
Microsoft®
SQL Server®

Persistence

- File
  - text (characters)
  - binary → images / audio / video

Data

- structured
  - table
    - RDBMS
- semi-structured
  - partially structured
  - json files / csv
    - p1 = { name: "p1" }
    - p2 = { firstname: "p1" }
    - File
    - NOSQL
- unstructured
  - image
  - audio
  - video

  } files

Database

- Relational
  - RDBMS
    - SQL Server
    - MYSQL
    - Oracle
    - MariaDB
    - IBM DB2
    - postgre SQL
    - SQLite
- NOSQL
  - MongoDB
  - redis
  - firebase
  - couch DB
  - couchbase
  - dynamo DB
  - cassandra

RDBMS

Overview

- RDBMS stands for **R**elational **D**atabase **M**anagement **S**ystem
- It is a database management system (DBMS) that is based on the relational model as introduced by E. F. Codd.
- It is the basis for SQL, and for all modern database systems like MS SQL Server, IBM DB2, Oracle, MySQL, and Microsoft Access
- It stores data in a row-based table structure which connects related data elements
- It includes functions that maintain the security, accuracy, integrity and consistency of the data

Advantages

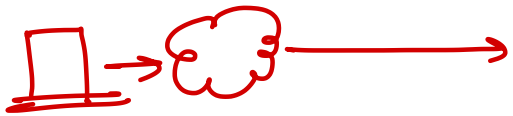
- Flexibility
  - Updating data is more efficient since the changes only need to be made in one place
  - Many applications can share the data stored in RDBMS
- Maintenance
  - Database administrators can easily maintain, control and update data in the database
  - Backups also become easier since automation tools included in the RDBMS automate these tasks
- Data structure
  - The table format used in RDBMSes is easy to understand and provides an organized and structural manner through which entries are matched by firing queries

