

Data Engineering in the Cloud

Basic SQL Queries - Part I

Xuemao Zhang
East Stroudsburg University

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Outline

Before performing data loading into a data warehouse, we need to review the traditional relational database

- Installation of [DBever](#)
- Basic SQL Queries
 - ▶ CREATE DATABASE - creates a new database.
 - ▶ CREATE TABLE - creates a new table.
 - ▶ SELECT - extracts data from a database.
 - ▶ ALTER and ADD - add a column in an existing table.
 - ▶ UPDATE - updates data in a database.
 - ▶ DELETE - deletes data from a database.
 - ▶ INSERT INTO - inserts new data into a database.
 - ▶ CREATE INDEX - create indexes in tables
- Window functions

DBeaver

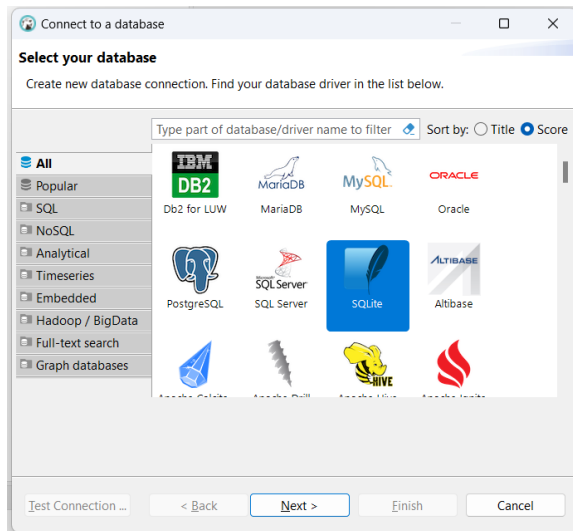
- DBeaver is free and open source universal database tool for developers and database administrators
- It is free and open-source.
- It is multiplatform.
- It supports any database having a JDBC driver.
 - ▶ One tool for all data sources.
 - ▶ A JDBC (Java Database Connectivity) driver is a software component that enables Java applications to interact with databases. It acts as an interface between Java applications and database management systems (DBMS), allowing Java code to execute SQL queries and retrieve results from databases.

DBeaver

- Installation of DBeaver Community <https://dbeaver.io/download/>

DBeaver

- New Database Connection



New Database Connection Ctrl+Shift+N
Recent SQL script Ctrl+Enter
Show Key Assist Ctrl+Shift+L
Find Actions Ctrl+3

DBeaver

- Let's connect an SQLite database file `employee.db`

The screenshot shows the 'Connect to a database' dialog box in DBeaver. The title bar says 'Connect to a database'. Below the title bar, the main heading is 'Generic JDBC Connection Settings' with a subtitle 'SQLite connection settings'. There is a blue feather icon in the top right corner. The dialog has two tabs: 'Main' (selected) and 'Driver properties'. Under the 'Main' tab, there is a 'General' section. It contains a 'Connect by:' label with two radio buttons: 'Host' (selected) and 'URL'. Below this is a 'JDBC URL:' label followed by a text field containing 'jdbc:sqlite:C:\Math418\LectureNotes\data\employee.db'. Below the text field is a 'Path:' label followed by a text field containing 'C:\Math418\LectureNotes\data\employee.db'. To the right of the 'Path' field are two buttons: 'Open ...' and 'Create ...'. At the bottom of the dialog, there are two links: 'Connection variables information' and 'Database documentation', followed by a text field containing 'Connection details (name, type, ...)'. At the very bottom, there is a 'Driver name:' label with the value 'SQLite' and a 'Driver Settings' button.

Connect to a database

Generic JDBC Connection Settings

SQLite connection settings

Main Driver properties

General

Connect by: ☒ Host ☐ URL

JDBC URL: jdbc:sqlite:C:\Math418\LectureNotes\data\employee.db

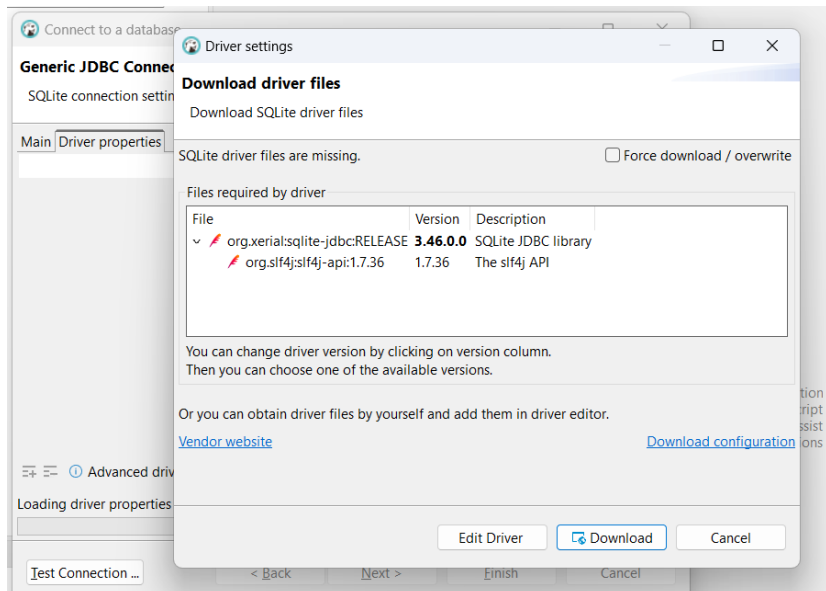
Path: C:\Math418\LectureNotes\data\employee.db

[Connection variables information](#) [Database documentation](#) Connection details (name, type, ...)

