



INSTITUTO POLITÉCNICO NACIONAL
ESCUELA SUPERIOR DE CÓMPUTO



SISTEMAS DISTRIBUIDOS

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Tarea 2: Implementación de una arquitectura de tres capas
en la nube

Fecha de Entrega: 18/Mar/2025

Objetivo:

En esta tarea se va a implementar una arquitectura de tres capas en la nube, consistente en una aplicación SPA, un servicio web REST para Tomcat y el DBMS MySQL.

Introducción:

¿Qué es una SPA?

SPA son las siglas de Single Page Application. Es un tipo de aplicación web donde todas las pantallas las muestra en la misma página, sin recargar el navegador.

Técnicamente, una SPA es un sitio donde existe un único punto de entrada, generalmente el archivo index.html. En la aplicación no hay ningún otro archivo HTML al que se pueda acceder de manera separada y que nos muestre un contenido o parte de la aplicación, toda la acción se produce dentro del mismo index.html.

Tomcat

Tomcat es un contenedor web con soporte de servlets y JSPs. No es un servidor de aplicaciones, como JBoss o JOnAS. Incluye el compilador Jasper, que compila JSPs convirtiéndolas en servlets. Tomcat, también llamado Apache Tomcat o Jakarta Tomcat, es un contenedor open source de servlets para la implementación de Java Servlet, JavaServer Pages (JSP), Java Expression Language y Java WebSocket.

¿Qué es una arquitectura de 3 capas?

La arquitectura en tres capas es un enfoque fundamental en el diseño de sistemas de software que separa la aplicación en tres secciones distintas y bien definidas:

1. Capa de presentación: Interfaz de usuario y visualización de datos.
2. Capa de lógica de negocio: Procesamiento y reglas de negocio.
3. Capa de acceso a datos: Interacción con la base de datos.

DESARROLLO

Instalación de Tomcat con soporte REST

1. Crear una máquina virtual con Ubuntu con al menos 1GB de RAM. Abrir los puertos 80 y el 8080 para protocolo TCP.
- En la siguiente imagen se puede ver la configuración básica de la VM de Ubuntu, con el nombre requerido en las especificaciones de la tarea: "T2-2023630338"

The screenshot shows the Microsoft Azure portal interface for creating a new virtual machine. The main section is titled 'Create a virtual machine' and includes the following fields:

- Subscription:** Azure for Students
- Resource group:** (New) T2-2023630338_group_03162125
- Instance details:**
 - Virtual machine name:** T2-2023630338
 - Region:** (US) East US 2
 - Availability options:** Availability zone
 - Zone options:** Self-selected zone (selected), with a note: "Choose up to 3 availability zones, one VM per zone". There is also an option for Azure-selected zone (Preview).
 - Availability zone:** Zone 1
 - A note: "You can now select multiple zones. Selecting multiple zones will create one VM per zone. Learn more" with a link.
- Security type:** Standard

At the bottom of the form, there are navigation buttons: '< Previous', 'Next : Disks >', and 'Review + create'.

- En la siguiente imagen se ve el SO que elegimos, el cual es Ubuntu Server 24, así como las especificaciones del tamaño (B1s con 1 CPU virtual y un 1 GB de RAM)

Create a virtual machine

⚠️ Changing Basic options may reset selections you have made. Review all options prior to creating the virtual machine.

Help me create a low cost VM | Help me create a VM optimized for high availability | Help me choose the right VM size for my workload

Security type: Standard

Image: Ubuntu Server 24.04 LTS - x64 Gen2

VM architecture: x64

Run with Azure Spot discount:

Size: Standard_B1s - 1 vcpu, 1 GiB memory (7.59 US\$/month) (free services eligible...)

Enable Hibernation:

Administrator account: Authentication type: Password

< Previous | Next : Disks > | Review + create | Give feedback

- En la siguiente imagen, elegimos el tipo de autenticación por contraseña con nuestro usuario "luisvela", también habilitamos los puertos de entrada 80 y 22, mas adelante abriremos el puerto 8080 que se nos pide en la tarea.

Create a virtual machine

⚠️ Changing Basic options may reset selections you have made. Review all options prior to creating the virtual machine.

Help me create a low cost VM | Help me create a VM optimized for high availability | Help me choose the right VM size for my workload

Administrator account: Authentication type: Password

Username: luisvela

Password:

Confirm password:

Inbound port rules: Select which virtual machine network ports are accessible from the public internet. You can specify more limited or granular network access on the Networking tab.

Public inbound ports: Allow selected ports

Select inbound ports: HTTP (80), SSH (22)

⚠️ This will allow all IP addresses to access your virtual machine. This is only recommended for testing. Use the Advanced controls in the Networking tab to...

< Previous | Next : Disks > | Review + create | Give feedback

- En la pestaña de las especificaciones del disco, vamos a seleccionar un tamaño de 30 GiB y un tipo de disco HDD Standard.