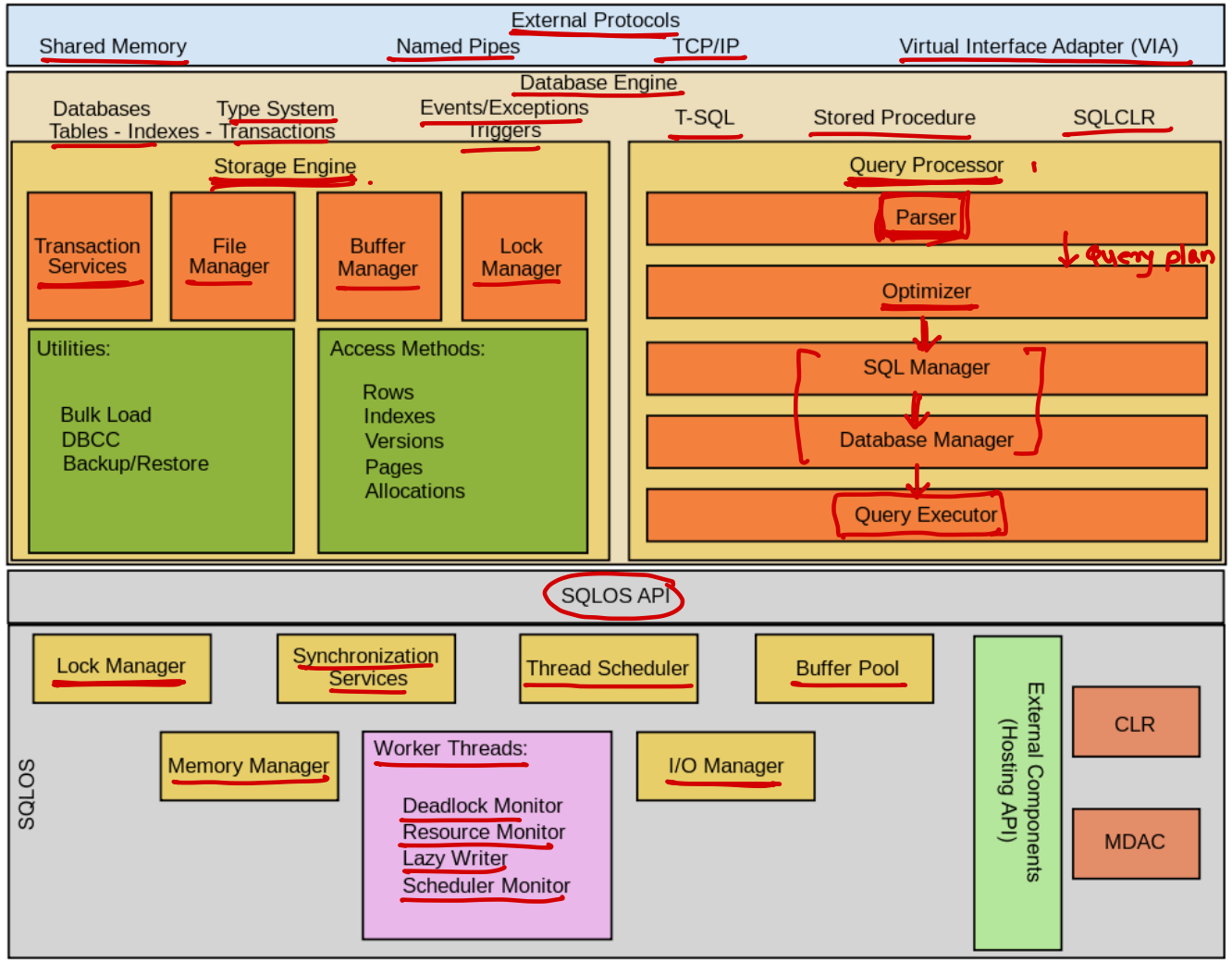
MS SQL Server

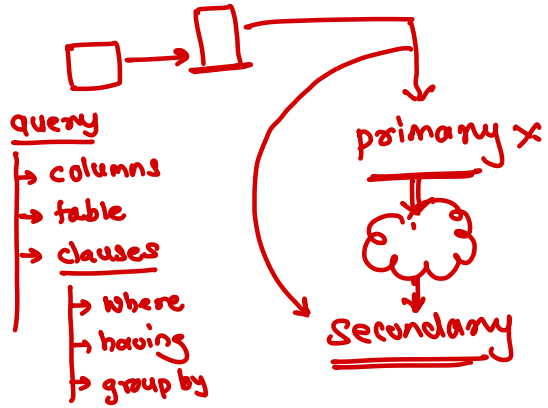
Overview

- SQL Server is a relational database management system, or RDBMS, developed and marketed by Microsoft
- Similar to other RDBMS software, SQL Server is built on top of SQL, a standard programming language for interacting with the relational databases
- SQL server is tied to Transact-SQL, or T-SQL, the Microsoft's implementation of SQL that adds a set of proprietary programming constructs
- SQL Server works exclusively on Windows environment for more than 20 years
- In 2016, Microsoft made it available on Linux
- SQL Server 2017 became generally available in October 2016 that ran on both Windows and Linux

SQL Server Architecture







Database Engine

- The core component of the SQL Server is the Database Engine
- The Database Engine consists of a relational engine that processes queries and a storage engine that manages database files, pages, pages, index, etc
- The database objects such as stored procedures, views, and triggers are also created and executed by the Database Engine
- **Relational Engine** (Query Processor)
  - The Relational Engine contains the components that determine the best way to execute a query
  - The relational engine is also known as the query processor.
  - The relational engine requests data from the storage engine based on the input query and processed the results
  - Some tasks of the relational engine include querying processing, memory management, thread and task management, buffer management, and distributed query processing
- **Storage Engine**
  - The storage engine is in charge of storage and retrieval of data from the storage systems such as disks and SAN.