Driver name: SQLite

DBeaver

- We need to download the driver files



- This database has two tables: employee_wf and product_wf

The screenshot shows the DBeaver interface with the Database Navigator on the left and the Data tab selected for the employee_wf table. The table structure and data are as follows:

	123 id	123 first_name	123 last_name	123 department_id	123 salary	123 years_worked
1	101	Diane	Turner	1	5	3
2	102	Clarence	Robinson	1	6	2
3	103	Eugene	Phillips	1	7	2
4	104	Philip	Mitchell	1	2	4
5	105	Ann	Wright	2	5	5
6	106	Charles	Wilson	2	1	5
7	107	Russell	Johnson	2	13	4
8	108	Jacqueline	Cook	2	5	6
9	109	Larry	Lee	3	6	4
10	110	Willie	Patterson	3	4	5
11	111	Janet	Ramirez	3	4	2
12	112	Doris	Bryant	3	6	1
13	113	Amy	Williams	3	6	1
14	114	Keith	Scott	3	4	8
15	115	Karen	Morris	4	6	6
16	116	Kathy	Sanders	4	14	1
17	117	Joe	Thompson	5	16	3
18	118	Barbara	Clark	5	15	1
19	119	Todd	Bell	5	5	1
20	120	Ronald	Butler	5	24	5

SQL Key Words

- [SQL Tutorial](https://www.w3schools.com/sql/sql_syntax.asp) https://www.w3schools.com/sql/sql_syntax.asp

Some of The Most Important SQL **Key Words**:

- 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
- 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

Basic SQL Commands - SELECT

SELECT	desired attributes
FROM	one or more tables
WHERE	conditions on rows of the tables are satisfied

- Retrieving an entire table
 - ▶ The **alias** `ew` can be used to refer to the `employee_wf` table in other parts of the query.

```
SELECT * FROM employee_wf ew;
```

- Return the first 5 rows only using key word `LIMIT`

```
SELECT * FROM employee_wf ew LIMIT 5;
```

Basic SQL Commands - SELECT

- Select columns

```
SELECT first_name, last_name, salary FROM employee_wf;
```

- Find unique years_worked using DISTINCT

```
SELECT DISTINCT years_worked FROM employee_wf;
```

Basic SQL Commands - SELECT

- The ORDER BY keyword is used to sort the result-set in ascending or descending order.

```
SELECT      *  
FROM        table  
ORDER BY    columns ASC|DESC;
```

- Order the data by variable years_worked

```
SELECT * FROM employee_wf  
ORDER BY years_worked ASC;
```

Basic SQL Commands - SELECT

- Select columns with years_worked >= 4

```
SELECT first_name, last_name, salary
FROM employee_wf
WHERE years_worked >= 4;
```

```
SELECT first_name, last_name, salary, years_worked
FROM employee_wf
WHERE years_worked >= 4;
```

- A boolean expression in the **WHERE** clause may contain the following operators or any combination:
 - ▶ AND
 - ▶ NOT
 - ▶ OR

Basic SQL Commands - SELECT

- Select columns with price \geq 1000 and brand == 'Apple'

```
SELECT product_name, price
FROM product_wf
WHERE price  $\geq$  1000 AND brand == 'Apple';
```

- Select columns with price between 600 and 1200

```
SELECT product_name, price
FROM product_wf
WHERE price  $\geq$  600 AND price  $\leq$  1200;
```

Basic SQL Commands - SELECT

- Select columns with brand is not Apple

```
SELECT product_name, price, brand  
FROM product_wf  
WHERE NOT brand == 'Apple';
```

```
SELECT product_name, price, brand  
FROM product_wf  
WHERE brand != 'Apple';
```

Basic SQL Commands - SELECT

- Select columns with brand is Apple or Dell

```
SELECT product_category, product_name, price, brand
FROM product_wf
WHERE brand == 'Apple' or brand == 'Dell';
```

- Select columns with species_id is brand is Apple or Dell and product_category=='Phone'

```
SELECT product_category, product_name, price, brand
FROM product_wf
WHERE (brand == 'Apple' or brand == 'Dell') and product_category=='Phone'
```


Basic SQL Commands - SELECT

- The CREATE TABLE statement copies data from one table into a new table.
- For example, we save the data with brand == 'Apple' as a table
 - ▶ We create another table

```
CREATE TABLE product_apple AS
SELECT *
FROM product_wf
WHERE brand = 'Apple';

SELECT * FROM product_apple;
```

Basic SQL Commands - SELECT

- The GROUP BY statement groups rows that have the same values into summary rows.

