SQL NOTES

Introduction to SQL

SQL is a standard language for accessing and manipulating databases.

What is SQL?

- SQL stands for Structured Query Language
- SQL lets you access and manipulate databases
- SQL is an ANSI (American National Standards Institute) standard

What Can SQL do?

- SQL can execute queries against a database
- SQL can retrieve data from a database
- SQL can insert records in a database
- SQL can update records in a database
- SQL can delete records from a database
- SQL can create new databases
- SQL can create new tables in a database

SQL DML and DDL

SQL can be divided into two parts: The Data Manipulation Language (DML) and the Data Definition Language (DDL).

The query and update commands form the DML part of SQL:

- **SELECT** - extracts data from a database
- **UPDATE** - updates data in a database
- **DELETE** - deletes data from a database
- **INSERT INTO** - inserts new data into a database

The DDL part of SQL permits database tables to be created or deleted. It also define indexes (keys), specify links between tables, and impose constraints between tables. The most important DDL statements in SQL are:

- **CREATE DATABASE** - creates a new database
- **ALTER DATABASE** - modifies a database
- **CREATE TABLE** - creates a new table
- **ALTER TABLE** - modifies a table
- **DROP TABLE** - deletes a table

- **CREATE INDEX** - creates an index (search key)
- **DROP INDEX** - deletes an index

The SQL SELECT Statement

The SELECT statement is used to select data from a database. The result is stored in a result table, called the result-set.

SQL SELECT Syntax

```
SELECT column_name(s)
FROM table_name
```

and

```
SELECT * FROM table_name
```

Note: SQL is not case sensitive. SELECT is the same as select.

An SQL SELECT Example

The "Persons" table:

P_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 select the content of the columns named "LastName" and "FirstName" from the table above.

We use the following SELECT statement:

```
SELECT LastName,FirstName FROM Persons
```

The result-set will look like this:

LastName	FirstName
Hansen	Ola
Svendson	Tove
Pettersen	Kari

SELECT * Example

Now we want to select all the columns from the "Persons" table.

We use the following SELECT statement:

```
SELECT * FROM Persons
```

Tip: The asterisk (*) is a quick way of selecting all columns!

The result-set will look like this:

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

SQL Syntax using WHERE condition

SELECT Company, Country FROM Customers WHERE Country = 'USA'

SQL Result

Company	Country
Island Trading	UK
Galería del gastrónomo	Spain
Laughing Bacchus Wine Cellars	Canada

Paris spécialités	France
Simons bistro	Denmark
Wolski Zajazd	Poland

The SQL SELECT DISTINCT Statement

In a table, some of the columns may contain duplicate values. This is not a problem, however, sometimes you will want to list only the different (distinct) values in a table.

The DISTINCT keyword can be used to return only distinct (different) values.

SQL SELECT DISTINCT Syntax

```
SELECT DISTINCT column_name(s)
FROM table_name
```

SELECT DISTINCT Example

The "Persons" table:

P_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 select only the distinct values from the column named "City" from the table above.

We use the following SELECT statement:

```
SELECT DISTINCT City FROM Persons
```

The result-set will look like this:

City
Sandnes
Stavanger

The WHERE Clause

The WHERE clause is used to extract only those records that fulfill a specified criterion.

SQL WHERE Syntax

```
SELECT column_name(s)
FROM table_name
WHERE column_name operator value
```

WHERE Clause Example

The "Persons" table:

P_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 select only the persons living in the city "Sandnes" from the table above.

We use the following SELECT statement:

```
SELECT * FROM Persons
WHERE City='Sandnes'
```

The result-set will look like this:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes

Quotes Around Text Fields

SQL uses single quotes around text values (most database systems will also accept double quotes).

Although, numeric values should not be enclosed in quotes.

For text values:

This is correct:

SELECT * FROM Persons WHERE FirstName='Tove'

This is wrong:

SELECT * FROM Persons WHERE FirstName=Tove

For numeric values:

This is correct:

SELECT * FROM Persons WHERE Year=1965

This is wrong:

SELECT * FROM Persons WHERE Year='1965'

Operators Allowed in the WHERE Clause

With the WHERE clause, the following operators can be used:

Operator	Description
=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
BETWEEN	Between an inclusive range
LIKE	Search for a pattern
IN	If you know the exact value you want to return for at least one of the columns

Note: In some versions of SQL the <> operator may be written as !=

The AND & OR Operators

The AND & OR operators are used to filter records based on more than one condition

The AND operator displays a record if both the first condition and the second condition is true.

The OR operator displays a record if either the first condition or the second condition is true.