The screenshot shows the 'Create a virtual machine' wizard on the Microsoft Azure portal. The current step is 'Create a virtual machine' (step 2 of 7). The 'OS disk' section is selected, showing the following configuration:

- OS disk size:** Image default (30 GiB)
- OS disk type:** Standard HDD (locally-redundant storage) (selected)
- Delete with VM:** Checked
- Key management:** Platform-managed key
- Enable Ultra Disk compatibility:** Unchecked

Below this, the 'Data disks for T2-2023630338' section is shown, with a note that you can add and configure additional data disks or attach existing ones. A table header row is visible, and two buttons at the bottom are 'Create and attach a new disk' and 'Attach an existing disk'.

At the bottom of the wizard, there are navigation buttons: '< Previous', 'Next : Networking >', and 'Review + create'. The status bar at the bottom right shows the date and time as 16/03/2025, 09:36 p.m.

- En la sección de Red, dejaremos las configuraciones tal y como están, para que se cree la red virtual a donde se conectara la VM, junto con la IP pública.

The screenshot shows the 'Create a virtual machine' wizard on the Microsoft Azure portal, currently at the 'Create a virtual machine' step (step 2 of 7). The 'Networking' section is selected, showing the following configuration:

- Virtual network:** (new) T2-2023630338-vnet
- Subnet:** (new) default (10.0.0.0/24)
- Public IP:** (new) T2-2023630338-ip
- NIC network security group:** Basic (selected)
- Public inbound ports:** Allow selected ports (selected)
- Select inbound ports:** HTTP (80), SSH (22)

A warning message is displayed in a callout box: "⚠️ This will allow all IP addresses to access your virtual machine. This is only recommended for testing. Use the Advanced controls in the Networking tab to create rules to limit inbound traffic to known IP addresses."

At the bottom of the wizard, there are navigation buttons: '< Previous', 'Next : Management >', and 'Review + create'. The status bar at the bottom right shows the date and time as 16/03/2025, 09:37 p.m.

- La configuración de administración queda igual.

Help me create a low cost VM Help me create a VM optimized for high availability Help me choose the right VM size for my workload

Your subscription is protected by Foundational Cloud Security Posture Management Free Plan.

Identity

Enable system assigned managed identity

Microsoft Entra ID

Login with Microsoft Entra ID RBAC role assignment of Virtual Machine Administrator Login or Virtual Machine User Login is required when using Microsoft Entra ID login. [Learn more](#)

Microsoft Entra ID login now uses SSH certificate-based authentication. You will need to use an SSH client that supports OpenSSH certificates. You can use Azure CLI or Cloud Shell from the Azure Portal. [Learn more](#)

Auto-shutdown

Enable auto-shutdown

Backup

Enable backup

< Previous Next : Monitoring > Review + create Give feedback

- En la sección de Monitoreo, deshabilitamos el diagnóstico de arranque

Help me create a low cost VM Help me create a VM optimized for high availability Help me choose the right VM size for my workload

Monitoring

Configure monitoring options for your VM.

Alerts

Enable recommended alert rules

Diagnostics

Boot diagnostics Enable with managed storage account (recommended)
Enable with custom storage account
 Disable

Enable OS guest diagnostics

Health

Enable application health monitoring

< Previous Next : Advanced > Review + create Give feedback

- Revisando la información básica antes de crear la VM

Basics

Subscription	Azure for Students (new) T2-202363038_group_03162125
Resource group	T2-202363038
Virtual machine name	T2-202363038
Region	East US 2
Availability options	Availability zone
Zone options	Self-selected zone
Availability zone	1
Security type	Standard
Image	Ubuntu Server 24.04 LTS - Gen2
VM architecture	x64
Size	Standard B1s (1 vcpu, 1 GiB memory)
Enable Hibernation	No
Authentication type	Password
Username	luisvela
Public inbound ports	SSH, HTTP
Azure Spot	No

< Previous | Next > | Create | Download a template for automation | Give feedback

18°C Despejado | 09:39 p.m. 16/03/2025

- Revisando la sección de Disco y Red antes de crear la VM.

Disks

OS disk size	Image default
OS disk type	Standard HDD LRS
Use managed disks	Yes
Delete OS disk with VM	Enabled
Ephemeral OS disk	No

Networking

Virtual network	(new) T2-202363038-vnet
Subnet	(new) default (10.0.0.0/24)
Public IP	(new) T2-202363038-ip
Accelerated networking	Off
Place this virtual machine behind an existing load balancing solution?	No
Delete public IP and NIC when VM is deleted	Disabled

< Previous | Next > | Create | Download a template for automation | Give feedback

18°C Despejado | 09:39 p.m. 16/03/2025

- Revisando la sección de Administración y Monitoreo antes de crear la VM.

