**SQL Database**

SQL CREATE DATABASE Statement

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The SQL CREATE DATABASE Statement

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

Syntax

CREATE DATABASE *databasename*;

CREATE DATABASE Example

The following SQL statement creates a database called "testDB":

Example

CREATE DATABASE testDB;

**Tip:** Make sure you have admin privilege before creating any database. Once a database is created, you can check it in the list of databases with the following SQL command: SHOW DATABASES;

SQL DROP DATABASE Statement

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The SQL DROP DATABASE Statement

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

Syntax

DROP DATABASE *databasename*;

**Note:** Be careful before dropping a database. Deleting a database will result in loss of complete information stored in the database!

DROP DATABASE Example

The following SQL statement drops the existing database "testDB":

Example

DROP DATABASE testDB;

**Tip:** Make sure you have admin privilege before dropping any database. Once a database is dropped, you can check it in the list of databases with the following SQL command: SHOW DATABASES;

SQL BACKUP DATABASE for SQL Server

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The SQL BACKUP DATABASE Statement

The BACKUP DATABASE statement is used in SQL Server to create a full back up of an existing SQL database.

Syntax

BACKUP DATABASE *databasename*  
TO DISK = '*filepath*';

The SQL BACKUP WITH DIFFERENTIAL Statement

A differential back up only backs up the parts of the database that have changed since the last full database backup.

Syntax

BACKUP DATABASE *databasename*  
TO DISK = '*filepath*'  
WITH DIFFERENTIAL;

BACKUP DATABASE Example

The following SQL statement creates a full back up of the existing database "testDB" to the D disk:

Example

BACKUP DATABASE testDB  
TO DISK = 'D:\backups\testDB.bak';

**Tip:** Always back up the database to a different drive than the actual database. Then, if you get a disk crash, you will not lose your backup file along with the database.

BACKUP WITH DIFFERENTIAL Example

The following SQL statement creates a differential back up of the database "testDB":

Example

BACKUP DATABASE testDB  
TO DISK = 'D:\backups\testDB.bak'  
WITH DIFFERENTIAL;

**Tip:** A differential back up reduces the back up time (since only the changes are backed up).

SQL CREATE TABLE Statement

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The SQL CREATE TABLE Statement

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.).

**Tip:** For an overview of the available data types, go to our complete [Data Types Reference](https://www.w3schools.com/sql/sql_datatypes.asp).

SQL CREATE TABLE Example

The following example creates a table called "Persons" that contains five columns: PersonID, LastName, FirstName, Address, and City:

Example

CREATE TABLE Persons (  
    PersonID int,  
    LastName varchar(255),  
    FirstName varchar(255),  
    Address varchar(255),  
    City varchar(255)  
);

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_create_table)

The PersonID column is of type int and will hold an integer.

The LastName, FirstName, Address, and City columns are of type varchar and will hold characters, and the maximum length for these fields is 255 characters.

The empty "Persons" table will now look like this:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PersonID** | **LastName** | **FirstName** | **Address** | **City** |
|  |  |  |  |  |

**Tip:** The empty "Persons" table can now be filled with data with the SQL [INSERT INTO](https://www.w3schools.com/sql/sql_insert.asp) statement.

Create Table Using Another Table

A copy of an existing table can also be created using CREATE TABLE.

The new table gets the same column definitions. All columns or specific columns can be selected.

If you create a new table using an existing table, the new table will be filled with the existing values from the old table.

Syntax

CREATE TABLE *new\_table\_name* AS  
    SELECT *column1, column2,...*  
    FROM *existing\_table\_name*  
    WHERE ....;

The following SQL creates a new table called "TestTables" (which is a copy of the "Customers" table):

Example

CREATE TABLE TestTable AS  
SELECT customername, contactname  
FROM customers;

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_create_table2)

SQL DROP TABLE Statement

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The SQL DROP TABLE Statement

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

Syntax

DROP TABLE *table\_name*;

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

SQL DROP TABLE Example

The following SQL statement drops the existing table "Shippers":

Example

DROP TABLE Shippers;

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_drop_table)

SQL TRUNCATE TABLE

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

Syntax

TRUNCATE TABLE *table\_name*;

SQL ALTER TABLE Statement

[❮ Previous](https://www.w3schools.com/sql/sql_drop_table.asp)[Next ❯](https://www.w3schools.com/sql/sql_constraints.asp)

SQL ALTER TABLE Statement

The ALTER TABLE statement is used to add, delete, or modify columns in an existing table.

The ALTER TABLE statement is also used to add and drop various constraints on an existing table.

ALTER TABLE - ADD Column

To add a column in a table, use the following syntax:

ALTER TABLE *table\_name*  
ADD *column\_name datatype*;

The following SQL adds an "Email" column to the "Customers" table:

Example

ALTER TABLE Customers  
ADD Email varchar(255);

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_alter_table)

ALTER TABLE - DROP COLUMN

To delete a column in a table, use the following syntax (notice that some database systems don't allow deleting a column):

ALTER TABLE *table\_name*  
DROP COLUMN *column\_name*;

The following SQL deletes the "Email" column from the "Customers" table:

Example

ALTER TABLE Customers  
DROP COLUMN Email;

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_alter_table2)

ALTER TABLE - ALTER/MODIFY COLUMN

To change the data type of a column in a table, use the following syntax:

**SQL Server / MS Access:**

ALTER TABLE *table\_name*  
ALTER COLUMN *column\_name datatype*;

**My SQL / Oracle (prior version 10G):**

ALTER TABLE *table\_name*  
MODIFY COLUMN *column\_name datatype*;

**Oracle 10G and later:**

ALTER TABLE *table\_name*  
MODIFY *column\_name datatype*;

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SQL ALTER TABLE Example

Look at the "Persons" table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID** | **LastName** | **FirstName** | **Address** | **City** |
| 1 | Hansen | Ola | Timoteivn 10 | Sandnes |
| 2 | Svendson | Tove | Borgvn 23 | Sandnes |
| 3 | Pettersen | Kari | Storgt 20 | Stavanger |

Now we want to add a column named "DateOfBirth" in the "Persons" table.

We use the following SQL statement:

ALTER TABLE Persons  
ADD DateOfBirth date;

Notice that the new column, "DateOfBirth", is of type date and is going to hold a date. The data type specifies what type of data the column can hold. For a complete reference of all the data types available in MS Access, MySQL, and SQL Server, go to our complete [Data Types reference](https://www.w3schools.com/sql/sql_datatypes.asp).

