

Introduction to DBMS

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Agenda

- Introduction to DBMS and RDBMS
- Key attributes
- Introduction to SQL
 - Data Types
- SQL Commands
 - DDL
 - DML
 - DQL
 - Select Statements

What is DBMS?

- DBMS stand for Database Management Systems
- These are systems to store, retrieve or ,sometimes, manipulate data
- Developed to handle large amount of data

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Why DBMS?

- Consider a bank that maintains customer's account details, employee details, bank device details, etc.
- This details needs to be stored in such a way that it can be added, deleted, updated and retrieved from one place
- DBMS is a software designed for this type of operations

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RDBMS

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What is RDBMS?

- RDBMS stand for Relational Database Management Systems
- RDBMS allows to store, retrieve or manipulate data, but in a more efficient way than DBMS
- Apart from rows and columns the RDBMS table has following components
 - Domain
 - Instance
 - Schema
 - Keys

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A database table

- A database consists of one or more tables
- A table is the most significant component in an RDBMS
- A table is where all data is stored
- A table constitutes of rows & columns
- Each column represents attributes of the entity

First Name	Last Name	Address	City	Age
Mickey	Mouse	123 Fantasy Way	Anaheim	73
Bat	Man	321 Cavern Ave	Gotham	54
Wonder	Woman	987 Truth Way	Paradise	39
Donald	Duck	555 Quack Street	Mallard	65
Bugs	Bunny	567 Carrot Street	Rascal	58
Wiley	Coyote	999 Acme Way	Canyon	61
Cat	Woman	234 Purrfect Street	Hairball	32
Tweety	Bird	543	Itotltaw	28

A record in a table

- Each row in a table is a record/tuple
- Each record is all of the information for each object, say a person or a product

First Name	Last Name	Address	City	Age
Mickey	Mouse	123 Fantasy Way	Anaheim	73
Bat	Man	321 Cavern Ave	Gotham	54
Wonder	Woman	987 Truth Way	Paradise	39
Donald	Duck	555 Quack Street	Mallard	65
Bugs	Bunny	567 Carrot Street	Rascal	58
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A column in a table

- Each column in a table is an attribute
- This gives one piece of information about the attribute. For example, last name of a customer

First Name	Last Name	Address	City	Age
Mickey	Mouse	123 Fantasy Way	Anaheim	73
Bat	Man	321 Cavern Ave	Gotham	54
Wonder	Woman	987 Truth Way	Paradise	39
Donald	Duck	555 Quack Street	Mallard	65
Bugs	Bunny	567 Carrot Street	Rascal	58
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Keys

- A key is a data item (a column or a set of column) to uniquely identify a record in a table
- It is used to fetch a single or a set of records from a table
- Keys can also provide several types of useful constraints. For example, a unique key constraint can help avoid enter a duplicate value

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Keys

A database supports various types of keys. Some of them are

- Candidate key
- Primary key
- Foreign key
- Unique key
- Alternate key

Keys

- Candidate key: An attribute (column) of a set of attributes that uniquely identifies a record
 - eg.: Customer ID + Store ID + Location ID in a customer transaction table
- Primary key: Identifies each record in a table and must never be the same for 2 records in a table
 - eg..: Customer ID identifying a customer uniquely in a customer table

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Difference between Candidate Key and Primary Key



Candidate Key

Candidate Key can be any column or a combination of columns that can qualify as unique key in database

There can be multiple Candidate Keys in one table. Each Candidate Key can qualify as Primary Key.

Primary Key

A Primary Key is a column or a combination of columns that uniquely identify a record

There is only one Primary Key in a table

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Keys

- Foreign key: Foreign keys are the columns of a table that points to the primary key of another table
 - eg.: CustomerID in customer transaction table points to the CustomerID in the customer tables

Keys

- Alternate key: An alternate key is a candidate key that is not considered as a primary key
 - eg.: Store Name + Store Location in a store information table
- Unique key: An attribute or a set of attributes to uniquely identify a record in a table. This is similar to a primary key but can contain a null value.
 - eg.: Store Name in a store information table

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Domain

- A domain is a set of values that an attribute can take
- An attribute would not accept any value outside of its domain
- For example, in a bank customer table, the field "account_no" will only accept integer values if you give the domain of the field as integer
- Apart from data type, you can set constraints to the attributes as well
- Such combination of constraints are known as Domain Constraints

