called directly by SQL statement like select func\_name from dual while PROCEDURES cannot.
- A FUNCTION does not allow the use of DDL statements (like: CREATE, ALTER, DROP etc.) while PROCEDURE can.

The major difference is that UDFs can be used like any other expression within SQL statements, whereas stored procedures must be invoked using the CALL statement.

### Note:

- MySQL permits routines to contain DDL statements, such as CREATE, ALTER and DROP in **stored procedure**,
- but DDL statements, such as CREATE, ALTER and DROP are not permitted in **stored function**.

# *calling procedure from function and contrariwise*

- DROP FUNCTION IF EXISTS F1;

delimiter \$\$

CREATE FUNCTION F1() returns VARCHAR(100)

DETERMINISTIC

begin

declare x VARCHAR(100) default 'Hello World';

# SELECT "Hello World";

call p1(x);

return x;

end \$\$

delimiter ;



# ERROR 1415 (0A000): Not allowed to  
return a result set from a function

- DROP PROCEDURE IF EXISTS P1;

delimiter \$\$

CREATE PROCEDURE P1(OUT para1 VARCHAR(100))

begin

# SELECT "Hello World123";



# ERROR 1415 (0A000): Not allowed to  
return a result set from a function

SELECT "Hello World123" INTO para1;

end \$\$

delimiter ;



This will work

source and call stored procedure

## *source and call stored procedure*

If you are already running mysql, you can execute an SQL script file using the **source** command or **\.** command

`source file_name.sql`

`\. file_name.sql`

```
MySQL> source pl1.sql;
MySQL> \. file_name.sql;
```

The CALL statement invokes a stored procedure that was defined previously with CREATE PROCEDURE. Stored procedures that take no arguments can be invoked without parentheses. That is, CALL sp\_name and CALL sp\_name() are equivalent.

`CALL sp_name([parameter[,...]])`

`CALL sp_name[()]`

```
MySQL> call sp_name;
MySQL> call sp_name();
```

## *delimiter - statement*

By default, mysql itself recognizes the semicolon as a statement delimiter, so you must redefine the delimiter temporarily to cause mysql to pass the entire stored program definition to the server. To redefine the mysql delimiter, use the delimiter command.

```
DROP PROCEDURE IF EXISTS procedurename;
delimiter $$
CREATE PROCEDURE procedurename()
begin
 statements.....
end $$
delimiter ;
```

```
DROP FUNCTION IF EXISTS functionname;
delimiter $$
CREATE FUNCTION functionname() RETURNS INT
DETERMINISTIC
begin
 statements.....
 return (something);
end $$
delimiter ;
```

# begin ... end compound-statement

A compound statement is a block that can contain:

- other blocks
- declarations of variables
- declarations of cursors
- declarations of exception handlers
- compound statements
- flow control constructs such as loops and conditional tests.

# *begin ... end*

BEGIN ... END syntax is used for writing compound statements, which can appear within stored programs (stored procedures and functions, triggers, and events). A compound statement can contain multiple statements, enclosed by the BEGIN and END keywords. statement\_list represents a list of one or more statements, each terminated by a semicolon (;) statement delimiter. The statement\_list itself is optional, so the empty compound statement (BEGIN END) is legal.

[begin\_label:] BEGIN

[statement\_list]

....

....

....

END [end\_label]

- DROP PROCEDURE IF EXISTS procedurename;  
delimiter \$\$  
CREATE PROCEDURE procedurename()  
begin  
    declare x BOOL default false;  
    begin  
        declare y BOOL default true;  
        SELECT x;  
    end ;  
    SELECT y;  
end \$\$  
delimiter ;

**DECLARE** variable\_name datatype(size) [ **DEFAULT** default\_value ];

1. declare x INT DEFAULT 0;  
SET x := 10;
2. declare y INT;  
SET y := 10;
3. **SET x := (SELECT 1001)**

**Declaring  
variables**

**DECLARE** variable\_name datatype(size)

**Assigning variables**

- 1 **DECLARE z INT;**
- 2 **SET z = 10;**

# declare variables

## Note:

- **DECLARE** is permitted only inside a **BEGIN ... END** compound statement and must be at its start, before any other statements.
- Only scalar values can be assigned. For example, a statement such as **SET x = (SELECT 1, 2)** **is invalid**.

