SQL database language

- SQL is used for
  - Defining and redefining databases and their access privileges
  - Tuning database storage structures
  - Fetching data from the database
    - On screen or into reports or files
    - For use within application programs
  - Maintaining the contents of the database
    - By direct interaction
    - Through application programs

SQL

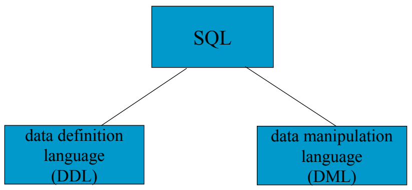
- SQL is standardized
- Latest standard on 1999
- Current implementations mainly based on SQL-92 standard (not completely)
- Dialects exist – there is a common kernel

SQL-tietokanta

- SQL-database consists of tables defined in one or more schemas
- Each schema has an owner, who owns also the tables defined in the schema. A tables consists of rows.
- A table correspond to the relation of the relational model, with one exception:
- All tables need not be mathematical relations – they may have duplicate rows (especially query results)

  mathematical multiset
  - Defining a key for a relation prevents duplicate rows

SQL


SQL
data definition language (DDL)
data manipulation language (DML)

users and privileges	queries
structure of data	maintenance operations
database procedures	

SQL

- In SQL keywords, table names, user names, column names and any element names may be written in upper or lower case or mixed case

  select name ≡ SELECT Name

- With respect to database data SQL is however case sensitive
- Make='Ford' doesn't retrieve the same rows as Make='FORD'

SQL DDL

- DDL contains statements for creation, modification and deletion of database elements like user, role, schema, table, domain, procedure, function, trigger, …
  - create - creates
  - alter - modifies
  - drop - deletes

SQL creating tables

- create table defines the structure of a table
- create table *tablename* (
  column definition 1, ….,
  column definition n
  [, *constraint 1*, …])

Column definition ::=
column_name datatype [not null]
[default *value*] [*column constraint* …]

Table definition

```
create table Ordered (
   OrderId       integer not null,
   WhenMade      date not null,
   Customer      integer not null,
   WayIssued     varchar(20),
   PaymentBy     varchar(20) not null,
   TotalPrice    decimal(6,2) not null,
   constraint pk_order primary key (OrderId),
   constraint fk_ordercustomer foreign key
      (Customer) references Customer
);
```

Table definition

```
create table Ordered (
   OrderId       integer not null,
   WhenMade      date not null,
   Customer      integer not null,
   WayIssued     varchar(20),
   PaymentBy     varchar(20) not null,
   TotalPrice    decimal(6,2) not null,
   constraint pk_order primary key (OrderId),
   constraint fk_ordercustomer foreign key
      (Customer) references Customer
);
```

date
(we have an Oracle database, thus this is a timestamp)

string
varying length

integer

decimal number
values exact, full length 6, decimal part 2

Table definition

```
create table Ordered (
   OrderId       integer not null,
   WhenMade      date not null,
   Customer      integer not null,
   WayIssued     varchar(20),
   PaymentBy     varchar(20) not null,
   TotalPrice    decimal(6,2) not null,
   constraint pk_order primary key (OrderId),
   constraint fk_ordercustomer foreign key
      (Customer) references Customer
);
```

obligatory value

key

foreign key

Table definition

- Times and dates
  - Date — date (day, month, year)
  - Time — time (hour, minutes, second,…)
  - Timestamp — date and time (Oracle's Date is actually a timestamp)
  - Interval

  - Computations with temporal values
    this_day date,
    this_day + 3 is a date 3 days from now

Table definition

- Specification of a foreign key may include rules on how to behave in case operations violate the referential integrity

  foreing key (*columns*) references *table* [(*columns2*)]
  [on delete {restrict | cascade |nullify}]
  [on update {restrict | cascade |nullify}]

an operation causes the target of reference to disappears:
restrict prevents the operation (this is default)
cascade causes the referring rows to be deleted (or foreign keys to be changed)
nullify assigns nulls to foreign keys

SQL query

Query elementys:

```
select result_specification
   from tables
   [where select_conditions]
   [group by grouping_criteria]
   [having group_restrictions]
   [order by ordering_criteria]
```

may be missing

A query produces a unnamed result table.

SQL query

```
select make, regNo
       from car
       where modelYear=1996 and
             color =‘red’ and make like ‘Fo%’
       order by make, regno
```

- Get make and registration number of model year 1996 red cars make of which begins with ‘Fo’. Order the result rows primarily by make and secondarily by registration number.

SQL query

```
select make, regNo
       from car
       where modelYear=1996 and
             color =‘red’ and make like ‘Fo%’
       order by make, regno
```

almost projection

selection

- Get make and registration number of model year 1996 red cars make of which begins with ‘Fo’. Order the result rows primarily by make and secondarily by registration number.

SQL-kysely

- The values for the elements in the result_specification are computed for each row combination that satisfies the selection criterial listed after keyword where.

```
select make
from car
where modelyear=1996 and
        color =‘red’ and make like ‘Fo%’
        order by make
```

If table had 100 red Fords of 1996 model, then the make ‘Ford’ would be in the result 100 times (each a separate row).

Thus this does not function as projection of relational algebra
- Duplicates are not eliminated

SQL kysely

- A projection like behavior may be obtained by including the keyword **distinct** in front of the result_specification

```
select distinct make
from car
where modelyear=1996 and
        color =‘red’ and make like ‘Fo%’
        order by make
```

Now there would be only one Ford

SQL query

- The condition part of a query may contain conditions where comparisons are made among
  – column values (referred by column names)
  – constants
  – values of functions
  – masks
  – ranges and
  – value sets
- The existence of values in columns may also be tested

SQL query

- If value null is involved in any comparison the expression evaluates to truth value unknown.
- A row satisfies (or a combination of rows) satisfies a selection criterion only if the criterion evaluates to true.
- Truth values true and false behave in logical expressions according the standard rules of logic (like in programming languages). The behavior of the three truth values is depicted in the following tables

AND	**true**	**false**	**unknown**
true	true	false	unknown
false	false	false	false
unknown	unknown	false	unknown

NOT	
true	false
false	true
unknown	unknown

SQL-kyselyt

OR	**true**	**false**	**unknown**
true	true	true	true
false	true	false	unknown
unknown	true	unknown	unknown

•Existence of values in a column is tested with:

Column is null: evaluates to true, if the value is null otherwise false

Column is not null: evaluates to false, if the value is null otherwise true

SQL query

- Computations that are possible depend on the type of values.
  - numeric values - standard arithmetics
  - temporal values – time arithmetics
  - textual values – only concatenation ||
- Textual and date values in single quatation marks ('value'), numerical values without quatation marks
- Various functions are available. They are, however, mostly implementation specific
- length(Column), round(Column), substring(Column,from, length), …

SQL query

- From part may contain one or more tables (or subqueries)
  - If there is only one table the operation is selection
- If there are many tables, the operation is cross product unless there are join condition in the where part in which case the operation is join (remember to include the join condition)