SQLOS

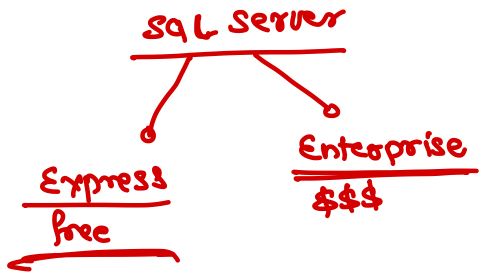
- Under the relational engine and storage engine is the SQL Server Operating System or SQLOS
- SQLOS provides many operating system services such as memory and I/O management
- Other services include exception handling and synchronization services

Services and Tools

- Microsoft provides both data management and business intelligence (BI) tools and services together with SQL Server
- **Data management tools**:
  - SQL Server includes SQL Server Integration Services (SSIS), SQL Server Data Quality Services, and SQL Server Master Data Services
  - To develop databases, SQL Server provides SQL Server Data tools; and to manage, deploy, and monitor databases SQL Server has SQL Server Management Studio (SSMS)
- **Data analysis tools**:
  - SQL Server offers SQL Server Analysis Services (SSAS)
  - SQL Server Reporting Services (SSRS) provides reports and visualization of data
  - The Machine Learning Services technology appeared first in SQL Server 2016 which was renamed from the R Services

SQL Server Editions

- SQL Server has four primary editions that have different bundled services and tools
- Two editions are available free of charge:
  - SQL Server **Developer edition** for use in database development and testing.
  - SQL Server **Expression** for small databases with the size up to 10 GB of disk storage capacity
- For larger and more critical applications, SQL Server offers the **Enterprise edition** that includes all SQL server's features
- SQL Server **Standard** Edition has partial feature sets of the Enterprise Edition and limits on the Server regarding the numbers of processor core and memory that can be configured



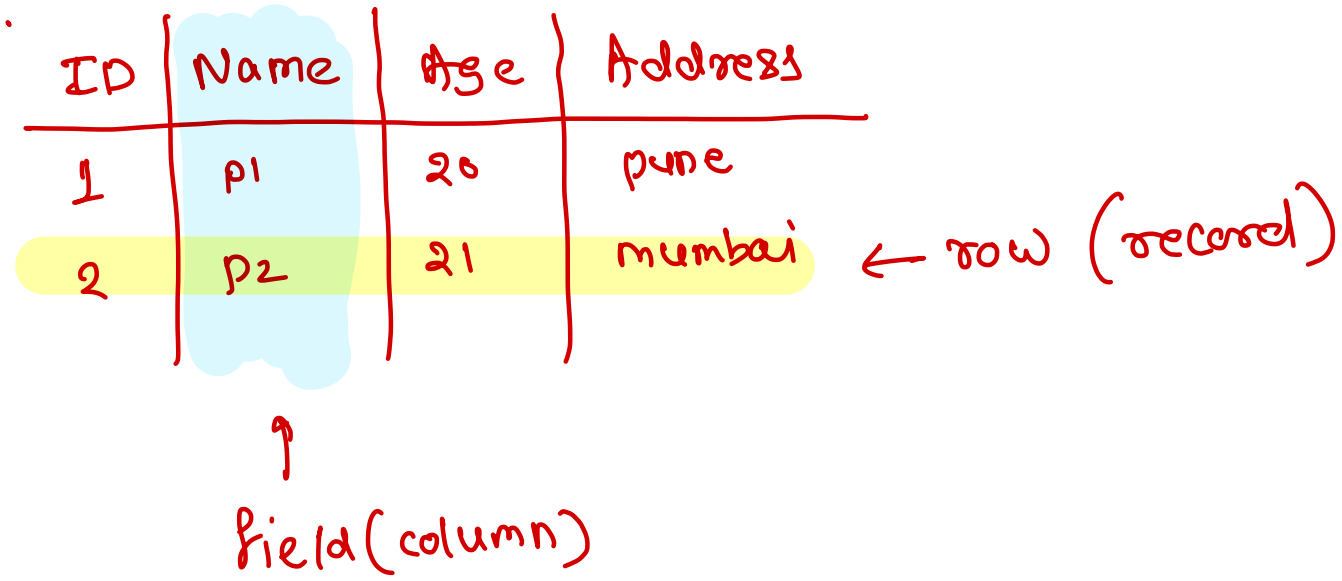
Foundation

Table

- The data in an RDBMS is stored in database objects which are called as **tables**
- This table is basically a collection of related data entries and it consists of numerous columns and rows