## Remember:

- First, you specify the variable name after the **DECLARE** keyword. The variable name must follow the naming rules of MySQL table column names.
- Second, you specify the data type of the variable and its size. A variable can have any MySQL data types such as **INT**, **VARCHAR**, and **DATETIME**.
- Third, when you declare a variable, its initial value is **NULL**. You can assign the variable a default value using the **DEFAULT** keyword.

## *local variable declare*

### Remember:

- A local variable takes precedence over a routine parameter or table column.
- A routine parameter takes precedence over a table column.

| C1 | C2 |
|----|----|
| 7  | 7  |

- ```
DROP PROCEDURE IF EXISTS pro1;
delimiter $
CREATE PROCEDURE pro1 (c1 INT)
begin
    declare c1 INT default 0;
    SELECT c1 FROM x;
end $
delimiter ;
```

```
mysql> CALL pro1(12);
```

local variable declare and user-defined variables

Local variables are declared within stored procedures and are only valid within the BEGIN...END block where they are declared. Local variables can have any SQL data type.

`DECLARE var_name [, var_name] ... type [DEFAULT value]`

User variables in MySQL stored procedures, user variables are referenced with an ampersand (@) prefixed to the user variable name.

`SET @var_name = expr [, @var_name = expr] ...`

- `DROP PROCEDURE IF EXISTS procedurename;
delimiter $$
CREATE PROCEDURE procedurename()
begin
declare x VARCHAR(12) default 'Infoway';
SELECT x;
end $$
delimiter ;`
- `DROP PROCEDURE IF EXISTS procedurename;
delimiter $$
CREATE PROCEDURE procedurename()
begin
set @x = 'Infoway';
SELECT @x;
end $$
delimiter ;`

local variable declare and user-defined variables

Local variables are declared within stored procedures and are only valid within the BEGIN...END block where they are declared. Local variables can have any SQL data type.

`DECLARE var_name [, var_name] ... type [DEFAULT value]`

User variables in MySQL stored procedures, user variables are referenced with an ampersand (@) prefixed to the user variable name.

`SET @var_name = expr [, @var_name = expr] ...`

- `DROP PROCEDURE IF EXISTS procedurename;`
`delimiter $$`
`CREATE PROCEDURE procedurename(x INT)`
`begin`
`SET x:=(SELECT 1001);`
`SET @y := (SELECT 2001);`
`end $$`
`delimiter ;`
- `DROP FUNCTION IF EXISTS functionname;`
`delimiter $$`
`CREATE PROCEDURE functionname(x INT) RETURNS INT`
`begin`
`SET x := (SELECT 1002);`
`SET @y := (SELECT 2002);`
`return(x);`
`end $$`
`delimiter ;`

local variable declare

Local variables are declared within stored procedures and are only valid within the BEGIN...END block where they are declared. Local variables can have any SQL data type.

DECLARE var_name [, var_name] ... type [DEFAULT value]

- DROP PROCEDURE IF EXISTS procedurename;

delimiter \$\$

CREATE PROCEDURE procedurename()

begin

declare x VARCHAR(20);

set x = 'Hello World';

SELECT x;

end \$\$

delimiter ;

local variable declare

- ```
DROP PROCEDURE IF EXISTS procedurename;
delimiter $$

CREATE PROCEDURE procedurename()
begin
 declare a INT default 10;
 declare b, c INT;
 set a = a + 100;
 set b = 2;
 set c = a + b;
 begin
 declare c INT;
 set c = 5;
 SELECT a, b, c;
 end;
 SELECT a, b, c;
end $$

delimiter ;
```

# delimiter problem

- ```
DROP PROCEDURE IF EXISTS procedurename;
delimiter$$
CREATE PROCEDURE procedurename(OUT para1 VARCHAR(100))
begin
    SELECT "Hello World123" INTO para1;
end $$
```

 delimiter;

if and loop label

if and loop

```
IF search_condition THEN statement_list  
    [ELSEIF search_condition THEN statement_list] ...  
    [ELSE statement_list]  
END IF
```

ITERATE means "start the loop again."

