



**Giza  
Systems**

## *Final Project*

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## **Project Goal**

**Build a secure, automated, and remote-accessible MySQL setup across two VMs. This reflects real-world infrastructure tasks in modern system administration, DevOps, and backend engineering roles.**

## **What will be built:**

- **A Red Hat 9 VM as the database server.**
- **An Ubuntu 22.04 VM as the remote client.**
- **A fully functioning MySQL 8+ server, configured with:**
- **A dedicated project database (ProjectDB)**
- **Two user roles: readonly\_user and readwrite\_user**
- **Opened port 3306 with safe firewall and bind-address settings.**

## **Automation with Scripts**

- **setup\_mysql\_server.sh: Sets up the server, creates users with specific privileges, configures the firewall, and allows remote connections.**
- **setup\_mysql\_client.sh: Automates connection tests and executes SQL queries to confirm user permissions.**

## setup mysql server.sh:

### Declaring Variables:

```
#!/bin/bash

set -e ##to exit on error

MYSQL_ROOT_PASSWORD="Root@1234"
DB_NAME="ProjectDB"
READ_ONLY_USER="readonly_user"
READ_ONLY_PASSWORD="Readonly@1234"
READ_WRITE_USER="readwrite_user"
READ_WRITE_PASSWORD="Readwrite@1234"
```

### Resetting the Network Adapters and Create Fresh Configurations

```
echo " Resetting and Configuring Network Adapters"

OLD_CONS=$(nmcli -t -f NAME connection show)
for con in $OLD_CONS; do
    echo "Deleting old connection: $con"
    sudo nmcli connection delete "$con" || true
done

sleep 2

IF_NAT=$(nmcli device | awk '/ethernet/ {print $1}' | head -n1)
IF_HOST=$(nmcli device | awk '/ethernet/ {print $1}' | tail -n1)
```

## Setting the Gateway and the routing tables

```
echo "Using $IF_NAT for NAT and $IF_HOST for Host-Only"

sudo nmcli connection add type ethernet ifname "$IF_NAT" con-name nat0
sudo nmcli connection add type ethernet ifname "$IF_HOST" con-name hostonly0

sudo nmcli connection up nat0
sudo nmcli connection up hostonly0

GATEWAY=$(nmcli -g IP4.GATEWAY device show "$IF_NAT" | head -n1)
if [ -n "$GATEWAY" ]; then
    sudo ip route del default || true
    sudo ip route add default via "$GATEWAY" dev "$IF_NAT"
    echo " Default route set via $GATEWAY on $IF_NAT"
else
    echo " Could not detect gateway on $IF_NAT"
fi

echo " Testing Internet..."
ping -c 3 8.8.8.8 || echo "Ping to 8.8.8.8 failed"
```

## Installing MYSQL Server and starting the service

```
echo "INSTALLING MYSQL SERVER:"

sudo dnf install -y https://dev.mysql.com/get/mysql80-community-release-el9-1.noarch.rpm

echo "Importing the latest MySQL GPG key:"
sudo rpm --import https://repo.mysql.com/RPM-GPG-KEY-mysql-2023

sudo dnf clean all

if dnf module list mysql | grep -q mysql; then
    sudo dnf module reset mysql -y
    sudo dnf module disable mysql -y
fi
sudo dnf install -y mysql-community-server

echo "Starting MySQL service:"
sudo systemctl enable mysqld
sudo systemctl start mysqld
```

## Check if the service is running and the installation is completed

```
if ! sudo systemctl is-active --quiet mysqld; then
    echo "Error: MySQL service is not running."
    exit 1
fi

echo "MYSQL SERVER INSTALLATION COMPLETED"
```