The screenshot shows the 'Create a virtual machine' wizard in the Microsoft Azure portal. At the top, there are three help buttons: 'Help me create a low cost VM', 'Help me create a VM optimized for high availability', and 'Help me choose the right VM size for my workload'. A green validation message 'Validation passed' is displayed. The configuration is divided into sections: Management, Monitoring, and Advanced. Under Management, settings include Microsoft Defender for Cloud (Basic (free)), System assigned managed identity (Off), Login with Microsoft Entra ID (Off), Auto-shutdown (Off), Backup (Disabled), Enable periodic assessment (Off), Enable hotpatch (Off), and Patch orchestration options (Image Default). Under Monitoring, settings include Alerts (Off), Boot diagnostics (Off), Enable OS guest diagnostics (Off), and Enable application health monitoring (Off). Under Advanced, there are buttons for '< Previous', 'Next >', and 'Create'.

- Una vez creada la VM, checando las especificaciones

The screenshot shows the 'Overview' page for a virtual machine named 'T2-2023630338' in the Microsoft Azure portal. The left sidebar lists navigation options: Home, Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Connect, Networking, Network settings, Load balancing, Application security groups, Network manager, Settings, Disks, Extensions + applications, Operating system, Configuration, and Advisor. The main content area displays the 'Essentials' section with details such as Resource group (T2-2023630338_group_03162125), Status (Running), Location (East US 2 (Zone 1)), Subscription (Azure for Students), Subscription ID (e1d319c4-9458-4992-b305-fe400976ae65), Availability zone (1), Tags (Add tags), Operating system (Linux (ubuntu 24.04)), Size (Standard B1s (1 vcpu, 1 GiB memory)), Public IP address (20.110.45.110), Virtual network/subnet (T2-2023630338-vnet/default), DNS name (Not configured), Health state (-), and Time created (3/17/2025, 3:41 AM UTC). Below this, tabs for Properties, Monitoring, Capabilities (7), Recommendations, and Tutorials are visible. The 'Virtual machine' section shows Computer name (T2-2023630338), Operating system (Linux (ubuntu 24.04)), VM generation (V2), VM architecture (x64), and Agent status (Ready). The 'Networking' section shows Public IP address (20.110.45.110, Network interface t2-2023630338vnet_z1), Public IP address (IPv6) (-), Private IP address (10.0.0.4), Private IP address (IPv6) (-), and Virtual network/subnet (T2-2023630338-vnet/default).

- Conectandonos a la VM por SSH

```
luisvela@T2-2023630338: ~ + 
PS C:\Users\luis Velasco> ssh luisvela@20.110.45.110
The authenticity of host '20.110.45.110 (20.110.45.110)' can't be established.
ED25519 key fingerprint is SHA256:vbK1n09+bHupa5m767dewD97AR1GczneBt/r6Zx+og.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '20.110.45.110' (ED25519) to the list of known hosts.
luisvela@20.110.45.110'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 Mon Mar 17 03:43:36 UTC 2025

System load: 0.23      Processes:          109
Usage of '/': 5.4% of 28.02GB   Users logged in:     0
Memory usage: 27%        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

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

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

luisvela@T2-2023630338:~$ |
```

18°C Despejado

ESP LAA 09:43 p.m. 16/03/2025

2. Crear Instalar JDK8.

- Haciendo sudo apt update para actualizar la lista de paquetes disponibles:

```
luisvela@T2-2023630338: ~ + 
luisvela@T2-2023630338:~$ sudo apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu noble InRelease
Get:2 http://azure.archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Get:3 http://azure.archive.ubuntu.com/ubuntu noble-backports InRelease [126 kB]
Get:4 http://azure.archive.ubuntu.com/ubuntu noble-security InRelease [126 kB]
Get:5 http://azure.archive.ubuntu.com/ubuntu noble/universe amd64 Packages [15.0 MB]
Get:6 http://azure.archive.ubuntu.com/ubuntu noble/universe Translation-en [5982 kB]
Get:7 http://azure.archive.ubuntu.com/ubuntu noble/universe amd64 Components [3871 kB]
Get:8 http://azure.archive.ubuntu.com/ubuntu noble/universe amd64 c-n-f Metadata [301 kB]
Get:9 http://azure.archive.ubuntu.com/ubuntu noble/multiverse amd64 Packages [269 kB]
Get:10 http://azure.archive.ubuntu.com/ubuntu noble/multiverse Translation-en [118 kB]
Get:11 http://azure.archive.ubuntu.com/ubuntu noble/multiverse amd64 Components [35.0 kB]
Get:12 http://azure.archive.ubuntu.com/ubuntu noble/multiverse amd64 c-n-f Metadata [8328 B]
Get:13 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages [919 kB]
Get:14 http://azure.archive.ubuntu.com/ubuntu noble-updates/main Translation-en [208 kB]
Get:15 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 Components [151 kB]
Get:16 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 c-n-f Metadata [13.4 kB]
Get:17 http://azure.archive.ubuntu.com/ubuntu noble-updates/universe amd64 Packages [1037 kB]
Get:18 http://azure.archive.ubuntu.com/ubuntu noble-updates/universe Translation-en [261 kB]
Get:19 http://azure.archive.ubuntu.com/ubuntu noble-updates/universe amd64 Components [364 kB]
Get:20 http://azure.archive.ubuntu.com/ubuntu noble-updates/universe amd64 c-n-f Metadata [25.8 kB]
Get:21 http://azure.archive.ubuntu.com/ubuntu noble-updates/restricted amd64 Packages [759 kB]
Get:22 http://azure.archive.ubuntu.com/ubuntu noble-updates/restricted Translation-en [153 kB]
Get:23 http://azure.archive.ubuntu.com/ubuntu noble-updates/restricted amd64 Components [212 kB]
Get:24 http://azure.archive.ubuntu.com/ubuntu noble-updates/restricted amd64 c-n-f Metadata [464 B]
Get:25 http://azure.archive.ubuntu.com/ubuntu noble-updates/multiverse amd64 Packages [30.1 kB]
Get:26 http://azure.archive.ubuntu.com/ubuntu noble-updates/multiverse Translation-en [5884 B]
Get:27 http://azure.archive.ubuntu.com/ubuntu noble-updates/multiverse amd64 Components [940 B]
Get:28 http://azure.archive.ubuntu.com/ubuntu noble-updates/multiverse amd64 c-n-f Metadata [656 B]
Get:29 http://azure.archive.ubuntu.com/ubuntu noble-backports/main amd64 Components [208 B]
Get:30 http://azure.archive.ubuntu.com/ubuntu noble-backports/main amd64 c-n-f Metadata [112 B]

luisvela@T2-2023630338:~$ |
```

