



INSTITUTO POLITÉCNICO NACIONAL
ESCUELA SUPERIOR DE CÓMPUTO



SISTEMAS DISTRIBUIDOS

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Grupo: 7CV3

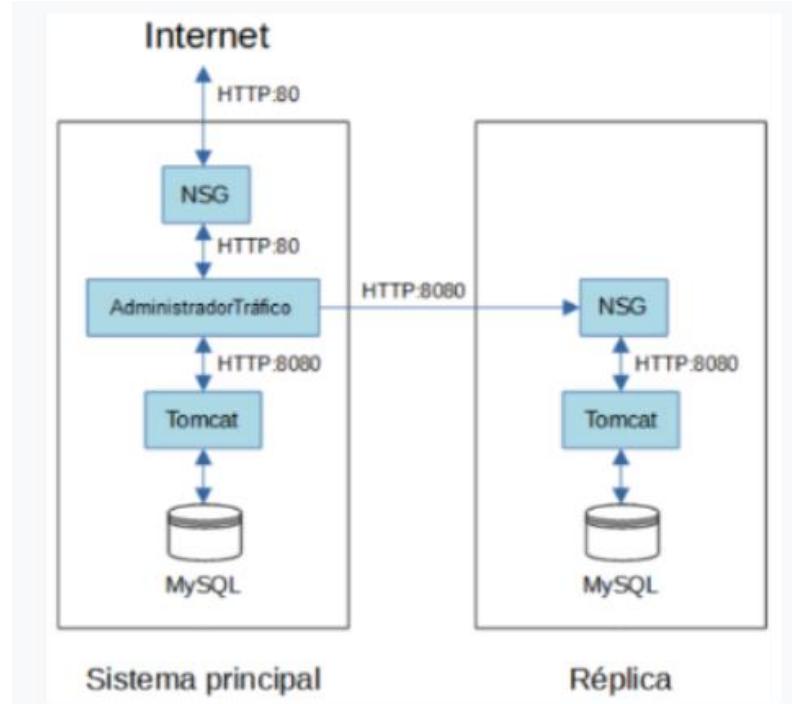
Tarea 5: Replicación de un sistema completo en la nube

Fecha de Entrega: 28/Abril/2025

DESARROLLO:

1. Replicación de un sistema HTTP

Considere la siguiente arquitectura



1. Crear dos maquinas virtuales usando la imagen creada en la tarea 2.

- Creando la primera VM con el nombre requerido, basado en la imagen de la T2.

La captura de pantalla muestra la interfaz de usuario de Microsoft Azure para la creación de una nueva máquina virtual. Los pasos realizados hasta la fecha son:

- 1. Se ha elegido la opción "Help me create a low cost VM".
- 2. El nombre de la máquina virtual es "T5-2023630338-SISTEMA-PRINCIPAL".
- 3. La ubicación es "(US) East US".
- 4. Se ha seleccionado la opción "Self-selected zone".
- 5. Se ha elegido la zona "Zone 1".
- 6. El tipo de seguridad es "Standard".
- 7. La imagen es "T2-2023630338-image - x64 Gen2".

En la parte inferior, se encuentran los botones "Next : Disks >" y "Review + create".

Give feedback

- Tanto el sistema principal como la réplica estarán en la misma Vnet

The screenshot shows the 'Networking' tab of the Azure VM creation wizard. It includes fields for Virtual network, Subnet, Public IP, and NIC network security group. The 'Basic' option is selected for the NIC network security group.

Virtual network *: (new) T5-2023630338-SISTEMA-PRINCIPAL-vnet

Subnet *: (new) default (10.0.0.0/24)

Public IP: (new) T5-2023630338-SISTEMA-PRINCIPAL-ip

NIC network security group: Basic

< Previous **Next : Management >** **Review + create**

[Give feedback](#)

- En la siguiente imagen, se muestra la creación de la primera VM1 así como la información de ésta.

The screenshot shows the Azure portal page for the VM named 'T5-2023630338-SISTEMA-PRINCIPAL'. The left sidebar shows various management options like Overview, Activity log, and Networking. The main pane displays detailed information about the VM, including its configuration, networking, size, and source image details.

Overview

Virtual machine

- Computer name: T5-2023630338-SISTEMA-PRINCIPAL
- Operating system: Linux (ubuntu 24.04)
- VM generation: V2
- VM architecture: x64
- Agent status: Ready
- Agent version: 2.12.0.2
- Hibernation: Disabled
- Host group: -
- Host: -
- Proximity placement group: -
- Colocation status: N/A
- Capacity reservation group: -
- Disk controller type: SCSI

Azure Spot

- Azure Spot: -
- Azure Spot eviction policy: -

Availability + scaling

- Availability zone: 1
- Availability set: -
- Scale Set: -

Networking

- Public IP address: 172.10.232.58 (Network interface: t5-2023630338-sistema-principal144_z1)
- Public IP address (IPv6): -
- Private IP address: 10.0.0.4
- Private IP address (IPv6): -
- Virtual network/subnet: T5-2023630338-SISTEMA-PRINCIPAL-vnet/default
- DNS name: Configure

Size

- Size: Standard B1s
- vCPUs: 1
- RAM: 1 GiB

Source image details

- Source image publisher: -
- Source image offer: -
- Source image plan: -

Disk

- OS disk: T5-2023630338-SISTEMA-PRINCIPAL_disk1_4cf65ec980934a6bba63de77f7269445
- Encryption at host: Disabled
- Azure disk encryption: Not enabled

- En la siguiente imagen se puede ver la VM2 (replica) junto con su información.

T5-2023630338-REPLICA Virtual machine

Overview

Virtual machine

Computer name	T5-2023630338-REPLICA
Operating system	Linux (ubuntu 24.04)
VM generation	V2
VM architecture	x64
Agent status	Ready
Agent version	2.12.0.2
Hibernation	Disabled
Host group	-
Host	-
Proximity placement group	-
Colocation status	N/A
Capacity reservation group	-
Disk controller type	SCSI

Azure Spot

Azure Spot	-
Azure Spot eviction policy	-

Availability + scaling

Availability zone (edit)	1
Availability set	-
Scale Set	-

Networking

Public IP address	172.210.232.125 (Network interface t5-2023630338-replica275_z1)
Public IP address (IPv6)	-
Private IP address	10.0.0.5
Private IP address (IPv6)	-
Virtual network/subnet	T5-2023630338-SISTEMA-PRINCIPAL-vnet/default
DNS name	Configure

Size

Size	Standard B1s
vCPUs	1
RAM	1 GiB

Source image details

Source image publisher	-
Source image offer	-
Source image plan	-

Disk

OS disk	T5-2023630338-REPLICA_disk1_075ad32fb844bbbe5942b1b17a80edb
Encryption at host	Disabled
Azure disk encryption	Not enabled
Ephemeral OS disk	N/A

2. Abrir el puerto de entrada 80 con protocolo TCP en la primera máquina virtual (sistema principal).

- Creando y añadiendo una regla de entrada para el puerto 80 TCP en la VM1:

T5-2023630338-SISTEMA-PRINCIPAL | Network settings

Network security group T5-2023630338-SISTEMA-PRINCIPAL-nsg (attached to networkInterface: t5-2023630338-sistema-principal144_z1) Impacts 0 subnets, 1 network interfaces

Inbound port rules (5)

Priority ↑	Name	Port	Protocol	Source	Destination
300	SSH	22	TCP	Any	Any
310	AllowAnyCustom80Inbound	80	TCP	Any	Any
65000	AllowVnetInbound	Any	Any	VirtualNetwork	VirtualNet
65001	AllowAzureLoadBalancerInbound	Any	Any	AzureLoadBalancer	Any
65500	DenyAllInbound	Any	Any	Any	Any

Outbound port rules (3)

3. Abrir el puerto de entrada 8080 con protocolo TCP en la segunda máquina virtual (réplica). Se deberá restringir el acceso a la réplica ingresando en el campo "Origen", la IP de la primera máquina virtual.

- En la siguiente imagen, se abre el puerto 8080 TCP en la VM2, ingresando en el origen la IP pública de la VM1.

The screenshot shows the Microsoft Azure portal interface. On the left, there's a sidebar with various navigation options like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Resource visualizer, Connect, and Networking. Under Networking, 'Network settings' is selected. The main content area shows a virtual machine named 'T5-2023630338-REPLICA'. It displays network settings, including a private IP address (10.0.0.5) and a network security group (T5-2023630338-REPLICA-nsg) attached to it. Below this, there's a table of inbound port rules:

Priority	Name	Port
300	SSH	22
65000	AllowVnetInBound	Any
65001	AllowAzureLoadBalancerInBound	Any
65500	DenyAllInBound	Any

To the right, a modal window titled 'Add inbound security rule' is open. It allows setting up a new security rule with the following configuration:

- Source: IP Addresses (172.210.232.58)
- Source IP addresses/CIDR ranges: 172.210.232.58
- Source port ranges: *
- Destination: Any
- Service: Custom
- Protocol: TCP (selected)
- Destination port ranges: 8080

At the bottom of the modal are 'Add' and 'Cancel' buttons, and a 'Give feedback' link.

4. Copiar el programa AdministradorTrafico.java a la primera máquina virtual (sistema principal).

- Ingresando por ssh a la VM1.

```
luisvela@T5-2023630338-SISTI ~ + 
PS C:\Users\Luis Velasco> ssh luisvela@172.210.232.58
luisvela@172.210.232.58's password:
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-1021-azure x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Wed Apr 16 04:47:36 UTC 2025

System load: 0.16      Processes:          109
Usage of /: 8.7% of 28.02GB  Users logged in:      0
Memory usage: 72%           IPv4 address for eth0: 10.0.0.4
Swap usage: 0%

* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

1 device has a firmware upgrade available.
Run 'fwupdmgr get-upgrades' for more information.

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

1 device has a firmware upgrade available.
Run 'fwupdmgr get-upgrades' for more information.

Last login: Mon Mar 17 10:02:39 2025 from 189.234.241.253
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ ls

7 18°C
Despejado
```

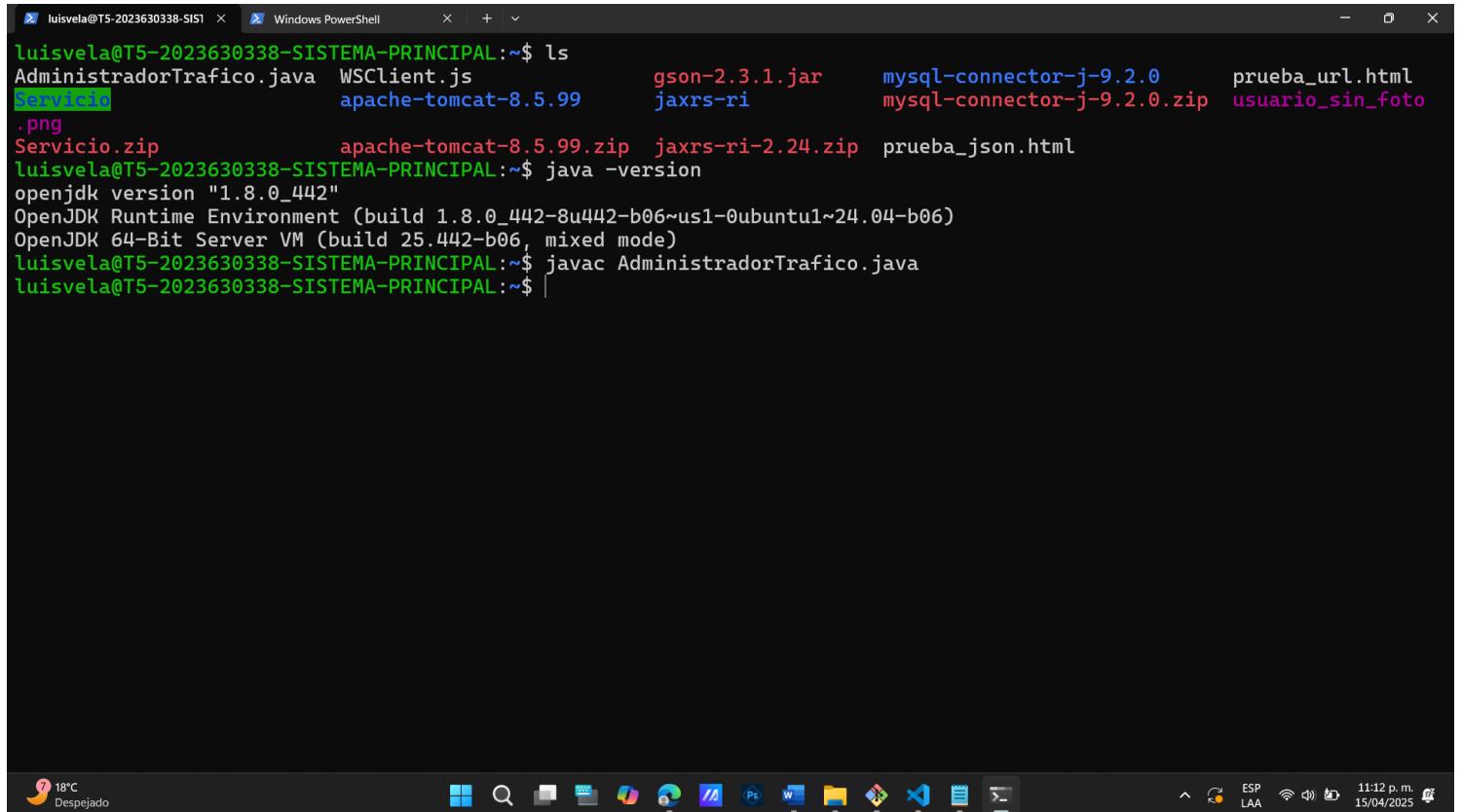
ESP LAA 10:47 p.m. 15/04/2025

- Subiendo el AdministradorTrafico.java por sftp

```
luisvela@T5-2023630338-SISTI ~ + 
PS C:\Users\Luis Velasco\OneDrive\Documentos\6to semestre\SistemasDistribuidos\Tarea5> sftp luisvela@172.210.232.58
luisvela@172.210.232.58's password:
Connected to 172.210.232.58.
sftp> put AdministradorTrafico.java
Uploading AdministradorTrafico.java to /home/luisvela/AdministradorTrafico.java
AdministradorTrafico.java
          100% 3971     64.6KB/s   00:00
sftp> |
```

