Using SQL Joins to Connect Tables and Retrieve Information

Project Description

The leadership team at my organization tasked me with assessing potential security risks and implementing necessary updates on employee computers. As a Linux administrator, I utilized SQL queries with filters and JOIN techniques to perform security-related tasks. These efforts involved analysing and integrating data from two interconnected tables, demonstrating my expertise in relational database management and security analysis.

Match Employees to their Machines

To link employees with their assigned machines, I wrote an SQL query on MariaDB to join two tables: `machines` and `employees`. The query focused on the **intersection of both tables**, ensuring that only rows with matching values were included.

```
clear
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Welcome to the MariaDB monitor.  Commands end with ; or \g.
Your MariaDB connection id is 41
Server version: 10.3.39-MariaDB-0+deb10u2 Debian 10

Copyright (c) 2000, 2018, Oracle, MariaDB Corporation Ab and others.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

MariaDB [organization]> clear
MariaDB [organization]> clear
MariaDB [organization]> SELECT *
    ->
    -> FROM machines;
+-------------+------------------+----------------+---------------+-------------+
| device_id   | operating_system | email_client   | OS_patch_date | employee_id |
+-------------+------------------+----------------+---------------+-------------+
| a184b775c707 | OS 1            | Email Client 1 | 2021-09-01    |        1156 |
| a192b174c940 | OS 2            | Email Client 1 | 2021-06-01    |        1052 |
| a305b818c708 | OS 3            | Email Client 2 | 2021-06-01    |        1182 |
| a317b635c465 | OS 1            | Email Client 2 | 2021-03-01    |        1130 |
| a320b137c219 | OS 2            | Email Client 2 | 2021-03-01    |        1000 |
| a398b471c573 | OS 3            | Email Client 2 | 2021-12-01    |           0 |
| a667b270c984 | OS 1            | Email Client 1 | 2021-03-01    |        1078 |
| a821b452c176 | OS 2            | Email Client 2 | 2021-12-01    |        1104 |
| a998b568c863 | OS 3            | Email Client 1 | 2021-12-01    |        1026 |
| b157c491d493 | OS 2            | Email Client 1 | 2021-03-01    |           0 |
```

```
MariaDB [organization]> SELECT *
    ->
    -> FROM employees;
+-------------+-------------+----------+-----------------------+-------------+
| employee_id | device_id   | username | department            | office      |
+-------------+-------------+----------+-----------------------+-------------+
|        1000 | a320b137c219 | elarson  | Marketing             | East-170    |
|        1001 | b239c825d303 | bmoreno  | Marketing             | Central-276 |
|        1002 | c116d593e558 | tshah    | Human Resources       | North-434   |
|        1003 | d394e816f943 | sgilmore | Finance               | South-153   |
|        1004 | e218f877g788 | eraab    | Human Resources       | South-127   |
|        1005 | f551g340h864 | gesparza | Human Resources       | South-366   |
|        1006 | g329h357i597 | alevitsk | Information Technology | East-320    |
|        1007 | h174i497j413 | wjaffrey | Finance               | North-406   |
|        1008 | i858j583k571 | abernard | Finance               | South-170   |
|        1009 | NULL         | lrodriqu | Sales                 | South-134   |
|        1010 | k2421212m542 | jlansky  | Finance               | South-109   |
|        1011 | l748m120n401 | drosas   | Sales                 | South-292   |
|        1012 | m756n668o146 | nmason   | Information Technology | North-160   |
|        1013 | n205o559p243 | zbernal  | Information Technology | South-229   |
|        1014 | NULL         | asundara | Information Technology | West-219    |
|        1015 | p611q262r945 | jsoto    | Finance               | North-271   |
|        1016 | q793r736s288 | sbaelish | Human Resources       | North-229   |
|        1017 | r550s824t230 | jclark   | Finance               | North-188   |
|        1018 | s310t540u653 | abellmas | Finance               | North-403   |
|        1019 | t815u205v470 | mcouliba | Information Technology | North-108   |
|        1020 | u899v381w363 | arutley  | Marketing             | South-351   |
|        1021 | v200w121x977 | smartell | Information Technology | South-138   |
|        1022 | w237x430y567 | arusso   | Finance               | West-465    |
```