18°C Despejado

ESP LAA 09:44 p.m. 16/03/2025

- Haciendo sudo apt install openjdk-8-jdk-headless para instalar el jdk8

```
luisvela@T2-2023630338:~$ sudo apt install openjdk-8-jdk-headless
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  ca-certificates-java fontconfig-config fonts-dejavu-core fonts-dejavu-mono java-common libavahi-client3
  libavahi-common-data libavahi-common3 libcups2t64 libfontconfig1 libjpeg-turbo8 libjpeg8 liblcms2-2 libpcslite1
  libxi6 libxrender1 libxtst6 openjdk-8-jre-headless x11-common
Suggested packages:
  default-jre cups-common liblcms2-utils pcscd openjdk-8-demo openjdk-8-source libnss-mdns fonts-dejavu-extra
  fonts-nanum fonts-ipafont-gothic fonts-ipafont-mincho fonts-wqy-microhei fonts-wqy-zenhei fonts-indic
The following NEW packages will be installed:
  ca-certificates-java fontconfig-config fonts-dejavu-core fonts-dejavu-mono java-common libavahi-client3
  libavahi-common-data libavahi-common3 libcups2t64 libfontconfig1 libjpeg-turbo8 libjpeg8 liblcms2-2 libpcslite1
  libxi6 libxrender1 libxtst6 openjdk-8-jdk-headless openjdk-8-jre-headless x11-common
0 upgraded, 20 newly installed, 0 to remove and 43 not upgraded.
Need to get 41.8 MB of archives.
After this operation, 151 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 ca-certificates-java all 20240118 [11.6 kB]
Get:2 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 fonts-dejavu-mono all 2.37-8 [502 kB]
Get:3 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 fonts-dejavu-core all 2.37-8 [835 kB]
Get:4 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 fontconfig-config amd64 2.15.0-1.1ubuntu2 [37.3 kB]
Get:5 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 java-common all 0.75+exp1 [6798 B]
Get:6 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 libavahi-common-data amd64 0.8-13ubuntu6 [29.7 kB]
Get:7 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 libavahi-common3 amd64 0.8-13ubuntu6 [23.3 kB]
Get:8 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 libavahi-client3 amd64 0.8-13ubuntu6 [26.8 kB]
Get:9 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 libcups2t64 amd64 2.4.7-1.2ubuntu7.3 [272 kB]
Get:10 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 libfontconfig1 amd64 2.15.0-1.1ubuntu2 [139 kB]
Get:11 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 libjpeg-turbo8 amd64 2.1.5-2ubuntu2 [150 kB]
Get:12 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 libjpeg8 amd64 8c-2ubuntu11 [2148 B]

18°C
Despejado
  ESP LAA 09:45 p.m.
  16/03/2025
```

- Comprobando que ha sido instalando, ejecutando java -version

```
luisvela@T2-2023630338:~$ 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@T2-2023630338:~$ |
```

