

Unit 4- Introduction to SQL (Structured Query Language)

Introduction

SQL is a database computer language designed for the retrieval and management of data in a relational database. SQL stands for Structured Query Language.

SQL is Structured Query Language, which is a computer language 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, such as –

- MS SQL Server using T-SQL,
- Oracle using PL/SQL,
- MS Access version of SQL is called JET SQL (native format) etc.

SQL is a language to operate databases; it includes database creation, deletion, fetching rows, modifying rows, etc. SQL is an ANSI (American National Standards Institute) standard language, but there are many different versions of the SQL language

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.

A Brief History of SQL

- **1970** – Dr. Edgar F. "Ted" Codd of IBM is known as the father of relational databases. He described a relational model for databases.
- **1974** – Structured Query Language appeared.
- **1978** – IBM worked to develop Codd's ideas and released a product named System/R.
- **1986** – IBM developed the first prototype of relational database and standardized by ANSI. The first relational database was released by Relational Software which later came to be known as Oracle.

SQL Process

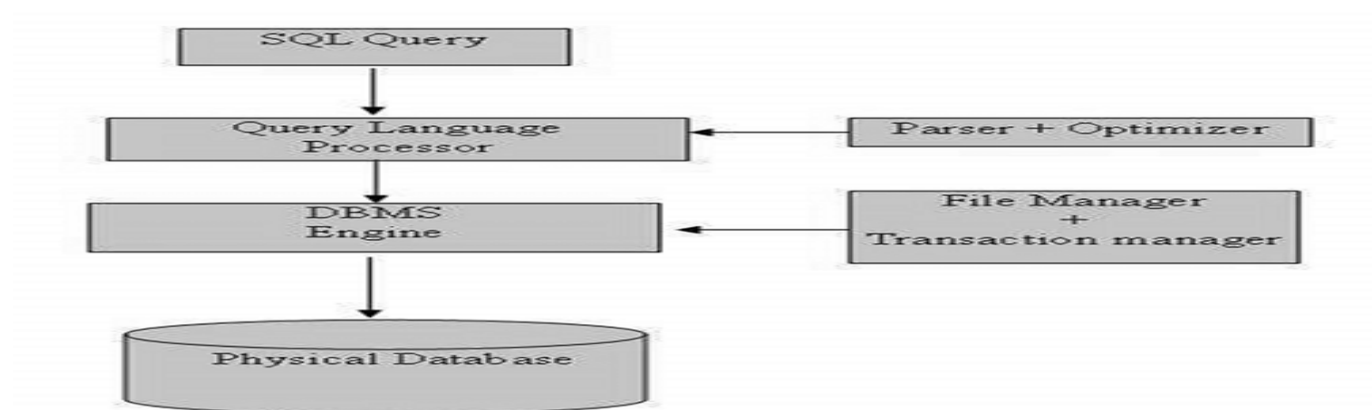
When you are executing an SQL command for any RDBMS, the system determines the best way to carry out your request and SQL engine figures out how to interpret the task.

There are various components included in this process.

These components are –

- Query Dispatcher
- Optimization Engines
- Classic Query Engine
- SQL Query Engine, etc.

Architecture of SQL



SQL Commands

The standard SQL commands to interact with relational databases are CREATE, SELECT, INSERT, UPDATE, DELETE and DROP. These commands can be classified into the following groups based on their nature –

DDL - Data Definition Language

Sr.No.	Command & Description
1	CREATE Creates a new table, a view of a table, or other object in the database.
2	ALTER Modifies an existing database object, such as a table.
3	DROP Deletes an entire table, a view of a table or other objects in the database.

DML - Data Manipulation Language

Sr.No.	Command & Description
1	SELECT Retrieves certain records from one or more tables.
2	INSERT Creates a record.
3	UPDATE Modifies records.
4	DELETE Deletes records.

DCL - Data Control Language

Sr.No.	Command & Description
1	GRANT Gives a privilege to user.
2	REVOKE Takes back privileges granted from user.

What is RDBMS?

RDBMS stands for **R**elational **D**atabase **M**anagement **S**ystem. RDBMS is the basis for SQL, and for all modern database systems like MS SQL Server, IBM DB2, Oracle, MySQL, and Microsoft Access.

A Relational database management system (RDBMS) is a database management system (DBMS) that is based on the relational model as introduced by E. F. Codd.