AND Operator Example

The "Persons" table:

P_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 select only the persons with the first name equal to "Tove" AND the last name equal to "Svendson":

We use the following SELECT statement:

```
SELECT * FROM Persons
WHERE FirstName='Tove'
AND LastName='Svendson'
```

The result-set will look like this:

P_Id	LastName	FirstName	Address	City
2	Svendson	Tove	Borgvn 23	Sandnes

OR Operator Example

Now we want to select only the persons with the first name equal to "Tove" OR the first name equal to "Ola":

We use the following SELECT statement:

```
SELECT * FROM Persons
WHERE FirstName='Tove'
OR FirstName='Ola'
```

The result-set will look like this:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes

Combining AND & OR

You can also combine AND and OR (use parenthesis to form complex expressions).

Now we want to select only the persons with the last name equal to "Svendson" AND the first name equal to "Tove" OR to "Ola":

We use the following SELECT statement:

```
SELECT * FROM Persons WHERE
LastName='Svendson'
AND (FirstName='Tove' OR FirstName='Ola')
```

The result-set will look like this:

P_Id	LastName	FirstName	Address	City
2	Svendson	Tove	Borgvn 23	Sandnes

The ORDER BY Keyword

The ORDER BY keyword is used to sort the result-set.

The ORDER BY keyword is used to sort the result-set by a specified column.

The ORDER BY keyword sort the records in ascending order by default.

If you want to sort the records in a descending order, you can use the DESC keyword.

SQL ORDER BY Syntax

```
SELECT column_name(s)
FROM table_name
ORDER BY column_name(s) ASC|DESC
```

ORDER BY Example

The "Persons" table:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger
4	Nilsen	Tom	Vingvn 23	Stavanger

Now we want to select all the persons from the table above, however, we want to sort the persons by their last name.

We use the following SELECT statement:

```
SELECT * FROM Persons
ORDER BY LastName
```

The result-set will look like this:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
4	Nilsen	Tom	Vingvn 23	Stavanger
3	Pettersen	Kari	Storgt 20	Stavanger
2	Svendson	Tove	Borgvn 23	Sandnes

ORDER BY DESC Example

Now we want to select all the persons from the table above, however, we want to sort the persons descending by their last name.

We use the following SELECT statement:

```
SELECT * FROM Persons
ORDER BY LastName DESC
```

The result-set will look like this:

P_Id	LastName	FirstName	Address	City
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger
4	Nilsen	Tom	Vingvn 23	Stavanger
1	Hansen	Ola	Timoteivn 10	Sandnes

The INSERT INTO Statement

The INSERT INTO statement is used to insert a new row in a table.

SQL INSERT INTO Syntax

It is possible to write the INSERT INTO statement in two forms.

The first form doesn't specify the column names where the data will be inserted, only their values:

```
INSERT INTO table_name
VALUES (value1, value2, value3,...)
```

The second form specifies both the column names and the values to be inserted:

```
INSERT INTO table_name (column1, column2, column3,...)
VALUES (value1, value2, value3,...)
```

SQL INSERT INTO Example

We have the following "Persons" table:

P_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 insert a new row in the "Persons" table.

We use the following SQL statement:

```
INSERT INTO Persons
VALUES (4,'Nilsen', 'Johan', 'Bakken 2', 'Stavanger')
```

The "Persons" table will now look like this:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger
4	Nilsen	Johan	Bakken 2	Stavanger

Insert Data Only in Specified Columns

It is also possible to only add data in specific columns.

The following SQL statement will add a new row, but only add data in the "P_Id", "LastName" and the "FirstName" columns:

```
INSERT INTO Persons (P_Id, LastName, FirstName)
VALUES (5, 'Tjessem', 'Jakob')
```

The "Persons" table will now look like this:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger
4	Nilsen	Johan	Bakken 2	Stavanger
5	Tjessem	Jakob		

The UPDATE Statement

The UPDATE statement is used to update existing records in a table.

SQL UPDATE Syntax

```
UPDATE table_name
SET column1=value, column2=value2,...
WHERE some_column=some_value
```

Note: Notice the WHERE clause in the UPDATE syntax. The WHERE clause specifies which record or records that should be updated. If you omit the WHERE clause, all records will be updated!

SQL UPDATE Example

The "Persons" table:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger
4	Nilsen	Johan	Bakken 2	Stavanger
5	Tjessem	Jakob		

Now we want to update the person "Tjessem, Jakob" in the "Persons" table.