LEAVE statement is used to exit the flow control construct that has the given label.

```
[begin_label:] LOOP  
    statement_list  
END LOOP [end_label]
```

ITERATE label

LEAVE label

if

```
IF search_condition THEN statement_list  
[ELSEIF search_condition THEN statement_list] ...  
[ELSE statement_list]  
END IF
```

e.g.

```
DROP PROCEDURE IF EXISTS procedurename;  
delimiter $$  
CREATE PROCEDURE procedurename(v_value INT)  
begin  
if v_value = 0 then  
    SELECT 'The enter value is 0' as "Message Box";  
elseif v_value = 1 THEN  
    SELECT 'The enter value is 1' as "Message Box";  
else  
    SELECT 'The enter value is neither 0 or 1' as "Message Box";  
end if;  
end $$  
delimiter ;
```

loop

```
[begin_label:] LOOP  
    statement_list  
END LOOP [end_label]
```

- ITERATE label
- LEAVE label

e.g.

```
DROP PROCEDURE IF EXISTS procedurename;  
delimiter $$  
CREATE PROCEDURE procedurename(v_value INT)  
begin  
    declare x INT default 0;  
    lbl:loop  
        set x = x + 1;  
        SELECT x;  
        if x = v_value then  
            leave lbl;  
        end if;  
    end loop lbl;  
end $$  
delimiter ;
```

ITERATE means "start the loop again."

LEAVE statement is used to exit the flow control construct that has the given label.

A procedure is a group of PL/SQL statements that you can call by name.

stored procedure

A procedure is a group of PL/SQL statements that you can call by name.

Remember:

- It is **not permitted** to assign the value DEFAULT to stored PROCEDURE or FUNCTION parameters
e.g.
`PROCEDURE procedurename(IN p_ID INT DEFAULT 10)`
- Or stored program local variables
e.g.
`SET var_name = DEFAULT some_value.`

stored procedure - examples

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename()`

`begin`

`SELECT * FROM emp;`

`end $$`

`delimiter ;`

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename()`

`begin`

`declare x VARCHAR(12);`

`SELECT ename INTO x FROM emp WHERE empno = 7788;`

`SELECT x;`

`end $$`

`delimiter ;`

stored procedure - examples

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename(IN para1 INT)`

`begin`

`declare x VARCHAR(12);`

`SELECT ename INTO x FROM emp WHERE empno = para1;`

`SELECT x;`

`end $$`

`delimiter ;`

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename(IN para1 VARCHAR(15))`

`begin`

`declare x VARCHAR(12);`

`SELECT job INTO x FROM emp WHERE ename = para1;`

`SELECT x;`

`end $$`

`delimiter ;`

stored procedure - examples

- DROP PROCEDURE IF EXISTS procedurename;

delimiter \$\$

CREATE PROCEDURE procedurename(**IN** para1 VARCHAR(12))

begin

 SELECT * FROM emp WHERE job = para1;

end \$\$

delimiter ;

- DROP PROCEDURE IF EXISTS procedurename;

delimiter \$\$

CREATE PROCEDURE procedurename(**IN** para1 VARCHAR(12), **OUT** s INT, **OUT** j VARCHAR(12))

begin

 SELECT para1, SUM(Sal) INTO varJob, varSumSal FROM emp WHERE job = para1;

end \$\$

delimiter ;

stored procedure - examples

- DROP PROCEDURE IF EXISTS procedurename;

delimiter \$\$

CREATE PROCEDURE procedurename(**IN** para1 VARCHAR(12))

begin

if (SELECT true FROM dept WHERE deptno = x) then

 SELECT * FROM emp WHERE deptno = x;

else

 SELECT "Data Not Found";

end if;

end \$\$

delimiter ;

stored procedure - examples

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename(IN p1 INT(2), IN p2 VARCHAR(12), IN p3 VARCHAR(10), IN p4 VARCHAR(20))`

`begin`

`INSERT into DEPT values (p1, p2, p3, p4);`

`end $$`

`delimiter ;`

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE myprocedure (INOUT p1 INT(2))`

