The SQL language

- SQL is the most important query language based on relational model.
- It's used to issue commands to the DBMS
- **SQL = Structured Query Language**
- The SQL standard is around since the 1970s
- Lots of features, we will only see a subset

SQL command types

- **DDL: Data definition language**
  - Used by database administrator to define the structures of a database like schema, tables, constraints, etc.



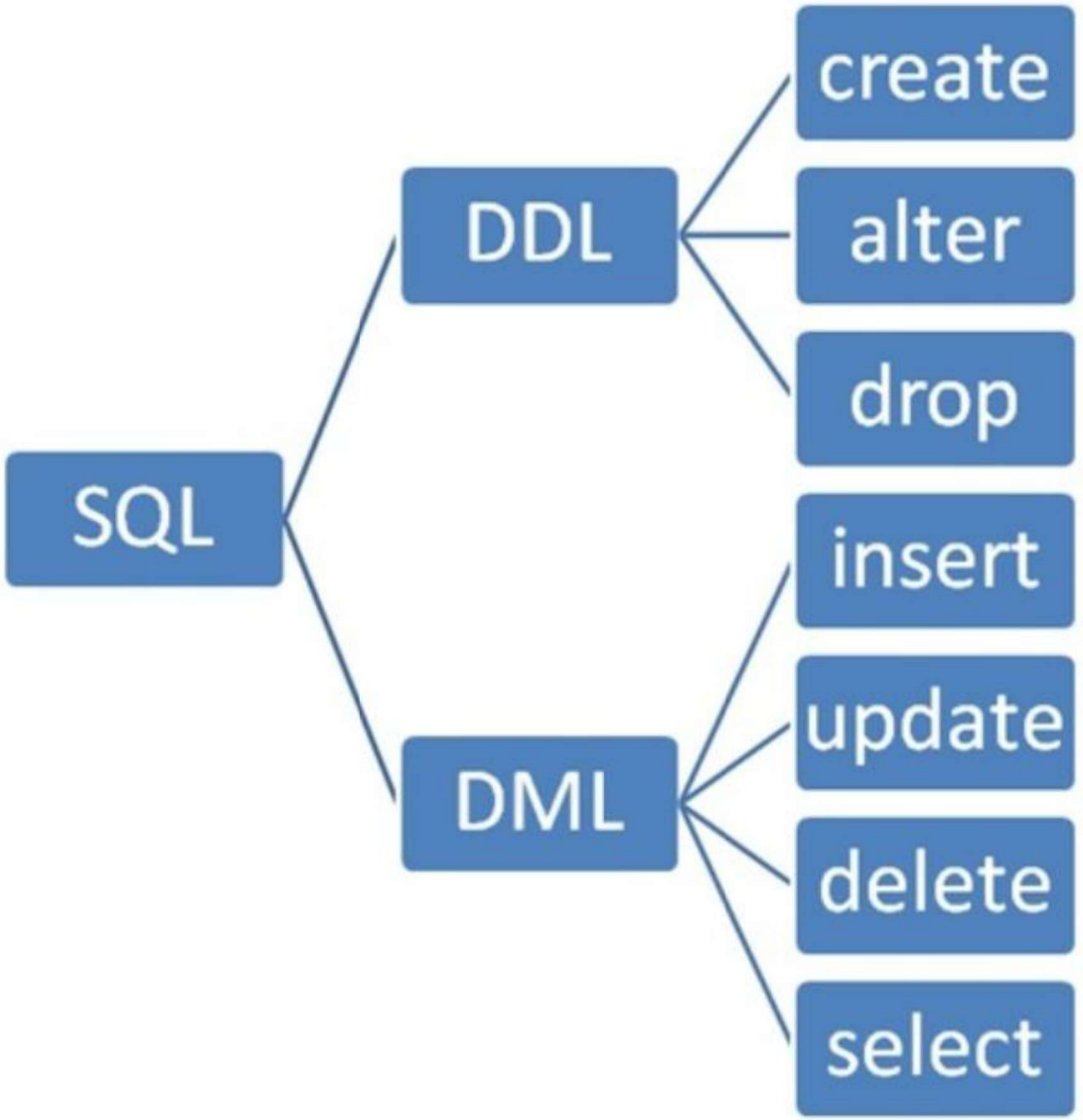
- **DML: Data manipulation language**
  - Does not affect the schema of the database but may affect its contents
  - Used by users/application to implement CRUD operations



- **TCL: Transaction control language**
  - Groups SQL commands (transactions)
- **DCL: data control language**
  - Assign data access rights



- **The key distinction is that the DDL command is used to create a database schema, while the DML command is used to retrieve data from the database and to modify the content of the table (data).**