ESP LAA 11:02 p.m. 15/04/2025

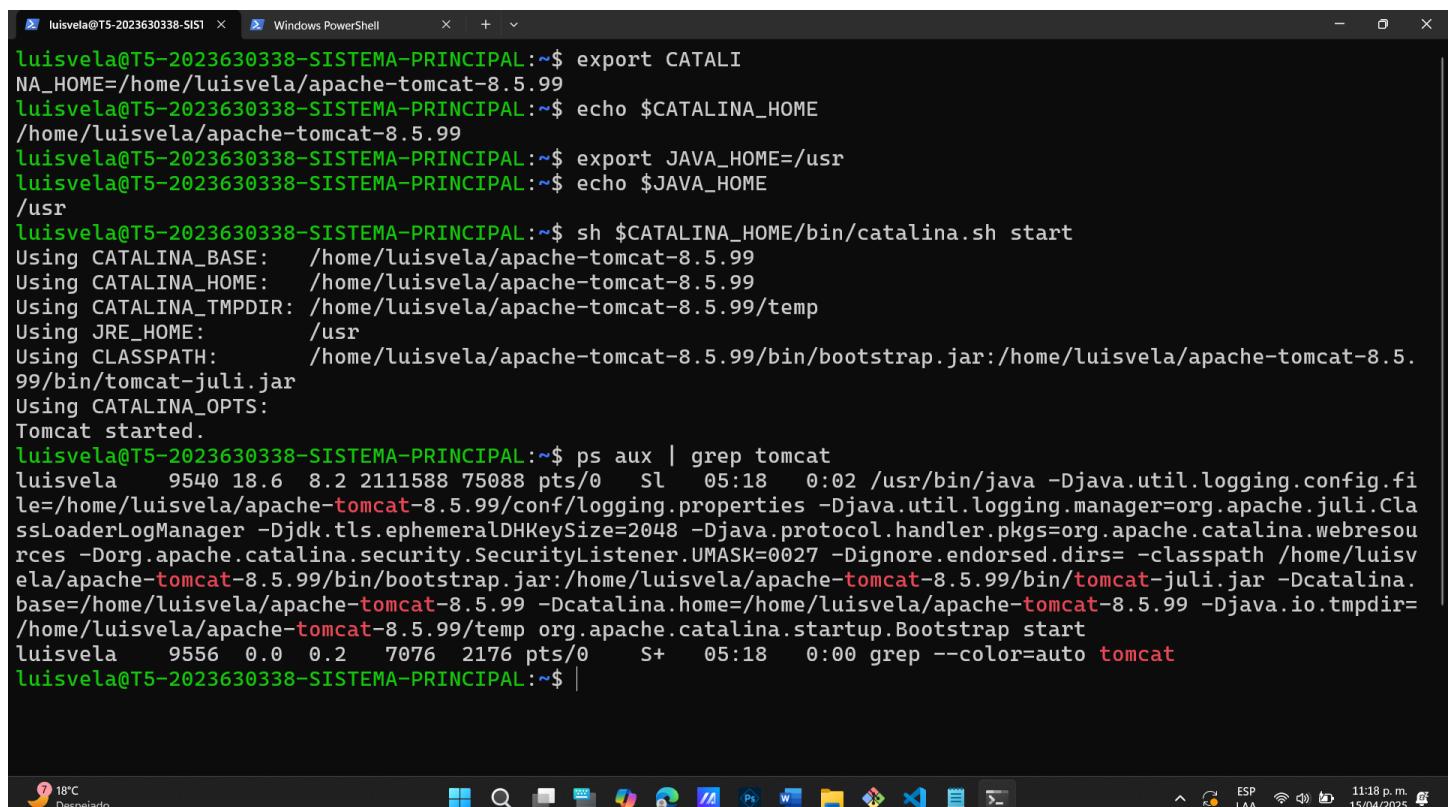
5. Compilar el programa AdministradorTrafico.java en la primera máquina virtual.



```
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ ls
AdministradorTrafico.java  WSClient.js      gson-2.3.1.jar      mysql-connector-j-9.2.0      prueba_url.html
Servicio                   apache-tomcat-8.5.99  jaxrs-ri           mysql-connector-j-9.2.0.zip   usuario_sin_foto
.png
Servicio.zip              apache-tomcat-8.5.99.zip  jaxrs-ri-2.24.zip  prueba_json.html
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ java -version
openjdk version "1.8.0_442"
OpenJDK Runtime Environment (build 1.8.0_442-8u442-b06~us1-0ubuntu1~24.04-b06)
OpenJDK 64-Bit Server VM (build 25.442-b06, mixed mode)
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ javac AdministradorTrafico.java
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ |
```

6. Iniciar la ejecución de Tomcat en ambas máquinas virtuales.

- Configurando las variables \$CATALINA_HOME y \$JAVA_HOME en la VM1 e iniciando Tomcat



```
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ export CATALINA_HOME=/home/luisvela/apache-tomcat-8.5.99
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ echo $CATALINA_HOME
/home/luisvela/apache-tomcat-8.5.99
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ export JAVA_HOME=/usr
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ echo $JAVA_HOME
/usr
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ sh $CATALINA_HOME/bin/catalina.sh start
Using CATALINA_BASE:   /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_HOME:   /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_TMPDIR: /home/luisvela/apache-tomcat-8.5.99/temp
Using JRE_HOME:        /usr
Using CLASSPATH:       /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/tomcat-juli.jar
Using CATALINA_OPTS:
Tomcat started.
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ ps aux | grep tomcat
luisvela    9540 18.6  8.2 2111588 75088 pts/0    Sl    05:18   0:02 /usr/bin/java -Djava.util.logging.config.file=/home/luisvela/apache-tomcat-8.5.99/conf/logging.properties -Djava.util.logging.manager=org.apache.juli.ClassLoaderLogManager -Djdk.tls.ephemeralDHKeySize=2048 -Djava.protocol.handler.pkgs=org.apache.catalina.webresources -Dorg.apache.catalina.security.SecurityListener.UMASK=0027 -Dignore.endorsed.dirs= -classpath /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/tomcat-juli.jar -Dcatalina.base=/home/luisvela/apache-tomcat-8.5.99 -Dcatalina.home=/home/luisvela/apache-tomcat-8.5.99 -Djava.io.tmpdir=/home/luisvela/apache-tomcat-8.5.99/temp org.apache.catalina.startup.Bootstrap start
luisvela    9556  0.0  0.2   7076  2176 pts/0    S+   05:18   0:00 grep --color=auto tomcat
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ |
```

- Conectando a la VM2 por ssh

```

PS C:\Users\luis Velasco> ssh luisvela@172.210.232.125
The authenticity of host '172.210.232.125 (172.210.232.125)' can't be established.
ED25519 key fingerprint is SHA256:k3m4RxDXmw2FWkcu0tYj09L5DhZGpIPgysMJvzsSi14.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '172.210.232.125' (ED25519) to the list of known hosts.
luisvela@172.210.232.125's password:
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-1021-azure x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Wed Apr 16 05:20:23 UTC 2025

System load: 0.08      Processes:          109
Usage of /: 8.7% of 28.02GB  Users logged in:    0
Memory usage: 68%          IPv4 address for eth0: 10.0.0.5
Swap usage: 0%

* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

Last login: Mon Mar 17 10:02:39 2025 from 189.234.241.253
luisvela@T5-2023630338-REPLICA:~$ |

```

18°C Despejado

ESP LAA 11:20 p.m. 15/04/2025

- Iniciando Tomcat en la VM2

```

luisvela@T5-2023630338-REPLICA:~$ export CATALINA_HOME=/home/luisvela/apache-tomcat-8.5.99
luisvela@T5-2023630338-REPLICA:~$ export JAVA_HOME=/usr
luisvela@T5-2023630338-REPLICA:~$ sh $CATALINA_HOME/bin/catalina.sh start
Using CATALINA_BASE:   /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_HOME:   /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_TMPDIR: /home/luisvela/apache-tomcat-8.5.99/temp
Using JRE_HOME:        /usr
Using CLASSPATH:       /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/tomcat-juli.jar
Using CATALINA_OPTS:
Tomcat started.

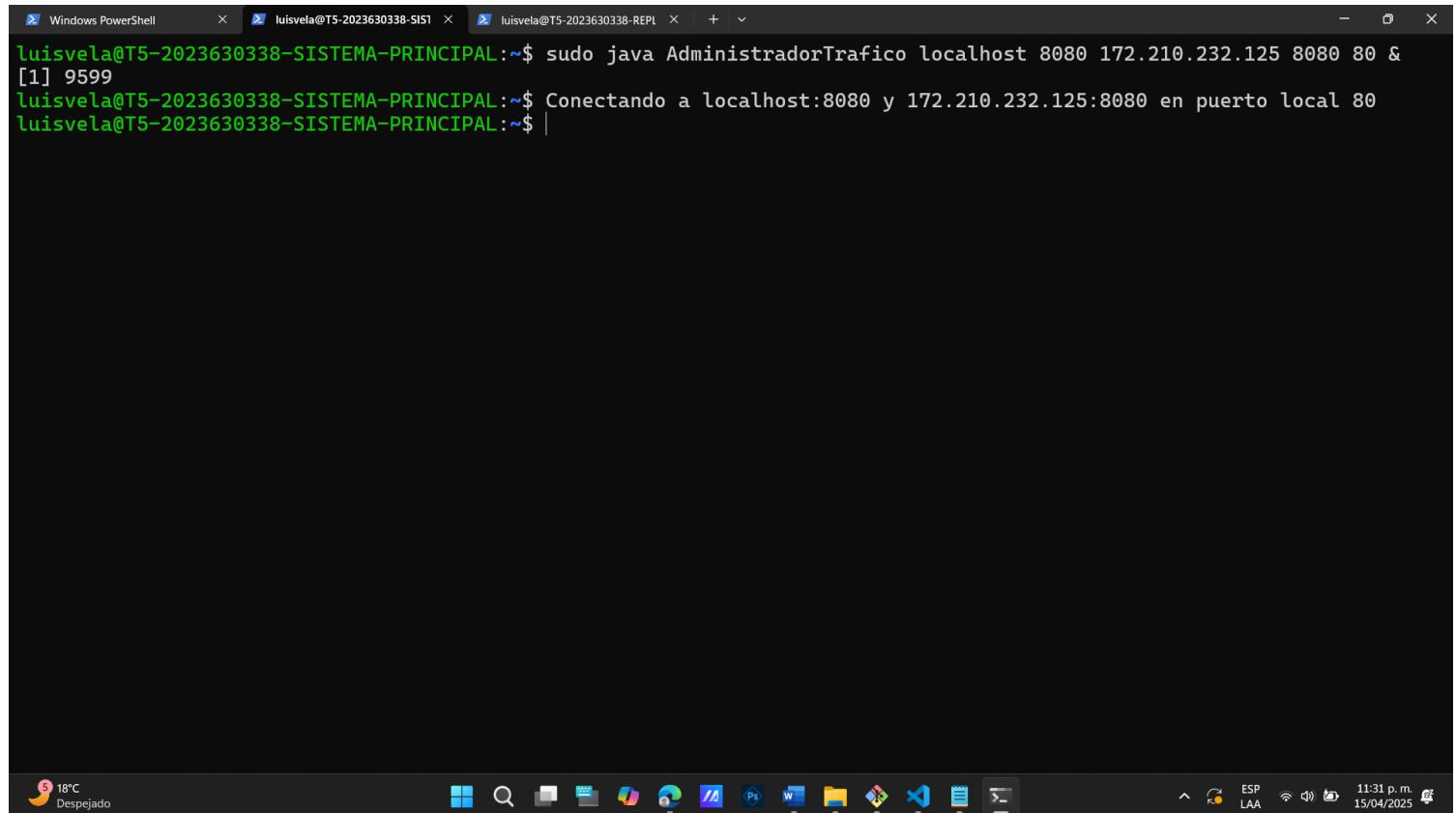
luisvela@T5-2023630338-REPLICA:~$ ps aux | grep tomcat
luisvela  1967  3.1  4.0 2099580 36848 pts/0    Sl   05:25  0:00 /usr/bin/java -Djava.util.logging.config.file=/home/luisvela/apache-tomcat-8.5.99/conf/logging.properties -Djava.util.logging.manager=org.apache.juli.ClassLoaderLogManager -Djdk.tls.ephemeralDHKeySize=2048 -Djava.protocol.handler.pkgs=org.apache.catalina.webresources -Dorg.apache.catalina.security.SecurityListener.UMASK=0027 -Dignore.endorsed.dirs=-classpath /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/tomcat-juli.jar -Dcatalina.base=/home/luisvela/apache-tomcat-8.5.99 -Dcatalina.home=/home/luisvela/apache-tomcat-8.5.99 -Djava.io.tmpdir=/home/luisvela/apache-tomcat-8.5.99/temp org.apache.catalina.startup.Bootstrap start
luisvela  1978  0.0  0.2   7076  2176 pts/0    S+   05:26  0:00 grep --color=auto tomcat
luisvela@T5-2023630338-REPLICA:~$ |

```

18°C Despejado

ESP LAA 11:26 p.m. 15/04/2025

7. Ejecutar en la primera máquina virtual el programa AdministradorTrafico.java



```
Windows PowerShell      x  luisvela@T5-2023630338-SISI  x  luisvela@T5-2023630338-REPL  x  +  v
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ sudo java AdministradorTrafico localhost 8080 172.210.232.125 8080 80 &
[1] 9599
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ Conectando a localhost:8080 y 172.210.232.125:8080 en puerto local 80
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ |
```

The screenshot shows a Windows terminal window with three tabs open. The active tab displays the command `sudo java AdministradorTrafico localhost 8080 172.210.232.125 8080 80 &` followed by the process ID [1] 9599. Below this, the message "Conectando a localhost:8080 y 172.210.232.125:8080 en puerto local 80" is shown, indicating a connection attempt. The taskbar at the bottom shows various application icons, and the system tray indicates the date and time as 11:31 p.m. on 15/04/2025.