The "Persons" table will now look like this:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ID** | **LastName** | **FirstName** | **Address** | **City** | **DateOfBirth** |
| 1 | Hansen | Ola | Timoteivn 10 | Sandnes |  |
| 2 | Svendson | Tove | Borgvn 23 | Sandnes |  |
| 3 | Pettersen | Kari | Storgt 20 | Stavanger |  |

Change Data Type Example

Now we want to change the data type of the column named "DateOfBirth" in the "Persons" table.

We use the following SQL statement:

ALTER TABLE Persons  
ALTER COLUMN DateOfBirth year;

Notice that the "DateOfBirth" column is now of type year and is going to hold a year in a two- or four-digit format.

DROP COLUMN Example

Next, we want to delete the column named "DateOfBirth" in the "Persons" table.

We use the following SQL statement:

ALTER TABLE Persons  
DROP COLUMN DateOfBirth;

The "Persons" table will now look like this:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID** | **LastName** | **FirstName** | **Address** | **City** |
| 1 | Hansen | Ola | Timoteivn 10 | Sandnes |
| 2 | Svendson | Tove | Borgvn 23 | Sandnes |
| 3 | Pettersen | Kari | Storgt 20 | Stavanger |

# SQL Constraints

[❮ Previous](https://www.w3schools.com/sql/sql_alter.asp)[Next ❯](https://www.w3schools.com/sql/sql_notnull.asp)

SQL constraints are used to specify rules for data in a table.

## SQL Create Constraints

Constraints can be specified when the table is created with the CREATE TABLE statement, or after the table is created with the ALTER TABLE statement.

### Syntax

CREATE TABLE table\_name (  
    column1 datatype *constraint*,  
    column2 datatype *constraint*,  
    column3 datatype *constraint*,  
    ....  
);

## SQL Constraints

SQL constraints are used to specify rules for the data in a table.

Constraints 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 table. If there is any violation between the constraint and the data action, the action is aborted.

Constraints can be column level or table level. Column level constraints apply to a column, and table level constraints apply to the whole table.

The following constraints are commonly used in SQL:

* [**NOT NULL**](https://www.w3schools.com/sql/sql_notnull.asp) - Ensures that a column cannot have a NULL value
* [**UNIQUE**](https://www.w3schools.com/sql/sql_unique.asp) - Ensures that all values in a column are different
* [**PRIMARY KEY**](https://www.w3schools.com/sql/sql_primarykey.asp) - A combination of a NOT NULL and UNIQUE. Uniquely identifies each row in a table
* [**FOREIGN KEY**](https://www.w3schools.com/sql/sql_foreignkey.asp) - Uniquely identifies a row/record in another table
* [**CHECK**](https://www.w3schools.com/sql/sql_check.asp) - Ensures that all values in a column satisfies a specific condition
* [**DEFAULT**](https://www.w3schools.com/sql/sql_default.asp) - Sets a default value for a column when no value is specified
* [**INDEX**](https://www.w3schools.com/sql/sql_create_index.asp) - Used to create and retrieve data from the database very quickly

# SQL NOT NULL Constraint

[❮ Previous](https://www.w3schools.com/sql/sql_constraints.asp)[Next ❯](https://www.w3schools.com/sql/sql_unique.asp)

## SQL NOT NULL Constraint

By default, a column can hold NULL values.

The NOT NULL constraint enforces a column to NOT accept NULL values.

This enforces a field to always contain a value, which means that you cannot insert a new record, or update a record without adding a value to this field.

## SQL NOT NULL on CREATE TABLE

The following SQL ensures that the "ID", "LastName", and "FirstName" columns will NOT accept NULL values when the "Persons" table is created:

### Example

CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255) NOT NULL,  
    Age int  
);

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_create_constraint_not_null)

## SQL NOT NULL on ALTER TABLE

To create a NOT NULL constraint on the "Age" column when the "Persons" table is already created, use the following SQL:

ALTER TABLE Persons  
MODIFY Age int NOT NULL;

# SQL UNIQUE Constraint

[❮ Previous](https://www.w3schools.com/sql/sql_notnull.asp)[Next ❯](https://www.w3schools.com/sql/sql_primarykey.asp)

## SQL UNIQUE Constraint

The UNIQUE constraint ensures that all values in a column are different.

Both the UNIQUE and PRIMARY KEY constraints provide a guarantee for uniqueness for a column or set of columns.

A PRIMARY KEY constraint automatically has a UNIQUE constraint.

However, you can have many UNIQUE constraints per table, but only one PRIMARY KEY constraint per table.

## SQL UNIQUE Constraint on CREATE TABLE

The following SQL creates a UNIQUE constraint on the "ID" column when the "Persons" table is created:

**SQL Server / Oracle / MS Access:**

CREATE TABLE Persons (  
    ID int NOT NULL UNIQUE,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int  
);

**MySQL:**

CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    UNIQUE (ID)  
);

To name a UNIQUE constraint, and to define a UNIQUE constraint on multiple columns, use the following SQL syntax:

**MySQL / SQL Server / Oracle / MS Access:**

CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    CONSTRAINT UC\_Person UNIQUE (ID,LastName)  
);

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## SQL UNIQUE Constraint on ALTER TABLE

To create a UNIQUE constraint on the "ID" column when the table is already created, use the following SQL:

**MySQL / SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
ADD UNIQUE (ID);

To name a UNIQUE constraint, and to define a UNIQUE constraint on multiple columns, use the following SQL syntax:

**MySQL / SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
ADD CONSTRAINT UC\_Person UNIQUE (ID,LastName);

## DROP a UNIQUE Constraint

To drop a UNIQUE constraint, use the following SQL:

**MySQL:**

ALTER TABLE Persons  
DROP INDEX UC\_Person;

**SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
DROP CONSTRAINT UC\_Person;

# SQL PRIMARY KEY Constraint

[❮ Previous](https://www.w3schools.com/sql/sql_unique.asp)[Next ❯](https://www.w3schools.com/sql/sql_foreignkey.asp)

## SQL PRIMARY KEY Constraint

The PRIMARY KEY constraint uniquely identifies each record in a table.

Primary keys must contain UNIQUE values, and cannot contain NULL values.

A table can have only ONE primary key; and in the table, this primary key can consist of single or multiple columns (fields).