What is a 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.

ID	NAME	AGE	ADDRESS	SALARY
+	+	+	+	+

1	Ramesh	32	Ahmedabad	2000.00
2	Khilan	25	Delhi	1500.00
3	kaushik	23	Kota	2000.00
4	Chaitali	25	Mumbai	6500.00
5	Hardik	27	Bhopal	8500.00
6	Komal	22	MP	4500.00
7	Muffy	24	Indore	10000.00

What is a field?

Every table is broken up into smaller entities called fields. The fields in the CUSTOMERS table consist of 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.

What is a Record or a Row?

A record is also called as a row of data is each individual entry that exists in a table. For example, there are 7 records in the above CUSTOMERS table. Following is a single row of data or record in the CUSTOMERS table –

1	Ramesh	32	Ahmedabad	2000.00
---	--------	----	-----------	---------

What is a column?

A column is a vertical entity in a table that contains all information associated with a specific field in a table.

For example, a column in the CUSTOMERS table is ADDRESS, which represents location description and would be as shown below –

ADDRESS
Ahmedabad
Delhi
Kota
Mumbai
Bhopal
MP
Indore

What is a NULL value?

A NULL value in a table is a value in a field that appears to be blank, which means a field with a NULL value is a field with no value.

It is very important to understand that a NULL value is different than a zero value or a field that contains spaces. A field with a NULL value is the one that has been left blank during a record creation.

SQL Constraints

Constraints are the rules enforced on data columns on a table. These are used to limit the type of data that can go into a table. This ensures the accuracy and

reliability of the data in the database.

Constraints can either be column level or table level. Column level constraints are applied only to one column whereas, table level constraints are applied to the entire table.

Following are some of the most commonly used constraints available in SQL –

- NOT NULL Constraint – Ensures that a column cannot have a NULL value.
- DEFAULT Constraint – Provides a default value for a column when none is specified.
- UNIQUE Constraint – Ensures that all the values in a column are different.
- PRIMARY Key – Uniquely identifies each row/record in a database table.
- FOREIGN Key – Uniquely identifies a row/record in any another database table.
- CHECK Constraint – The CHECK constraint ensures that all values in a column satisfy certain conditions.
- INDEX – Used to create and retrieve data from the database very quickly.

Data Integrity

The following categories of data integrity exist with each RDBMS –

- **Entity Integrity** – There are no duplicate rows in a table.
- **Domain Integrity** – Enforces valid entries for a given column by restricting the type, the format, or the range of values.
- **Referential integrity** – Rows cannot be deleted, which are used by other records.
- **User-Defined Integrity** – Enforces some specific business rules that do not fall into entity, domain or referential integrity.

SQL - Data Types

SQL Data Type is an attribute that specifies the type of data of any object. Each column, variable and expression has a related data type in SQL. You can use these data types while creating your tables. You can choose a data type for a table column based on your requirement.

Exact Numeric Data Types

DATA TYPE	FROM	TO
bigint	-9,223,372,036,854,775,808	9,223,372,036,854,775,807
int	-2,147,483,648	2,147,483,647
smallint	-32,768	32,767
tinyint	0	255
bit	0	1

decimal	-10 ³⁸ +1	10 ³⁸ -1
numeric	-10 ³⁸ +1	10 ³⁸ -1
money	-922,337,203,685,477.5808	+922,337,203,685,477.5807
smallmoney	-214,748.3648	+214,748.3647

Approximate Numeric Data Types

DATA TYPE	FROM	TO
float	-1.79E + 308	1.79E + 308
real	-3.40E + 38	3.40E + 38

Date and Time Data Types

DATA TYPE	FROM	TO
datetime	Jan 1, 1753	Dec 31, 9999
smalldatetime	Jan 1, 1900	Jun 6, 2079
date	Stores a date like June 30, 1991	
time	Stores a time of day like 12:30 P.M.	

Character Strings Data Types

Sr.No	DATA TYPE & Description
1	char Maximum length of 8,000 characters.(Fixed length non-Unicode characters)
2	varchar Maximum of 8,000 characters.(Variable-length non-Unicode data).
3	varchar(max)

	Maximum length of 2E + 31 characters, Variable-length non-Unicode data (SQL Server 2005 only).
4	text Variable-length non-Unicode data with a maximum length of 2,147,483,647 characters.