8. En un dispositivo móvil (celular o tableta), ingresar la siguiente URL: http://ip-máquina-virtual-1/prueba_json.html



9. Se deberá realizar las siguientes pruebas:

9.1 Dar de alta tres usuarios incluyendo una imagen (no utilizar datos ni imágenes personales).

- Registrando al 1er usuario Ryan



Alta de usuario

Email *
ryan@gmail.com
Nombre *
ryan
Apellido paterno *
ryan
Apellido materno
ryan
Fecha de nacimiento *
10/10/1997, 11:36 p.m.
Teléfono
5510112233
Género
Masculino



Elegir archivos Screenshot...earchbox.jpg

Agregar usuario
Limpiar pantalla
Regresar



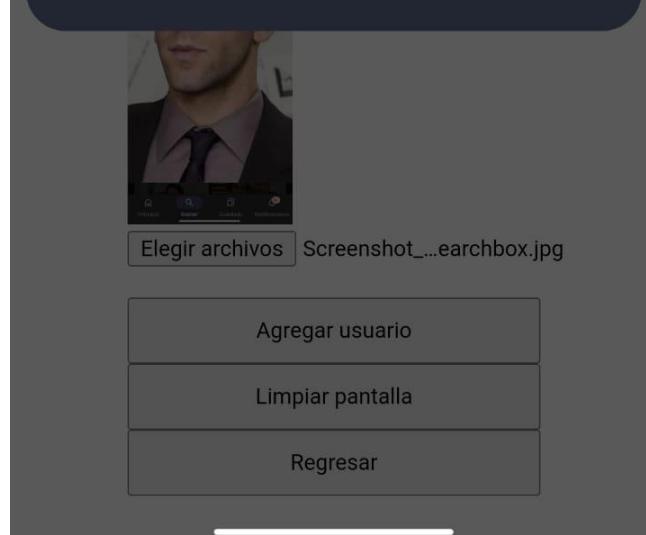
Alta de usuario

Email *
ryan@gmail.com
Nombre *
ryan
Apellido paterno *
ryan
Apellido materno
ryan
Fecha de nacimiento *
10/10/1997, 11:36 p.m.
Teléfono

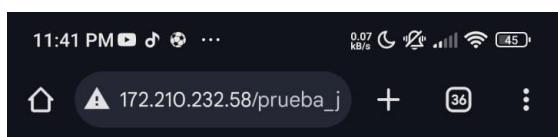
172.210.232.58 dice

OK

Aceptar



- Registrando al 2do usuario (Andy)



Alta de usuario

Email *

Nombre *

Apellido paterno *

Apellido materno

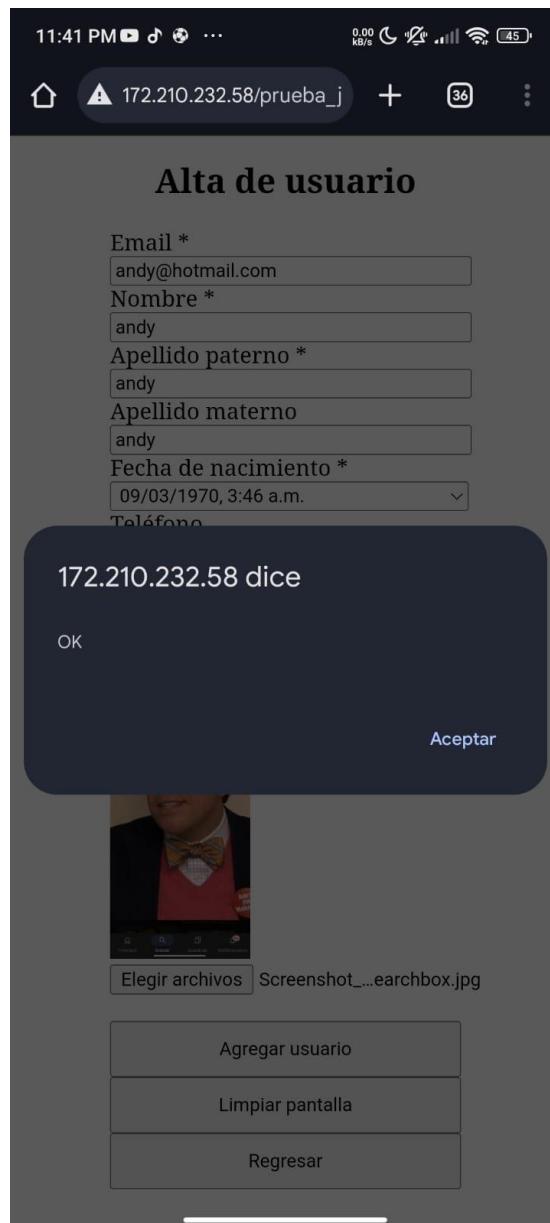
Fecha de nacimiento *

Teléfono

Genero



Screenshot_...earchbox.jpg



Alta de usuario

Email *

Nombre *

Apellido paterno *

Apellido materno

Fecha de nacimiento *

Teléfono

172.210.232.58 dice

OK

Aceptar



Screenshot_...earchbox.jpg

- Registrando al 3er usuario (kevin)



Alta de usuario

Email *
kevin@gmail.com
Nombre *
kevin
Apellido paterno *
Kevin
Apellido materno
kevin
Fecha de nacimiento *
09/10/1991, 3:47 a.m.
Teléfono
1144770099
Genero
Masculino



Elegir archivos Screenshot...earchbox.jpg

Agregar usuario
Limpiar pantalla
Regresar



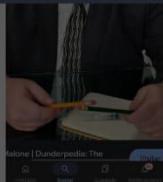
Alta de usuario

Email *
kevin@gmail.com
Nombre *
kevin
Apellido paterno *
Kevin
Apellido materno
kevin
Fecha de nacimiento *
09/10/1991, 3:47 a.m.
Teléfono

172.210.232.58 dice

OK

Aceptar



Elegir archivos Screenshot...earchbox.jpg

Agregar usuario
Limpiar pantalla
Regresar

Mostrar el contenido de las bases de datos en ambas computadoras (en el caso de la imagen, mostrar solo la longitud del campo que contiene la imagen).

- Checando los registros de usuarios en la primera computadora (Sistema Principal)

```
luisvela@T5-2023630338-SIST ~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 14
Server version: 8.0.41-0ubuntu0.24.04.1 (Ubuntu)

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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> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+-----+-----+
| id_usuario | email | nombre | apellido_paterno | apellido_materno | fecha_nacimiento | telefono | genero |
+-----+-----+-----+-----+-----+-----+-----+-----+
|       6 | ryan@gmail.com | ryan | ryan | ryan | 1997-10-11 04:36:00 | 5510112233 | M
|       7 | andy@hotmail.com | andy | andy | andy | 1970-03-09 09:46:00 | 1122558800 | F
|       8 | kevin@gmail.com | kevin | Kevin | kevin | 1991-10-09 09:47:00 | 1144770099 | M
+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

mysql> |
```

Iconos de la barra de tareas: Titulo deportivo, Preocupaciones, Buscador, Archivos, Configuración, WPS Office, Word, Excel, Powerpoint, OneDrive, Visual Studio Code, Notepad, Edge, Microsoft Store.

- Consultando el tamaño de la imagen de los usuarios

```
luisvela@T5-2023630338-SIST ~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 24
Server version: 8.0.41-0ubuntu0.24.04.1 (Ubuntu)

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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> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> DESCRIBE fotos_usuarios;
+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+
| id_foto | int | NO | PRI | NULL | auto_increment |
| foto | longblob | YES | NULL |          |
| id_usuario | int | NO | MUL | NULL |          |
+-----+-----+-----+-----+-----+
3 rows in set (2.05 sec)

mysql> select u.nombre, fu.id_foto, LENGTH(fu.foto) as tam_imagen from fotos_usuarios fu join usuarios u ON fu.id_usuario = u.id_usuario;
+-----+-----+-----+
| nombre | id_foto | tam_imagen |
+-----+-----+-----+
| ryan | 3 | 720435 |
| andy | 4 | 534545 |
| kevin | 5 | 1518861 |
+-----+-----+-----+
3 rows in set (0.85 sec)
```

Iconos de la barra de tareas: 16°C, Despejado, Buscador, Archivos, Configuración, WPS Office, Word, Excel, Powerpoint, OneDrive, Visual Studio Code, Notepad, Edge, Microsoft Store.

- Ahora consultando a los usuarios y el tamaño de sus imágenes en la segunda computadora (REPLICA)

```

luisvela@T5-2023630338-SIST ~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 11
Server version: 8.0.41-Ubuntu0.24.04.1 (Ubuntu)

Copyright (c) 2000, 2025, Oracle and/or its affiliates.

Oracle is a registered trademark of Oracle Corporation and/or its
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> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+-----+-----+
| id_usuario | email | nombre | apellido_paterno | apellido_materno | fecha_nacimiento | telefono | genero |
+-----+-----+-----+-----+-----+-----+-----+-----+
| 6 | ryan@gmail.com | ryan | ryan | ryan | 1997-10-11 04:36:00 | 5510112233 | M |
| 7 | andy@hotmail.com | andy | andy | andy | 1970-03-09 09:46:00 | 1122558800 | F |
| 8 | kevin@gmail.com | kevin | Kevin | kevin | 1991-10-09 09:47:00 | 1144770099 | M |
+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

mysql> select u.nombre, fu.id_foto, LENGTH(fu.foto) as tam_imagen from fotos_usuarios fu join usuarios u ON fu.id_usuario = u.id_usuario;
+-----+-----+-----+
| nombre | id_foto | tam_imagen |
+-----+-----+-----+
| ryan | 3 | 720435 |
| andy | 4 | 534545 |
| kevin | 5 | 1518861 |
+-----+-----+-----+
3 rows in set (0.00 sec)

8 16°C Despejado 12:49 a.m. 16/04/2025

```

9.2 Modificar algún dato en cada usuario.

- Cambiando el nombre principal de los 3 usuarios.

Modifica usuario

Email *

Nombre *

Apellido paterno *

Apellido materno

Fecha de nacimiento *

Teléfono

Genero

Elegir archivos Sin archivos seleccionados
Quitar foto

Guardar cambios Regresar

Modifica usuario

Email *

Nombre *

Apellido paterno *

Apellido materno

Fecha de nacimiento *

Teléfono

Genero

Elegir archivos Sin archivos seleccionados
Quitar foto

Guardar cambios Regresar

Modifica usuario

Email *

Nombre *

Apellido paterno *

Apellido materno

Fecha de nacimiento *

Teléfono

Genero

Elegir archivos Sin archivos seleccionados
Quitar foto

Guardar cambios Regresar

Mostrar el contenido de las bases de datos en ambas computadoras.

- Mostrando el registro de los usuarios en la primera máquina (Sistema Principal)

```
luisvela@T5-2023630338-SISTI ~ luisvela@T5-2023630338-REPL ~ + 
luisvela@T5-2023630338-SISTEMA-PRINCIPAL:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 11
Server version: 8.0.41-Ubuntu0.24.04.1 (Ubuntu)

Copyright (c) 2000, 2025, Oracle and/or its affiliates.

Oracle is a registered trademark of Oracle Corporation and/or its
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> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+
| id_usuario | email           | nombre        | apellido_paterno | apellido_materno | fecha_nacimiento | telefono      | genero |
+-----+-----+-----+-----+-----+-----+
|       6 | ryan@gmail.com   | OtroNombre    | ryan            | ryan            | 1997-10-11 04:36:00 | 5510112233 | M
|       7 | andy@hotmail.com | OtroNombree   | andy           | andy           | 1970-03-09 09:46:00 | 1122558800 | F
|       8 | kevin@gmail.com  | otroNombreeee | Kevin          | kevin          | 1991-10-09 09:47:00 | 1144770099 | M
+-----+-----+-----+-----+-----+-----+

```

- Mostrando el registro de los usuarios en la segunda máquina (REPLICAS).

```
luisvela@T5-2023630338-SISTI ~ luisvela@T5-2023630338-REP ~ + 
luisvela@T5-2023630338-REPLICA:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 11
Server version: 8.0.41-Ubuntu0.24.04.1 (Ubuntu)

Copyright (c) 2000, 2025, Oracle and/or its affiliates.

Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective
owners.

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

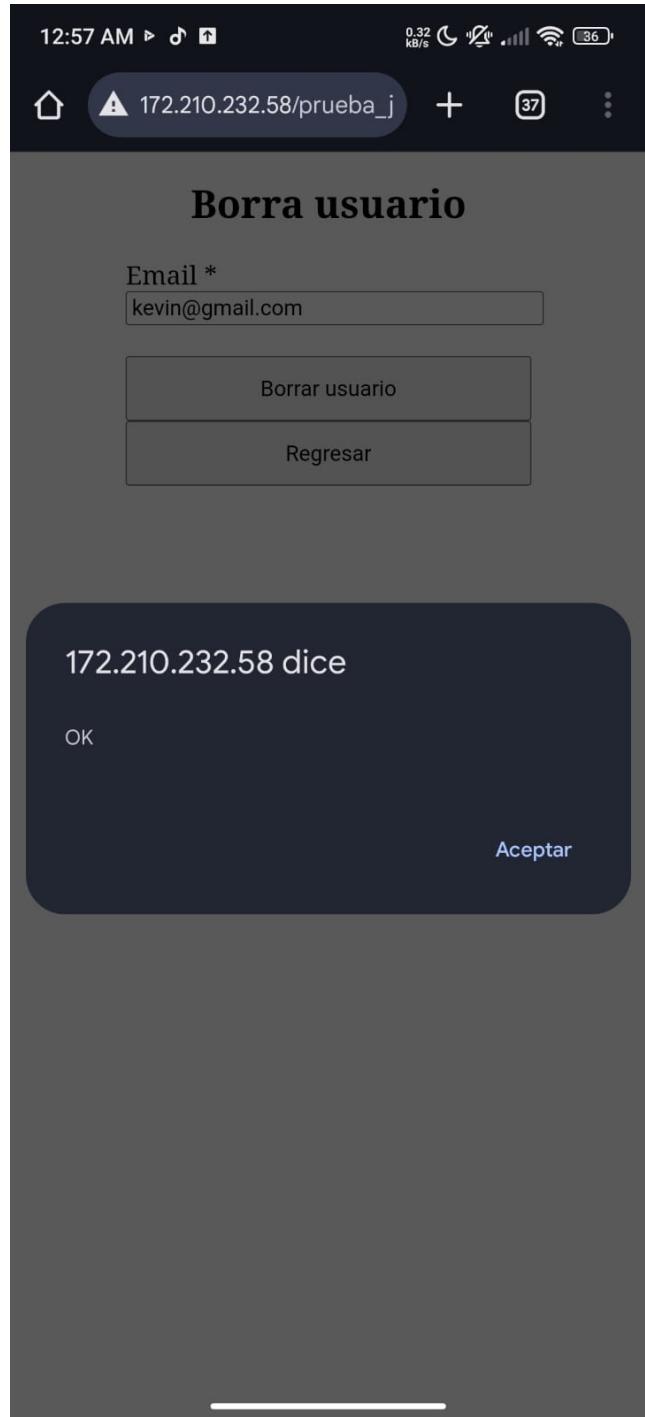
mysql> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+
| id_usuario | email           | nombre        | apellido_paterno | apellido_materno | fecha_nacimiento | telefono      | genero |
+-----+-----+-----+-----+-----+-----+
|       6 | ryan@gmail.com   | OtroNombre    | ryan            | ryan            | 1997-10-11 04:36:00 | 5510112233 | M
|       7 | andy@hotmail.com | OtroNombree   | andy           | andy           | 1970-03-09 09:46:00 | 1122558800 | F
|       8 | kevin@gmail.com  | otroNombreeee | Kevin          | kevin          | 1991-10-09 09:47:00 | 1144770099 | M
+-----+-----+-----+-----+-----+-----+

```

9.3 Eliminar uno de los usuarios.

- Borrando al usuario con email: kevin@gmail.com



Mostrar el contenido de las bases de datos en ambas computadoras.