## SQL PRIMARY KEY on CREATE TABLE

The following SQL creates a PRIMARY KEY on the "ID" column when the "Persons" table is created:

**MySQL:**

CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    PRIMARY KEY (ID)  
);

**SQL Server / Oracle / MS Access:**

CREATE TABLE Persons (  
    ID int NOT NULL PRIMARY KEY,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int  
);

To allow naming of a PRIMARY KEY constraint, and for defining a PRIMARY KEY constraint on multiple columns, use the following SQL syntax:

**MySQL / SQL Server / Oracle / MS Access:**

CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    CONSTRAINT PK\_Person PRIMARY KEY (ID,LastName)  
);

**Note:** In the example above there is only ONE PRIMARY KEY (PK\_Person). However, the VALUE of the primary key is made up of TWO COLUMNS (ID + LastName).

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## SQL PRIMARY KEY on ALTER TABLE

To create a PRIMARY KEY constraint on the "ID" column when the table is already created, use the following SQL:

**MySQL / SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
ADD PRIMARY KEY (ID);

To allow naming of a PRIMARY KEY constraint, and for defining a PRIMARY KEY constraint on multiple columns, use the following SQL syntax:

**MySQL / SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
ADD CONSTRAINT PK\_Person PRIMARY KEY (ID,LastName);

**Note:** If you use the ALTER TABLE statement to add a primary key, the primary key column(s) must already have been declared to not contain NULL values (when the table was first created).

## DROP a PRIMARY KEY Constraint

To drop a PRIMARY KEY constraint, use the following SQL:

**MySQL:**

ALTER TABLE Persons  
DROP PRIMARY KEY;

**SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
DROP CONSTRAINT PK\_Person;

# SQL FOREIGN KEY Constraint

[❮ Previous](https://www.w3schools.com/sql/sql_primarykey.asp)[Next ❯](https://www.w3schools.com/sql/sql_check.asp)

## SQL 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.

Look at the following two tables:

"Persons" table:

|  |  |  |  |
| --- | --- | --- | --- |
| **PersonID** | **LastName** | **FirstName** | **Age** |
| 1 | Hansen | Ola | 30 |
| 2 | Svendson | Tove | 23 |
| 3 | Pettersen | Kari | 20 |

"Orders" table:

|  |  |  |
| --- | --- | --- |
| **OrderID** | **OrderNumber** | **PersonID** |
| 1 | 77895 | 3 |
| 2 | 44678 | 3 |
| 3 | 22456 | 2 |
| 4 | 24562 | 1 |

Notice that the "PersonID" column in the "Orders" table points to the "PersonID" column in the "Persons" table.

The "PersonID" column in the "Persons" table is the PRIMARY KEY in the "Persons" table.

The "PersonID" column in the "Orders" table is a FOREIGN KEY in the "Orders" table.

The FOREIGN KEY constraint is used to prevent actions that would destroy links between tables.

The FOREIGN KEY constraint also prevents invalid data from being inserted into the foreign key column, because it has to be one of the values contained in the table it points to.

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## SQL FOREIGN KEY on CREATE TABLE

The following SQL creates a FOREIGN KEY on the "PersonID" column when the "Orders" table is created:

**MySQL:**

CREATE TABLE Orders (  
    OrderID int NOT NULL,  
    OrderNumber int NOT NULL,  
    PersonID int,  
    PRIMARY KEY (OrderID),  
    FOREIGN KEY (PersonID) REFERENCES Persons(PersonID)  
);

**SQL Server / Oracle / MS Access:**

CREATE TABLE Orders (  
    OrderID int NOT NULL PRIMARY KEY,  
    OrderNumber int NOT NULL,  
    PersonID int FOREIGN KEY REFERENCES Persons(PersonID)  
);

To allow naming of a FOREIGN KEY constraint, and for defining a FOREIGN KEY constraint on multiple columns, use the following SQL syntax:

**MySQL / SQL Server / Oracle / MS Access:**

CREATE TABLE Orders (  
    OrderID int NOT NULL,  
    OrderNumber int NOT NULL,  
    PersonID int,  
    PRIMARY KEY (OrderID),  
    CONSTRAINT FK\_PersonOrder FOREIGN KEY (PersonID)  
    REFERENCES Persons(PersonID)  
);

## SQL FOREIGN KEY on ALTER TABLE

To create a FOREIGN KEY constraint on the "PersonID" column when the "Orders" table is already created, use the following SQL:

**MySQL / SQL Server / Oracle / MS Access:**

ALTER TABLE Orders  
ADD FOREIGN KEY (PersonID) REFERENCES Persons(PersonID);

To allow naming of a FOREIGN KEY constraint, and for defining a FOREIGN KEY constraint on multiple columns, use the following SQL syntax:

**MySQL / SQL Server / Oracle / MS Access:**

ALTER TABLE Orders  
ADD CONSTRAINT FK\_PersonOrder  
FOREIGN KEY (PersonID) REFERENCES Persons(PersonID);

## DROP a FOREIGN KEY Constraint

To drop a FOREIGN KEY constraint, use the following SQL:

**MySQL:**

ALTER TABLE Orders  
DROP FOREIGN KEY FK\_PersonOrder;

**SQL Server / Oracle / MS Access:**

ALTER TABLE Orders  
DROP CONSTRAINT FK\_PersonOrder;

# SQL CHECK Constraint

[❮ Previous](https://www.w3schools.com/sql/sql_foreignkey.asp)[Next ❯](https://www.w3schools.com/sql/sql_default.asp)

## SQL CHECK Constraint

The CHECK constraint is used to limit the value range that can be placed in a column.

If you define a CHECK constraint on a single column it allows only certain values for this column.

If you define a CHECK constraint on a table it can limit the values in certain columns based on values in other columns in the row.

## SQL CHECK on CREATE TABLE

The following SQL creates a CHECK constraint on the "Age" column when the "Persons" table is created. The CHECK constraint ensures that the age of a person must be 18, or older:

**MySQL:**

CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    CHECK (Age>=18)  
);

**SQL Server / Oracle / MS Access:**

CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int CHECK (Age>=18)  
);

To allow naming of a CHECK constraint, and for defining a CHECK constraint on multiple columns, use the following SQL syntax:

**MySQL / SQL Server / Oracle / MS Access:**

CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    City varchar(255),  
    CONSTRAINT CHK\_Person CHECK (Age>=18 AND City='Sandnes')  
);

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## SQL CHECK on ALTER TABLE

To create a CHECK constraint on the "Age" column when the table is already created, use the following SQL:

**MySQL / SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
ADD CHECK (Age>=18);

To allow naming of a CHECK constraint, and for defining a CHECK constraint on multiple columns, use the following SQL syntax:

**MySQL / SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
ADD CONSTRAINT CHK\_PersonAge CHECK (Age>=18 AND City='Sandnes');

## DROP a CHECK Constraint

To drop a CHECK constraint, use the following SQL:

**SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
DROP CONSTRAINT CHK\_PersonAge;

**MySQL:**

ALTER TABLE Persons  
DROP CHECK CHK\_PersonAge;

# SQL DEFAULT Constraint

[❮ Previous](https://www.w3schools.com/sql/sql_check.asp)[Next ❯](https://www.w3schools.com/sql/sql_create_index.asp)

## SQL DEFAULT Constraint

The DEFAULT constraint is used to provide a default value for a column.