The SQL query retrieved the following data:

- Username (from the relevant table)
- Operating system (from the relevant table)
- Employee ID (from the `employees` table)

To avoid ambiguity for shared column names, I used the `table.column` format. The result included 185 rows, each representing a unique username, operating system, and device ID, providing a comprehensive view of the assigned machines.

```
MariaDB [organization]> SELECT *
    ->
    -> FROM machines
    ->
    -> INNER JOIN employees ON machines.device_id = employees.device_id;
+-------------+-----------------+---------------+--------------+-------------+-------------+-------------+----------+-----------------------
-+-------------+
| device_id   | operating_system | email_client  | OS_patch_date | employee_id | employee_id | device_id   | username | department
 | office      |
+-------------+-----------------+---------------+--------------+-------------+-------------+-------------+----------+-----------------------
-+-------------+
| a320b137c219 | OS 2            | Email Client 2 | 2021-03-01   |        1000 |        1000 | a320b137c219 | elarson  | Marketing
 | East-170    |
| b239c825d303 | OS 1            | Email Client 1 | 2021-03-01   |        1001 |        1001 | b239c825d303 | bmoreno  | Marketing
 | Central-276 |
| c116d593e558 | OS 3            | Email Client 1 | 2021-09-01   |        1002 |        1002 | c116d593e558 | tshah    | Human Resources
 | North-434   |
| d394e816f943 | OS 3            | Email Client 2 | 2021-03-01   |        1003 |        1003 | d394e816f943 | sgilmore | Finance
 | South-153   |
| e218f877g788 | OS 2            | Email Client 1 | 2021-09-01   |        1004 |        1004 | e218f877g788 | eraab    | Human Resources
 | South-127   |
| f551g340h864 | OS 3            | Email Client 2 | 2021-12-01   |        1005 |        1005 | f551g340h864 | gesparza | Human Resources
 | South-366   |
| g329h357i597 | OS 1            | Email Client 2 | 2021-06-01   |        1006 |        1006 | g329h357i597 | alevitsk | Information Technology
 | East-320    |
| h174i497j413 | OS 2            | Email Client 1 | 2021-03-01   |        1007 |        1007 | h174i497j413 | wjaffrey | Finance
```

```
| Central-247 |
| d790e839f461 | OS 1            | Email Client 1 | 2021-06-01    |       1185 |       1185 | d790e839f461 | revens   | Sales
 | North-330   |
| e281f433g404 | OS 1            | Email Client 2 | 2021-12-01    |       1186 |       1186 | e281f433g404 | sacosta  | Sales
 | North-460   |
| f963g637h851 | OS 1            | Email Client 1 | 2021-06-01    |       1187 |       1187 | f963g637h851 | bbode    | Finance
 | East-351    |
| g164h566i795 | OS 1            | Email Client 1 | 2021-09-01    |       1188 |       1188 | g164h566i795 | noshiro  | Finance
 | West-252    |
| h784i120j837 | OS 3            | Email Client 2 | 2021-12-01    |       1189 |       1189 | h784i120j837 | slefkowi | Human Resources
 | West-342    |
| k570l183m949 | OS 3            | Email Client 1 | 2021-12-01    |       1192 |       1192 | k570l183m949 | rlaghari | Information Technology
 | East-138    |
| l186m618n319 | OS 1            | Email Client 2 | 2021-12-01    |       1193 |       1193 | l186m618n319 | esantiag | Information Technology
 | Central-300 |
| m340n287o441 | OS 2            | Email Client 2 | 2021-09-01    |       1194 |       1194 | m340n287o441 | zwarren  | Human Resources
 | West-212    |
| n516o853p957 | OS 1            | Email Client 1 | 2021-09-01    |       1195 |       1195 | n516o853p957 | orainier | Finance
 | East-346    |
| o225p357q829 | OS 3            | Email Client 1 | 2021-12-01    |       1196 |       1196 | o225p357q829 | sshah2   | Information Technology
 | South-385   |
| p791q114r509 | OS 2            | Email Client 1 | 2021-09-01    |       1197 |       1197 | p791q114r509 | aabara   | Information Technology
 | North-159   |
| q308r573s459 | OS 3            | Email Client 1 | 2021-03-01    |       1198 |       1198 | q308r573s459 | jmartine | Marketing
 | South-117   |
| r520s571t459 | OS 2            | Email Client 2 | 2021-03-01    |       1199 |       1199 | r520s571t459 | areyes   | Human Resources
 | East-100    |
+--------------+-----------------+----------------+---------------+------------+------------+--------------+----------+-----------------------
-+-------------+
185 rows in set (0.043 sec)
```