Basic DDL Commands in SQL

- **CREATE**: to define new tables (relation schemas)
- **DROP**: to remove tables from the database
- **ALTER**: to change the definitions of existing tables (to change relation schema)
- Other features of DDL: Specify constraints

ALTER example:

TeacherID	name	birthdate	phone

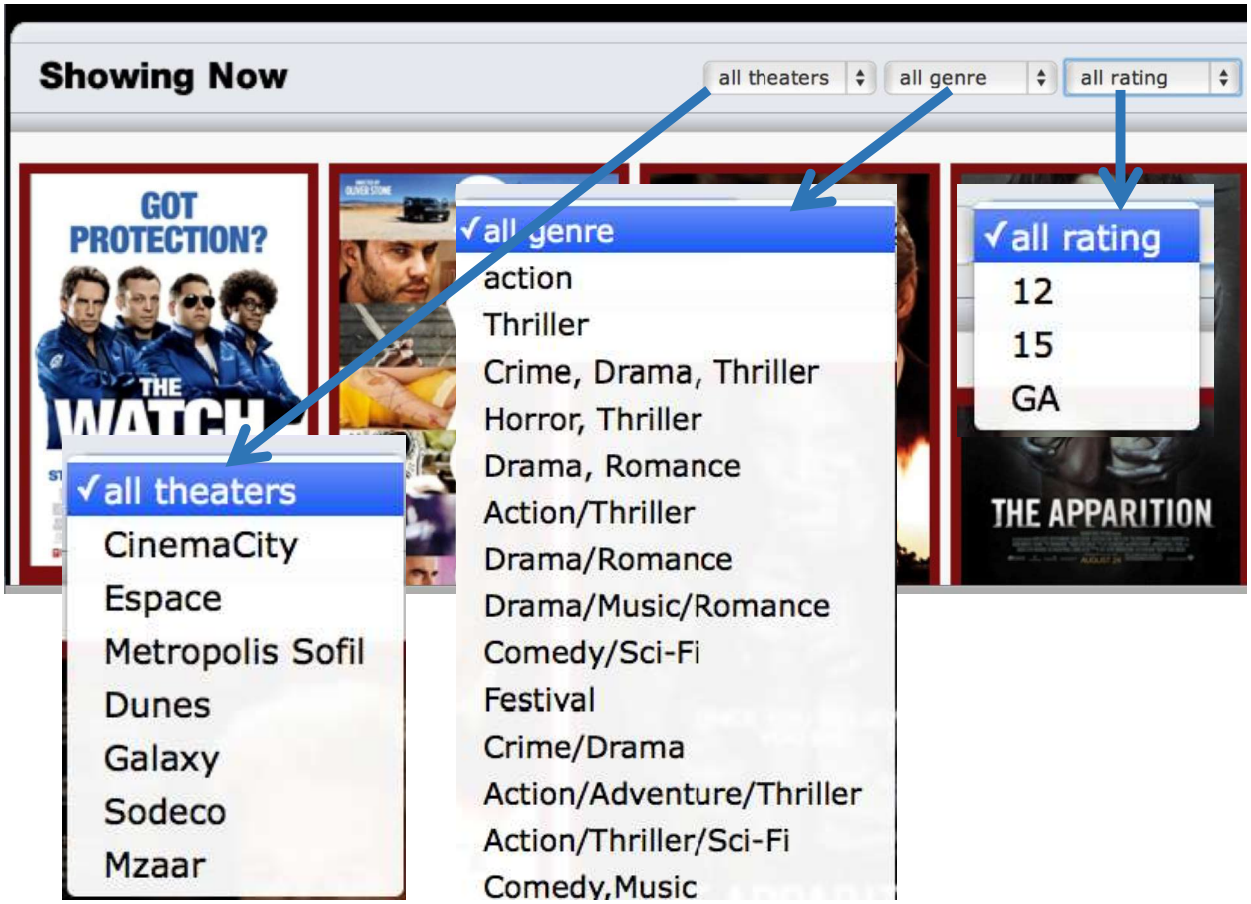
Basic DML Commands in SQL

- **INSERT (CREATE new data records)**: to add new rows to tables
- **UPDATE**: to change the "state" (the value) of rows.
- **DELETE**: to remove rows
- **SELECT (READ)**: a query command that retrieves data from the database

Acronym CRUD is used to refer to DML operations: Create, Read, Update, and Delete