The default value will be added to all new records IF no other value is specified.

## SQL DEFAULT on CREATE TABLE

The following SQL sets a DEFAULT value for the "City" column when the "Persons" table is created:

**My SQL / SQL Server / Oracle / MS Access:**

CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    City varchar(255) DEFAULT 'Sandnes'  
);

The DEFAULT constraint can also be used to insert system values, by using functions like GETDATE():

CREATE TABLE Orders (  
    ID int NOT NULL,  
    OrderNumber int NOT NULL,  
    OrderDate date DEFAULT GETDATE()  
);

## SQL DEFAULT on ALTER TABLE

To create a DEFAULT constraint on the "City" column when the table is already created, use the following SQL:

**MySQL:**

ALTER TABLE Persons  
ALTER City SET DEFAULT 'Sandnes';

**SQL Server:**

ALTER TABLE Persons  
ADD CONSTRAINT df\_City  
DEFAULT 'Sandnes' FOR City;

**MS Access:**

ALTER TABLE Persons  
ALTER COLUMN City SET DEFAULT 'Sandnes';

**Oracle:**

ALTER TABLE Persons  
MODIFY City DEFAULT 'Sandnes';

## DROP a DEFAULT Constraint

To drop a DEFAULT constraint, use the following SQL:

**MySQL:**

ALTER TABLE Persons  
ALTER City DROP DEFAULT;

**SQL Server / Oracle / MS Access:**

ALTER TABLE Persons  
ALTER COLUMN City DROP DEFAULT;

# SQL CREATE INDEX Statement

[❮ Previous](https://www.w3schools.com/sql/sql_default.asp)[Next ❯](https://www.w3schools.com/sql/sql_autoincrement.asp)

## SQL CREATE INDEX Statement

The CREATE INDEX statement is used to create indexes in tables.

Indexes are used to retrieve data from the database more quickly than otherwise. The users cannot see the indexes, they are just used to speed up searches/queries.

**Note:** Updating a table with indexes takes more time than updating a table without (because the indexes also need an update). So, only create indexes on columns that will be frequently searched against.

### CREATE INDEX Syntax

Creates an index on a table. Duplicate values are allowed:

CREATE INDEX index\_name  
ON table\_name (column1, column2, ...);

### CREATE UNIQUE INDEX Syntax

Creates a unique index on a table. Duplicate values are not allowed:

CREATE UNIQUE INDEX index\_name  
ON table\_name (column1, column2, ...);

**Note:** The syntax for creating indexes varies among different databases. Therefore: Check the syntax for creating indexes in your database.

## CREATE INDEX Example

The SQL statement below creates an index named "idx\_lastname" on the "LastName" column in the "Persons" table:

CREATE INDEX idx\_lastname  
ON Persons (LastName);

If you want to create an index on a combination of columns, you can list the column names within the parentheses, separated by commas:

CREATE INDEX idx\_pname  
ON Persons (LastName, FirstName);

## DROP INDEX Statement

The DROP INDEX statement is used to delete an index in a table.

**MS Access:**

DROP INDEX index\_name ON table\_name;

**SQL Server:**

DROP INDEX table\_name.index\_name;

**DB2/Oracle:**

DROP INDEX index\_name;

**MySQL:**

ALTER TABLE table\_nameDROP INDEX index\_name;

# SQL AUTO INCREMENT Field

[❮ Previous](https://www.w3schools.com/sql/sql_create_index.asp)[Next ❯](https://www.w3schools.com/sql/sql_dates.asp)

## AUTO INCREMENT Field

Auto-increment allows a unique number to be generated automatically when a new record is inserted into a table.

Often this is the primary key field that we would like to be created automatically every time a new record is inserted.

## Syntax for MySQL

The following SQL statement defines the "Personid" column to be an auto-increment primary key field in the "Persons" table:

CREATE TABLE Persons (  
    Personid int NOT NULL AUTO\_INCREMENT,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    PRIMARY KEY (Personid)  
);

MySQL uses the AUTO\_INCREMENT keyword to perform an auto-increment feature.

By default, the starting value for AUTO\_INCREMENT is 1, and it will increment by 1 for each new record.

To let the AUTO\_INCREMENT sequence start with another value, use the following SQL statement:

ALTER TABLE Persons AUTO\_INCREMENT=100;

To insert a new record into the "Persons" table, we will NOT have to specify a value for the "Personid" column (a unique value will be added automatically):

INSERT INTO Persons (FirstName,LastName)  
VALUES ('Lars','Monsen');

The SQL statement above would insert a new record into the "Persons" table. The "Personid" column would be assigned a unique value. The "FirstName" column would be set to "Lars" and the "LastName" column would be set to "Monsen".

## Syntax for SQL Server

The following SQL statement defines the "Personid" column to be an auto-increment primary key field in the "Persons" table:

CREATE TABLE Persons (  
    Personid int IDENTITY(1,1) PRIMARY KEY,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int  
);

The MS SQL Server uses the IDENTITY keyword to perform an auto-increment feature.

In the example above, the starting value for IDENTITY is 1, and it will increment by 1 for each new record.

**Tip:** To specify that the "Personid" column should start at value 10 and increment by 5, change it to IDENTITY(10,5).

To insert a new record into the "Persons" table, we will NOT have to specify a value for the "Personid" column (a unique value will be added automatically):

INSERT INTO Persons (FirstName,LastName)  
VALUES ('Lars','Monsen');

The SQL statement above would insert a new record into the "Persons" table. The "Personid" column would be assigned a unique value. The "FirstName" column would be set to "Lars" and the "LastName" column would be set to "Monsen".