## Get the temporary default Root Password created from MYSQL LOGS

```
TEMP_PASS=$(sudo grep 'temporary password' /var/log/mysqld.log | tail -n 1 | awk '{print $NF}')
if [ -z "$TEMP_PASS" ]; then
    echo "Error: Could not retrieve temporary password from /var/log/mysqld.log"
    exit 1
fi

echo "Checking if MySQL root password is already set..."
if mysqladmin -u root -p"$TEMP_PASS" status 2>/dev/null; then
    echo "Temporary password is valid, proceeding with secure installation."
else
    echo "Temporary password is invalid. Checking if root password is already set to $MYSQL_ROOT_PASSWORD..."
    if mysqladmin -u root -p"$MYSQL_ROOT_PASSWORD" status 2>/dev/null; then
        echo "Root password is already set to $MYSQL_ROOT_PASSWORD. Skipping secure installation."
        TEMP_PASS="$MYSQL_ROOT_PASSWORD"
    else
        echo "Error: Unable to log in with temporary password or root password."
        exit 1
    fi
fi
```

## Securing MySQL and setting the Password

```
mysql --connect-expired-password -u root -p"$TEMP_PASS" <<EOF

ALTER USER 'root'@'localhost' IDENTIFIED BY '$MYSQL_ROOT_PASSWORD';
DELETE FROM mysql.user WHERE User='';
DROP DATABASE IF EXISTS test;
FLUSH PRIVILEGES;
EOF
```

## Creating the new Database with the 2 users (Read only user and Read write user)

```
echo "Creating a new database: $DB_NAME"
sudo mysql -uroot -p"$MYSQL_ROOT_PASSWORD" <<EOF
CREATE DATABASE IF NOT EXISTS $DB_NAME;
CREATE USER IF NOT EXISTS '$READ_ONLY_USER'@'%' IDENTIFIED BY '$READ_ONLY_PASSWORD';
GRANT SELECT ON $DB_NAME.* TO '$READ_ONLY_USER'@'%';

CREATE USER IF NOT EXISTS '$READ_WRITE_USER'@'%' IDENTIFIED BY '$READ_WRITE_PASSWORD';
GRANT CREATE, SELECT, INSERT, UPDATE, DELETE ON $DB_NAME.* TO '$READ_WRITE_USER'@'%' ;

FLUSH PRIVILEGES;
EOF
```

## At the end, enabling clients to connect to the server through the port 3306


```
sudo sed -i "s/^bind-address.*bind-address = 0.0.0.0/" /etc/my.cnf.d/mysqlld.cnf || echo "bind-address=0.0.0.0" | sudo tee -a /etc/my.cnf.d/mysqlld.cnf

echo "Restarting MySQL service to apply changes:"
sudo systemctl restart mysqld

echo "adding port 3306 to firewall"
sudo firewall-cmd --permanent --add-port=3306/tcp
sudo firewall-cmd --reload

echo "Installation and configuration of MySQL server completed successfully."
echo "Server script completed."
```

## Executing the Server Script



The image shows a terminal window titled "youssef@192:~" with a file path of "file:///192.168.127.132/home/youssef". The terminal displays the output of a script named "server2.sh". The script installs MySQL 8.0 Community Server. It shows the process of updating subscription management repositories, resolving dependencies, and installing the package. It also shows the MySQL service being started and configured. The script ends with a message "Installation and configuration of MySQL server completed successfully." and "Server script completed."

```
youssef@192:~$ nano server2.sh
youssef@192:~$ ./server2.sh
INSTALLING MYSQL SERVER:
Updating Subscription Management repositories.
Last metadata expiration check: 0:04:40 ago on Thu 31 Jul 2025 08:03:10 AM EEST.
mysql80-community-release-el9-1.noarch 8.9 kB/s | 10 kB    00:01
Package mysql80-community-release-el9-1.noarch is already installed.
Dependencies resolved.
Nothing to do.
Complete!
Importing the latest MySQL GPG key:
Updating Subscription Management repositories.
21 files removed
Error: No matching Modules to list
Updating Subscription Management repositories.
MySQL 8.0 Community Server          51 kB/s | 23 kB    00:00
MySQL Connectors Community          48 kB/s | 19 kB    00:00
MySQL Tools Community                29 kB/s | 10 kB    00:00
Red Hat Enterprise Linux 10 for x86_64 1.0 MB/s | 15 MB    00:14
Red Hat Enterprise Linux 10 for x86_64 466 kB/s | 2.9 MB    00:06
Package mysql-community-server-8.0.43-1.el9.x86_64 is already installed.
Dependencies resolved.
Nothing to do.
Complete!
Starting MySQL service:
MYSQL SERVER INSTALLATION COMPLETED
Checking if MySQL root password is already set...
Temporary password is invalid. Checking if root password is already set to Root@1234...
Uptime: 3492 Threads: 2 Questions: 47 Slow queries: 0 Opens: 216 Flush tables: 3 Open tables: 132 Queries per second avg: 0.013
Root password is already set to Root@1234. Skipping secure installation.
mysql: [Warning] Using a password on the command line interface can be insecure.
Creating a new database: ProjectDB
mysql: [Warning] Using a password on the command line interface can be insecure.
Restarting MySQL service to apply changes:
adding port 3306 to firewall
success
success
Installation and configuration of MySQL server completed successfully.
Server script completed.
youssef@192:~$
```