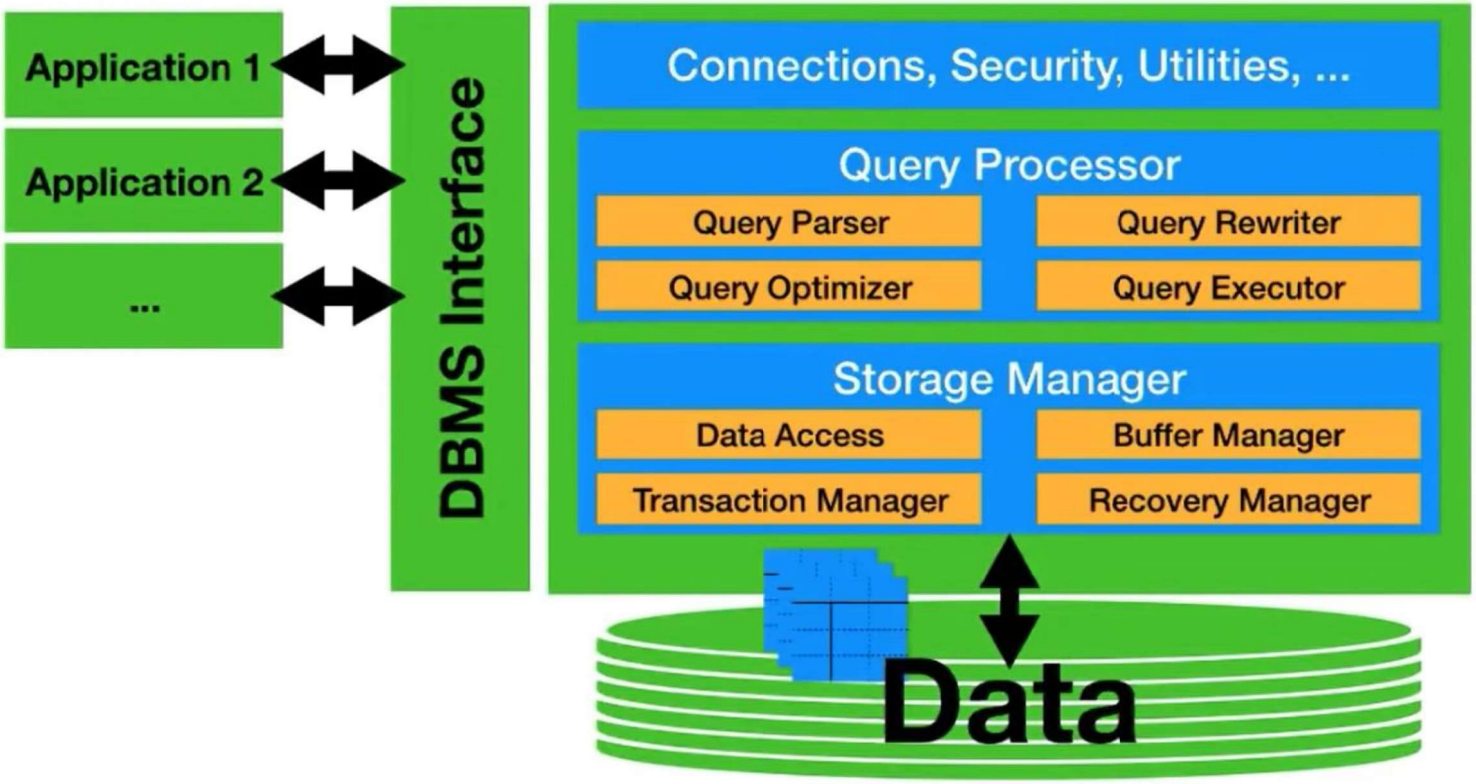
TeacherID	name	birthdate	phone
1	John W Smith	1990	81999999
2	Jane White	1983	71888888

Concept of a query



Overview of DBMS

- A DBMS has several components that work together to execute SQL commands



The Query Processor

- ✓ Translates the query into a query plan which is a sequence of operations to be performed on the data.
- ✓ Executes each of the steps in the chosen query plan and interacts with other components.

Storage manager

- Data access: keeps track of the location of files on the disk and obtains the blocks of data upon request.
- Buffer manager: A database buffer is a memory location used by a DBMS to temporarily hold data that has recently been accessed or updated in the database.
  - It acts as a link between the programs accessing the data and the physical storage devices.
  - The buffer is essential for enhancing the DBMS's overall performance:
    - Caching frequently requested data in memory decreases the frequency of disc I/O operations, accelerating query and transaction processing.

Transaction manager

- It accepts transaction commands from app.
- It insures atomicity and isolation of transactions (start and end of transaction)

The ACID concept:

- A: Atomicity → Either all or none of the transaction operation is done.
- C: Consistency → A transaction transfers the database from one consistent (correct) state to another consistent state.
- I: Isolation → Each transaction should appear as if no other transaction is executing at the same time. Although multiple transactions execute concurrently, it must appear as if the transaction are running serially (one after the other). Locks are used for that purpose.
- D: Durability → The results of transactions are permanent i.e. the result will never be lost with subsequent failure.

Logging and recovery manager

- Every change in the database must be logged.

- In case of crash, recovery manager will examine logs and recover the database.