- Mostrando a los usuarios en la primera máquina (Sistema Principal).

```
luisvela@T5-2023630338-SISTI ~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 12
Server version: 8.0.41-0ubuntu0.24.04.1 (Ubuntu)

Copyright (c) 2000, 2025, Oracle and/or its affiliates.

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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> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+-----+
| id_usuario | email | nombre | apellido_paterno | apellido_materno | fecha_nacimiento | telefono | genero |
+-----+-----+-----+-----+-----+-----+-----+
|       6 | ryan@gmail.com | OtroNombre | ryan | ryan | 1997-10-11 04:36:00 | 5510112233 | M
|       7 | andy@hotmail.com | OtroNombree | andy | andy | 1970-03-09 09:46:00 | 1122558800 | F
+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.00 sec)

mysql> |
```

- Mostrando a los usuarios en la segunda máquina (REPLICA)

```
luisvela@T5-2023630338-SISTI ~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 12
Server version: 8.0.41-0ubuntu0.24.04.1 (Ubuntu)

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

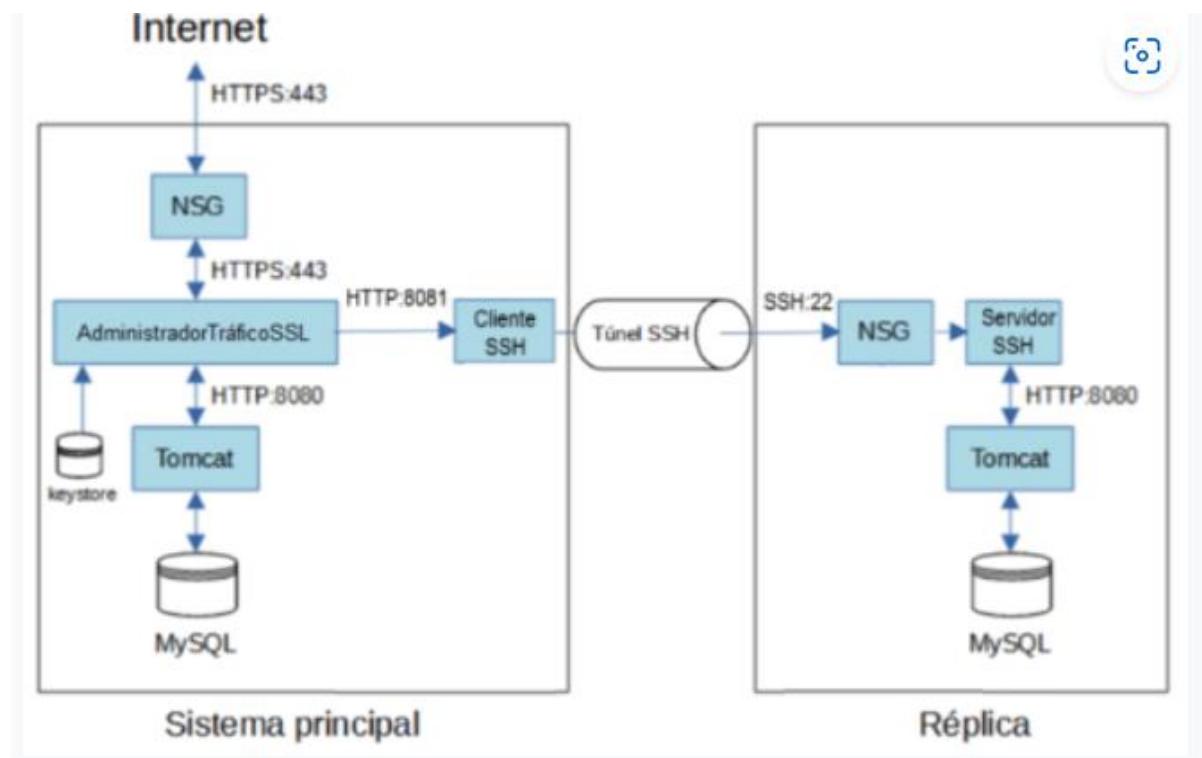
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+-----+
| id_usuario | email | nombre | apellido_paterno | apellido_materno | fecha_nacimiento | telefono | gene
ro |
+-----+-----+-----+-----+-----+-----+-----+
|       6 | ryan@gmail.com | OtroNombre | ryan | ryan | 1997-10-11 04:36:00 | 5510112233 | M
|       7 | andy@hotmail.com | OtroNombree | andy | andy | 1970-03-09 09:46:00 | 1122558800 | F
+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.00 sec)
```

2. Replicación de un sistema HTTPS

Considere la siguiente arquitectura.



1. Crear dos máquinas virtuales usando la imagen creada en la tarea 2.

- Primera VM creada, junto con su información.

Captura de pantalla del portal de Microsoft Azure, mostrando las propiedades de una máquina virtual llamada "T5-2023630338-SISTEMA-PRINCIPAL-SSL".

Información general:

- Nombre: T5-2023630338-SISTEMA-PRINCIPAL-SSL
- Estado: Ready
- Tamaño: Standard B1s
- Imagen: t5-2023630338-sistema-principal-ssl982_z1

Red:

- IP Pública: 20.97.211.236
- Subred: T5-2023630338-SISTEMA-PRINCIPAL-SSL-vnet/default
- DNS: Configure

Tamaño:

- vCPUs: 1
- RAM: 1 GiB

Detalles de la imagen:

- Fabricante de imágenes: -
- Oferta de imágenes: -
- Plano de imágenes: -

Disco:

- OS Disk: T5-2023630338-SISTEMA-PRINCIPAL-SSL_disk1_a67cabbe6c9245a7af6d681273cb3c13
- Encriptación en host: Deshabilitado
- Encriptación de Azure Disk: No habilitado

Otras:

- Zona de disponibilidad: 1
- Conjunto de disponibilidad: -
- Escala Set: -

- Segunda VM creada, junto son su información.

The screenshot shows the Azure portal interface for a virtual machine named T5-2023630338-REPLICA-SSL. The left sidebar contains navigation links for Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Resource visualizer, Connect, Networking, Network settings, Load balancing, Application security groups, Network manager, Settings, Disks, Extensions + applications, Operating system, and Configuration. The main content area displays the following details:

- Virtual machine** section:

Computer name	T5-2023630338-REPLICA-SSL
Operating system	Linux (ubuntu 24.04)
VM generation	V2
VM architecture	x64
Agent status	Ready
Agent version	2.12.0.2
Hibernation	Disabled
Host group	-
Host	-
Proximity placement group	-
Colocation status	N/A
Capacity reservation group	-
Disk controller type	SCSI
- Azure Spot** section:

Azure Spot	-
Azure Spot eviction policy	-
- Networking** section:

Public IP address	20.109.48.73 (Network interface t5-2023630338-replica-ssl16_z1)
Public IP address (IPv6)	-
Private IP address	10.0.0.4
Private IP address (IPv6)	-
Virtual network/subnet	T5-2023630338-REPLICA-SSL-vnet/default
DNS name	Configure
- Size** section:

Size	Standard B1s
vCPUs	1
RAM	1 GiB
- Source image details** section:

Source image publisher	-
Source image offer	-
Source image plan	-
- Disk** section:

OS disk	T5-2023630338-REPLICA-SSL_disk1_f0a168ba1f2c42679d46f084be04de50
Encryption at host	Disabled
Azure disk encryption	Not enabled
Ephemeral OS disk	N/A

2. Abrir el puerto de entrada 443 con protocolo TCP en la primera máquina virtual (sistema principal).

- Regla de entrada al puerto 443 TCP en la VM1 creada.

The screenshot shows the Azure portal interface for a virtual machine named T5-2023630338-SISTEMA-PRINCIPAL-SSL. The left sidebar contains navigation links for Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Resource visualizer, Connect, Networking, Network settings, Load balancing, Application security groups, Network manager, and Settings. The main content area displays the following details:

- Network settings** section:

Priority ↑	Name	Port	Protocol	Source	Destination	Action
300	SSH	22	TCP	Any	Any	Allow
310	AllowAnyCustom443Inbound	443	TCP	Any	Any	Allow
65000	AllowVnetInbound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowAzureLoadBalancerInbound	Any	Any	AzureLoadBalancer	Any	Allow
65500	DenyAllInbound	Any	Any	Any	Any	Deny

3. Abrir el puerto de entrada 22 en la segunda máquina virtual (réplica). Se deberá restringir el acceso a la réplica ingresando en el campo "Origen", la IP de la primera máquina virtual (por seguridad, la primera máquina virtual será la única computadora que podrá acceder la segunda máquina virtual).

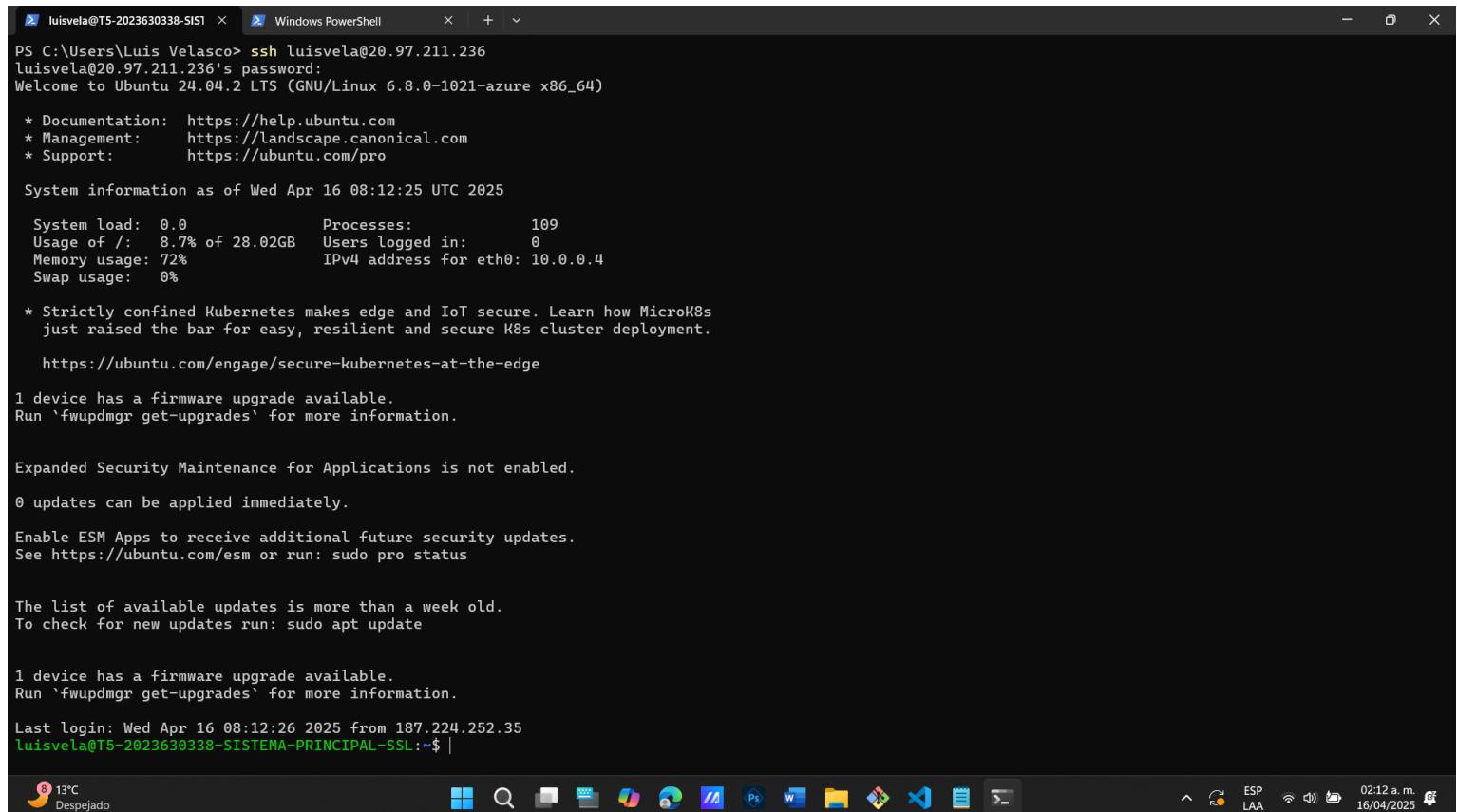
Priority ↑	Name	Port	Protocol	Source	Destination	Action
300	SSH	22	TCP	Any	Any	Allow
310	AllowCidrBlockCustom22Inbound	22	Any	20.97.211.236	Any	Allow
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowAzureLoadBalancerInBound	Any	Any	AzureLoadBalancer	Any	Allow
65500	DenyAllInBound	Any	Any	Any	Any	Deny

4. Modificar el programa AdministradorTrafico.java para recibir peticiones HTTPS. El programa se llamará AdministradorTraficoSSL.java.

- El programa que se usará en esta parte es el programa que se uso en la Tarea 1.