SELECT	column1 aggregate(column2)
FROM	table name
WHERE	condition
GROUP BY	column1
ORDER BY	column1;

```
SELECT brand, avg(price)
FROM product_wf
GROUP BY brand;
```

- [SQLite Aggregate Functions](https://www.sqlite.org/lang_aggfunc.html): https://www.sqlite.org/lang_aggfunc.html

Basic SQL Commands - SELECT

- Some other arithmetic summaries: Min, Max, Count and Sum/Total

```
SELECT  min(price) as min_price, max(price) as max_price,  
        count(price) as n_price, sum(price) as sum_price  
FROM    product_wf;
```

Basic SQL Commands - SELECT

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

```
DROP TABLE product_apple;
```

Basic SQL Commands - ALTER and ADD

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

ALTER TABLE

table name

ADD

column name datatype;

- For example, we add another column age

```
ALTER TABLE employee_wf  
ADD age integer;
```

Basic SQL Commands - UPDATE

- The UPDATE statement is used to modify the existing records in a table.

UPDATE	table name
SET	column1 = value1, column2 = value2, ...
WHERE	condition;

Note: The WHERE clause specifies which record(s) that should be updated. If you omit the WHERE clause, all records in the table will be updated! You cannot undo an update unless you ran it inside a [transaction](https://www.sqlitetutorial.net/sqlite-transaction/)

<https://www.sqlitetutorial.net/sqlite-transaction/>

- Let's update the first record

```
UPDATE employee_wf  
SET age=40  
WHERE id = 101;
```

```
select * from employee_wf  
where id = 101;
```

Basic SQL Commands - DELETE

- The DELETE statement is used to delete existing records in a table.

DELETE FROM table name
WHERE condition;

Note: The WHERE clause specifies which record(s) that should be deleted. If you omit the WHERE clause, all records in the table will be deleted! Again, you cannot undo a delete.

- Let's delete the first record

```
DELETE FROM surveys  
WHERE record_id = 1;
```

```
select * from surveys  
where record_id = 1; /*an empty row will be returned*/
```

Basic SQL Commands - INSERT INTO

- The INSERT INTO statement is used to insert new records/rows in a table.
- ❶ Specify both the column names and the values to be inserted:
INSERT INTO table name (column1, column2, column3, ...)
VALUES (value1, value2, value3, ...);
- ❷ If you are adding values for all the columns of the table, you do not need to specify the column names in the SQL query. However, make sure the order of the values is in the same order as the columns in the table.
INSERT INTO table name
VALUES (value1, value2, value3, ...);
- Let's insert one more row
 - ▶ Be careful, the Primary Key cannot be NULL

```
INSERT INTO employee_wf (id, first_name, last_name, department_id,sal)
VALUES (101,      'Diane',      'Turner',      1,  5,  3,  40);
```

```
select * from employee_wf
where id = 101;
```


Basic SQL Commands - CREATE INDEX

- 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.

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

```
CREATE INDEX      index name  
ON                table name (column1, column2, ...);
```

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

```
UNIQUE INDEX      index name  
ON                table name (column1, column2, ...);
```

Basic SQL Commands - CREATE INDEX

- The SQL statement below creates an index named `idx_dpt` on the `department_id` column in the `employee_wf` table:

```
CREATE INDEX idx_dpt  
ON employee_wf (department_id);
```

- 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_dptid  
ON employee_wf (department_id, id);
```

Basic SQL Commands - CREATE INDEX

- An index can be dropped using the DROP command.

DROP INDEX index name;

```
DROP INDEX idx_dpt;  
DROP INDEX idx_dptid;
```

Basic SQL Commands - CREATE INDEX

Testing Index performance:

- To test if indexes will begin to decrease query times, you can run a set of queries on your database, record the time it takes those queries to finish, and then begin creating indexes and rerunning your tests.
 - ▶ To do this, try using the `EXPLAIN QUERY PLAN` clause to see how SQLite will execute the query
 - ▶ This data base is too small:(

```
EXPLAIN QUERY PLAN SELECT *  
FROM employee_wf  
WHERE department_id = 3;
```

Window functions

Types of window functions

- Aggregate: avg, sum, min, max, count
- Ranking: rank, dense_rank, row_number, ntile
- Value: first_value, lag, lead

```
/*average by department*/  
SELECT department_id, avg(salary) from employee_wf  
group by department_id;
```

Window functions

```
SELECT department_id, avg(salary) from  
employee_wf group by department_id;
```

```
/*the sum of the salary column over all rows in employee_wf */  
SELECT *, SUM(salary) OVER() as total_salary from employee_wf;
```

Window functions

```
/* total salary for each department,*/  
SELECT *, SUM(salary) OVER(PARTITION by department_id)  
as total_salary from employee_wf;  
  
/*For each employee based on department, percentage of salary*/  
select  
    *,  
    (salary * 100) /(sum(salary) over( PARTITION by department_id))  
FROM  
    employee_wf;
```

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