Operator in SQL

An operator is a reserved word or a character used primarily in an SQL statement's WHERE clause to perform operation(s), such as comparisons and arithmetic operations. These Operators are used to specify conditions in an SQL statement and to serve as conjunctions for multiple conditions in a statement.

- Arithmetic operators
- Comparison operators
- Logical operators
- Operators used to negate conditions

SQL Arithmetic Operators

- Assume '**variable a**' holds 10 and '**variable b**' holds 20, then –
- Show Examples

Operator	Description	Example
+ (Addition)	Adds values on either side of the operator.	a + b will give 30
- (Subtraction)	Subtracts right hand operand from left hand operand.	a - b will give -10
* (Multiplication)	Multiplies values on either side of the operator.	a * b will give 200
/ (Division)	Divides left hand operand by right hand operand.	b / a will give 2
% (Modulus)	Divides left hand operand by right hand operand and returns remainder.	b % a will give 0

SQL Comparison Operators

Assume 'variable a' holds 10 and 'variable b' holds 20, then –

Show Examples

Operator	Description	Example
=	Checks if the values of two operands are equal or not, if yes then condition becomes true.	(a = b) is not true.
!=	Checks if the values of two operands are equal or not, if values are not equal then condition becomes true.	(a != b) is true.
<>	Checks if the values of two operands are equal or not, if values are not equal then condition becomes true.	(a <> b) is true.
>	Checks if the value of left operand is greater than the value of right operand, if yes then condition becomes true.	(a > b) is not true.
<	Checks if the value of left operand is less than the value of right operand, if yes then condition becomes true.	(a < b) is true.
>=	Checks if the value of left operand is greater than or equal to the value of right operand, if yes then condition becomes true.	(a >= b) is not true.
<=	Checks if the value of left operand is less than or equal to the value of right operand, if yes then condition becomes true.	(a <= b) is true.
!<	Checks if the value of left operand is not less than the value of right operand, if yes then condition becomes true.	(a !< b) is false.
!>	Checks if the value of left operand is not greater than the value of right operand, if yes then condition becomes true.	(a !> b) is true.

SQL Logical Operators

Here is a list of all the logical operators available in SQL.

Show Examples

Sr.No	Operator & Description
.	

1	ALL The ALL operator is used to compare a value to all values in another value set.
2	AND The AND operator allows the existence of multiple conditions in an SQL statement's WHERE clause.
3	ANY The ANY operator is used to compare a value to any applicable value in the list as per the condition.
4	BETWEEN The BETWEEN operator is used to search for values that are within a set of values, given the minimum value and the maximum value.
5	EXISTS The EXISTS operator is used to search for the presence of a row in a specified table that meets a certain criterion.
6	IN The IN operator is used to compare a value to a list of literal values that have been specified.
7	LIKE The LIKE operator is used to compare a value to similar values using wildcard operators.
8	NOT The NOT operator reverses the meaning of the logical operator with which it is used. Eg: NOT EXISTS, NOT BETWEEN, NOT IN, etc. This is a negate operator.
9	OR The OR operator is used to combine multiple conditions in an SQL statement's WHERE clause.
10	IS NULL The NULL operator is used to compare a value with a NULL value.
11	UNIQUE The UNIQUE operator searches every row of a specified table for uniqueness (no duplicates).

SQL - Expressions

An expression is a combination of one or more values, operators and SQL functions that evaluate to a value. These SQL EXPRESSIONs are like formulae and they are written in query language. You can also use them to query the database for a specific set of data.

Syntax

Consider the basic syntax of the SELECT statement as follows –

```
SELECT column1, column2, columnN  
FROM table_name  
WHERE [CONDITION|EXPRESSION];
```

There are different types of SQL expressions, which are mentioned below –

- Boolean
- Numeric
- Date

Boolean Expressions

SQL Boolean Expressions fetch the data based on matching a single value. Following is the syntax –

```
SELECT column1, column2, columnN  
FROM table_name  
WHERE SINGLE VALUE MATCHING EXPRESSION;
```

Numeric Expression

These expressions are used to perform any mathematical operation in any query. Following is the syntax –

```
SELECT numerical_expression as OPERATION_NAME  
[FROM table_name  
WHERE CONDITION] ;
```

Date Expressions

Date Expressions return current system date and time values –