# Testing The mysqld status

```
youssef@192:~$ sudo systemctl status mysqld
```

```
● mysqld.service - MySQL Server
   Loaded: loaded (/usr/lib/systemd/system/mysqld.service; enabled; preset: disabled)
   Active: active (running) since Thu 2025-07-31 08:08:34 EEST; 1min 57s ago
 Invocation: 8a02f962725d4967b26a0c2c85edb4f7
    Docs: man:mysqld(8)
          http://dev.mysql.com/doc/refman/en/using-systemd.html
   Process: 7465 ExecStartPre=/usr/bin/mysqld_pre_systemd (code=exited, status=0/SUCCESS)
  Main PID: 7494 (mysqld)
    Status: "Server is operational"
     Tasks: 37 (limit: 13425)
  Memory: 379.6M (peak: 397.7M)
     CPU: 2.518s
   CGroup: /system.slice/mysqld.service
           └─7494 /usr/sbin/mysqld
```

```
Jul 31 08:08:32 192.168.127.132 systemd[1]: Starting mysqld.service - MySQL Server...
```

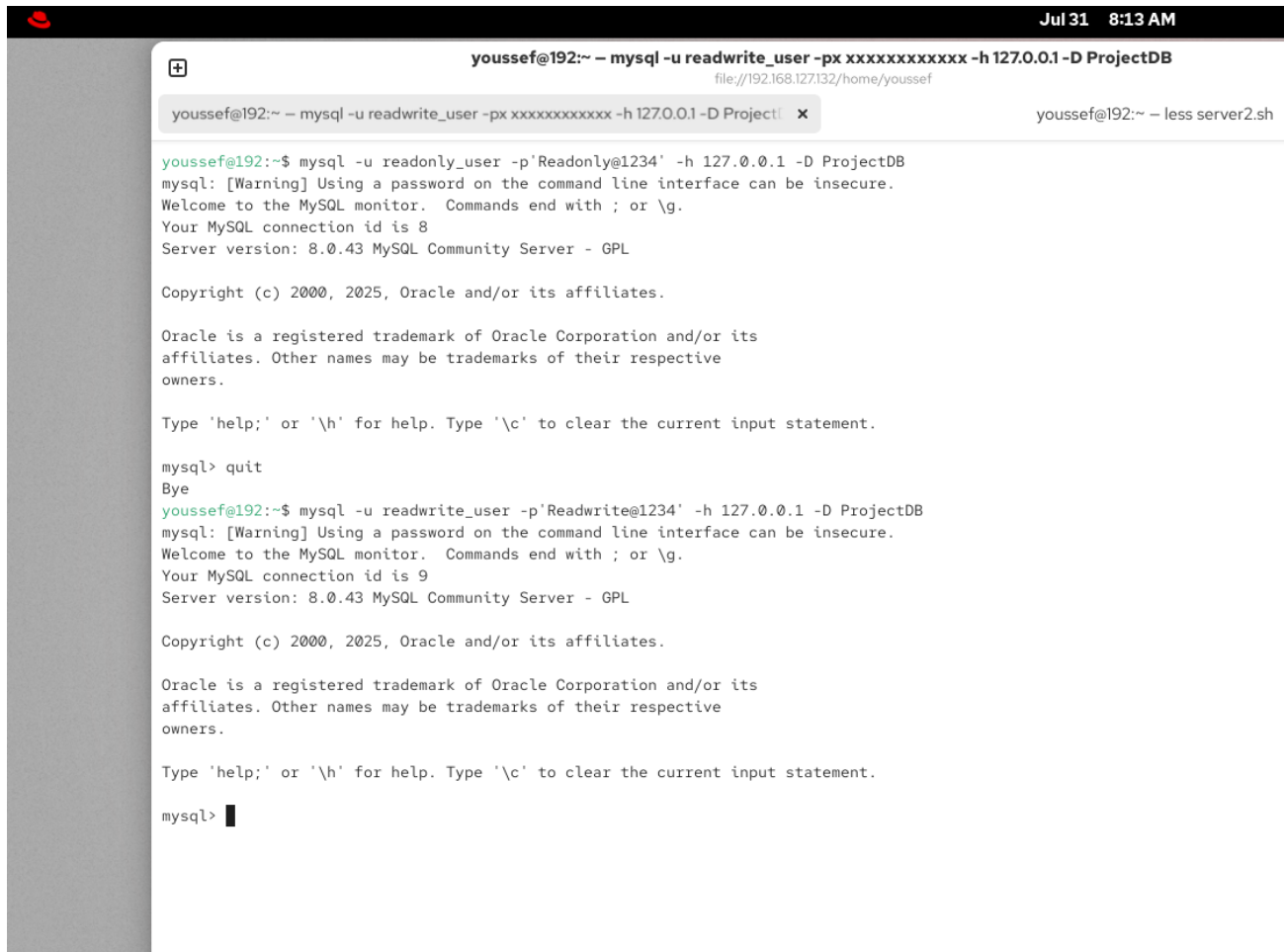
```
Jul 31 08:08:34 192.168.127.132 (mysqld)[7494]: mysqld.service: Referenced but unset environment variable evaluates to an empty string: MYSQLD_
```

```
Jul 31 08:08:34 192.168.127.132 systemd[1]: Started mysqld.service - MySQL Server.
```

```
lines 1-18/18 (END)
```