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## Syntax for Access

The following SQL statement defines the "Personid" column to be an auto-increment primary key field in the "Persons" table:

CREATE TABLE Persons (  
    Personid AUTOINCREMENT PRIMARY KEY,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int  
);

The MS Access uses the AUTOINCREMENT keyword to perform an auto-increment feature.

By default, the starting value for AUTOINCREMENT is 1, and it will increment by 1 for each new record.

**Tip:** To specify that the "Personid" column should start at value 10 and increment by 5, change the autoincrement to AUTOINCREMENT(10,5).

To insert a new record into the "Persons" table, we will NOT have to specify a value for the "Personid" column (a unique value will be added automatically):

INSERT INTO Persons (FirstName,LastName)  
VALUES ('Lars','Monsen');

The SQL statement above would insert a new record into the "Persons" table. The "Personid" column would be assigned a unique value. The "FirstName" column would be set to "Lars" and the "LastName" column would be set to "Monsen".

## Syntax for Oracle

In Oracle the code is a little bit more tricky.

You will have to create an auto-increment field with the sequence object (this object generates a number sequence).

Use the following CREATE SEQUENCE syntax:

CREATE SEQUENCE seq\_person  
MINVALUE 1  
START WITH 1  
INCREMENT BY 1  
CACHE 10;

The code above creates a sequence object called seq\_person, that starts with 1 and will increment by 1. It will also cache up to 10 values for performance. The cache option specifies how many sequence values will be stored in memory for faster access.

To insert a new record into the "Persons" table, we will have to use the nextval function (this function retrieves the next value from seq\_person sequence):

INSERT INTO Persons (Personid,FirstName,LastName)  
VALUES (seq\_person.nextval,'Lars','Monsen');

The SQL statement above would insert a new record into the "Persons" table. The "Personid" column would be assigned the next number from the seq\_person sequence. The "FirstName" column would be set to "Lars" and the "LastName" column would be set to "Monsen".

SQL Working With Dates

[❮ Previous](https://www.w3schools.com/sql/sql_autoincrement.asp)[Next ❯](https://www.w3schools.com/sql/sql_view.asp)

SQL Dates

The most difficult part when working with dates is to be sure that the format of the date you are trying to insert, matches the format of the date column in the database.

As long as your data contains only the date portion, your queries will work as expected. However, if a time portion is involved, it gets more complicated.

SQL Date Data Types

**MySQL** comes with the following data types for storing a date or a date/time value in the database:

* DATE - format YYYY-MM-DD
* DATETIME - format: YYYY-MM-DD HH:MI:SS
* TIMESTAMP - format: YYYY-MM-DD HH:MI:SS
* YEAR - format YYYY or YY

**SQL Server** comes with the following data types for storing a date or a date/time value in the database:

* DATE - format YYYY-MM-DD
* DATETIME - format: YYYY-MM-DD HH:MI:SS
* SMALLDATETIME - format: YYYY-MM-DD HH:MI:SS
* TIMESTAMP - format: a unique number

**Note:** The date types are chosen for a column when you create a new table in your database!

SQL Working with Dates

You can compare two dates easily if there is no time component involved!

Assume we have the following "Orders" table:

|  |  |  |
| --- | --- | --- |
| **OrderId** | **ProductName** | **OrderDate** |
| 1 | Geitost | 2008-11-11 |
| 2 | Camembert Pierrot | 2008-11-09 |
| 3 | Mozzarella di Giovanni | 2008-11-11 |
| 4 | Mascarpone Fabioli | 2008-10-29 |

Now we want to select the records with an OrderDate of "2008-11-11" from the table above.

We use the following SELECT statement:

SELECT \* FROM Orders WHERE OrderDate='2008-11-11'

The result-set will look like this:

|  |  |  |
| --- | --- | --- |
| **OrderId** | **ProductName** | **OrderDate** |
| 1 | Geitost | 2008-11-11 |
| 3 | Mozzarella di Giovanni | 2008-11-11 |

Now, assume that the "Orders" table looks like this (notice the time component in the "OrderDate" column):

|  |  |  |
| --- | --- | --- |
| **OrderId** | **ProductName** | **OrderDate** |
| 1 | Geitost | 2008-11-11 13:23:44 |
| 2 | Camembert Pierrot | 2008-11-09 15:45:21 |
| 3 | Mozzarella di Giovanni | 2008-11-11 11:12:01 |
| 4 | Mascarpone Fabioli | 2008-10-29 14:56:59 |

If we use the same SELECT statement as above:

SELECT \* FROM Orders WHERE OrderDate='2008-11-11'

we will get no result! This is because the query is looking only for dates with no time portion.

**Tip:** To keep your queries simple and easy to maintain, do not allow time components in your dates!

# SQL Views

[❮ Previous](https://www.w3schools.com/sql/sql_dates.asp)[Next ❯](https://www.w3schools.com/sql/sql_injection.asp)

## SQL CREATE VIEW Statement

In SQL, a view is a virtual table based on the result-set of an SQL statement.

A view contains rows and columns, just like a real table. The fields in a view are fields from one or more real tables in the database.

You can add SQL functions, WHERE, and JOIN statements to a view and present the data as if the data were coming from one single table.

### CREATE VIEW Syntax

CREATE VIEW view\_name AS  
SELECT column1, column2, ...  
FROM table\_name  
WHERE condition;

**Note:** A view always shows up-to-date data! The database engine recreates the data, using the view's SQL statement, every time a user queries a view.

## SQL CREATE VIEW Examples

The following SQL creates a view that shows all customers from Brazil:

### Example

CREATE VIEW [Brazil Customers] AS  
SELECT CustomerName, ContactName  
FROM Customers  
WHERE Country = 'Brazil';

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_view1)

We can query the view above as follows:

### Example

SELECT \* FROM [Brazil Customers];

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_view2)

The following SQL creates a view that selects every product in the "Products" table with a price higher than the average price:

### Example

CREATE VIEW [Products Above Average Price] AS  
SELECT ProductName, Price  
FROM Products  
WHERE Price > (SELECT AVG(Price) FROM Products);

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_view3)

We can query the view above as follows:

### Example

SELECT \* FROM [Products Above Average Price];

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_view4)

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## SQL Updating a View

A view can be updated with the CREATE OR REPLACE VIEW command.

### SQL CREATE OR REPLACE VIEW Syntax

CREATE OR REPLACE VIEW view\_name AS  
SELECT column1, column2, ...  
FROM table\_name  
WHERE condition;

The following SQL adds the "City" column to the "Brazil Customers" view:

### Example

CREATE OR REPLACE VIEW [Brazil Customers] AS  
SELECT CustomerName, ContactName, City  
FROM Customers  
WHERE Country = 'Brazil';

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_view5)

## SQL Dropping a View

A view is deleted with the DROP VIEW command.

