Hands-on Lab: Sub-queries and Nested Selects

Estimated time needed: 20 minutes

Objectives

After completing this lab, you will be able to:

- Write SQL queries that demonstrate the necessity of using sub-queries
- Compose sub-queries in the where clause
- Build column expressions (for example, sub-query in place of a column)
- Write table expressions (for example, sub-query in place of a table)

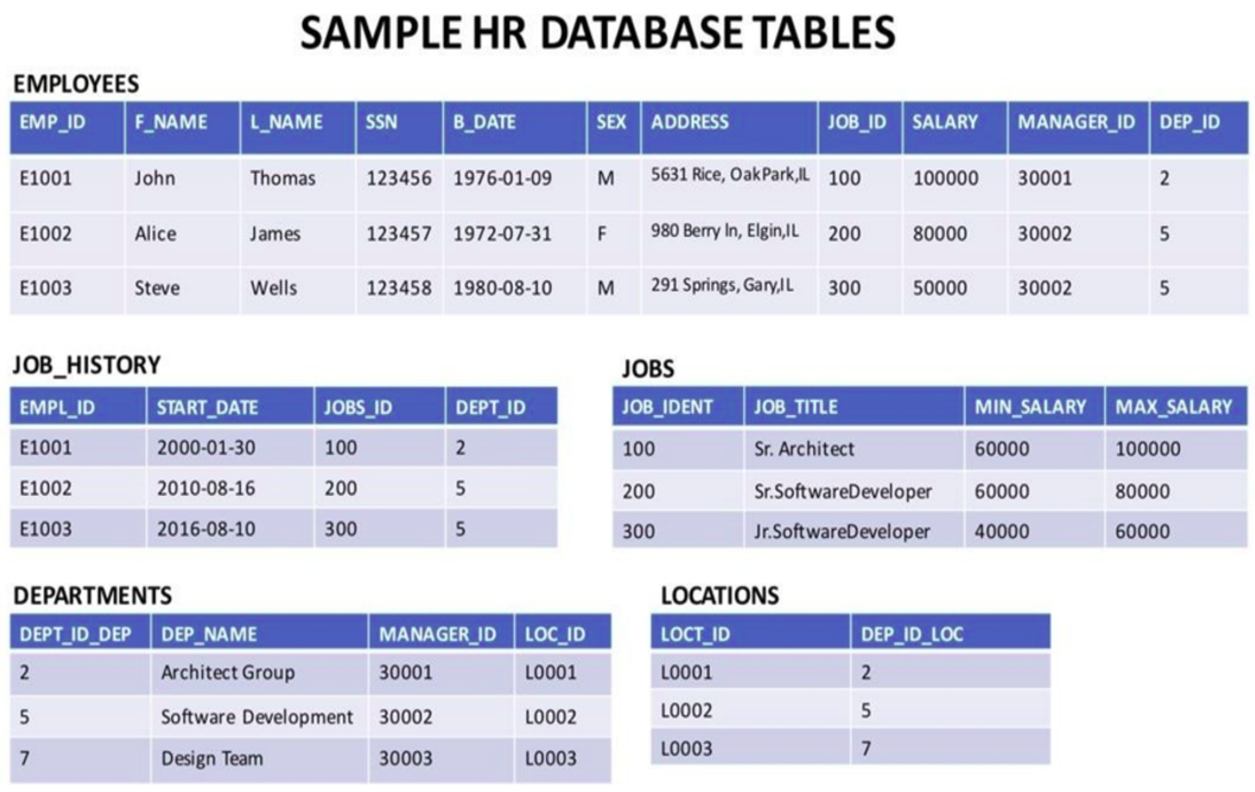
Software Used in this Lab

In this lab, you will use MySQL. MySQL is a Relational Database Management System (RDBMS) designed to store, manipulate, and retrieve data efficiently.

To complete this lab, you will use MySQL relational database service available as part of IBM Skills Network Labs (SN Labs) Cloud IDE. SN Labs is a virtual lab environment used in this course.

Database Used in this Lab

The database used in this lab is internal. You will be working on a sample HR database. This HR database schema consists of 5 tables: **EMPLOYEES**, **JOB_HISTORY**, **JOBS**, **DEPARTMENTS**, and **LOCATIONS**. Each table has a few rows of sample data. The following diagram shows the tables for the HR database:



SAMPLE HR DATABASE TABLES

EMPLOYEES

EMP_ID	F_NAME	L_NAME	SSN	B_DATE	SEX	ADDRESS	JOB_ID	SALARY	MANAGER_ID	DEP_ID
E1001	John	Thomas	123456	1976-01-09	M	5631 Rice, OakPark,IL	100	100000	30001	2
E1002	Alice	James	123457	1972-07-31	F	980 Berry ln, Elgin,IL	200	80000	30002	5
E1003	Steve	Wells	123458	1980-08-10	M	291 Springs, Gary,IL	300	50000	30002	5

JOB_HISTORY

EMPL_ID	START_DATE	JOBS_ID	DEPT_ID
E1001	2000-01-30	100	2
E1002	2010-08-16	200	5
E1003	2016-08-10	300	5

JOBS

JOB_IDENT	JOB_TITLE	MIN_SALARY	MAX_SALARY
100	Sr. Architect	60000	100000
200	Sr.SoftwareDeveloper	60000	80000
300	Jr.SoftwareDeveloper	40000	60000

DEPARTMENTS

DEPT_ID_DEP	DEP_NAME	MANAGER_ID	LOC_ID
2	Architect Group	30001	L0001
5	Software Development	30002	L0002
7	Design Team	30003	L0003

LOCATIONS

LOCT_ID	DEP_ID_LOC
L0001	2
L0002	5
L0003	7

Load the database

Using the skills acquired in the previous modules, you should first create the database in MySQL. Follow the steps below.