## Accessing Both users from the server



The image shows a terminal window titled "youssef@192:~ - mysql -u readwrite\_user -px xxxxxxxxxxxx -h 127.0.0.1 -D ProjectDB". The window contains two separate MySQL sessions. The first session is for the 'readonly\_user' with password 'Readonly@1234', showing connection ID 8. The second session is for the 'readwrite\_user' with password 'Readwrite@1234', showing connection ID 9. Both sessions display the same MySQL welcome message and version information (8.0.43 MySQL Community Server - GPL).

```
youssef@192:~ - mysql -u readwrite_user -px xxxxxxxxxxxx -h 127.0.0.1 -D ProjectDB
youssef@192:~ - less server2.sh

youssef@192:~$ mysql -u readonly_user -p'Readonly@1234' -h 127.0.0.1 -D ProjectDB
mysql: [Warning] Using a password on the command line interface can be insecure.
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 8
Server version: 8.0.43 MySQL Community Server - GPL

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affiliates. Other names may be trademarks of their respective
owners.

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

mysql> quit
Bye
youssef@192:~$ mysql -u readwrite_user -p'Readwrite@1234' -h 127.0.0.1 -D ProjectDB
mysql: [Warning] Using a password on the command line interface can be insecure.
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 9
Server version: 8.0.43 MySQL Community Server - GPL

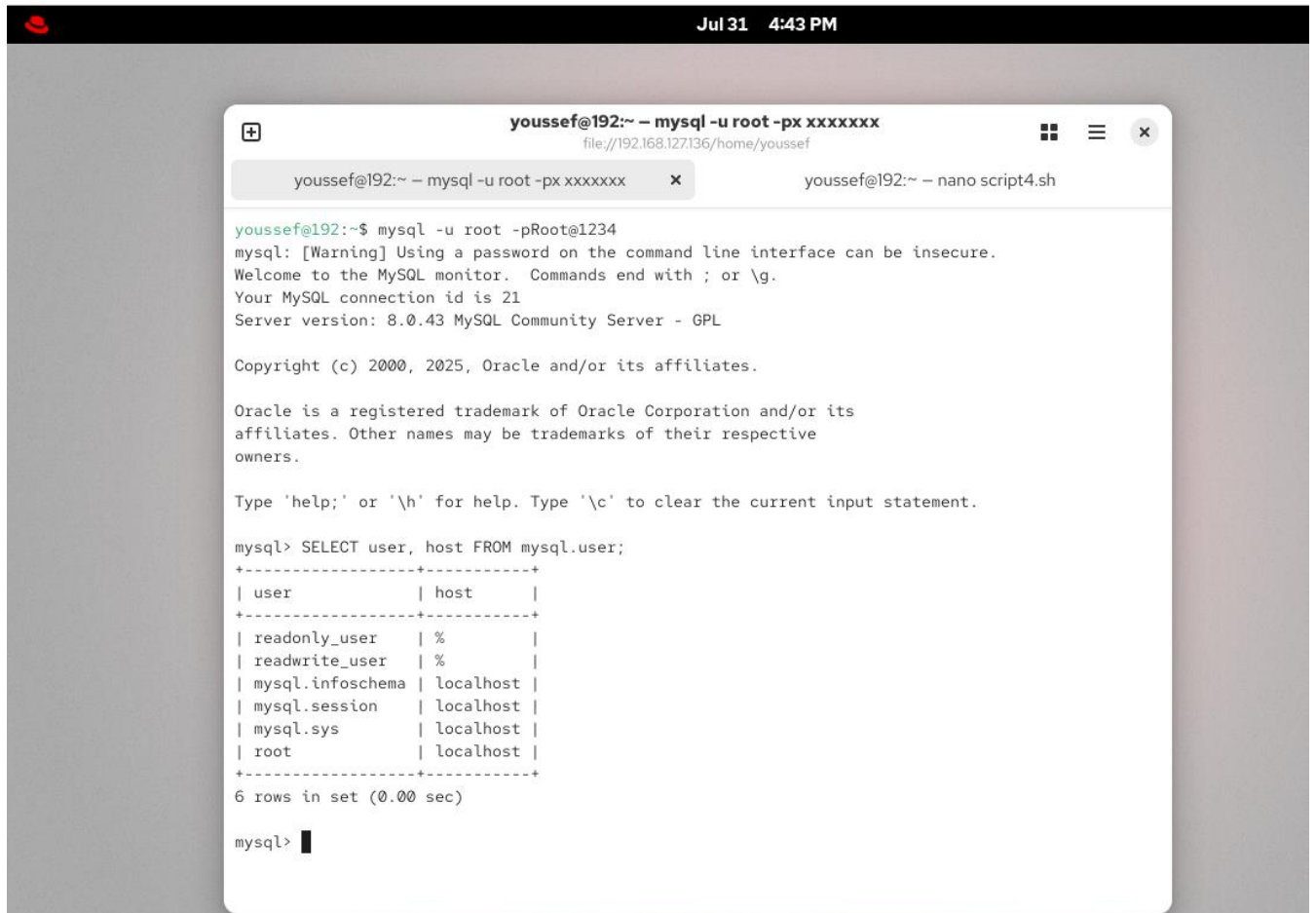
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affiliates. Other names may be trademarks of their respective
owners.

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

mysql> █
```