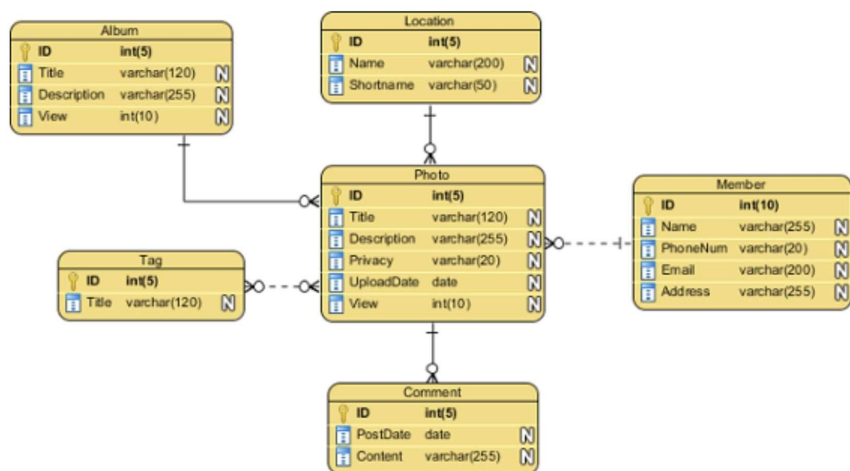
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Schemas

- A database schema is a blueprint that represents the logical view of the database
- It defines tables and the relationship between them
- A database schema is broadly categorized into
 - Physical Schema: How data is stored in actual storage is described at this level
 - Logical Schema: Pertains to the logical constraints (design) that need to be applied to the data stored

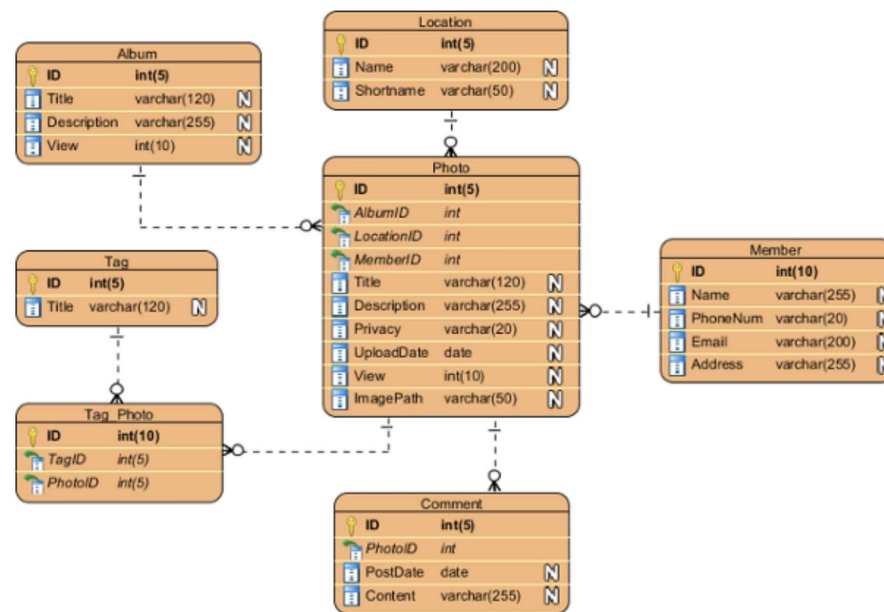
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Logical vs Physical Schemas



Logical ERD example

Logical schema is designed based on information gathered from business requirements. This schema need not have any column types defined. But in case you do so it is with the intent to help in business analysis



Physical ERD example

Physical schema represents actual blueprint of a relational database. In this schema, the data types, primary key, foreign keys and constraints are to be designed by the database designers.

Instance

- In RDBMS, there are lot of changes taking place in a table, over time
- Data get inserted, manipulated and deleted in parallel
- The data stored in a database at a particular moment of time is called instance

Instance

- For example, consider 'customer' table in the database 'bank' has 10,000 records, so the instance of the database at this point is 10,000
- Let's say, we are going to add 1000 more records in the same table, tomorrow
- So the instance of the database will be 11,000 tomorrow

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*There are many benefits to having a DBMS, but one of the most important is the **security** it provides to your business or organization.*

Using a database management system lets end users and programmers access the same data without compromising its integrity.