- Añadir una regla para el puerto de entrada 8080 para el protocolo TCP en la VM

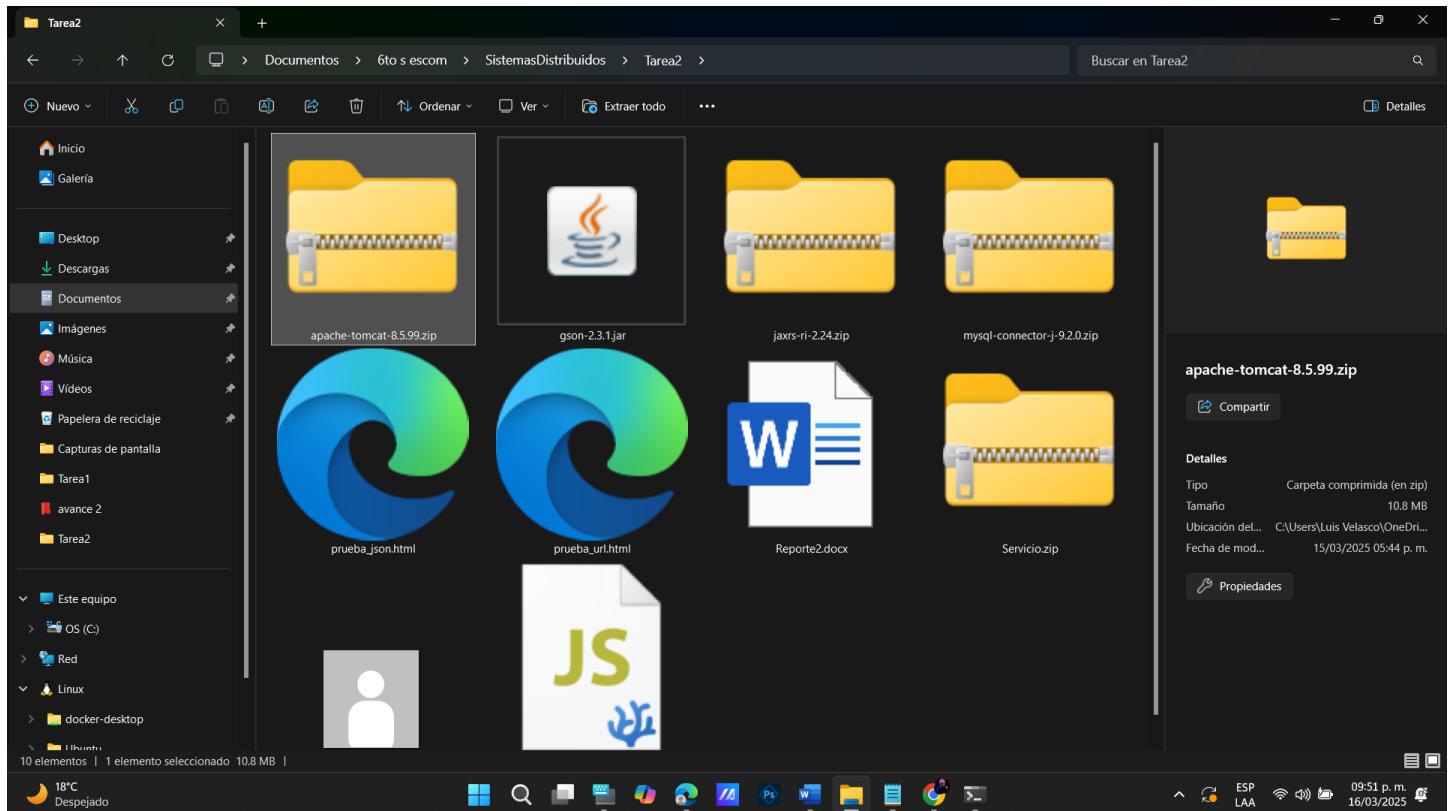
The screenshot shows the Microsoft Azure portal interface. On the left, the navigation menu is open, showing 'Virtual machines' and 'T2-2023630338'. The main area displays the 'Network settings' for this VM. On the right, a modal window titled 'Add inbound security rule' is open, showing the configuration for a new rule named 'T2-2023630338-nsg'. The rule is set to allow traffic from 'Any' source port range (8080) to 'Any' destination port range (8080) via TCP. The 'Inbound port rules' table shows five existing rules: SSH (port 22), HTTP (port 80), AllowVnetInbound (port 65000), AllowAzureLoadBalancerInbound (port 65001), and DenyAllInbound (port 65500). The 'Outbound port rules' table shows three entries.

- Comprobando que se ha creado correctamente la regla de los puertos de entrada

The screenshot shows the Microsoft Azure portal interface, similar to the previous one but with a different tab selected in the navigation bar. The 'Virtual machines' section shows 'T2-2023630338'. The 'Network settings' page is displayed, showing the 'Inbound port rules' table. The table now includes the new rule added in the previous step: 'AllowAnyCustom8080Inbound' (Priority 330, Port 8080, Protocol TCP, Action Allow). The other rules listed are SSH (Priority 300, Port 22, Protocol TCP, Action Allow), HTTP (Priority 320, Port 80, Protocol TCP, Action Allow), AllowVnetInbound (Priority 65000, Port Any, Protocol Any, Action Allow), AllowAzureLoadBalancerInbound (Priority 65001, Port Any, Protocol Any, Action Allow), and DenyAllInbound (Priority 65500, Port Any, Protocol Any, Action Deny).