Return More Data

LEFT JOIN:

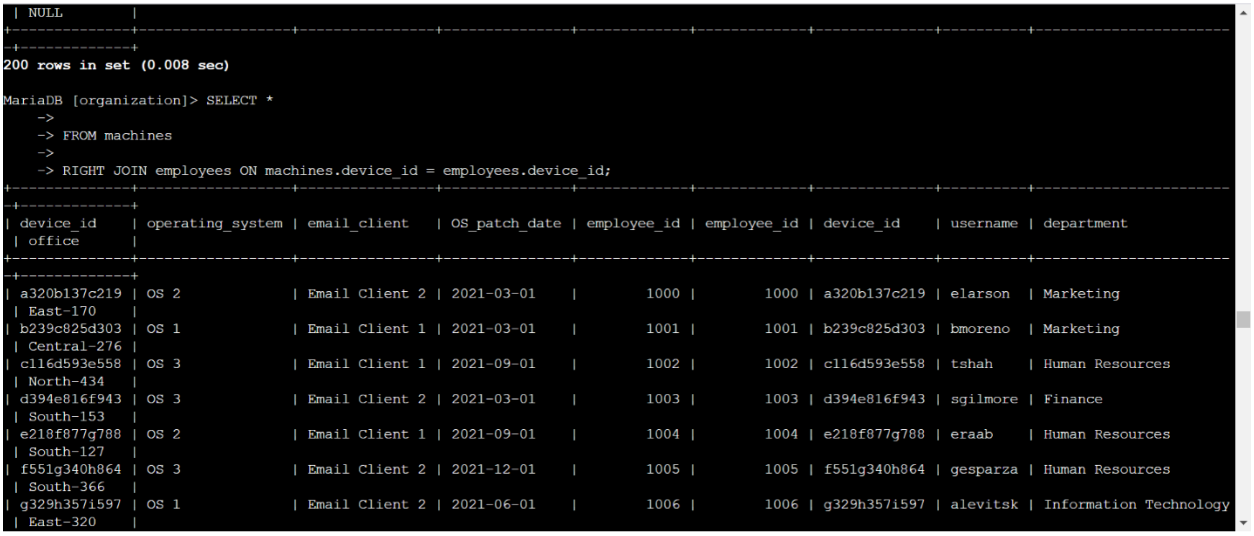
- Ensured that all rows from the `machines` table were included, regardless of whether they had matching entries in the `employees` table.
- Used the `device_id` column as the link between the tables.
- Highlighted all machines, including those not assigned to an employee, by populating unmatched rows from the `employees` table with `NULL` values

```
-+-------------+
185 rows in set (0.100 sec)

MariaDB [organization]> SELECT *
    ->
    -> FROM machines
    ->
    -> LEFT JOIN employees ON machines.device_id = employees.device_id;
+--------------+-----------------+----------------+---------------+------------+------------+--------------+----------+-----------------------
-+-------------+
| device_id    | operating_system | email_client   | OS_patch_date | employee_id | employee_id | device_id    | username | department
 | office      |
+--------------+-----------------+----------------+---------------+------------+------------+--------------+----------+-----------------------
-+-------------+
| a320b137c219 | OS 2            | Email Client 2 | 2021-03-01    |       1000 |       1000 | a320b137c219 | elarson  | Marketing
 | East-170    |
| b239c825d303 | OS 1            | Email Client 1 | 2021-03-01    |       1001 |       1001 | b239c825d303 | bmoreno  | Marketing
 | Central-276 |
| c116d593e558 | OS 3            | Email Client 1 | 2021-09-01    |       1002 |       1002 | c116d593e558 | tshah    | Human Resources
 | North-434   |
| d394e816f943 | OS 3            | Email Client 2 | 2021-03-01    |       1003 |       1003 | d394e816f943 | sgilmore | Finance
 | South-153   |
| e218f877g788 | OS 2            | Email Client 1 | 2021-09-01    |       1004 |       1004 | e218f877g788 | eraab    | Human Resources
 | South-127   |
| f551g340h864 | OS 3            | Email Client 2 | 2021-12-01    |       1005 |       1005 | f551g340h864 | gesparza | Human Resources
 | South-366   |
| g329h357i597 | OS 1            | Email Client 2 | 2021-06-01    |       1006 |       1006 | g329h357i597 | alevitsk | Information Technology
 | East-320    |
| h174i497j413 | OS 2            | Email Client 1 | 2021-03-01    |       1007 |       1007 | h174i497j413 | wjaffrey | Finance
 | North-406   |
```