Structured Query Language (SQL) Basics

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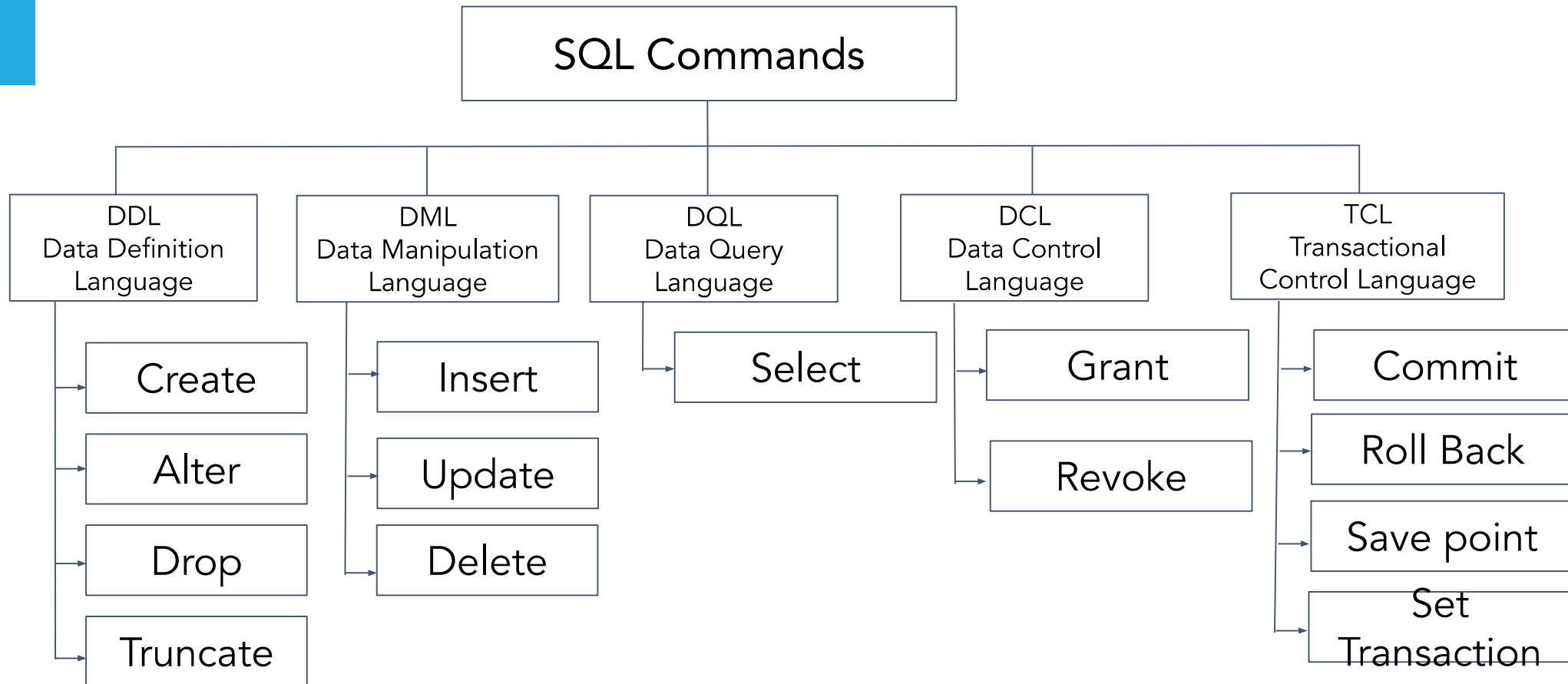
SQL Introduction

The commands available in SQL can be broadly categorised as follows:

- Data Definition Language (DDL)
- Data Manipulation Language (DML)
- Data Query Language (DQL)
- Data Control Language (DCL)
- Transactional Control Language (TCL)