3. Descargar la distribución binaria de Tomcat 8 (apache-tomcat-8.5.99.zip)

- En la siguiente imagen se observa el archivo descargado en mi máquina local.



4. Copiar a la máquina virtual el archivo ZIP descargado anteriormente y desempacarlo usando el comando unzip

- Conectándose por SFTP a la VM y mandando el archivo .zip

```
luisvela@T2-2023630338: ~ x Windows PowerShell x + 
PS C:\Users\Luis Velasco\OneDrive\Documentos\6to s escom\SistemasDistribuidos\Tarea2> sftp lui
svela@20.110.45.110
luisvela@20.110.45.110's password:
Connected to 20.110.45.110.
sftp> put apache-tomcat-8.5.99.zip
Uploading apache-tomcat-8.5.99.zip to /home/luisvela/apache-tomcat-8.5.99.zip
apache-tomcat-8.5.99.zip                                100%   11MB   4.9MB/s   00:02
sftp> |
```

- Comprobando que el .zip llego a la VM, tirando un ls

```
luisvela@T2-2023630338:~$ ls
apache-tomcat-8.5.99.zip
luisvela@T2-2023630338:~$ |
```

The screenshot shows a Windows PowerShell window titled "Windows PowerShell". The command "ls" was run, and it returned the file "apache-tomcat-8.5.99.zip". The window is set against a dark background with a taskbar at the bottom containing various icons for Microsoft applications like Word, Excel, and File Explorer.

- Descomprimiendo

```
luisvela@T2-2023630338:~$ unzip apache-tomcat-8.5.99.zip
Archive: apache-tomcat-8.5.99.zip
creating: apache-tomcat-8.5.99/
creating: apache-tomcat-8.5.99/bin/
creating: apache-tomcat-8.5.99/conf/
creating: apache-tomcat-8.5.99/lib/
creating: apache-tomcat-8.5.99/logs/
creating: apache-tomcat-8.5.99/temp/
creating: apache-tomcat-8.5.99/webapps/
creating: apache-tomcat-8.5.99/webapps/ROOT/
creating: apache-tomcat-8.5.99/webapps/ROOT/WEB-INF/
creating: apache-tomcat-8.5.99/webapps/docs/
creating: apache-tomcat-8.5.99/webapps/docs/META-INF/
creating: apache-tomcat-8.5.99/webapps/docs/WEB-INF/
creating: apache-tomcat-8.5.99/webapps/docs/WEB-INF/jsp/
creating: apache-tomcat-8.5.99/webapps/docs/annotationapi/
creating: apache-tomcat-8.5.99/webapps/docs/api/
creating: apache-tomcat-8.5.99/webapps/docs/appdev/
creating: apache-tomcat-8.5.99/webapps/docs/appdev/sample/
creating: apache-tomcat-8.5.99/webapps/docs/appdev/sample/docs/
creating: apache-tomcat-8.5.99/webapps/docs/appdev/sample/src/
creating: apache-tomcat-8.5.99/webapps/docs/appdev/sample/src/mypackage/
creating: apache-tomcat-8.5.99/webapps/docs/appdev/sample/web/
```

The screenshot shows a Windows PowerShell window titled "Windows PowerShell". The command "unzip apache-tomcat-8.5.99.zip" was run, and it listed the creation of numerous subdirectories within the "apache-tomcat-8.5.99" folder, including "bin", "conf", "lib", "logs", "temp", "webapps", "docs", and various subfolders under "docs". The window is set against a dark background with a taskbar at the bottom containing various icons for Microsoft applications like Word, Excel, and File Explorer.

5. Eliminar el directorio webapps el cual se encuentra dentro del directorio tomcat. Crear un directorio nuevo webapps y dentro de este crear el directorio ROOT

- Eliminando el directorio webapps

```
luisvela@T2-2023630338:~/a x Windows PowerShell x + v
luisvela@T2-2023630338:~$ ls
apache-tomcat-8.5.99
apache-tomcat-8.5.99.zip
luisvela@T2-2023630338:~$ cd apache-tomcat-8.5.99
luisvela@T2-2023630338:~/apache-tomcat-8.5.99$ rm -rf webapps
luisvela@T2-2023630338:~/apache-tomcat-8.5.99$ ls
BUILDING.txt      README.md      conf   work
CONTRIBUTING.md  RELEASE-NOTES  lib
LICENSE          RUNNING.txt    logs
luisvela@T2-2023630338:~/apache-tomcat-8.5.99$ |
```

The screenshot shows a Windows PowerShell window titled "Windows PowerShell". The command `ls` is run, showing files like `BUILDING.txt`, `README.md`, `conf`, `work`, etc. Then `cd apache-tomcat-8.5.99` is run, followed by `rm -rf webapps`. Finally, `ls` is run again, showing the directory structure without the `webapps` folder.