4.1. Copiar el programa AdministradorTraficoSSL.java a la primera máquina virtual (sistema principal).

- Entrando por ssh a la VM1.



```
PS C:\Users\Luis Velasco> ssh luisvela@20.97.211.236
luisvela@20.97.211.236's password:
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-1021-azure x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Wed Apr 16 08:12:25 UTC 2025

System load: 0.0          Processes:           109
Usage of /: 8.7% of 28.02GB  Users logged in:      0
Memory usage: 72%          IPv4 address for eth0: 10.0.0.4
Swap usage:  0%

* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

1 device has a firmware upgrade available.
Run `fwupdmgr get-upgrades` for more information.

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

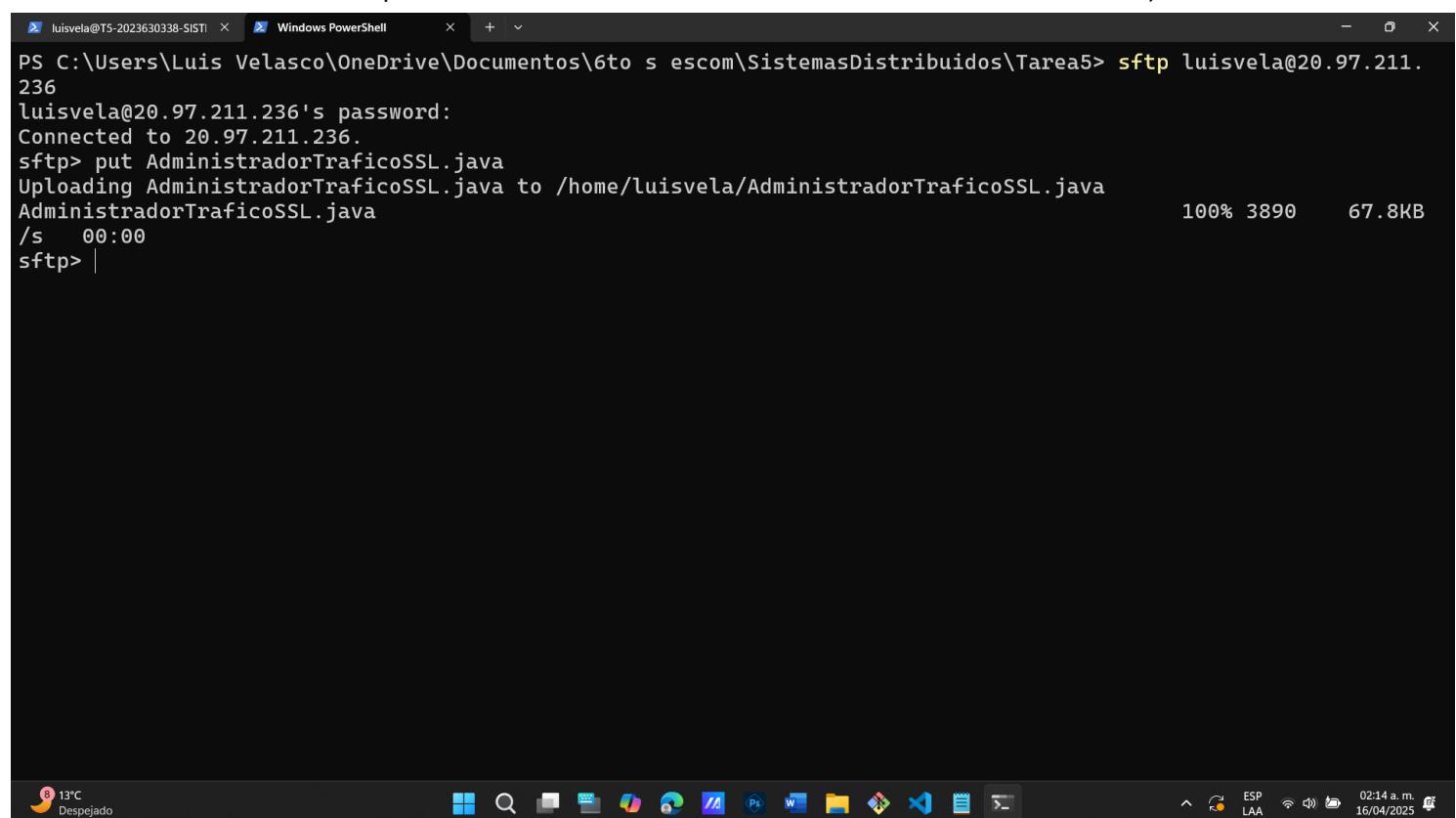
Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

1 device has a firmware upgrade available.
Run `fwupdmgr get-upgrades` for more information.

Last login: Wed Apr 16 08:12:26 2025 from 187.224.252.35
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ |
```

- Usando SFTP para transferir el AdministradorTraficoSSL.java a la VM1.



```
PS C:\Users\Luis Velasco\OneDrive\Documentos\6to semestre\SistemasDistribuidos\Tarea5> sftp luisvela@20.97.211.236
luisvela@20.97.211.236's password:
Connected to 20.97.211.236.
sftp> put AdministradorTraficoSSL.java
Uploading AdministradorTraficoSSL.java to /home/luisvela/AdministradorTraficoSSL.java
AdministradorTraficoSSL.java                                100% 3890     67.8KB
/s 00:00
sftp> |
```

4.2 Crear un keystore para servidor incluyendo un certificado auto-firmado en la primera máquina virtual (Sistema Principal-SSL)

- Generando el keysotre y el certificado auto firmado.

```
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ keytool -genkeypair -keyalg RSA -alias certificado_servidor -keystore keystore_servidor.jks -storepass 1234567
What is your first and last name?
[Unknown]: luis
What is the name of your organizational unit?
[Unknown]:
What is the name of your organization?
[Unknown]:
What is the name of your City or Locality?
[Unknown]: CMDX
What is the name of your State or Province?
[Unknown]: CDMX
What is the two-letter country code for this unit?
[Unknown]: MX
Is CN=luis, OU=Unknown, O=Unknown, L=CMDX, ST=CDMX, C=MX correct?
[no]: yes

Enter key password for <certificado_servidor>
      (RETURN if same as keystore password):

Warning:
The JKS keystore uses a proprietary format. It is recommended to migrate to PKCS12 which is an industry standard format using "keytool -importkeystore -srckeystore keystore_servidor.jks -destkeystore keystore_servidor.jks -deststoretype pkcs12".
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ ls
AdministradorTraficoSSL.java  Servicio.zip  apache-tomcat-8.5.99      gson-2.3.1.jar  jaxrs-ri-2.24.zip      m
mysql-connector-j-9.2.0        prueba_json.html  usuario_sin_foto.png  Servicio        WSClient.js   apache-tomcat-8.5.99.zip  jaxrs-ri      keystore_servidor.jks  m
mysql-connector-j-9.2.0.zip    prueba_url.html
```

4.3 Agregar el nombre del keystore y la contraseña al programa AdministradorTraficoSSL.java.

- En la siguiente imagen, vemos como agregamos el keystore y la contraseña al código

```
C:\> Users > Luis Velasco > OneDrive > Documentos > 6to s escom > SistemasDistribuidos > Tarea5 > AdministradorTraficoSSLjava > AdministradorTraficoSSL.java
```

```
5  class AdministradorTraficoSSL {
90  public static void main(String[] args) throws Exception {
99    puertoServidor1 = Integer.parseInt(args[2]);
100   ipServidor2 = args[3];
101   puertoServidor2 = Integer.parseInt(args[4]);

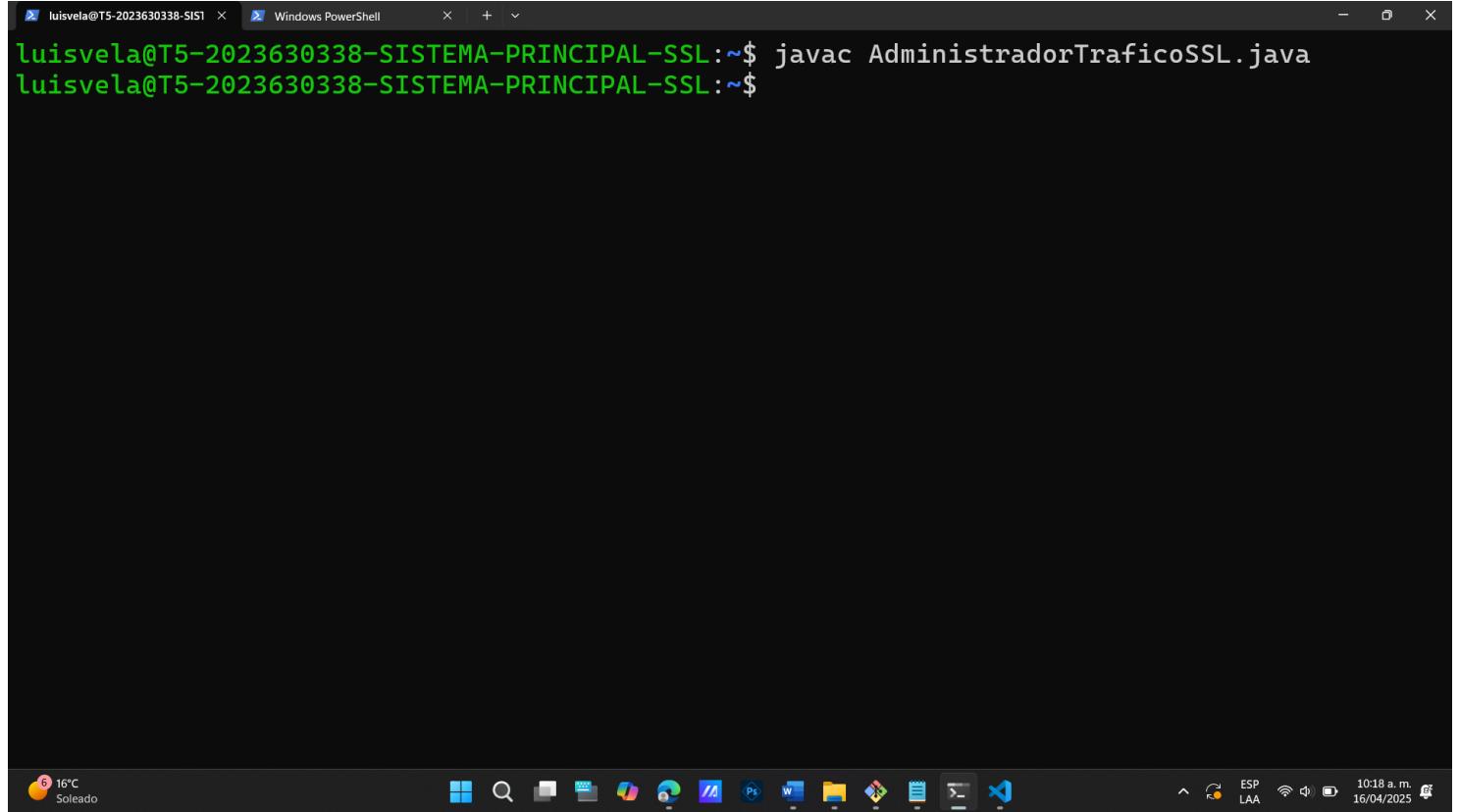
102   //simplenete agregamos el codigo para el servidor https seguro que vimos en clase
103   System.setProperty(key:"javax.net.ssl.keyStore", value:"keystore_servidor.jks");
104   System.setProperty(key:"javax.net.ssl.keyStorePassword", value:"1234567");

105   SSLServerSocketFactory socket_factory = (SSLServerSocketFactory)SSLServerSocketFactory.getDefault();
106   // SSLServerSocketFactory.getDefault();
107   ServerSocket serverSocket = socket_factory.createServerSocket(puertoLocal);
108   // SSLServerSocket serverSocket = (SSLServerSocket) socketFactory.createServerSocket(puertoLocal);

109   System.out.println("Servidor HTTPS seguro ejecutando en el puerto: " + puertoLocal);

110   for (;;) {
111     Socket cliente = serverSocket.accept();
112     new Worker(cliente).start();
113   }
114 }
```

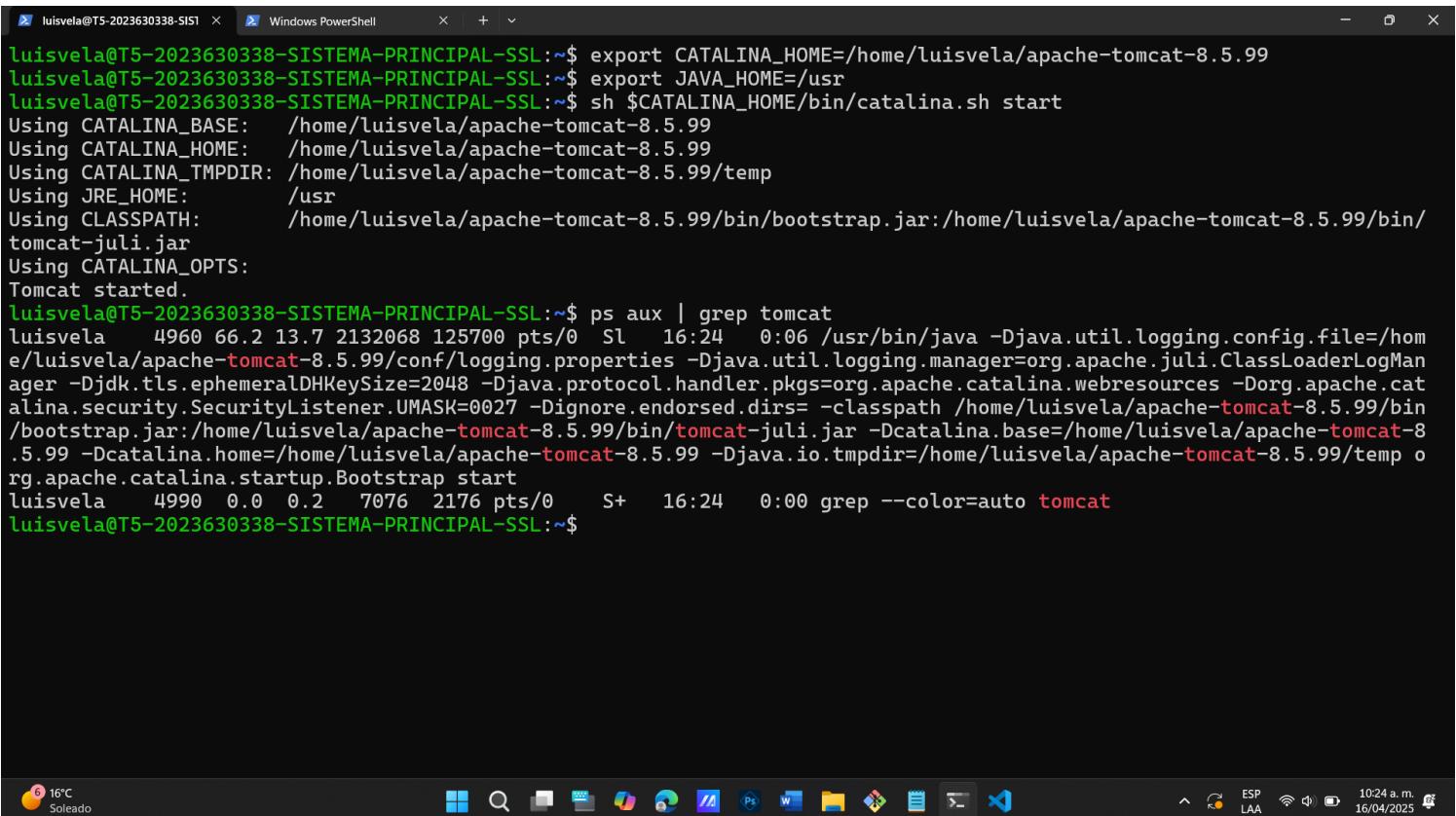
5. Compilar el programa AdministradorTraficoSSL.java en la primera máquina virtual.



```
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ javac AdministradorTraficoSSL.java
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$
```