`begin`

`set p1 = p1+2;`

`end $$`

`delimiter ;`

`mysql> SET @x = 10`

`mysql> CALL procudeureName(@x);`

`mysql> SELECT @x`

stored procedure - examples

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename()`

`begin`

`CREATE TABLE temp (IN col1 INT);`

`end $$`

`delimiter ;`

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename(IN v1 INT, IN v2 VARCHAR(20), IN v3 VARCHAR(20), IN v4 VARCHAR(20))`

`begin`

`INSERT INTO dept VALUES (v1, v2, v3, v4);`

`end $$`

`delimiter ;`

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename(IN var1 INT)`

`begin`

`SELECT * FROM emp LIMIT var1;`

`end $$`

`delimiter ;`

stored procedure - examples

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename()`

`begin`

`CREATE TABLE temp (col1 INT);`

`end $$`

`delimiter ;`

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename()`

`begin`

`#CREATE TABLE temp (col1 INT);`

`#ALTER TABLE temp ADD col2 INT;`

`#DROP TABLE temp;`

`end $$`

`delimiter ;`

stored procedure - examples

- ```
DROP PROCEDURE IF EXISTS procedurename;
delimiter $$

CREATE PROCEDURE procedurename()
begin
 declare exit handler for 1146 CREATE TABLE abc(id INT, ename VARCHAR(20));
 SELECT * FROM abc;
end $$

delimiter ;
```

## *stored procedure - examples*

- `DROP PROCEDURE IF EXISTS procedurename;`  
`delimiter $$`  
`CREATE PROCEDURE procedurename(IN x INT, IN y INT, OUT z INT, OUT z1 INT )`  
`begin`  
    `set z = x + y;`  
    `set z1 = x * y;`  
`end $$`  
`delimiter ;`

---

```
mysql> SET @a := 0;
mysql> SET @b := 0;
mysql> CALL pro1(5, 4, @a, @b);
```

*dynamic stored procedure*

prepared sql statement

## *prepared sql statement*

The PREPARE statement prepares a SQL statement and assigns it a name, stmt\_name. The prepared statement is executed with EXECUTE and released with DEALLOCATE PREPARE.

PREPARE stmt\_name FROM preparable\_stmt

EXECUTE stmt\_name  
[ USING @var\_name [, @var\_name ] . . . ]

{ DEALLOCATE | DROP } PREPARE stmt\_name

```
SET @skip=1; SET @numrows=5;
PREPARE STMT FROM 'SELECT * FROM table_name LIMIT ?, ?';
EXECUTE STMT USING @skip, @numrows;
```

# *prepared sql statement*

## Example of prepared statement

- PREPARE STMT FROM 'SELECT \* FROM emp';  
EXECUTE STMT;
- SET @x := 'SELECT \* FROM emp WHERE deptno = 10';  
PREPARE STMT FROM @x;  
EXECUTE STMT;
- SET @x:=10;  
PREPARE STMT FROM 'SELECT \* FROM emp WHERE deptno = ?';  
EXECUTE STMT USING @x;
- SET @x:=10, @y := 3000;  
PREPARE STMT FROM 'SELECT \* FROM emp WHERE deptno = ? and sal >= ?';  
EXECUTE STMT USING @x, @y;
- DEALLOCATE PREPARE stat1;

# *dynamic stored procedure - examples*

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename(table_name VARCHAR(10))`

`begin`

`set @t1 = CONCAT('SELECT * FROM ', table_name );`

`PREPARE STMT FROM @t1;`

`EXECUTE STMT;`

`end $$`

`delimiter ;`

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $$`

`CREATE PROCEDURE procedurename(c1 VARCHAR(10), x VARCHAR(10))`

`begin`

`set @t1 = CONCAT('SELECT ', c1 , ' FROM ',x );`

`PREPARE STMT FROM @t1;`

`EXECUTE STMT;`

`end $$`

`delimiter ;`

## *dynamic stored procedure - examples*

- `DROP PROCEDURE IF EXISTS procedurename;`

`delimiter $`

```
CREATE PROCEDURE procedurename(in _DEPTNO INT, _DNAME VARCHAR(20), _LOC VARCHAR(20), _PWD
VARCHAR(20))
```