### SQL DROP VIEW Syntax

DROP VIEW view\_name;

The following SQL drops the "Brazil Customers" view:

### Example

DROP VIEW [Brazil Customers];

[Try it Yourself »](https://www.w3schools.com/sql/trysql.asp?filename=trysql_view6)

# SQL Injection

[❮ Previous](https://www.w3schools.com/sql/sql_view.asp)[Next ❯](https://www.w3schools.com/sql/sql_hosting.asp)

## SQL Injection

SQL injection is a code injection technique that might destroy your database.

SQL injection is one of the most common web hacking techniques.

SQL injection is the placement of malicious code in SQL statements, via web page input.

## SQL in Web Pages

SQL injection usually occurs when you ask a user for input, like their username/userid, and instead of a name/id, the user gives you an SQL statement that you will **unknowingly** run on your database.

Look at the following example which creates a SELECT statement by adding a variable (txtUserId) to a select string. The variable is fetched from user input (getRequestString):

### Example

txtUserId = getRequestString("UserId");  
txtSQL = "SELECT \* FROM Users WHERE UserId = " + txtUserId;

The rest of this chapter describes the potential dangers of using user input in SQL statements.

## SQL Injection Based on 1=1 is Always True

Look at the example above again. The original purpose of the code was to create an SQL statement to select a user, with a given user id.

If there is nothing to prevent a user from entering "wrong" input, the user can enter some "smart" input like this:

UserId: 

Then, the SQL statement will look like this:

SELECT \* FROM Users WHERE UserId = 105 OR 1=1;

The SQL above is valid and will return ALL rows from the "Users" table, since **OR 1=1** is always TRUE.

Does the example above look dangerous? What if the "Users" table contains names and passwords?

The SQL statement above is much the same as this:

SELECT UserId, Name, Password FROM Users WHERE UserId = 105 or 1=1;

A hacker might get access to all the user names and passwords in a database, by simply inserting 105 OR 1=1 into the input field.

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## SQL Injection Based on ""="" is Always True

Here is an example of a user login on a web site:

Username:  


Password:  


### Example

uName = getRequestString("username");  
uPass = getRequestString("userpassword");  
  
sql = 'SELECT \* FROM Users WHERE Name ="' + uName + '" AND Pass ="' + uPass + '"'

### Result

SELECT \* FROM Users WHERE Name ="John Doe" AND Pass ="myPass"

A hacker might get access to user names and passwords in a database by simply inserting " OR ""=" into the user name or password text box:

User Name:  


Password:  


The code at the server will create a valid SQL statement like this:

### Result

SELECT \* FROM Users WHERE Name ="" or ""="" AND Pass ="" or ""=""

The SQL above is valid and will return all rows from the "Users" table, since **OR ""=""** is always TRUE.

## SQL Injection Based on Batched SQL Statements

Most databases support batched SQL statement.

A batch of SQL statements is a group of two or more SQL statements, separated by semicolons.

The SQL statement below will return all rows from the "Users" table, then delete the "Suppliers" table.

### Example

SELECT \* FROM Users; DROP TABLE Suppliers

Look at the following example:

### Example

txtUserId = getRequestString("UserId");  
txtSQL = "SELECT \* FROM Users WHERE UserId = " + txtUserId;

And the following input:

User id: 

The valid SQL statement would look like this:

### Result

SELECT \* FROM Users WHERE UserId = 105; DROP TABLE Suppliers;

## Use SQL Parameters for Protection

To protect a web site from SQL injection, you can use SQL parameters.

SQL parameters are values that are added to an SQL query at execution time, in a controlled manner.

### ASP.NET Razor Example

txtUserId = getRequestString("UserId");  
txtSQL = "SELECT \* FROM Users WHERE UserId = @0";  
db.Execute(txtSQL,txtUserId);

Note that parameters are represented in the SQL statement by a @ marker.

The SQL engine checks each parameter to ensure that it is correct for its column and are treated literally, and not as part of the SQL to be executed.

### Another Example

txtNam = getRequestString("CustomerName");  
txtAdd = getRequestString("Address");  
txtCit = getRequestString("City");  
txtSQL = "INSERT INTO Customers (CustomerName,Address,City) Values(@0,@1,@2)";  
db.Execute(txtSQL,txtNam,txtAdd,txtCit);

## Examples

The following examples shows how to build parameterized queries in some common web languages.

SELECT STATEMENT IN ASP.NET:

txtUserId = getRequestString("UserId");  
sql = "SELECT \* FROM Customers WHERE CustomerId = @0";  
command = new SqlCommand(sql);  
command.Parameters.AddWithValue("@0",txtUserId);  
command.ExecuteReader();

INSERT INTO STATEMENT IN ASP.NET:

txtNam = getRequestString("CustomerName");  
txtAdd = getRequestString("Address");  
txtCit = getRequestString("City");  
txtSQL = "INSERT INTO Customers (CustomerName,Address,City) Values(@0,@1,@2)";  
command = new SqlCommand(txtSQL);  
command.Parameters.AddWithValue("@0",txtNam);  
command.Parameters.AddWithValue("@1",txtAdd);  
command.Parameters.AddWithValue("@2",txtCit);  
command.ExecuteNonQuery();

INSERT INTO STATEMENT IN PHP:

$stmt = $dbh->prepare("INSERT INTO Customers (CustomerName,Address,City)  
VALUES (:nam, :add, :cit)");  
$stmt->bindParam(':nam', $txtNam);  
$stmt->bindParam(':add', $txtAdd);  
$stmt->bindParam(':cit', $txtCit);  
$stmt->execute();

# SQL Hosting

[❮ Previous](https://www.w3schools.com/sql/sql_injection.asp)[Next ❯](https://www.w3schools.com/sql/sql_datatypes.asp)

## SQL Hosting

If you want your web site to be able to store and retrieve data from a database, your web server should have access to a database-system that uses the SQL language.

If your web server is hosted by an Internet Service Provider (ISP), you will have to look for SQL hosting plans.

The most common SQL hosting databases are MS SQL Server, Oracle, MySQL, and MS Access.

## MS SQL Server

Microsoft's SQL Server is a popular database software for database-driven web sites with high traffic.

SQL Server is a very powerful, robust and full featured SQL database system.