6. Iniciar la ejecución de Tomcat en ambas máquinas virtuales.

- Iniciando tomcat en la VM1



```
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ export CATALINA_HOME=/home/luisvela/apache-tomcat-8.5.99
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ export JAVA_HOME=/usr
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ sh $CATALINA_HOME/bin/catalina.sh start
Using CATALINA_BASE:   /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_HOME:   /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_TMPDIR: /home/luisvela/apache-tomcat-8.5.99/temp
Using JRE_HOME:        /usr
Using CLASSPATH:       /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/
tomcat-juli.jar
Using CATALINA_OPTS:
Tomcat started.
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ ps aux | grep tomcat
luisvela  4960 66.2 13.7 2132068 125700 pts/0 Sl  16:24  0:06 /usr/bin/java -Djava.util.logging.config.file=/home/luisvela/apache-tomcat-8.5.99/conf/logging.properties -Djava.util.logging.manager=org.apache.juli.ClassLoaderLogManager -Djdk.tls.ephemeralDHKeySize=2048 -Djava.protocol.handler.pkgs=org.apache.catalina.webresources -Dorg.apache.catalina.security.SecurityListener.UMASK=0027 -Dignore.endorsed.dirs= -classpath /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/tomcat-juli.jar -Dcatalina.base=/home/luisvela/apache-tomcat-8.5.99 -Dcatalina.home=/home/luisvela/apache-tomcat-8.5.99 -Djava.io.tmpdir=/home/luisvela/apache-tomcat-8.5.99/temp org.apache.catalina.startup.Bootstrap start
luisvela  4990  0.0  0.2  7076  2176 pts/0 S+  16:24  0:00 grep --color=auto tomcat
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$
```

- Ingresando por ssh a la VM2

```

PS C:\Users\Luis Velasco> ssh luisvela@20.109.48.73
luisvela@20.109.48.73's password:
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-1021-azure x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Wed Apr 16 16:30:44 UTC 2025

System load: 0.0      Processes:          111
Usage of /: 9.3% of 28.02GB  Users logged in:    0
Memory usage: 71%           IPv4 address for eth0: 10.0.0.4
Swap usage:  0%

* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

1 device has a firmware upgrade available.
Run 'fwupdmgr get-upgrades' for more information.

Expanded Security Maintenance for Applications is not enabled.

69 updates can be applied immediately.
44 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

1 device has a firmware upgrade available.
Run 'fwupdmgr get-upgrades' for more information.

Last login: Wed Apr 16 16:30:57 2025 from 187.224.252.35
luisvela@T5-2023630338-REPLICA-SSL:~$
```

- Iniciando la ejecución de la VM2

```

luisvela@T5-2023630338-SISTI:~$ export CATALINA_HOME=/home/luisvela/apache-tomcat-8.5.99
luisvela@T5-2023630338-REPLICA-SSL:~$ export JAVA_HOME=/usr
luisvela@T5-2023630338-REPLICA-SSL:~$ sh $CATALINA_HOME/bin/catalina.sh start
Using CATALINA_BASE:   /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_HOME:   /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_TMPDIR: /home/luisvela/apache-tomcat-8.5.99/temp
Using JRE_HOME:        /usr
Using CLASSPATH:       /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/tomcat-juli.jar
Using CATALINA_OPTS:
Tomcat started.
luisvela@T5-2023630338-REPLICA-SSL:~$ ps aux | grep tomcat
luisvela  4454 61.8 11.9 2132068 109100 pts/0 Sl  16:34  0:05 /usr/bin/java -Djava.util.logging.config.file=/home/luisvela/apache-tomcat-8.5.99/conf/logging.properties -Djava.util.logging.manager=org.apache.juli.ClassLoaderLogManager -Djdk.tls.ephemeralDHKeySize=2048 -Djava.protocol.handler.pkgs=org.apache.catalina.webresources -Dorg.apache.catalina.security.SecurityListener.UMASK=0027 -Dignore.endorsed.dirs= -classpath /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/tomcat-juli.jar -Dcatalina.base=/home/luisvela/apache-tomcat-8.5.99 -Dcatalina.home=/home/luisvela/apache-tomcat-8.5.99 -Djava.io.tmpdir=/home/luisvela/apache-tomcat-8.5.99/temp org.apache.catalina.startup.Bootstrap start
luisvela  4486  0.0  0.2  7076 2176 pts/0 S+  16:35  0:00 grep --color=auto tomcat
luisvela@T5-2023630338-REPLICA-SSL:~$
```

7. Crear un túnel SSH entre la primera máquina virtual y la réplica.

7.1 Crear un par de claves pública y privada para que no se pida contraseña cuando se cree el túnel.

- En la computadora cliente del túnel ssh (primera máquina virtual-SistemaPrincipal-SSL), ejecutando el siguiente comando para crear el par de claves; donde t indica el algoritmo a usar y -b el tamaño de la llave en bits.



```
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ ssh-keygen -t rsa -b 2048
Generating public/private rsa key pair.
Enter file in which to save the key (/home/luisvela/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/luisvela/.ssh/id_rsa
Your public key has been saved in /home/luisvela/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:LTI7ZbcVWBxt1y2t523ELgYIM4piKZaycEl90bURbSA luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL
The key's randomart image is:
+---[RSA 2048]---+
|   . Eo=+ .oo .o |
|   . . +.ooo. + =|
|   ..o o o.=.... =|
|+o* . . . . . . +|
|= . o S o . . =.|
| . * o o o =      |
|   o . . o          |
|                   .|
+---[SHA256]---+
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$
```

- Para copiar la clave pública a la computadora que ejecuta el servidor (REPLICA-SSL); ejecutar ssh-copy-id usuario@ipHost, donde usuario es el nombre de usuario de la computadora que ejecuta el servidor (hacer esto desde la computadora cliente (SistemaPrincipal-SSL)).

```
Windows PowerShell luisvela@T5-2023630338-REPL luisvela@T5-2023630338-REP + - x
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ ssh-copy-id luisvela@20.109.48.73
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "/home/luisvela/.ssh/id_rsa.pub"
The authenticity of host '20.109.48.73 (20.109.48.73)' can't be established.
ED25519 key fingerprint is SHA256:A210oX0FwSle/PvozZL1do/nF+N2FMdCFUhacPBAZTA.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
luisvela@20.109.48.73's password:

Number of key(s) added: 1

Now try logging into the machine, with: "ssh 'luisvela@20.109.48.73'"
and check to make sure that only the key(s) you wanted were added.

luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ ssh luisvela@20.109.48.73
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-1021-azure x86_64)

6 19°C Soleado 11:19 a.m. 16/04/2025
```

- Ahora, ejecutar en la computadora cliente "ssh usuario@ipHost" para probar el acceso (en este caso, el acceso ya no pide contraseña).

```
Windows PowerShell luisvela@T5-2023630338-REPL luisvela@T5-2023630338-REP + - x
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ ssh luisvela@20.109.48.73
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-1021-azure x86_64)

* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/pro

System information as of Wed Apr 16 17:17:03 UTC 2025

System load: 0.0 Processes: 112
Usage of /: 9.4% of 28.02GB Users logged in: 1
Memory usage: 83% IPv4 address for eth0: 10.0.0.4
Swap usage: 0%

* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

1 device has a firmware upgrade available.
Run `fwupdmgr get-upgrades` for more information.

Expanded Security Maintenance for Applications is not enabled.

69 updates can be applied immediately.
44 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

1 device has a firmware upgrade available.
Run `fwupdmgr get-upgrades` for more information.

Last login: Wed Apr 16 16:31:23 2025 from 187.224.252.35
luisvela@T5-2023630338-REPLICA-SSL:~$ |
```

- Implementando el túnel SSH
- En la computadora cliente del túnel SSH, el AdministradorTraficoSSL.java deberá abrir el puerto 8081, ya que tomcat ya está ejecutando en el puerto 8080. (No es necesario crear una regla de entrada ya que este proceso se ejecuta de forma segura dentro de una Vnet).
- Ejecutando el comando “ssh -N -f -L 8081:localhost:8080 usuario@host” en la computadora cliente.

Dónde:

- -N No se ejecutará un comando remoto, solo se creará el túnel SSH.
- -f ssh se ejecutará en segundo plano (background).
- -L 40000:localhost:50000, el cliente se conecta al cliente SSH por el puerto 40000, el endpoint "localhost:50000" indica que el servidor SSH se conecta al servidor en localhost por el puerto 50000. En este caso, se está realizando un mapeo del puerto 40000 al puerto 50000.
- usuario es el nombre del usuario en la computadora remota (que ejecuta el servidor).
- host es la dirección IP de la computadora remota.

The screenshot shows a Windows PowerShell window with three tabs open. The active tab displays the command: `ssh -N -f -L 8081:localhost:8080 luisvela@20.109.48.73`. Below the command, the output of the `ps -ef | grep ssh` command is shown, listing several processes related to the SSH connection. The taskbar at the bottom shows various icons, including the Start button, a weather icon (Soleado, 20°C), and system status icons (Wi-Fi, battery, etc.).

```
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ ssh -N -f -L 8081:localhost:8080 luisvela@20.109.48.73
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ ps -ef | grep ssh
root      1100      1  0 17:14 ?        00:00:00 sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 start
ups
root      1101     1100  0 17:14 ?        00:00:00 sshd: luisvela [priv]
luisvela   1235     1101  0 17:14 ?        00:00:00 sshd: luisvela@pts/0
luisvela   1477      1  0 17:48 ?        00:00:00 ssh -N -f -L 8081:localhost:8080 luisvela@20.109.48.73
luisvela   1485     1236  0 17:50 pts/0    00:00:00 grep --color=auto ssh
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ |
```

8. Ejecutar en la primera máquina virtual el programa AdministradorTraficoSSL.java.

- Ejecutando el comando “sudo java AdministradorTraficoSLL localhost 8080 localhost 8081 443 &”

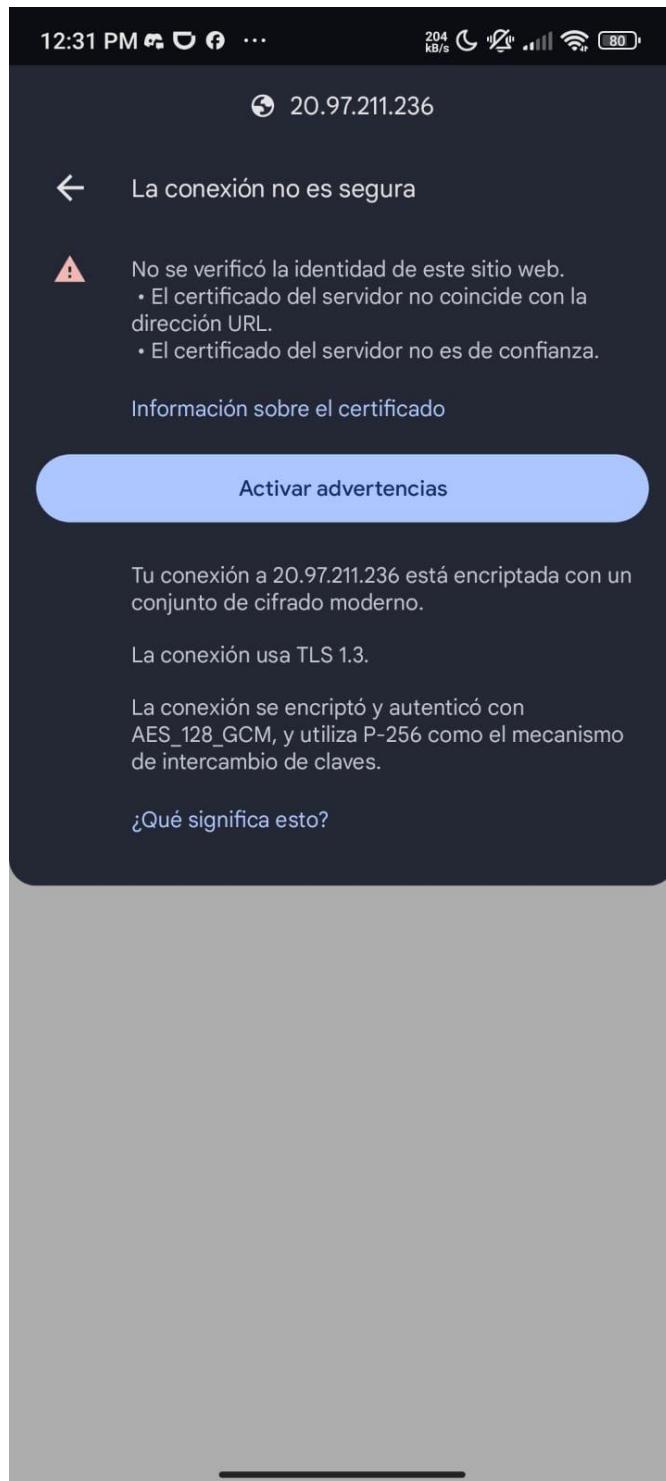
Donde:

- localhost es la IP de Tomcat
 - 8080 es el puerto en donde escucha Tomcat
 - localhost es la IP del cliente del túnel SSH (recordar que ejecuta en la misma máquina)
 - 8081 es el puerto en donde escucha el cliente del túnel.

```
Windows PowerShell x luisvela@T5-2023630338-REPL x luisvela@T5-2023630338-SISI x + - x
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ sudo java AdministradorTraficoSSL localhost 8080 localhost 8081 443 &
[1] 1865
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ Conectando a localhost:8080 y localhost:8081 en puerto local (SSL) 443
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ |
```

10.1 Dar de alta tres usuarios incluyendo una imagen (no utilizar datos ni imágenes personales).

- Al entrar al servicio web, el navegador manda una advertencia ya que usamos un certificado auto firmado.



- Dando de alta al primer usuario Messi

Alta de usuario

Email *
messi@gmail.com

Nombre *
Messi

Apellido paterno *
Messi

Apellido materno
Messi

Fecha de nacimiento *
20/12/1979, 7:27 a.m.