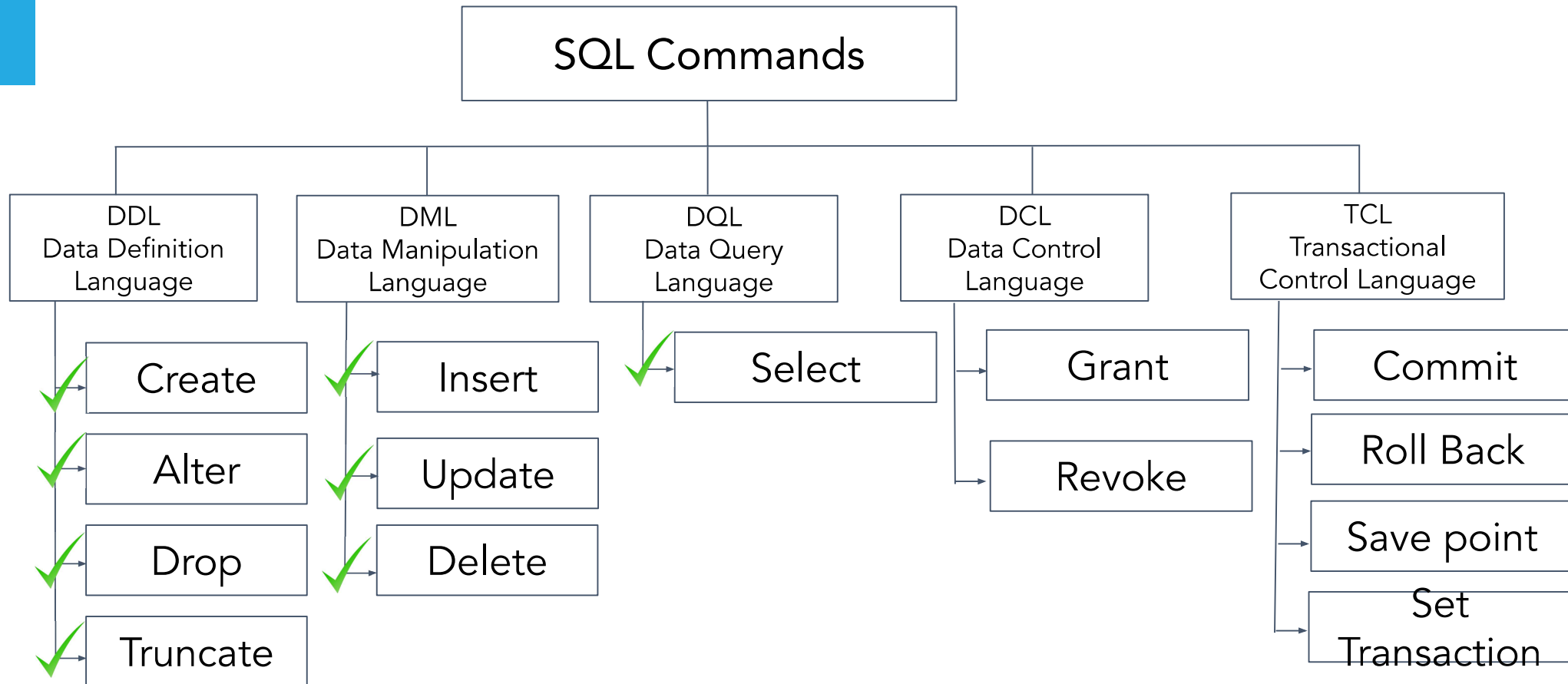
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Types of SQL Commands



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Types of SQL Commands



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Data Definition Language (DDL)

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Data Definition Language (DDL)

- A database is a collection of many tables, and a database server can hold many of these databases

Database Server —> Databases —> Tables (defined by columns) —> Rows

- Databases and tables are referred to as database objects
- Any operation, such as *creating*, *modifying*, or *deleting* database objects, is called **Data Definition Language (DDL)**

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Data Definition Language (DDL)

- DDL is used to create a new schema as well as to modify an existing schema
- The typical commands available in DDL are:
 - CREATE
 - ALTER
 - DROP
 - TRUNCATE

Create Database

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DDL - CREATE DATABASE- Syntax

- The CREATE DATABASE statement is used to create a new SQL database

Syntax:

```
CREATE DATABASE databasename;
```

The semicolon character (;) is a SQL statement terminator

- To create tables in the database you need to first select the database. Use the following syntax to select the database:

```
USE databasename;
```

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DDL - CREATE DATABASE - Example

- We will create a database called company

```
CREATE DATABASE company;
```

- Use **SHOW DATABASES** to check if the database *company* has been **CREATED**

Database
company
information_schema
mysql
performance_schema
sys

The database *company* is now created

Default system databases

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Drop Database

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DDL - DROP DATABASE - Syntax

- The DROP DATABASE statement is used to drop an existing SQL database

Syntax:

```
DROP DATABASE databasename;
```



Database name

DDL - DROP DATABASE - Example

- The following SQL statement drops the existing database "company":

```
DROP DATABASE company;
```