## Show all the users on the server

A terminal window titled 'youssef@192:~ - mysql -u root -px xxxxxxxx' is shown. The user has executed the command 'mysql -u root -pRoot@1234'. The terminal displays the MySQL welcome message and the output of the 'SELECT user, host FROM mysql.user;' query. The output is a table with 6 rows and 2 columns: 'user' and 'host'. The users listed are 'readonly\_user', 'readwrite\_user', 'mysql.infoschema', 'mysql.session', 'mysql.sys', and 'root'. All hosts are 'localhost'.

```
youssef@192:~$ mysql -u root -pRoot@1234
mysql: [Warning] Using a password on the command line interface can be insecure.
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 21
Server version: 8.0.43 MySQL Community Server - GPL

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owners.

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

mysql> SELECT user, host FROM mysql.user;
+-----+-----+
| user          | host          |
+-----+-----+
| readonly_user | %             |
| readwrite_user | %             |
| mysql.infoschema | localhost    |
| mysql.session  | localhost    |
| mysql.sys      | localhost    |
| root          | localhost    |
+-----+-----+
6 rows in set (0.00 sec)

mysql>
```

# setup mysql client.sh

## Declaring Variables and Installing MYSQL-Client

```
#!/bin/bash

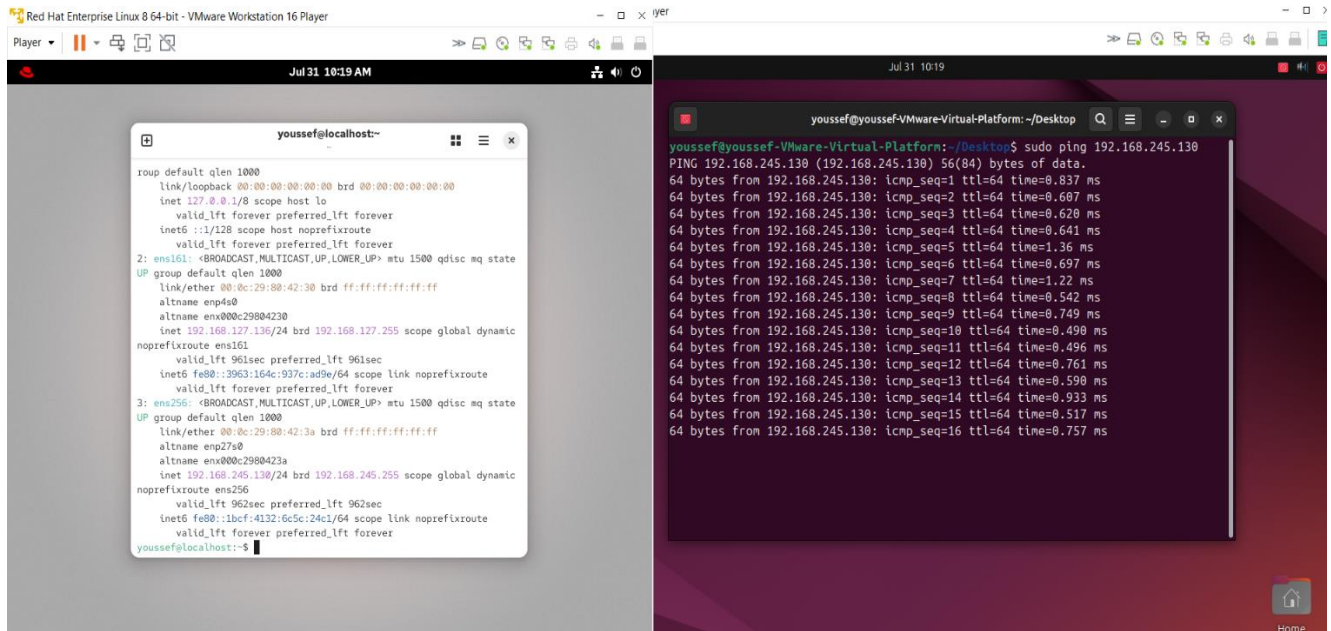
set -e

MYSQL_SERVER_IP="192.168.245.130"
DB_NAME="ProjectDB"
READ_ONLY_USER="readonly_user"
READ_ONLY_PASSWORD="Readonly@1234"
READ_WRITE_USER="readwrite_user"
READ_WRITE_PASSWORD="Readwrite@1234"

echo "Installing MySQL client"
sudo apt update -y
sudo apt install mysql-client -y

echo "Client script completed."
```