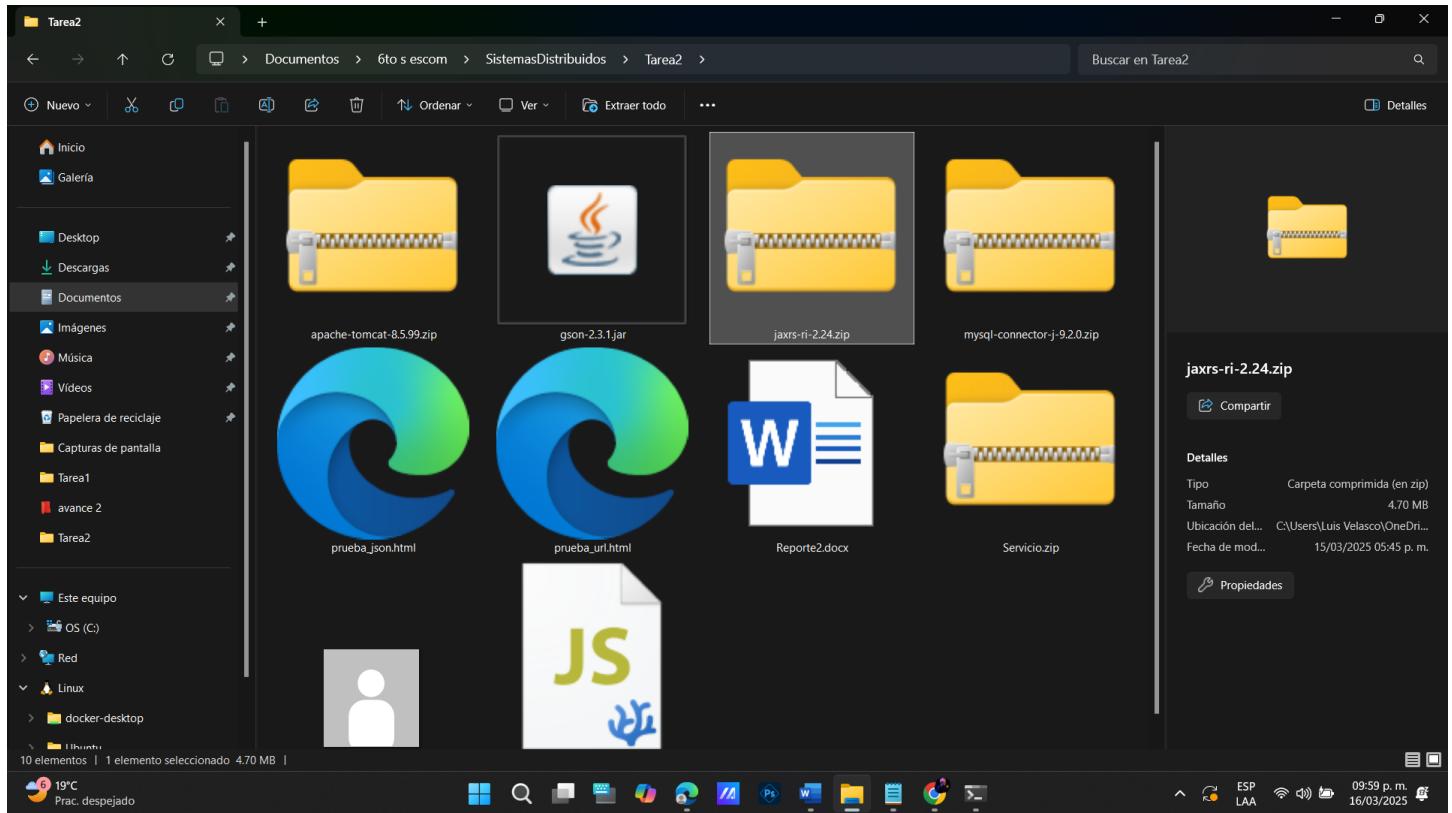
- Creando un nuevo directorio webapps y dentro de este un directorio llamado ROOT

```
luisvela@T2-2023630338:~/a x Windows PowerShell x + v
luisvela@T2-2023630338:~/apache-tomcat-8.5.99$ mkdir webapps
luisvela@T2-2023630338:~/apache-tomcat-8.5.99$ mkdir ./webapps/ROOT
luisvela@T2-2023630338:~/apache-tomcat-8.5.99$ ls
BUILDING.txt      LICENSE      README.md      RUNNING.txt  conf   logs   webapps
CONTRIBUTING.md  NOTICE       RELEASE-NOTES  bin        lib    temp   work
luisvela@T2-2023630338:~/apache-tomcat-8.5.99$ ls ./webapps
ROOT
luisvela@T2-2023630338:~/apache-tomcat-8.5.99$ |
```

The screenshot shows a Windows PowerShell window titled "Windows PowerShell". The commands `mkdir webapps` and `mkdir ./webapps/ROOT` are run. Then `ls` is run, showing the directory structure including the newly created `webapps` and `ROOT` directories.