- Use **SHOW DATABASES** to check if the database *company* has been **DROPPED**

Database
information_schema
mysql
performance_schema
sys



We see the database *company* is now dropped

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Create Tables

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Prerequisites for Creating Tables

- To create and maintain table, you need a database
- While defining columns in a table, you should mention:
 - the name of the columns,
 - datatype (integer, floating point, string, and so on), and
 - default value (if any)
- Let's take a look at data types before we create table

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Data Types

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Built - in Data Types

- Numeric: TINYINT, SMALLINT, MEDIUMINT, INT, BIGINT, and BIT
- Floating numbers: DECIMAL, FLOAT, and DOUBLE
- Strings: CHAR, VARCHAR, BINARY, VARBINARY, BLOB, TEXT, ENUM, and SET
- Date and Time: DATE, TIME, DATETIME, TIMESTAMP, and YEAR

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Every relational database has its own maximum and minimum size limit for different data types, you don't need to remember the limit. Idea is to have the knowledge of what data type to be used in a specific scenario

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Numeric - Data Types

Datatype	From	To
Bit	0	1
Tinyint	0	255
Smallint	-32768	32767
mediumint	-8388608	8388607
int	-2,147,483,648	2,147,483,647
bigint	-2^{63}	$2^{63}-1$

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Floating Numbers

Datatype	Specification
Decimal	Max digits is 65
Float	A precision from 0 to 23 results in a 4-byte single-precision FLOAT column. A precision from 24 to 53 results in an 8-byte double-precision DOUBLE column.

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Strings

Datatype	Description
CHAR	The length can be any value from 0 to 255
VARCHAR	The length can be specified as a value from 0 to 65,535
BINARY	Fixed length with maximum length of 8,000 bytes
VARBINARY	Variable length storage with maximum length of 8,000 bytes
BLOB	For binary large objects
TEXT	Variable length storage with maximum size of 1GB data

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Date and Time

Datatype	Description
DATE	Stores date in the format YYYY-MM-DD
TIME	Stores time in the format HH:MI:SS
DATETIME	Stores date and time information in the format YYYY-MM-DD HH:MI:SS
TIMESTAMP	Stores number of seconds passed since the Unix epoch ('1970-01-01 00:00:00' UTC)
YEAR	Stores year in 2 digit or 4 digit format. Range 1901 to 2155 in 4-digit format. Range 70 to 69, representing 1970 to 2069.

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did you know?

MySQL supports various data types. Refer to the MySQL documentation for more details

<https://dev.mysql.com/doc/refman/8.0/en/data-types.html>

CREATE TABLE - Syntax

- The CREATE TABLE statement is used to create a new table in a database

Syntax:

```
CREATE TABLE table_name (  
    column1 datatype,  
    column2 datatype,  
    column3 datatype,  
    ....);
```

- The column parameters specify the names of the columns of the table
- The datatype parameter specifies the type of data the column can hold (e.g. varchar, integer, date, etc.).

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CREATE TABLE - Example

- We will create a customers table, which will hold the customers information
- The table will have the following columns in it
 - CustomerID
 - FirstName
 - LastName and
 - Country

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CREATE TABLE - Example

- We will create a table "customers" in the company database. Select the database 'company' using **USE company** command

```
CREATE TABLE customers (  
  CustomerId int,  
  first_name varchar(20),  
  last_name varchar(20),  
  country varchar(20)  
);
```

It is declared as an integer since it contains only integers

first_name, last_name, and country: They contain strings, so they are defined as **varchar**

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CREATE TABLE - Example

- The CustomerID column is of type int and will hold an integer
- 'firstName', 'lastName', and 'country' columns are of type varchar with maximum length of 20 characters
- Check the definition of the table by using: describe *customers* :

Field	Type	Null	Key	Default	Extra
CustomerId	int(11)	YES		NULL	
first_name	varchar(20)	YES		NULL	
last_name	varchar(20)	YES		NULL	
country	varchar(20)	YES		NULL	

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Drop Table

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DROP TABLE - Syntax

- The DROP TABLE statement is used to drop an existing table in a database

Syntax:

```
DROP TABLE table_name;
```



Be careful before dropping a table. Deleting a table will result in loss of complete information stored in the table!!!!

DROP and TRUNCATE TABLE - Example

- The following SQL statement drops the existing table "company":

```
DROP TABLE customers;
```

- The TRUNCATE TABLE statement is used to delete the data inside a table, but not the table itself

```
TRUNCATE TABLE customers;
```

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