# Pinging the Server IP



## Executing the Client Script

```
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ ./client1.sh
Installing MySQL client
Hit:1 http://security.ubuntu.com/ubuntu noble-security InRelease
Hit:2 http://eg.archive.ubuntu.com/ubuntu noble InRelease
Hit:3 http://eg.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:4 http://eg.archive.ubuntu.com/ubuntu noble-backports InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
156 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
mysql-client is already the newest version (8.0.42-0ubuntu0.24.04.2).
0 upgraded, 0 newly installed, 0 to remove and 156 not upgraded.
Testing connection to MySQL server at 192.168.245.130
mysql: [Warning] Using a password on the command line interface can be insecure.
+-----+
| Database |
+-----+
| ProjectDB |
| information_schema |
| performance_schema |
+-----+
Successfully connected to MySQL server as readonly_user
Running a sample SELECT query on ProjectDB with the READ_ONLY_USER
mysql: [Warning] Using a password on the command line interface can be insecure.
+-----+
| Tables_in_ProjectDB |
+-----+
| TABLE1_test |
+-----+
Running a sample INSERT query on ProjectDB with the READ_ONLY_USER
mysql: [Warning] Using a password on the command line interface can be insecure.
ERROR 1142 (42000) at line 1: CREATE command denied to user 'readonly_user'@'192.168.245.131' for table 'client_test'
CORRECT, Failed to create table with read_only_user
Testing CREATE operation with read-write user
mysql: [Warning] Using a password on the command line interface can be insecure.
Successfully connected and executed write query as readwrite_user

Testing INSERT operation with read-write user
mysql: [Warning] Using a password on the command line interface can be insecure.
INSERT successful as readwrite_user
Client script completed.
youssef@youssef-VMware-Virtual-Platform:~/Desktop$
```

# MANUAL TEST AFTER EXECUTING THE SCRIPT

```
youssef@youssef-VMware-Virtual-Platform: ~/Desktop
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readonly_user -pReadonly@1234 -e "SHOW DATABASES;"
mysql: [Warning] Using a password on the command line interface can be insecure.
+-----+
| Database |
+-----+
| ProjectDB |
| information_schema |
| performance_schema |
+-----+
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readonly_user -pReadonly@1234 ProjectDB -e "CREATE TABLE read_only_table;"
mysql: [Warning] Using a password on the command line interface can be insecure.
ERROR 1142 (42000) at line 1: CREATE command denied to user 'readonly_user'@'192.168.245.131' for table 'read_only_table'
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readonly_user -pReadonly@1234 ProjectDB -e "SHOW TABLES;"
mysql: [Warning] Using a password on the command line interface can be insecure.