RIGHT JOIN:

- Ensured that all rows from the `employees` table were included, even if they lacked matching entries in the `machines` table.
- Used the `device_id` column as the link between the tables.
- Highlighted all employees, including those without assigned `machines`, by populating unmatched rows from the machines table with `NULL` values.



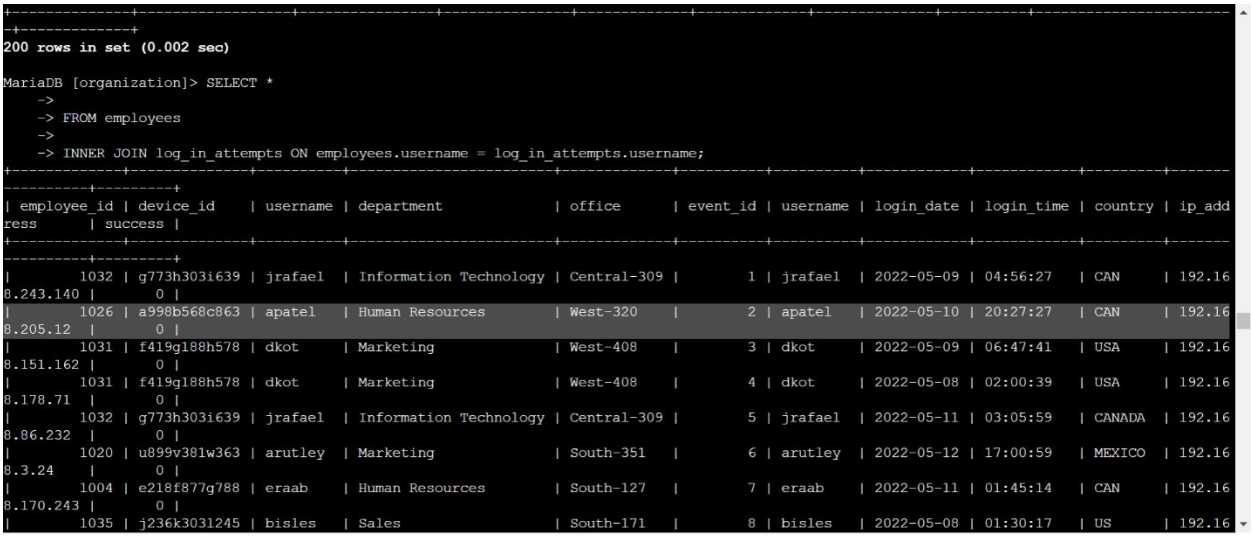
```
| NULL        |
+-------------+-----------------+---------------+---------------+-------------+-------------+-------------+----------+-----------------------
-+-------------+
200 rows in set (0.008 sec)

MariaDB [organization]> SELECT *
    ->
    -> FROM machines
    ->
    -> RIGHT JOIN employees ON machines.device_id = employees.device_id;
+-------------+-----------------+---------------+---------------+-------------+-------------+-------------+----------+-----------------------
-+-------------+
| device_id   | operating_system | email_client  | OS_patch_date | employee_id | employee_id | device_id   | username | department
 | office      |
+-------------+-----------------+---------------+---------------+-------------+-------------+-------------+----------+-----------------------
-+-------------+
| a320b137c219 | OS 2            | Email Client 2 | 2021-03-01    |        1000 |        1000 | a320b137c219 | elarson  | Marketing
 | East-170    |
| b239c825d303 | OS 1            | Email Client 1 | 2021-03-01    |        1001 |        1001 | b239c825d303 | bmoreno  | Marketing
 | Central-276 |
| c116d593e558 | OS 3            | Email Client 1 | 2021-09-01    |        1002 |        1002 | c116d593e558 | tshah    | Human Resources
 | North-434   |
| d394e816f943 | OS 3            | Email Client 2 | 2021-03-01    |        1003 |        1003 | d394e816f943 | sgilmore | Finance
 | South-153   |
| e218f877g788 | OS 2            | Email Client 1 | 2021-09-01    |        1004 |        1004 | e218f877g788 | eraab    | Human Resources
 | South-127   |
| f551g340h864 | OS 3            | Email Client 2 | 2021-12-01    |        1005 |        1005 | f551g340h864 | gesparza | Human Resources
 | South-366   |
| g329h357i597 | OS 1            | Email Client 2 | 2021-06-01    |        1006 |        1006 | g329h357i597 | alevitsk | Information Technology
 | East-320    |
```