Field

- Every table is broken up into smaller entities called fields
- The fields in the CUSTOMERS table can consist ID, NAME, AGE, ADDRESS and SALARY
- A field is a column in a table that is designed to maintain specific information about every record in the table

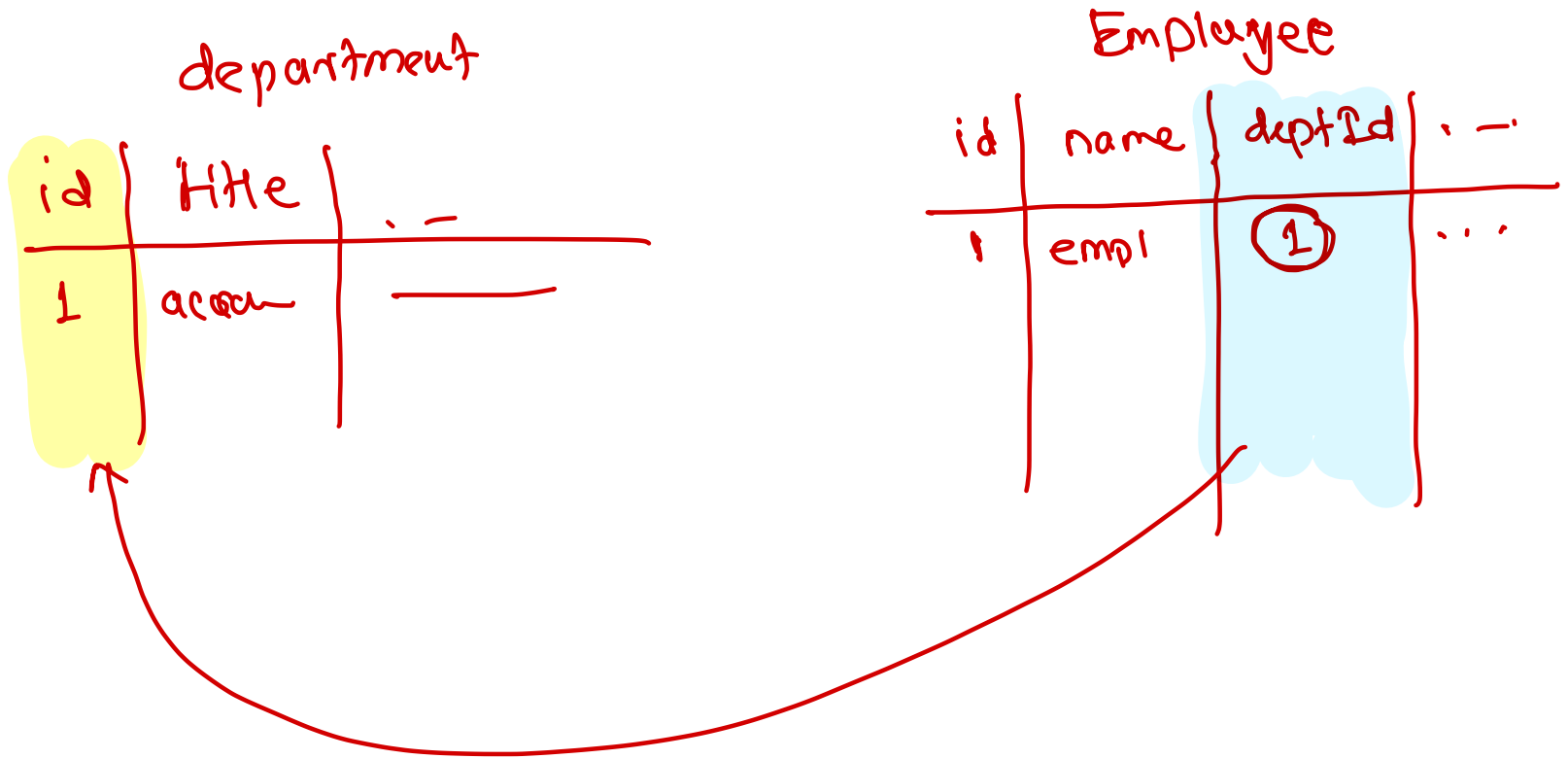


Record or Row

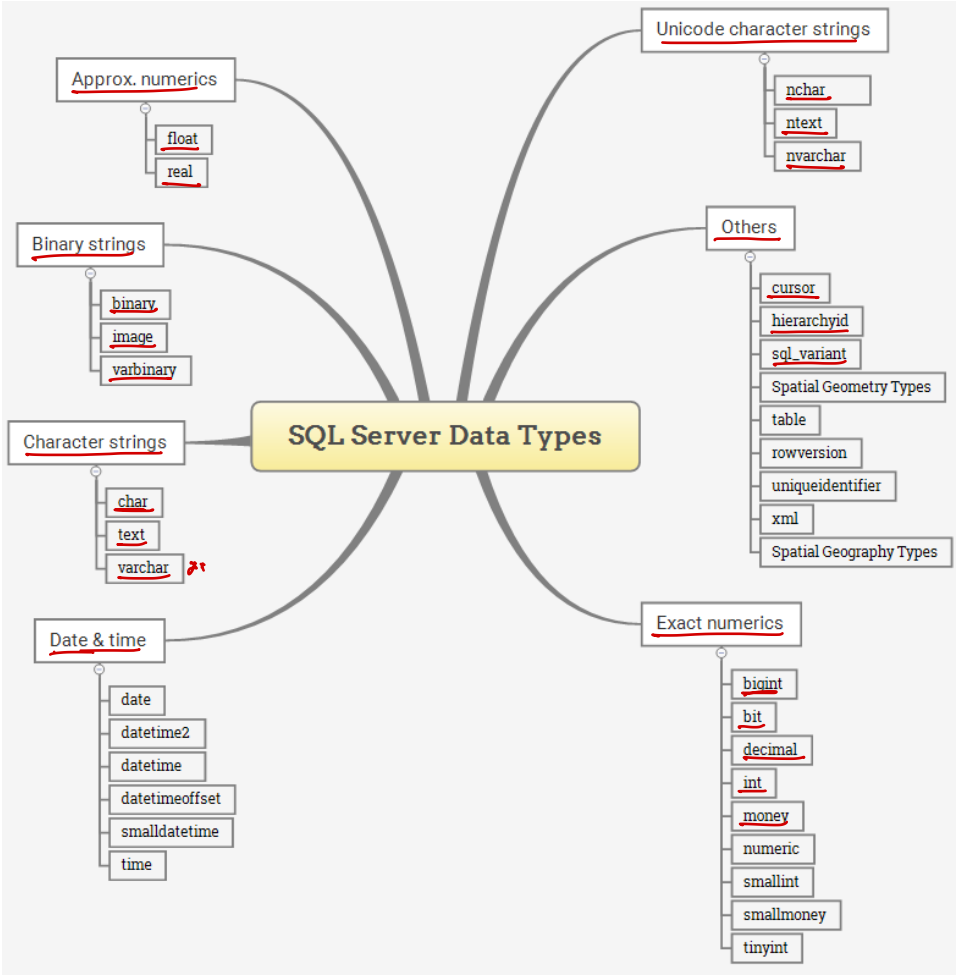
- A record is also called as a row of data is each individual entry that exists in a table
- A records shows information about an entity
- A record will split the information in fields or columns

Relationship

- Relationship is a link between two tables
- Relationship can be created using primary and foreign keys



Data Types


SQL Server Data Types
Approx. numerics
float
real
Binary strings
binary
image
varbinary
Character strings
char
text
varchar
Date & time
date
datetime2
datetime
datetimeoffset
smalldatetime
time
Unicode character strings
nchar
ntext
nvarchar
Others
cursor
hierarchyid
sql_variant
Spatial Geometry Types
table
rowversion
uniqueidentifier
xml
Spatial Geography Types
Exact numerics
bigint
bit
decimal
int
money
numeric
smallint
smallmoney
tinyint