1. Open the phpMyAdmin interface from the Skills Network Toolbox in Cloud IDE.
2. Create a blank database named 'HR'. Use the script shared in the link below to create the required tables.
   Script_Create_Tables.sql
3. Download the files in the links below to your local device (if not already done in previous labs)
   Departments.csv
   Jobs.csv
   JobsHistory.csv
   Locations.csv
   Employees.csv
4. Use these files in the phpMyAdmin interface as the data for the respective tables in the 'HR' database.

Sub-queries and Nested Selects

Say you are asked to retrieve all employee records whose salary is lower than the average salary. You might use the following query to do this.

```
SELECT *
FROM EMPLOYEES
WHERE salary < AVG(salary);
```

Copied!

However, this query will generate an error stating, "Illegal use of group function." Here, the group function is `AVG` and cannot be used directly in the condition since it has not been retrieved from the data. Therefore, the condition will use a sub-query to retrieve the average salary information to compare the existing salary. The modified query would become:

```
SELECT *
FROM EMPLOYEES
WHERE SALARY < (SELECT AVG(SALARY) FROM EMPLOYEES);
```

Copied!

Now, consider executing a query that retrieves all employee records with EMP_ID, SALARY, and maximum salary as MAX_SALARY in every row. For this, the maximum salary must be queried and used as one of the columns. This can be done using the query below.

```
SELECT EMP_ID, SALARY, (SELECT MAX(SALARY) FROM EMPLOYEES) AS MAX_SALARY
FROM EMPLOYEES;
```

Copied!

Now, consider that you wish to extract the first and last names of the oldest employee. Since the oldest employee will be the one with the smallest date of birth, the query can be written as:

```
SELECT F_NAME, L_NAME
FROM EMPLOYEES
WHERE DOB = (SELECT MIN(DOB) FROM EMPLOYEES);
```

Copied!

You may also use sub-queries to create derived tables, which can then be used to query specific information. Say you want to know the average salary of the top 5 earners in the company. You will first have to extract a table of the top five salaries as a table. From that table, you can query the average value of the salary. The query can be written as follows.

```
SELECT AVG(SALARY)
FROM (SELECT SALARY
      FROM EMPLOYEES
      ORDER BY SALARY DESC
      LIMIT 5) AS SALARY_TABLE;
```

Copied!

Note that it is necessary to give an alias to any derived tables.

Practice Problems

1. Write a query to find the average salary of the five least-earning employees.

▾ Click here for a hint
You need to order the data in ascending salary order and limit it to the top five entries, treating this as a derived table. Take the average of these entries.
▾ Click here for the solution

```
SELECT AVG(SALARY)
FROM (SELECT SALARY
      FROM EMPLOYEES
      ORDER BY SALARY
      LIMIT 5) AS SALARY_TABLE;
```

Copied!

2. Write a query to find the records of employees older than the average age of all employees.

▾ Click here for a hint
Age in years can be calculated as the year component in the difference between DOB and current date. You need to compare the age in years with average age in years. The average age in years will be evaluated as a sub-query.
▾ Click here for the solution

```
SELECT *
FROM EMPLOYEES
WHERE YEAR(FROM_DAYS(DATEDIFF(CURRENT_DATE,BirthDate))) >
    (SELECT AVG(YEAR(FROM_DAYS(DATEDIFF(CURRENT_DATE,BirthDate))))
    FROM Employees);
```

Copied!

3. From the Job_History table, display the list of Employee IDs, years of service, and average years of service for all entries.

▾ Click here for hint
For this, you need to calculate the years of service as a difference between the date of joining and the current date. Average years of service need to be queried separately to be displayed.
▾ Click here for solution

```
1
2
3
4
```

```
SELECT EMPL_ID, YEAR(FROM_DAYS(DATEDIFF(CURRENT_DATE, STARTDATE))),
    (SELECT AVG(YEAR(FROM_DAYS(DATEDIFF(CURRENT_DATE, STARTDATE))))
    FROM JOB_HISTORY)
FROM JOB_HISTORY;
```

Copied!

Conclusion

Congratulations! You have completed this lab and are ready for the next topic.

You should now be able to:

- Write SQL queries that demonstrate the necessity of using sub-queries
- Compose sub-queries in the WHERE clause
- Build Column Expressions (for example, sub-query in place of a column)
- Write Table Expressions (for example, sub-query in place of a table)

Author(s)

Abhishek Gagneja

Lakshmi Holla

Malika Singla

Changelog

Date	Version	Changed by	Change Description
2023-10-11	1.2	Beth Larsen	QA pass, minor text edits
2023-10-11	1.1	Misty Taylor	ID Check
2023-10-10	1.0	Abhishek Gagneja	New Version of the lab created

Date	Version	Changed by	Change Description
2023-05-04	0.3	Rahul Jaideep	Updated Markdown file
2022-07-27	0.2	Lakshmi Holla	Updated HTML tag
2021-11-01	0.1	Lakshmi Holla, Malika Singla	Initial Version