Both **JOIN** queries produced 200 rows each. However, some columns contained `NULL` values, reflecting the absence of corresponding data in the related table.

Retrieve Login Attempt Data

To further investigate the security incident, I retrieved details of all employees who had made login attempts. This involved performing an **INNER JOIN** on the `employees` and `log_in_attempts` tables, using the `username` column as the link. This query provided a focused dataset of relevant login activities, supporting a deeper analysis of potential security risks.



```
200 rows in set (0.002 sec)

MariaDB [organization]> SELECT *
    ->
    -> FROM employees
    ->
    -> INNER JOIN log_in_attempts ON employees.username = log_in_attempts.username;
+-------------+-------------+----------+-----------------------+-------------+----------+----------+------------+------------+---------+-------
---------+---------+
| employee_id | device_id    | username | department            | office      | event_id | username | login_date | login_time | country | ip_add
ress      | success |
+-------------+-------------+----------+-----------------------+-------------+----------+----------+------------+------------+---------+-------
---------+---------+
|        1032 | g773h303i639 | jrafael  | Information Technology | Central-309 |        1 | jrafael  | 2022-05-09 | 04:56:27   | CAN     | 192.16
8.243.140 |       0 |
|        1026 | a998b568c863 | apatel   | Human Resources       | West-320    |        2 | apatel   | 2022-05-10 | 20:27:27   | CAN     | 192.16
8.205.12  |       0 |
|        1031 | f419g188h578 | dkot     | Marketing             | West-408    |        3 | dkot     | 2022-05-09 | 06:47:41   | USA     | 192.16
8.151.162 |       0 |
|        1031 | f419g188h578 | dkot     | Marketing             | West-408    |        4 | dkot     | 2022-05-08 | 02:00:39   | USA     | 192.16
8.178.71  |       0 |
|        1032 | g773h303i639 | jrafael  | Information Technology | Central-309 |        5 | jrafael  | 2022-05-11 | 03:05:59   | CANADA  | 192.16
8.86.232  |       0 |
|        1020 | u899v381w363 | arutley  | Marketing             | South-351   |        6 | arutley  | 2022-05-12 | 17:00:59   | MEXICO  | 192.16
8.3.24    |       0 |
|        1004 | e218f877g788 | eraab    | Human Resources       | South-127   |        7 | eraab    | 2022-05-11 | 01:45:14   | CAN     | 192.16
8.170.243 |       0 |
|        1035 | j236k3031245 | bisles   | Sales                 | South-171   |        8 | bisles   | 2022-05-08 | 01:30:17   | US      | 192.16
```

Summary

I developed SQL queries to join two tables, analysing three specific scenarios:

1. **Inner Join:** Retrieved only the rows with matching values in both tables, focusing on shared data.
1. **Left Join:** Included all rows from the `machines` table, with unmatched `employees` data represented as `NULL`.
2. **Right Join:** Included all rows from the `employees` table, with unmatched `machines` data represented as NULL.

Each query was tailored to explore different aspects of the data, providing critical insights for relational database management and security analysis. The investigation of login attempts via **INNER JOIN** further supported security risk assessments by linking employees to their activity logs.