+-----+
| Tables_in_ProjectDB |
+-----+
| TABLE1_test |
| client_test |
+-----+
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readonly_user -pReadonly@1234 ProjectDB -e "SHOW COLUMNS FROM client_test;"
mysql: [Warning] Using a password on the command line interface can be insecure.
+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+
| id | int | NO | PRI | NULL | auto_increment |
| message | varchar(100) | YES | | NULL | |
+-----+
```

```
youssef@youssef-VMware-Virtual-Platform:~/Desktop
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readonly_user -pReadonly@1234 ProjectDB -e "INSERT INTO client_test (id,message) VALUES (50,'HELLO');"
mysql: [Warning] Using a password on the command line interface can be insecure.
ERROR 1142 (42000) at line 1: INSERT command denied to user 'readonly_user'@'192.168.245.131' for table 'client_test'
youssef@youssef-VMware-Virtual-Platform:~/Desktop$
```

```
youssef@youssef-VMware-Virtual-Platform:~/Desktop
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readwrite_user -pReadwrite@1234 -e "SHOW DATABASES;"
mysql: [Warning] Using a password on the command line interface can be insecure.
+-----+
| Database |
+-----+
| ProjectDB |
| information_schema |
| performance_schema |
+-----+
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readwrite_user -pReadwrite@1234 ProjectDB -e "SHOW TABLES;"
mysql: [Warning] Using a password on the command line interface can be insecure.
+-----+
| Tables_in_ProjectDB |
+-----+
| TABLE1_test |
| client_test |
+-----+
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readwrite_user -pReadwrite@1234 ProjectDB -e "SHOW COLUMNS FROM TABLE1_test;"
mysql: [Warning] Using a password on the command line interface can be insecure.
+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+
| id | int | NO | PRI | NULL | |
+-----+
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readwrite_user -pReadwrite@1234 ProjectDB -e "INSERT INTO TABLE1_test (id) VALUES (60) ;"
mysql: [Warning] Using a password on the command line interface can be insecure.
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readwrite_user -pReadwrite@1234 ProjectDB -e "SELECT * FROM TABLE1_test;"
mysql: [Warning] Using a password on the command line interface can be insecure.
+----+
| id |
+----+
| 60 |
+----+
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readwrite_user -pReadwrite@1234 ProjectDB -e "DELETE FROM TABLE1_test WHERE id=60 ;"
mysql: [Warning] Using a password on the command line interface can be insecure.
youssef@youssef-VMware-Virtual-Platform:~/Desktop$ mysql -h 192.168.245.130 -u readwrite_user -pReadwrite@1234 ProjectDB -e "SELECT * FROM TABLE1_test;"
mysql: [Warning] Using a password on the command line interface can be insecure.
youssef@youssef-VMware-Virtual-Platform:~/Desktop$
```