Teléfono
5511009978

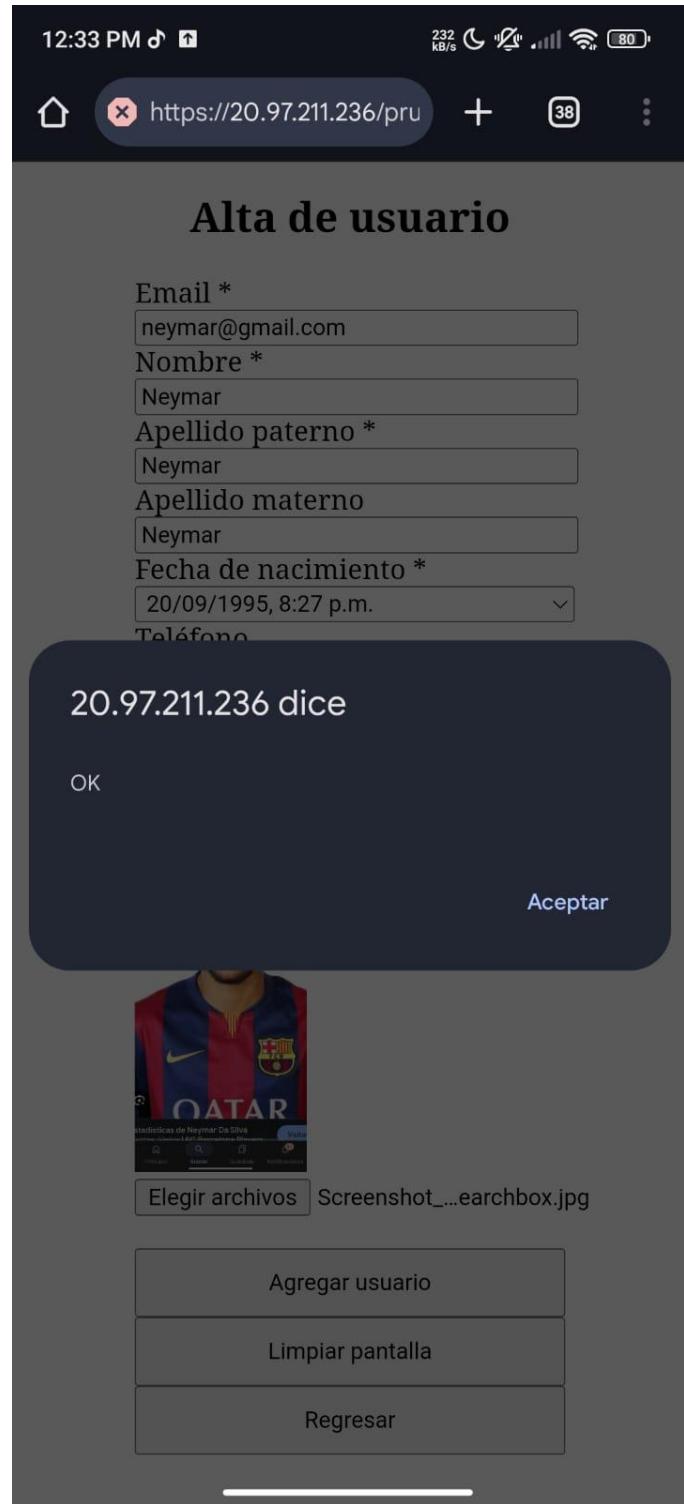
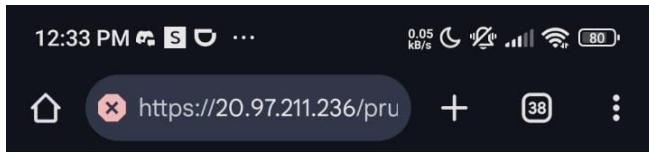
Género
Masculino

20.97.211.236 dice

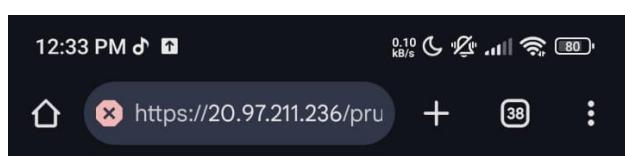
OK

Aceptar

- Registrado al segundo usuario Neymar



- Registrando al tercer usuario Luis Suárez



Alta de usuario

Email *

Nombre *

Apellido paterno *

Apellido materno

Fecha de nacimiento *

Teléfono

Género

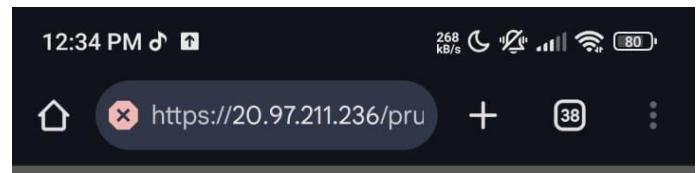


Elegir archivos Screenshot_earchbox.jpg

[Agregar usuario](#)

[Limpiar pantalla](#)

[Regresar](#)



Alta de usuario

Email *

Nombre *

Apellido paterno *

Apellido materno

Fecha de nacimiento *

Teléfono

20.97.211.236 dice

OK

Aceptar



Elegir archivos Screenshot_earchbox.jpg

[Agregar usuario](#)

[Limpiar pantalla](#)

[Regresar](#)

Los datos de los usuarios deberán ser diferentes a los utilizados en la primera parte de la tarea.

Mostrar el contenido de las bases de datos en ambas computadoras (en el caso de la imagen, mostrar solo la longitud del campo que contiene la imagen).

- Mostrando los contenidos requeridos de la base de datos en la VM1

```

Windows PowerShell          luisvela@T5-2023630338-REPL  luisvela@T5-2023630338-SISTI  luisvela@T5-2023630338-SISTI
luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 14
Server version: 8.0.41-0ubuntu0.24.04.1 (Ubuntu)

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owners.

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

mysql> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+-----+
| id_usuario | email      | nombre    | apellido_paterno | apellido_materno | fecha_nacimiento | telefono   | genero |
+-----+-----+-----+-----+-----+-----+-----+
|       6 | messi@gmail.com | Messi     | Messi           | Messi           | 1979-12-20 13:27:00 | 5511009978 | M
|       7 | neymar@gmail.com | Neymar    | Neymar          | Neymar          | 1995-09-21 02:27:00 | 2255889900 | M
|       8 | suarez@hotmail.com | Suárez   | Suárez          | Suárez          | 1985-11-22 02:29:00 | 2277554018 | M
+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

mysql> select u.nombre, fu.id_foto, LENGTH(foto) as tam_imagen from fotos_usuarios fu join usuarios u ON fu.id_usuario = u.id_usuario;
+-----+-----+-----+
| nombre | id_foto | tam_imagen |
+-----+-----+-----+
| Messi | 3 | 672498 |
| Neymar | 4 | 651958 |
| Suárez | 5 | 763297 |
+-----+-----+-----+
3 rows in set (0.02 sec)

5 Título deportivo
Fórmula 1: Red B...
Windows Taskbar icons
12:46 p.m. 16/04/2025

```

- Mostrando los contenidos requeridos en la base de datos en la VM2

```

Windows PowerShell          luisvela@T5-2023630338-REP  luisvela@T5-2023630338-SISTI  luisvela@T5-2023630338-SISTI  luisvela@T5-2023630338-SISTI
luisvela@T5-2023630338-REPLICA-SSL:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 11
Server version: 8.0.41-0ubuntu0.24.04.1 (Ubuntu)

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owners.

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

mysql> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+-----+
| id_usuario | email      | nombre    | apellido_paterno | apellido_materno | fecha_nacimiento | telefono   | genero |
+-----+-----+-----+-----+-----+-----+-----+
|       6 | messi@gmail.com | Messi     | Messi           | Messi           | 1979-12-20 13:27:00 | 5511009978 | M
|       7 | neymar@gmail.com | Neymar    | Neymar          | Neymar          | 1995-09-21 02:27:00 | 2255889900 | M
|       8 | suarez@hotmail.com | Suárez   | Suárez          | Suárez          | 1985-11-22 02:29:00 | 2277554018 | M
+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.01 sec)

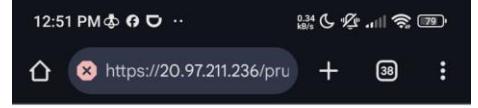
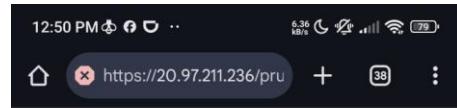
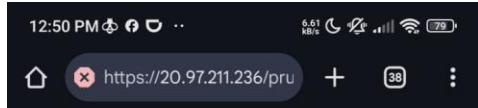
mysql> select u.nombre, fu.id_foto, LENGTH(foto) as tam_imagen from fotos_usuarios fu join usuarios u ON fu.id_usuario = u.id_usuario;
+-----+-----+-----+
| nombre | id_foto | tam_imagen |
+-----+-----+-----+
| Messi | 3 | 672498 |
| Neymar | 4 | 651958 |
| Suárez | 5 | 763297 |
+-----+-----+-----+
3 rows in set (0.01 sec)

uv UV extremo
Ahora
Windows Taskbar icons
12:47 p.m. 16/04/2025

```

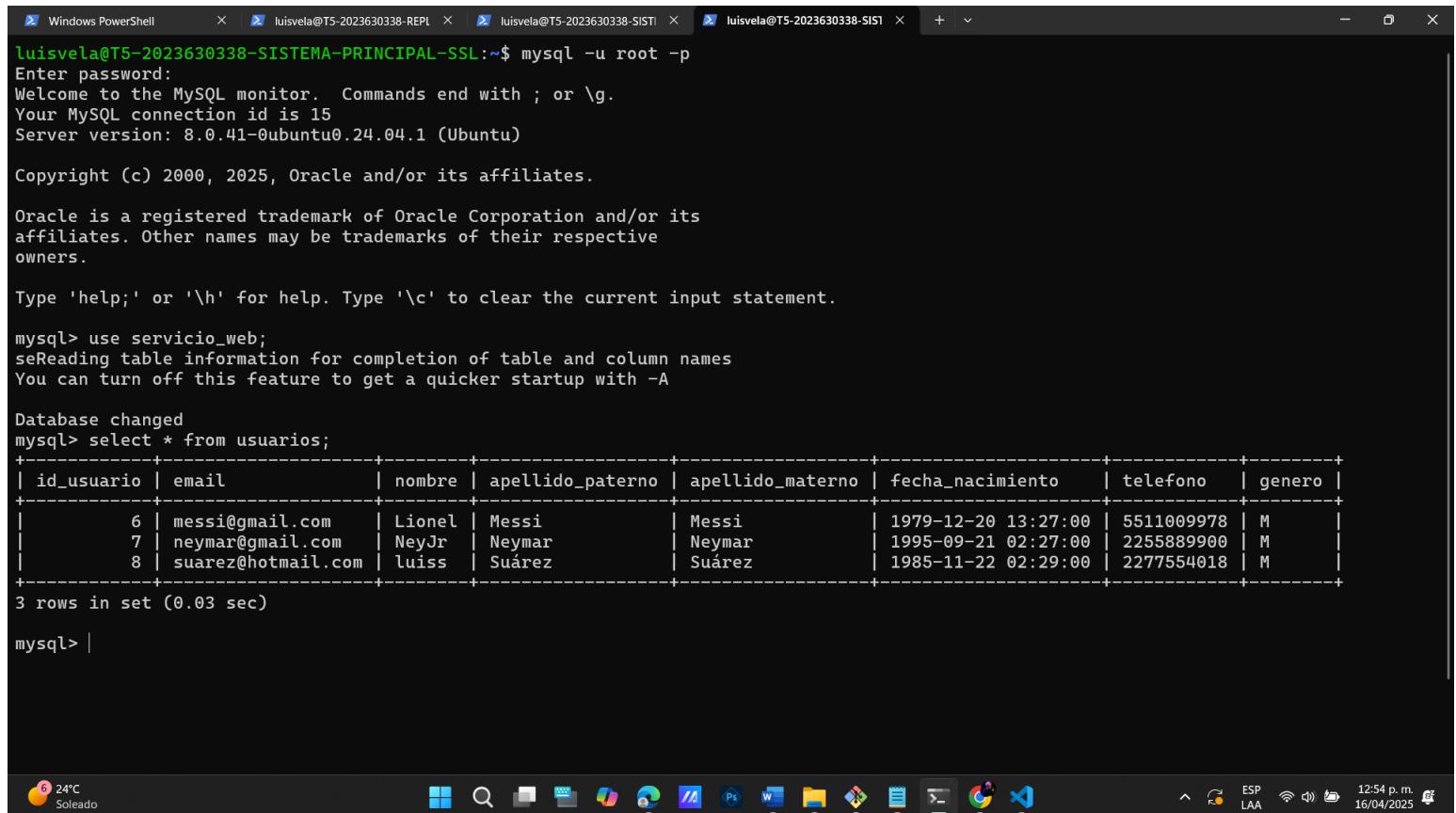
10.2. Modificar algún dato en cada usuario.

- Modificando el nombre principal de los 3 usuarios.



Mostrar el contenido de las bases de datos en ambas computadoras.