## Oracle

Oracle is also a popular database software for database-driven web sites with high traffic.

Oracle is a very powerful, robust and full featured SQL database system.

## MySQL

MySQL is also a popular database software for web sites.

MySQL is a very powerful, robust and full featured SQL database system.

MySQL is an inexpensive alternative to the expensive Microsoft and Oracle solutions.

## Access

When a web site requires only a simple database, Microsoft Access can be a solution.

Access is not well suited for very high-traffic, and not as powerful as MySQL, SQL Server, or Oracle.

# SQL Data Types for MySQL, SQL Server, and MS Access

[❮ Previous](https://www.w3schools.com/sql/sql_hosting.asp)[Next ❯](https://www.w3schools.com/sql/sql_ref_keywords.asp)

The data type of a column defines what value the column can hold: integer, character, money, date and time, binary, and so on.

## SQL Data Types

Each column in a database table is required to have a name and a data type.

An SQL developer must decide what type of data that will be stored inside each column when creating a table. The data type is a guideline for SQL to understand what type of data is expected inside of each column, and it also identifies how SQL will interact with the stored data.

**Note:** Data types might have different names in different database. And even if the name is the same, the size and other details may be different! **Always check the documentation!**

## MySQL Data Types (Version 8.0)

In MySQL there are three main data types: string, numeric, and date and time.

### String data types:

|  |  |
| --- | --- |
| **Data type** | **Description** |
| CHAR(size) | A FIXED length string (can contain letters, numbers, and special characters). The size parameter specifies the column length in characters - can be from 0 to 255. Default is 1 |
| VARCHAR(size) | A VARIABLE length string (can contain letters, numbers, and special characters). The size parameter specifies the maximum column length in characters - can be from 0 to 65535 |
| BINARY(size) | Equal to CHAR(), but stores binary byte strings. The size parameter specifies the column length in bytes. Default is 1 |
| VARBINARY(size) | Equal to VARCHAR(), but stores binary byte strings. The size parameter specifies the maximum column length in bytes. |
| TINYBLOB | For BLOBs (Binary Large OBjects). Max length: 255 bytes |
| TINYTEXT | Holds a string with a maximum length of 255 characters |
| TEXT(size) | Holds a string with a maximum length of 65,535 bytes |
| BLOB(size) | For BLOBs (Binary Large OBjects). Holds up to 65,535 bytes of data |
| MEDIUMTEXT | Holds a string with a maximum length of 16,777,215 characters |
| MEDIUMBLOB | For BLOBs (Binary Large OBjects). Holds up to 16,777,215 bytes of data |
| LONGTEXT | Holds a string with a maximum length of 4,294,967,295 characters |
| LONGBLOB | For BLOBs (Binary Large OBjects). Holds up to 4,294,967,295 bytes of data |
| ENUM(val1, val2, val3, ...) | A string object that can have only one value, chosen from a list of possible values. You can list up to 65535 values in an ENUM list. If a value is inserted that is not in the list, a blank value will be inserted. The values are sorted in the order you enter them |
| SET(val1, val2, val3, ...) | A string object that can have 0 or more values, chosen from a list of possible values. You can list up to 64 values in a SET list |

### Numeric data types:

|  |  |
| --- | --- |
| **Data type** | **Description** |
| BIT(size) | A bit-value type. The number of bits per value is specified in size. The size parameter can hold a value from 1 to 64. The default value for size is 1. |
| TINYINT(size) | A very small integer. Signed range is from -128 to 127. Unsigned range is from 0 to 255. The size parameter specifies the maximum display width (which is 255) |
| BOOL | Zero is considered as false, nonzero values are considered as true. |
| BOOLEAN | Equal to BOOL |
| SMALLINT(size) | A small integer. Signed range is from -32768 to 32767. Unsigned range is from 0 to 65535. The size parameter specifies the maximum display width (which is 255) |
| MEDIUMINT(size) | A medium integer. Signed range is from -8388608 to 8388607. Unsigned range is from 0 to 16777215. The size parameter specifies the maximum display width (which is 255) |
| INT(size) | A medium integer. Signed range is from -2147483648 to 2147483647. Unsigned range is from 0 to 4294967295. The size parameter specifies the maximum display width (which is 255) |
| INTEGER(size) | Equal to INT(size) |
| BIGINT(size) | A large integer. Signed range is from -9223372036854775808 to 9223372036854775807. Unsigned range is from 0 to 18446744073709551615. The size parameter specifies the maximum display width (which is 255) |
| FLOAT(size, d) | A floating point number. The total number of digits is specified in size. The number of digits after the decimal point is specified in the d parameter. This syntax is deprecated in MySQL 8.0.17, and it will be removed in future MySQL versions |
| FLOAT(p) | A floating point number. MySQL uses the p value to determine whether to use FLOAT or DOUBLE for the resulting data type. If p is from 0 to 24, the data type becomes FLOAT(). If p is from 25 to 53, the data type becomes DOUBLE() |
| DOUBLE(size, d) | A normal-size floating point number. The total number of digits is specified in size. The number of digits after the decimal point is specified in the d parameter |
| DOUBLE PRECISION(size, d) |  |
| DECIMAL(size, d) | An exact fixed-point number. The total number of digits is specified in size. The number of digits after the decimal point is specified in the d parameter. The maximum number for size is 65. The maximum number for d is 30. The default value for size is 10. The default value for d is 0. |
| DEC(size, d) | Equal to DECIMAL(size,d) |

**Note:** All the numeric data types may have an extra option: UNSIGNED or ZEROFILL. If you add the UNSIGNED option, MySQL disallows negative values for the column. If you add the ZEROFILL option, MySQL automatically also adds the UNSIGNED attribute to the column.