`begin`

```
set @a := _DEPTNO;
```

```
set @b := _DNAME;
```

```
set @c := _LOC;
```

```
set @d := _PWD;
```

```
set @x:= concat("INSERT INTO dept VALUES(?, ?, ?, ?)");
```

```
PREPARE STMT FROM @x;
```

```
EXECUTE STMT USING @a, @b, @c ,@d;
```

`end $`

`delimiter ;`

A DETERMINISTIC function always returns the same result for the same input parameters whereas a non-deterministic function returns different results for the same input parameters. If you don't use DETERMINISTIC or NOT DETERMINISTIC , MySQL uses the NOT DETERMINISTIC option by default.

```
SET GLOBAL log_bin_trust_function_creators = 1;
```

# functions

The RETURNS clause may be specified *only for a FUNCTION*, for which it is mandatory. It indicates the return type of the function, and the function body must contain a RETURN value statement.

## Note:

- By default, all parameters are IN parameters.
- You cannot specify IN, OUT or INOUT modifiers to the parameters.
- It is possible to create a stored function with the same name as a built-in function, but to invoke the stored function it is necessary to qualify it with a schema name.

# *user defined function*

## Remember:

- It is possible to create a stored function with the same name as a built-in function, but to invoke the stored function it is necessary to qualify it with a schema name.  
e.g. `SELECT db1.length();`
- ERROR 1415 (0A000): Not allowed to return a result set from a function  
e.g.  
`SELECT "Hello World"; // will not work in FUNCTION`  
`SELECT "Hello World" INTO x; // will work in FUNCTION`
- ERROR 1336 (0A000) : **Dynamic SQL** is not allowed in **stored function or trigger**.
- ERROR 1422 (HY000) : **EXPLICIT** or **IMPLICIT** commit is not allowed in **stored function or trigger**.

# *user defined function - examples*

- DROP FUNCTION IF EXISTS functionname;  
delimiter \$\$  
CREATE FUNCTION functionname() RETURNS INT  
DETERMINISTIC  
begin  
declare x INT;  
set x = 1001;  
return (x);  
end \$\$  
delimiter ;
- DROP FUNCTION IF EXISTS functionname;  
delimiter \$\$  
CREATE FUNCTION functionname(para1 VARCHAR(12)) RETURNS INT  
DETERMINISTIC  
begin  
declare total INT default 0;  
SELECT SUM(sal) INTO total FROM emp WHERE job=para1;  
return (total);  
end \$\$  
delimiter ;

## *user defined function - examples*

- `DROP FUNCTION IF EXISTS functionname;`  
`delimiter $$`  
`CREATE FUNCTION functionname() RETURNS INT`  
`DETERMINISTIC`  
`begin`  
    `return (SELECT MAX(deptno) + 1 FROM dept);`  
`end $$`  
`delimiter ;`
- `DROP FUNCTION IF EXISTS functionname;`  
`delimiter $$`  
`CREATE FUNCTION functionname() RETURNS INT`  
`DETERMINISTIC`  
`begin`  
    `return CONCAT(UPPER(LEFT(x,1)), SUBSTR(LOWER(x), 2 ));`  
`end $$`  
`delimiter ;`