## **Questions for Understanding**

### **1. What is the purpose of having read-only and read-write users?**

To implement principle of least privilege.

- Read-only users can query data but cannot modify it. Useful for reporting, analytics, or monitoring.
- Read-write users can perform inserts, updates, and deletes. Used by applications that need to modify the database.

Benefits:

- Prevents accidental or malicious changes.
- Limits damage if credentials are compromised.
- Easier to audit and control access.

### **2. Why is it important to automate server setup using Shell scripts?**

- Ensures consistency across multiple environments (dev/test/prod).
- Saves time and effort during setup or reinstallation.
- Reduces human error.
- Enables repeatable deployments (in CI/CD pipelines or cloud setups).

### 3. What changes are required in the MySQL configuration to allow remote access?

- Edit my.cnf or mysqld.cnf and change:  
`bind-address = 0.0.0.0` (to allow connections from any host)
- Create users with % or specific IP in the host field:  
`CREATE USER 'user'@'%' IDENTIFIED BY 'password';`
- Grant appropriate privileges:  
`GRANT SELECT ON db.* TO 'readonly_user'@'%';`
- Restart MySQL after config changes:  
`sudo systemctl restart mysqld`

### 4. What security risks exist when opening MySQL to external connections, and how can we mitigate them?

Risks:

- Unauthorized access if credentials are leaked.
- Brute-force attacks.
- Data interception if traffic is unencrypted.
- SQL injection if used with vulnerable apps.

Mitigations:

- Use strong passwords and rotate them regularly.
- Restrict access with firewall rules or only allow known IPs.
- Use SSL/TLS encryption for client-server connections.
- Avoid using % in host field if not necessary.
- Do not expose MySQL port (3306) publicly unless required.
- Regularly audit logs and permissions.



## 5. How would you secure the MySQL root account in a production environment?

- Set a strong, unique password.
- Use `mysql_secure_installation` to:
  1. Remove anonymous users
  2. Disallow remote root login
  3. Remove test database
- Restrict root to localhost only:  
`ALTER USER 'root'@'%' IDENTIFIED WITH mysql_native_password BY 'newpass';`  
`REVOKE ALL PRIVILEGES ON *.* FROM 'root'@'%';`  
`DROP USER 'root'@'%';`
- Use `sudo` and local socket (`mysql -u root -p`) instead of remote root login.
- Enable two-factor authentication or use IAM-based authentication in cloud platforms.