### Date and Time data types:

|  |  |
| --- | --- |
| **Data type** | **Description** |
| DATE | A date. Format: YYYY-MM-DD. The supported range is from '1000-01-01' to '9999-12-31' |
| DATETIME(fsp) | A date and time combination. Format: YYYY-MM-DD hh:mm:ss. The supported range is from '1000-01-01 00:00:00' to '9999-12-31 23:59:59'. Adding DEFAULT and ON UPDATE in the column definition to get automatic initialization and updating to the current date and time |
| TIMESTAMP(fsp) | A timestamp. TIMESTAMP values are stored as the number of seconds since the Unix epoch ('1970-01-01 00:00:00' UTC). Format: YYYY-MM-DD hh:mm:ss. The supported range is from '1970-01-01 00:00:01' UTC to '2038-01-09 03:14:07' UTC. Automatic initialization and updating to the current date and time can be specified using DEFAULT CURRENT\_TIMESTAMP and ON UPDATE CURRENT\_TIMESTAMP in the column definition |
| TIME(fsp) | A time. Format: hh:mm:ss. The supported range is from '-838:59:59' to '838:59:59' |
| YEAR | A year in four-digit format. Values allowed in four-digit format: 1901 to 2155, and 0000. MySQL 8.0 does not support year in two-digit format. |

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## SQL Server Data Types

### String data types:

|  |  |  |  |
| --- | --- | --- | --- |
| **Data type** | **Description** | **Max size** | **Storage** |
| char(n) | Fixed width character string | 8,000 characters | Defined width |
| varchar(n) | Variable width character string | 8,000 characters | 2 bytes + number of chars |
| varchar(max) | Variable width character string | 1,073,741,824 characters | 2 bytes + number of chars |
| text | Variable width character string | 2GB of text data | 4 bytes + number of chars |
| nchar | Fixed width Unicode string | 4,000 characters | Defined width x 2 |
| nvarchar | Variable width Unicode string | 4,000 characters |  |
| nvarchar(max) | Variable width Unicode string | 536,870,912 characters |  |
| ntext | Variable width Unicode string | 2GB of text data |  |
| binary(n) | Fixed width binary string | 8,000 bytes |  |
| varbinary | Variable width binary string | 8,000 bytes |  |
| varbinary(max) | Variable width binary string | 2GB |  |
| image | Variable width binary string | 2GB |  |

### Numeric data types:

|  |  |  |
| --- | --- | --- |
| **Data type** | **Description** | **Storage** |
| bit | Integer that can be 0, 1, or NULL |  |
| tinyint | Allows whole numbers from 0 to 255 | 1 byte |
| smallint | Allows whole numbers between -32,768 and 32,767 | 2 bytes |
| int | Allows whole numbers between -2,147,483,648 and 2,147,483,647 | 4 bytes |
| bigint | Allows whole numbers between -9,223,372,036,854,775,808 and 9,223,372,036,854,775,807 | 8 bytes |
| decimal(p,s) | Fixed precision and scale numbers.  Allows numbers from -10^38 +1 to 10^38 –1.  The p parameter indicates the maximum total number of digits that can be stored (both to the left and to the right of the decimal point). p must be a value from 1 to 38. Default is 18.  The s parameter indicates the maximum number of digits stored to the right of the decimal point. s must be a value from 0 to p. Default value is 0 | 5-17 bytes |
| numeric(p,s) | Fixed precision and scale numbers.  Allows numbers from -10^38 +1 to 10^38 –1.  The p parameter indicates the maximum total number of digits that can be stored (both to the left and to the right of the decimal point). p must be a value from 1 to 38. Default is 18.  The s parameter indicates the maximum number of digits stored to the right of the decimal point. s must be a value from 0 to p. Default value is 0 | 5-17 bytes |
| smallmoney | Monetary data from -214,748.3648 to 214,748.3647 | 4 bytes |
| money | Monetary data from -922,337,203,685,477.5808 to 922,337,203,685,477.5807 | 8 bytes |
| float(n) | Floating precision number data from -1.79E + 308 to 1.79E + 308.  The n parameter indicates whether the field should hold 4 or 8 bytes. float(24) holds a 4-byte field and float(53) holds an 8-byte field. Default value of n is 53. | 4 or 8 bytes |
| real | Floating precision number data from -3.40E + 38 to 3.40E + 38 | 4 bytes |

### Date and Time data types:

|  |  |  |
| --- | --- | --- |
| **Data type** | **Description** | **Storage** |
| datetime | From January 1, 1753 to December 31, 9999 with an accuracy of 3.33 milliseconds | 8 bytes |
| datetime2 | From January 1, 0001 to December 31, 9999 with an accuracy of 100 nanoseconds | 6-8 bytes |
| smalldatetime | From January 1, 1900 to June 6, 2079 with an accuracy of 1 minute | 4 bytes |
| date | Store a date only. From January 1, 0001 to December 31, 9999 | 3 bytes |
| time | Store a time only to an accuracy of 100 nanoseconds | 3-5 bytes |
| datetimeoffset | The same as datetime2 with the addition of a time zone offset | 8-10 bytes |
| timestamp | Stores a unique number that gets updated every time a row gets created or modified. The timestamp value is based upon an internal clock and does not correspond to real time. Each table may have only one timestamp variable |  |

### Other data types:

|  |  |
| --- | --- |
| **Data type** | **Description** |
| sql\_variant | Stores up to 8,000 bytes of data of various data types, except text, ntext, and timestamp |
| uniqueidentifier | Stores a globally unique identifier (GUID) |
| xml | Stores XML formatted data. Maximum 2GB |
| cursor | Stores a reference to a cursor used for database operations |
| table | Stores a result-set for later processing |

## Microsoft Access Data Types

|  |  |  |
| --- | --- | --- |
| **Data type** | **Description** | **Storage** |
| Text | Use for text or combinations of text and numbers. 255 characters maximum |  |
| Memo | Memo is used for larger amounts of text. Stores up to 65,536 characters. **Note:** You cannot sort a memo field. However, they are searchable |  |
| Byte | Allows whole numbers from 0 to 255 | 1 byte |
| Integer | Allows whole numbers between -32,768 and 32,767 | 2 bytes |
| Long | Allows whole numbers between -2,147,483,648 and 2,147,483,647 | 4 bytes |
| Single | Single precision floating-point. Will handle most decimals | 4 bytes |
| Double | Double precision floating-point. Will handle most decimals | 8 bytes |
| Currency | Use for currency. Holds up to 15 digits of whole dollars, plus 4 decimal places. **Tip:** You can choose which country's currency to use | 8 bytes |
| AutoNumber | AutoNumber fields automatically give each record its own number, usually starting at 1 | 4 bytes |
| Date/Time | Use for dates and times | 8 bytes |
| Yes/No | A logical field can be displayed as Yes/No, True/False, or On/Off. In code, use the constants True and False (equivalent to -1 and 0). **Note:** Null values are not allowed in Yes/No fields | 1 bit |
| Ole Object | Can store pictures, audio, video, or other BLOBs (Binary Large OBjects) | up to 1GB |
| Hyperlink | Contain links to other files, including web pages |  |
| Lookup Wizard | Let you type a list of options, which can then be chosen from a drop-down list | 4 bytes |