# *user defined function - examples*

- `DROP FUNCTION IF EXISTS functionname;`

`delimiter $`

`CREATE FUNCTION functionname() RETURNS VARCHAR(40)`

`deterministic`

`begin`

`declare x, y, z VARCHAR(40) default "";`

`declare cnt INT default 1;`

`lbl:loop`

`SELECT CAST(CHAR(FLOOR(65 + RAND() * 27)) as CHAR) INTO y;`

`SELECT CAST(CHAR(FLOOR( 97 + RAND() * 27)) as CHAR) INTO z;`

`SET x := CONCAT(x, y, z);`

`if cnt > 2 then`

`leave lbl;`

`end if;`

`SET cnt := cnt + 1;`

`end loop lbl;`

`return(x);`

`end $`

`delimiter ;`

# *user defined function - examples*

- `DROP FUNCTION IF EXISTS functionname;`

`delimiter $$`

`CREATE FUNCTION functionname(xx INT) RETURNS VARCHAR(50)`

`DETERMINISTIC`

`begin`

`declare x BOOL;`

`SELECT True INTO x FROM emp WHERE empno = xx;`

`if x then`

`return (SELECT CONCAT(ename, " ", job, " ", sal) FROM emp WHERE empno = xx);`

`else`

`return "deptno is not valid";`

`end if;`

`end $$`

`delimiter ;`

## *user defined function - examples*

- `DROP FUNCTION IF EXISTS functionname;`  
`delimiter $$`  
`CREATE FUNCTION functionname(no INT) RETURNS VARCHAR(20)`  
`DETERMINISTIC`  
`begin`  
`declare x VARCHAR(20);`  
`SELECT distinct 'Number present' INTO x FROM t1 WHERE c1 = no;`  
`if x is not null then`  
`return(x);`  
`else`  
`return(no);`  
`end if;`  
`end $$`  
`delimiter ;`

- **DROP FUNCTION IF EXISTS** functionname;

delimiter \$

**CREATE FUNCTION** functionname(x **VARCHAR(1000)**) **RETURNS** **VARCHAR(1000)**

**DETERMINISTIC**

**begin**

declare y **INT** default 0;

declare z **VARCHAR(1000)** default " ";

lbl:loop

set y := y+1;

set z := TRIM(CONCAT( z, SUBSTR( x, y, 1 ), ' ' ));

if y >= LENGTH(x) then

  leave lbl;

end if;

end loop lbl;

**return** (SUBSTR( z, 1, LENGTH( z ) - 1 ));

**end** \$

delimiter ;

- **DROP FUNCTION IF EXISTS** functionname;

delimiter \$

**CREATE FUNCTION** functionname( x **VARCHAR**(1000)) **RETURNS** **VARCHAR**(1000)

**DETERMINISTIC**

**begin**

declare y **INT** default 0;

declare z **VARCHAR**(1000) default " ";

lbl:loop

set y := y+1;

if ASCII(SUBSTR( x, y, 1 )) NOT BETWEEN 48 AND 57 then

    set z := CONCAT( z, SUBSTR( x, y, 1 ));

end if;

if y > LENGTH(x) then

    leave lbl;

end if;

end loop lbl;

**return** (SUBSTR(TRIM(z),1, LENGTH(z)));

**end** \$

delimiter ;

- **DROP FUNCTION IF EXISTS** functionname;

delimiter \$

**CREATE FUNCTION** functionname( x **VARCHAR**(1000) ) **RETURNS** **VARCHAR**(1000)

**DETERMINISTIC**

**begin**

declare y **INT** default 0;

declare z **VARCHAR**(1000) default " ";

lbl:loop

set y := y+1;

if ASCII(SUBSTR( x, y, 1 )) NOT BETWEEN 65 AND 90 and ASCII(SUBSTR( x, y, 1 )) not between 97 AND 122 then

    set z := CONCAT( z, SUBSTR( x, y, 1 ));

end if;

if y > LENGTH(x) then

    leave lbl;

end if;

end loop lbl;

return (SUBSTR(TRIM(z),1, LENGTH(z)));

**end** \$

delimiter ;

# *user defined function with cursor - examples*

- `DROP FUNCTION IF EXISTS functionname;`

`delimiter $`

`CREATE FUNCTION functionname() RETURNS VARCHAR(10000)`

`DETERMINISTIC`

`begin`

`declare x, y VARCHAR(100);`

`declare z VARCHAR(10000) default "";`

`declare c1 CURSOR for SELECT deptno, dname FROM dept ORDER BY deptno DESC;`

`declare exit handler for 1329 return z;`

`open c1;`

`lbl:loop`

`fetch c1 into x, y;`

`set z := concat(x, " ", y, " ", "\n ", z);`

`end loop lbl;`

`end $`

`delimiter ;`

## *user defined function - examples*

- `DROP FUNCTION IF EXISTS functionname;`

`delimiter $$`

`CREATE FUNCTION functionname() RETURNS VARCHAR(20)`

`DETERMINISTIC`

`begin`

`#CREATE TABLE temp (col1 INT);`

`#ALTER TABLE temp ADD col2 INT;`

`#DROP TABLE temp;`

`return "done";`

`end $$`

`delimiter ;`

**ERROR 1422 (HY000): Explicit or implicit commit is not allowed in stored function or trigger.**