CRUD Operations

Create Table Operation

```sql
CREATE TABLE Customers (
  Id INT IDENTITY PRIMARY KEY,
  Name VARCHAR(50),
  Age INT,
  Address VARCHAR(255),
  Salary FLOAT
);
```

```sql
CREATE TABLE Products (
  Id INT IDENTITY PRIMARY KEY,
  Title VARCHAR(50),
  Price FLOAT,
  Description VARCHAR(512),
  Company VARCHAR(50)
);
```

Read Operation

```
SELECT [ID]
      ,[NAME]
      ,[AGE]
      ,[ADDRESS]
      ,[SALARY]
FROM [MyDB].[dbo].[Customers]
```

RESULTS ⌘+⌥+R

	ID	NAME	AGE	ADDRESS	SALARY
1	2	customer 2	14	mumbai	10.6

Update Operation

```
UPDATE [MyDB].[dbo].[Customers]
SET
    [NAME] = 'New Customer Name'
WHERE
    [ID] = 2
```

RESULTS ⌘+⌥+R

	ID	NAME	AGE	ADDRESS	SALARY
1	2	New Customer Name	14	mumbai	10.6

Delete Operation

```
DELETE FROM [MyDB].[dbo].[Customers]
WHERE
    [ID] = 2
```

SQL

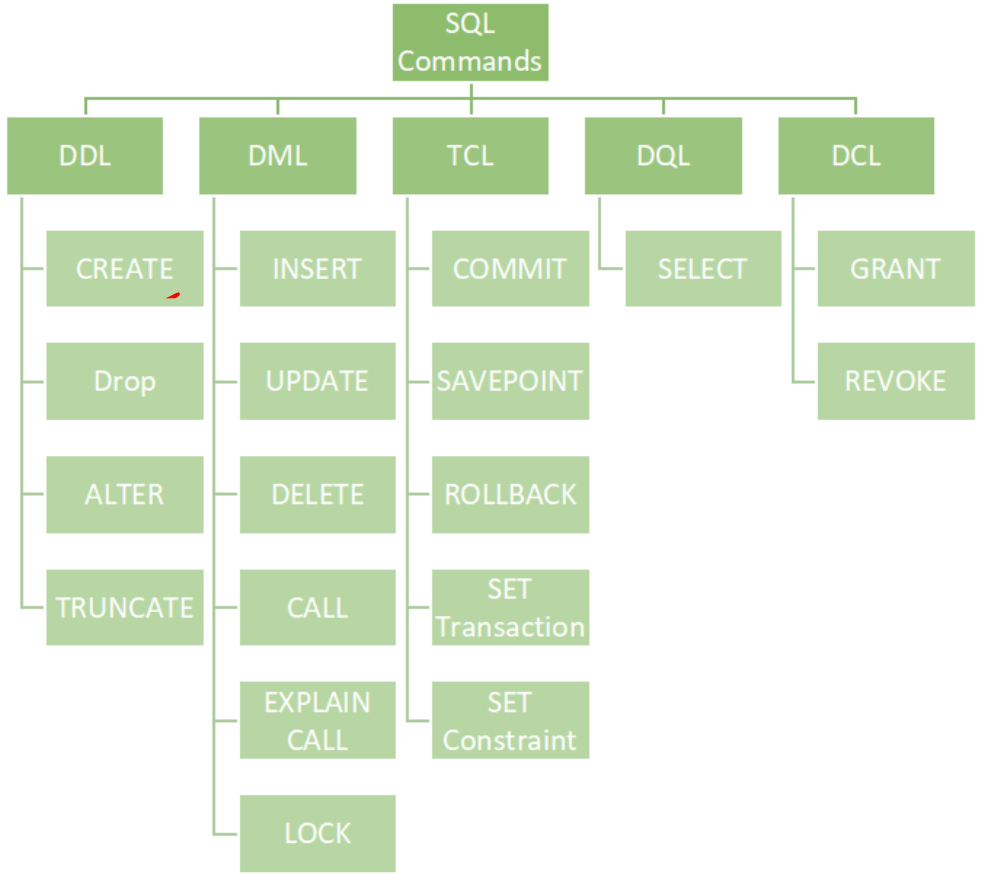
- SQL stands for Structured Query Language
- It is a database computer language, used for storing, manipulating and retrieving data stored in a relational database
- SQL is the standard language for Relational Database System
- All the Relational Database Management Systems (RDMS) like MySQL, MS Access, Oracle, Sybase, Informix, Postgres and SQL Server use SQL as their standard database language
- Also, they are using different dialects
  - MS SQL Server using T-SQL,
  - Oracle using PL/SQL,
  - MS Access version of SQL is called JET SQL (native format) etc.