- Mostrando el contenido modificado de los usuarios en la VM1. (Sistema Principal-SSL)



```

luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 15
Server version: 8.0.41-0ubuntu0.24.04.1 (Ubuntu)

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

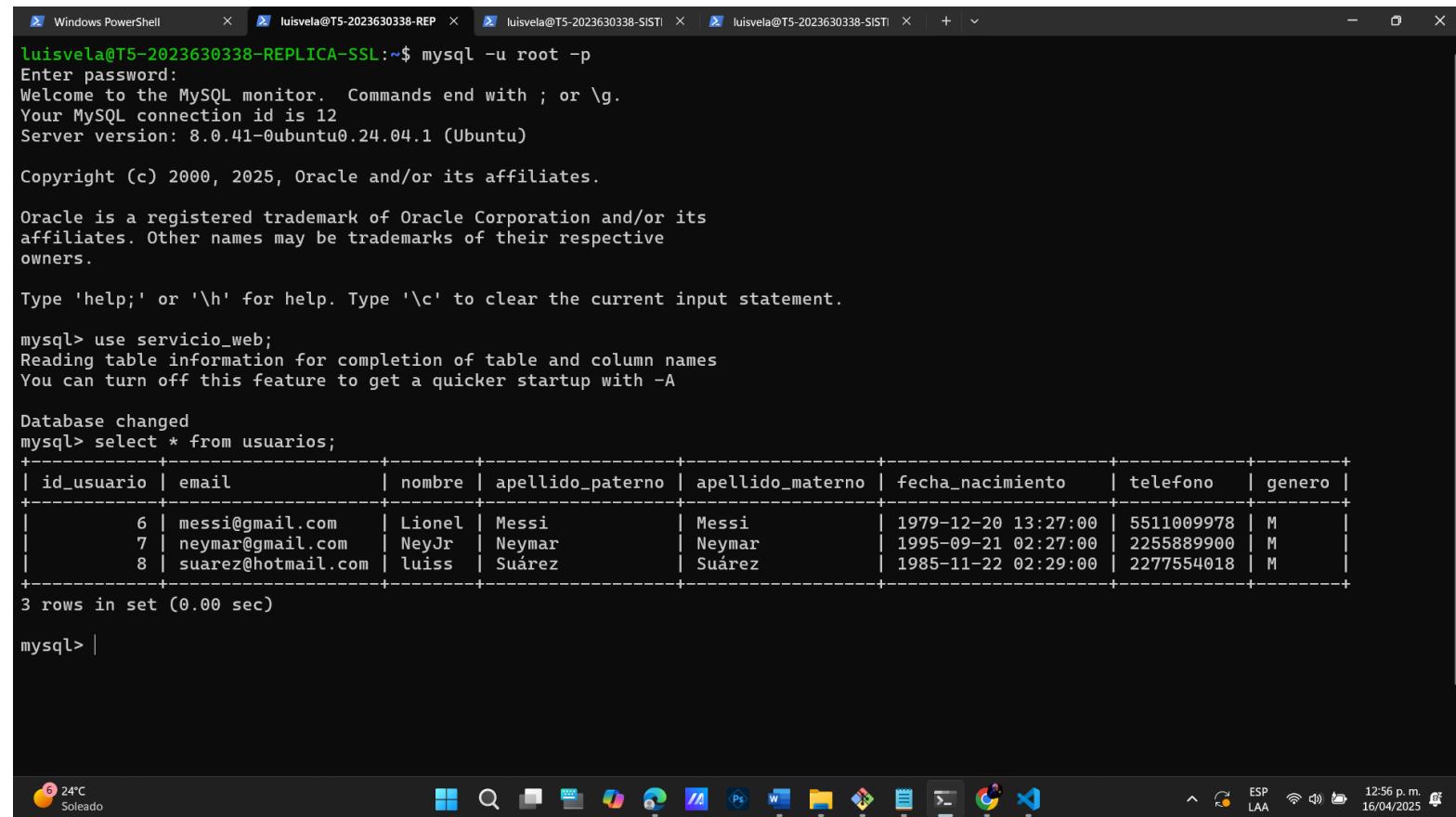
mysql> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+
| id_usuario | email | nombre | apellido_paterno | apellido_materno | fecha_nacimiento | telefono | genero |
+-----+-----+-----+-----+-----+-----+
|       6 | messi@gmail.com | Lionel | Messi           | Messi            | 1979-12-20 13:27:00 | 5511009978 | M
|       7 | neymar@gmail.com | NeyJr   | Neymar          | Neymar          | 1995-09-21 02:27:00 | 2255889900 | M
|       8 | suarez@hotmail.com | luiss   | Suárez          | Suárez          | 1985-11-22 02:29:00 | 2277554018 | M
+-----+-----+-----+-----+-----+-----+
3 rows in set (0.03 sec)

mysql> |

```

- Mostrando el contenido modificado de los usuarios en la VM2 (REPLICA).



```

luisvela@T5-2023630338-REPLICA-SSL:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 12
Server version: 8.0.41-0ubuntu0.24.04.1 (Ubuntu)

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

mysql> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

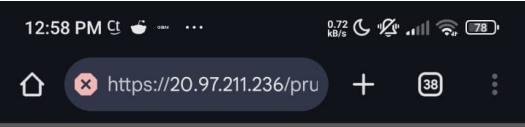
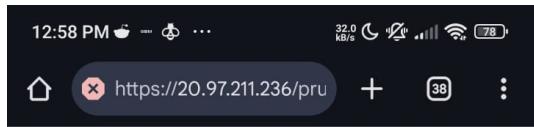
Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+
| id_usuario | email | nombre | apellido_paterno | apellido_materno | fecha_nacimiento | telefono | genero |
+-----+-----+-----+-----+-----+-----+
|       6 | messi@gmail.com | Lionel | Messi           | Messi            | 1979-12-20 13:27:00 | 5511009978 | M
|       7 | neymar@gmail.com | NeyJr   | Neymar          | Neymar          | 1995-09-21 02:27:00 | 2255889900 | M
|       8 | suarez@hotmail.com | luiss   | Suárez          | Suárez          | 1985-11-22 02:29:00 | 2277554018 | M
+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

mysql> |

```

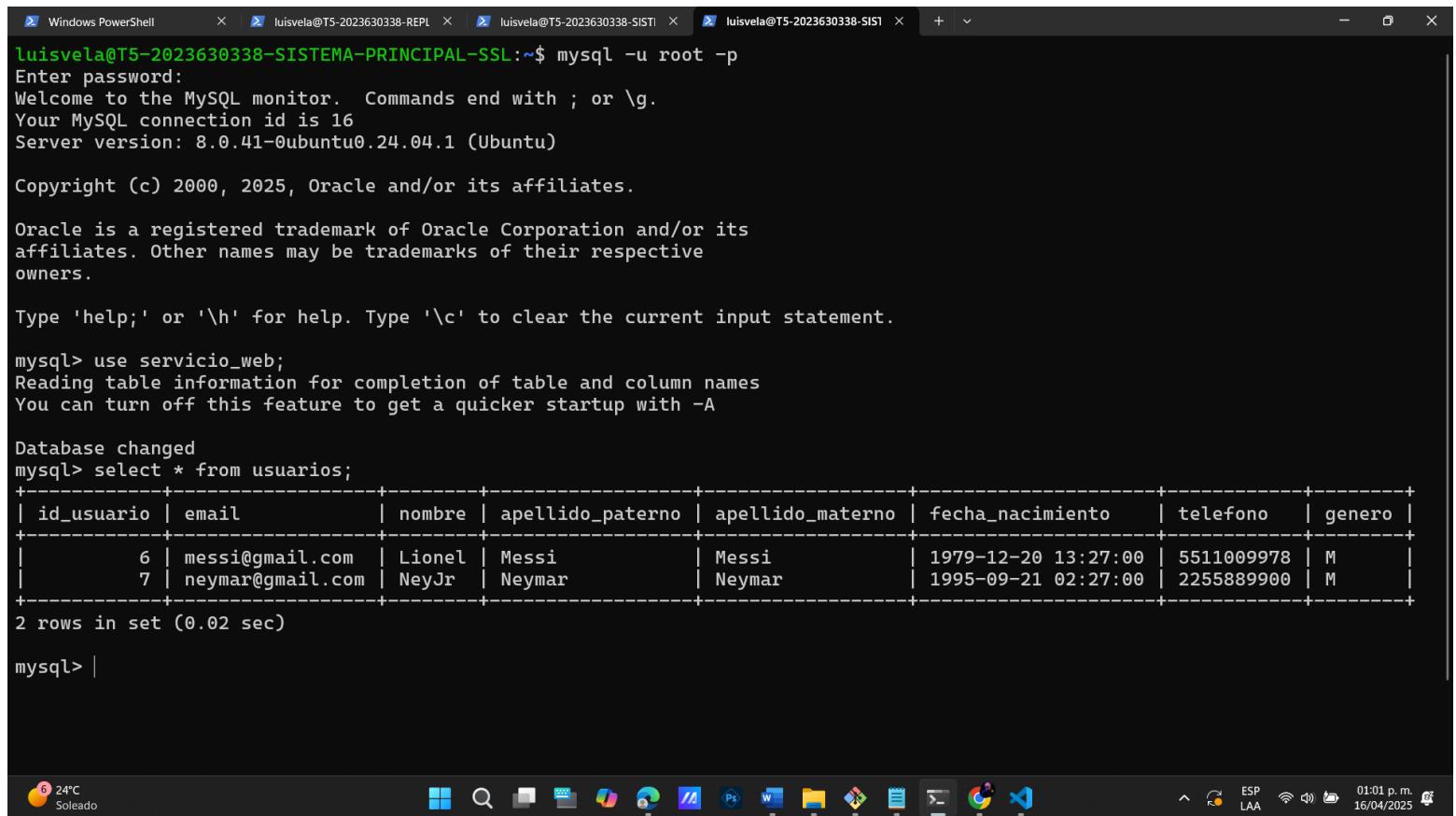
10.3. Eliminar uno de los usuarios.

- Eliminando al usuario con email suarez@hotmail.com



Mostrar el contenido de las bases de datos en ambas computadoras

- Mostrando los usuarios de la base de datos en la VM1 (Sistema-Principal-SSL).



```

luisvela@T5-2023630338-SISTEMA-PRINCIPAL-SSL:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 16
Server version: 8.0.41-Ubuntu0.24.04.1 (Ubuntu)

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owners.

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

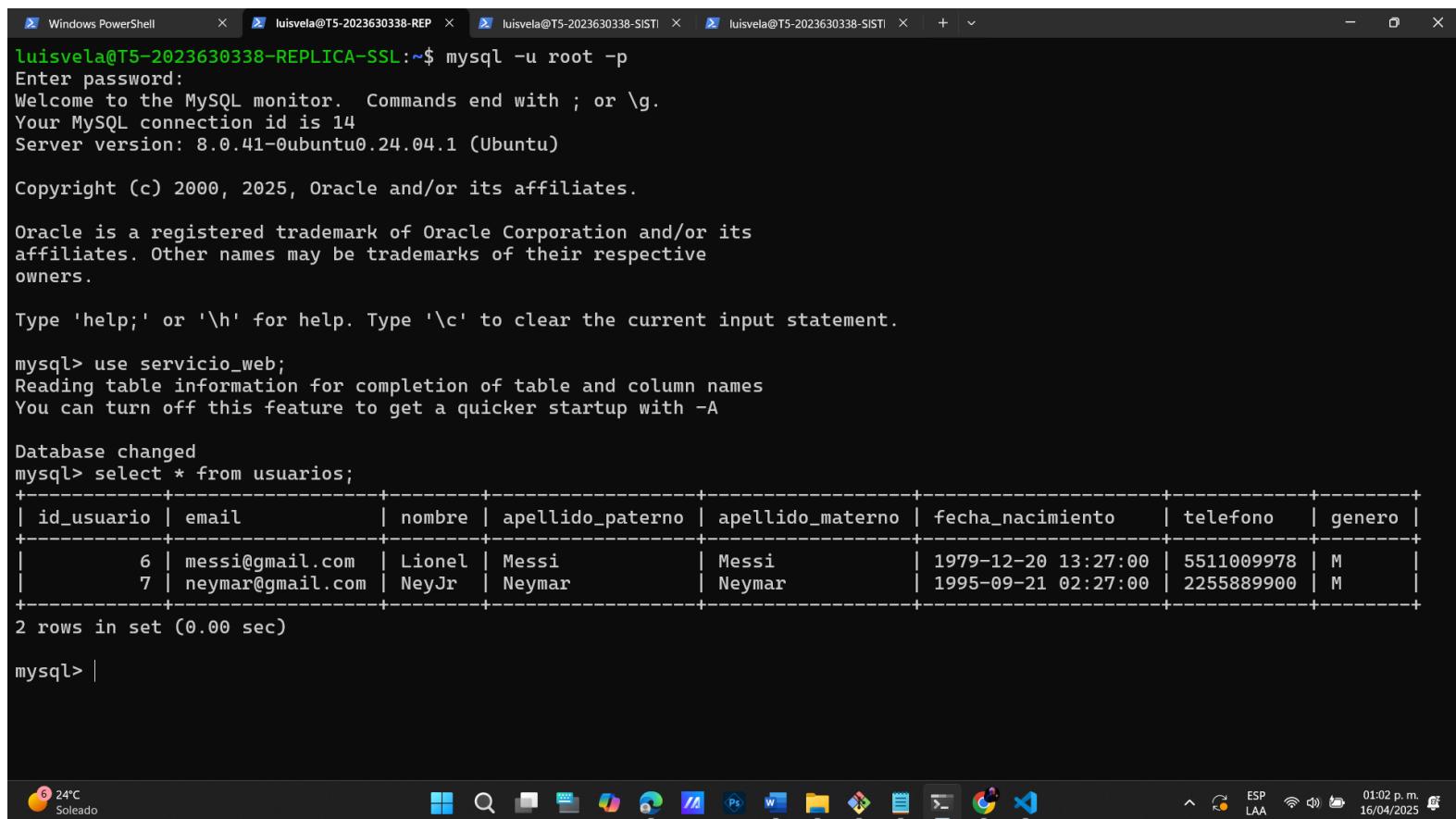
mysql> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+-----+
| id_usuario | email | nombre | apellido_paterno | apellido_materno | fecha_nacimiento | telefono | genero |
+-----+-----+-----+-----+-----+-----+-----+
|       6 | messi@gmail.com | Lionel | Messi           | Messi           | 1979-12-20 13:27:00 | 5511009978 | M
|       7 | neymar@gmail.com | NeyJr   | Neymar          | Neymar          | 1995-09-21 02:27:00 | 2255889900 | M
+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.02 sec)

mysql> |

```

- Mostrando los usuarios de la base de datos en la VM2 (REPLICA).



```

luisvela@T5-2023630338-REPLICA-SSL:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 14
Server version: 8.0.41-Ubuntu0.24.04.1 (Ubuntu)

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

mysql> use servicio_web;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from usuarios;
+-----+-----+-----+-----+-----+-----+-----+
| id_usuario | email | nombre | apellido_paterno | apellido_materno | fecha_nacimiento | telefono | genero |
+-----+-----+-----+-----+-----+-----+-----+
|       6 | messi@gmail.com | Lionel | Messi           | Messi           | 1979-12-20 13:27:00 | 5511009978 | M
|       7 | neymar@gmail.com | NeyJr   | Neymar          | Neymar          | 1995-09-21 02:27:00 | 2255889900 | M
+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.00 sec)

mysql> |

```

CONCLUSIONES:

Esta tarea me parece que es muy útil ya que me imagino que suele ser muy común en casi todos los sistemas profesionales, independientemente de que tan grande o pequeño sea, ya que es claro que el área de sistemas, siempre hay que estar dispuesto a aceptar que puedo haber errores como la perdida de datos, es por esto que se me hace muy útil tener un sistema replicado.

También esta tarea me hizo pensar en las variantes que pueden surgir en la arquitectura del sistema, ya que específicamente en la arquitectura de esta tarea, teníamos tanto el sistema principal como la replica en una misma red virtual, pero tal vez se puedan implementar en Vnets separadas, con el objetivo de estar preparados ante desastres naturales o fallos físicos, recuperación ante fallos, etc.

Por último, me he dado cuenta de la gran utilidad que tiene levantar un túnel SSH para comunicar servicios, principalmente aspectos de seguridad para prevenir intercepción de datos por parte de un tercero.