Introduction to SQL

Learning outcomes

- Background to SQL

- Purpose and importance of SQL

- Starting SQL
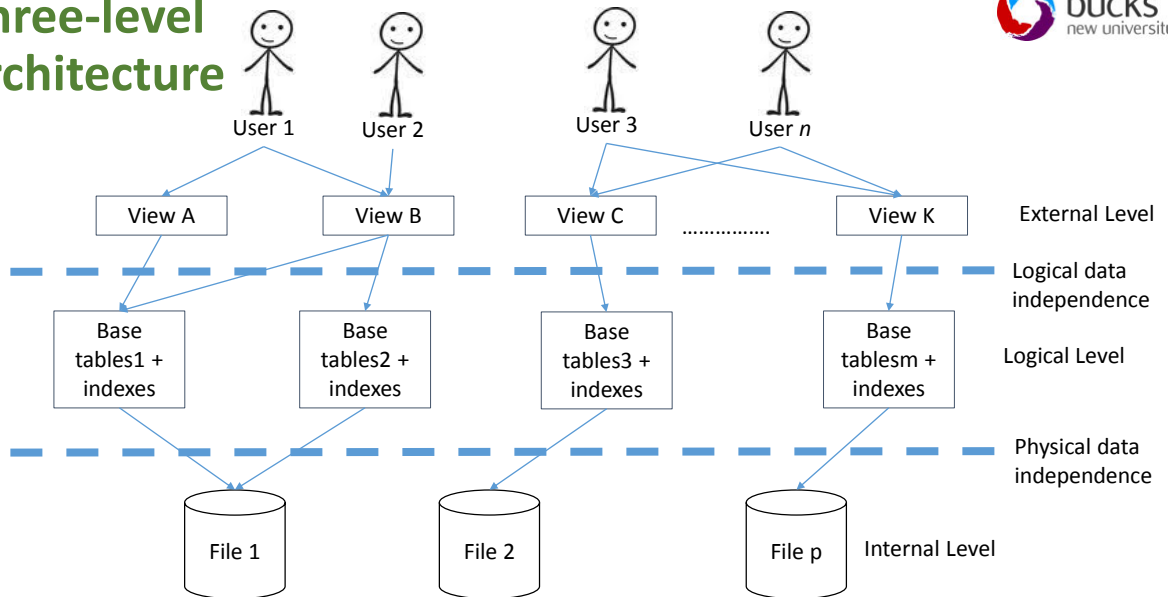
Structured Query Language (SQL)

- Originally called SEQUEL
- Early relational database management system was designed at IBM research for a database called System R.
- SQL is the **standard** language for relational databases.
- The standardisation was a joint initiative between ANSI (American National Standards institute) and ISO (Internal Standards Organisation) around 1986.
- Comprehensive database language and has statements for: data definitions, queries and updates.

Many SQL versions

- Around 1970 Larry Ellison, Ed Miner and Ed Oates developed an early commercial version of a relational database (Oracle).
- Oracle was developed with SQL as its language base.
- From around 1981 many relational management systems emerged
- Todays many variations of SQL: Microsoft SQL, PostgresSQL, Microsoft Access, MYSQL etc.
- There are a variety of SQL dialects with standard features and extensions depending on the vendor.

Three-level architecture

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User 1   User 2   User 3   User n

| View A | | View B | | View C | .... | View K | External Level

—   Logical data independence

| Base tables1 + indexes | | Base tables2 + indexes | | Base tables3 + indexes | | Base tablesm + indexes | Logical Level

—   Physical data independence

File 1   File 2   File p   Internal Level

Categories of SQL commands

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- DDL – Data Definition Language - defining the structure of the database

- DML – Data Manipulation Language – retrieving and updating the database.

- DCL – Data Control Language – used for controlling access to the database

DDL SQL commands

- **CREATE DATABASE - creates a new database**
- CREATE SCHEMA
- **CREATE TABLE - creates a new table**
- **ALTER TABLE - modifies a table**
- CREATE INDEX - creates an index (search key)
- ALTER TABLE - modifies a table
- **RENAME TABLE**
- DROP INDEX - deletes an index

- These statements are used to create, change and destroy structures that make up the logical model.
- These commands can be used to make changes to the database structure.

DML SQL commands

- **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/table

- These statement manipulate the database.
- Commands used to retrieve, store, modify, delete, insert and update data in database.

DCL SQL commands

- GRANT- gives user's access privileges to the database.
- REVOKE- withdraw a user's access privileges given by using the GRANT command.

- These commands are used to control privileges

SQL Functions: performing calculations

SQL Aggregate functions return a single values and are calculated from values in a column.

- **AVG()** - Returns the average value
- **COUNT()** - Returns the number of rows
- FIRST() - Returns the first value
- LAST() - Returns the last value
- **MAX()** - Returns the largest value
- **MIN()** - Returns the smallest value
- **SUM()** - Returns the sum

Other SQL Functions

GROUP BY - Forms groups of tuples/rows with same attribute values

ORDER BY - Specifies sort order of the output

HAVING - Filters the groups subject to condition(s)

DISTINCT - The SELECT DISTINCT statement is used to return only distinct (different) values. Inside a table, a column often contains many duplicate values; and sometimes you only want to list the different (distinct) values.

SQL JOIN - combines rows from two or more tables, based on a related column between them.

SQL questions

- Why have you written the commands in uppercase?
  - Some systems do require the commands to be capitalised. However, SQL is not case sensitive. Capitals make is easy to see the commands, from everything else e.g.
    CREATE DATABASE projects;

- What is the notation for naming databases and tables?
  - Create descriptive names
  - Avoid capital letters
  - Be consistent with your approach

SQL questions

- Naming tables and databases
  - Some examples of naming databases and tables:
    - project, projectlist, projectList or project_list

- When do I use quotes "…" or '…'?
  - All non-numeric literals must be enclosed in quotes e.g. 'New York' or "New York"
    - Depending on the dialect of the SQL system you are using.

SQL questions

How do I represent numerical data?
- All numeric literals must <u>not</u> be enclosed in quotes e.g. 650.00

- How do I end my SQL command?
  - Semicolon ; is the standard way to separate each SQL statement in database systems that allow more than one SQL statement to be executed in the same call to the server.

SQL practical's & assessment

- Your options for SQL:
  - Microsoft Access
  - MySQL using Putty
  - Use any other SQL system on your own device

(Note: you are not being assessed for using the system, this is not implementation (This is Level 6 where we implement in Oracle&Mongo). You are being assessed that you can write standard SQL – the system is of no consequence at this stage). Choose wisely, you do not want to be hindered by the system when attempting the assessment. Choose system where you can create the database and tables speedily and concentrate on the commands: CMD or GUI.

- Ensure whichever system you choose you become familiar with it for the assessment.

- The exercises are written in standard SQL, you may need to adjust the syntax dialect for your choice of system.

SQL assessment

- Be able to do the following:
  - Create the database and tables
  - Given a result, determine if the command is correct
  - Given a result, write the corresponding SQL command
  - Write a SQL command which displays specific elements from one or more tables

- You need to be familiar with the common SQL commands

References

- Carter, J. (2002) Database Design and Programming. 2nd ed. Berkshire: McGraw Hill.

- McFadden, F.R., Hoffer, J.A. and Prescott, M.B. (2005) *Modern Database Management*. 5th ed. Harlow: Addison-Wesley.