Applications of SQL

- Allows users to access data in the relational database management systems
- Allows users to describe the data
- Allows users to define the data in a database and manipulate that data
- Allows to embed within other languages using SQL modules, libraries & pre-compilers
- Allows users to create and drop databases and tables
- Allows users to create view, stored procedure, functions in a database
- Allows users to set permissions on tables, procedures and views

SQL Statements

- These SQL commands are mainly categorized into following categories
  - DDL – Data Definition Language
  - DQL – Data Query Language
  - DML – Data Manipulation Language
  - DCL – Data Control Language
  - TCL – Transaction Control Language



DDL (Data Definition Language)

- Commands that can be used to define the database schema
- It simply deals with descriptions of the database schema and is used to create and modify the structure of database objects in the database.
- These commands are normally not used by a general user, who should be accessing the database via an application
- List of DDL commands:
  - **CREATE**: This command is used to create the database or its objects (like table, index, function, views, store procedure, and triggers).
  - **DROP**: This command is used to delete objects from the database.
  - **ALTER:** This is used to alter the structure of the database.
  - **TRUNCATE:** This is used to remove all records from a table, including all spaces allocated for the records are removed
  - **COMMENT**: This is used to add comments to the data dictionary
  - **RENAME:** This is used to rename an object existing in the database

DQL (Data Query Language)

- DQL statements are used for performing queries on the data within schema objects
- The purpose of the DQL Command is to get some schema relation based on the query passed to it
- It is a component of SQL statement that allows getting data from the database and imposing order upon it
- List of DQL:
  - **SELECT**
    - It is used to retrieve data from the tables
    - This command allows getting the data out of the database to perform operations with it
    - When a SELECT is fired against a table or tables the result is compiled into a further temporary table, which is displayed or perhaps received by the program i.e. a front-end.

DML(Data Manipulation Language)

- The SQL commands that deals with the manipulation of data present in the database
- It includes most of the SQL statements
- It is the component of the SQL statement that controls access to data and to the database
- Basically, DCL statements are grouped with DML statements
- List of DML commands:
  - **INSERT** : It is used to insert data into a table.
  - **UPDATE:** It is used to update existing data within a table.
  - **DELETE** : It is used to delete records from a database table.
  - **LOCK:** Table control concurrency.
  - **CALL:** Call a PL/SQL or JAVA subprogram.
  - **EXPLAIN PLAN:** It describes the access path to data.

DCL (Data Control Language)

- DCL includes commands such as GRANT and REVOKE which mainly deal with the rights, permissions, and other controls of the database system
- List of DCL commands:
  - **GRANT:** This command gives users access privileges to the database
  - **REVOKE:** This command withdraws the user's access privileges given by using the GRANT command

TCL (Transaction Control Language)

- TCL commands deal with the transactions
- List of TCL commands
  - **COMMIT**: Commits a Transaction
  - **ROLLBACK**: Rollbacks a transaction in case of any error occurs
  - **SAVEPOINT**: Sets a savepoint within a transaction
  - **SET TRANSACTION:** Specify characteristics for the transaction