We use the following SQL statement:

```
UPDATE Persons
SET Address='Nissestien 67', City='Sandnes'
WHERE LastName='Tjessem' AND FirstName='Jakob'
```

The "Persons" table will now look like this:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes

3	Pettersen	Kari	Storgt 20	Stavanger
4	Nilsen	Johan	Bakken 2	Stavanger
5	Tjessem	Jakob	Nissestien 67	Sandnes

SQL UPDATE Warning

Be careful when updating records. If we had omitted the WHERE clause in the example above, like this:

```
UPDATE Persons
SET Address='Nissestien 67', City='Sandnes'
```

The "Persons" table would have looked like this:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Nissestien 67	Sandnes
2	Svendson	Tove	Nissestien 67	Sandnes
3	Pettersen	Kari	Nissestien 67	Sandnes
4	Nilsen	Johan	Nissestien 67	Sandnes
5	Tjessem	Jakob	Nissestien 67	Sandnes

The DELETE Statement

The DELETE statement is used to delete rows in a table.

SQL DELETE Syntax

```
DELETE FROM table_name
WHERE some_column=some_value
```

Note: Notice the WHERE clause in the DELETE syntax. The WHERE clause specifies which record or records that should be deleted. If you omit the WHERE clause, all records will be deleted!

SQL DELETE Example

The "Persons" table:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger
4	Nilsen	Johan	Bakken 2	Stavanger
5	Tjessem	Jakob	Nissestien 67	Sandnes

Now we want to delete the person "Tjessem, Jakob" in the "Persons" table.

We use the following SQL statement:

```
DELETE FROM Persons
WHERE LastName='Tjessem' AND FirstName='Jakob'
```

The "Persons" table will now look like this:

P_Id	LastName	FirstName	Address	City
1	Hansen	Ola	Timoteivn 10	Sandnes
2	Svendson	Tove	Borgvn 23	Sandnes
3	Pettersen	Kari	Storgt 20	Stavanger
4	Nilsen	Johan	Bakken 2	Stavanger

Delete All Rows

It is possible to delete all rows in a table without deleting the table. This means that the table structure, attributes, and indexes will be intact:

```
DELETE FROM table_name
```

or

```
DELETE * FROM table_name
```

Note: Be very careful when deleting records. You cannot undo this statement!

The CREATE DATABASE Statement

The CREATE DATABASE statement is used to create a database.

SQL CREATE DATABASE Syntax

```
CREATE DATABASE database_name
```

CREATE DATABASE Example

Now we want to create a database called "my_db".

We use the following CREATE DATABASE statement:

```
CREATE DATABASE my_db
```

Database tables can be added with the CREATE TABLE statement.

The CREATE TABLE Statement

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

SQL CREATE TABLE Syntax

```
CREATE TABLE table_name
(
column_name1 data_type,
column_name2 data_type,
column_name3 data_type,
....
)
```

The data type specifies what type of data the column can hold.

CREATE TABLE Example

Now we want to create a table called "Persons" that contains five columns: P_Id, LastName, FirstName, Address, and City.

We use the following CREATE TABLE statement:

```
CREATE TABLE Persons
(
P_Id int,
```

```
LastName varchar(255),
FirstName varchar(255),
Address varchar(255),
City varchar(255)
)
```

The P_Id column is of type int and will hold a number. The LastName, FirstName, Address, and City columns are of type varchar with a maximum length of 255 characters.

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

P_Id	LastName	FirstName	Address	City

SQL Constraints

Constraints are used to limit the type of data that can go into a table.

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

We will focus on the following constraints:

- **NOT NULL-** The NOT NULL constraint enforces a column to NOT accept NULL values. The NOT NULL constraint enforces a field to always contain a value. This means that you cannot insert a new record, or update a record without adding a value to this field.
- **UNIQUE-** The UNIQUE constraint uniquely identifies each record in a database table.The UNIQUE and PRIMARY KEY constraints both provide a guarantee for uniqueness for a column or set of columns.A PRIMARY KEY constraint automatically has a UNIQUE constraint defined on it.Note that you can have many UNIQUE constraints per table, but only one PRIMARY KEY constraint per table.
- **PRIMARY KEY**- The PRIMARY KEY constraint uniquely identifies each record in a database table.Primary keys must contain unique values.A primary key column cannot contain NULL values.Each table should have a primary key, and each table can have only one primary key.
- **CHECK-** 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.
- **DEFAULT-** The DEFAULT constraint is used to insert a default value into a column.The default value will be added to all new records, if no other value is specified.

The ALTER TABLE Statement

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

SQL ALTER TABLE Syntax

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

```
ALTER TABLE table_name
ADD column_name datatype
```

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
```

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

```
ALTER TABLE table_name
ALTER COLUMN column_name datatype
```

SQL ALTER TABLE Example

Look at the "Persons" table:

P_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

The "Persons" table will now like this:

P_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-digit 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 like this:

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