6. Descargar la biblioteca "Jersey", el cual es una implementación de JAX-RS la cual permite ejecutar servicios web estilo REST sobre Tomcat.

- En la siguiente imagen se puede ver el archivo comprimido en mi máquina local



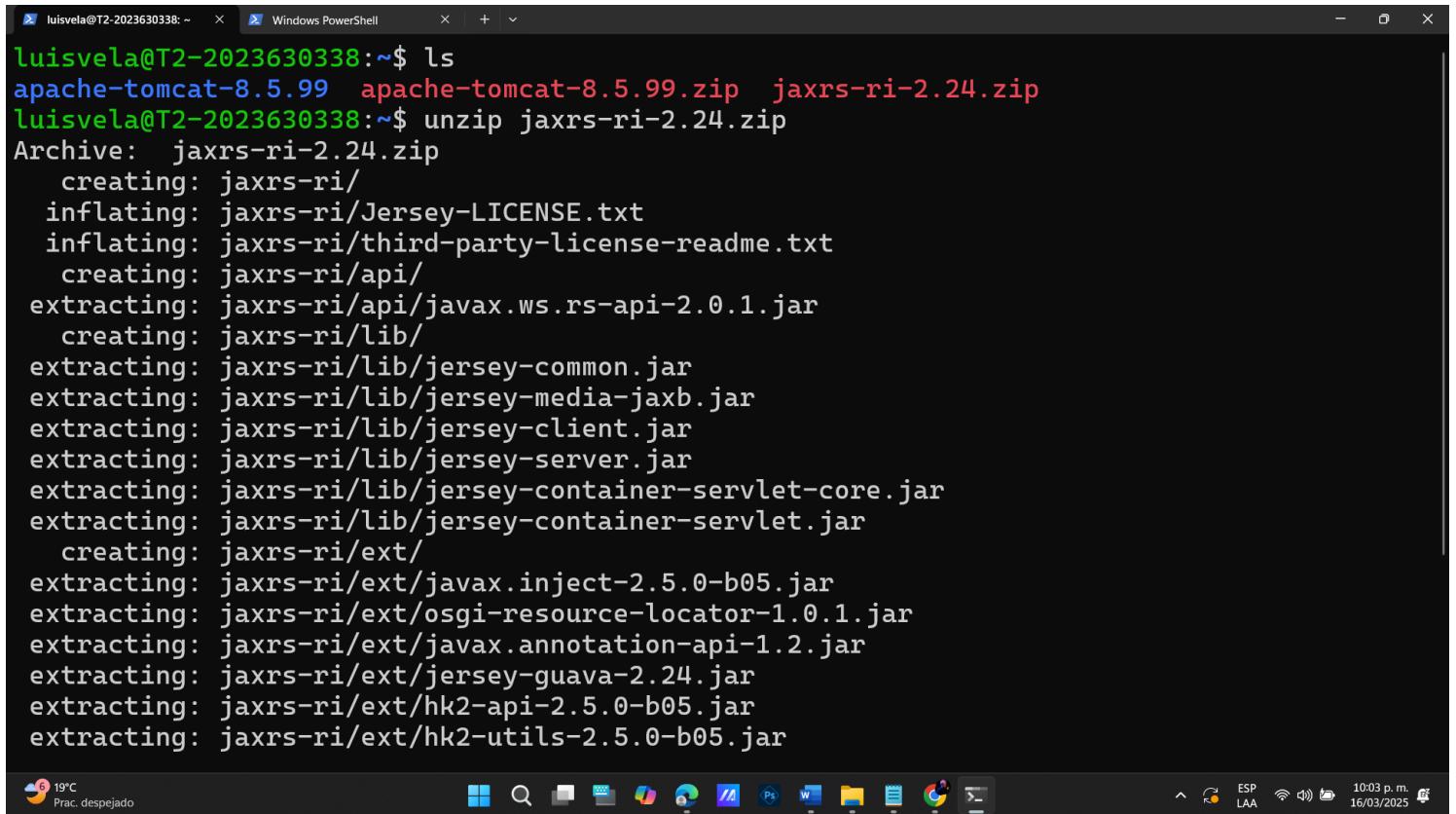
7. Copiar a la máquina virtual el archivo descargado anteriormente, desempacarlo y copiar todos los archivos con extensión .jar, los cuales se encuentran en el directorio "lib" de Tomcat

- Mandando el .ip por SFTP a la VM

```
PS C:\Users\Luis Velasco\OneDrive\Documentos\6to s escom\SistemasDistribuidos\Tarea2> sftp lui
svela@20.110.45.110
luisvela@20.110.45.110's password:
Connected to 20.110.45.110.
sftp> put jaxrs-ri-2.24.zip
Uploading jaxrs-ri-2.24.zip to /home/luisvela/jaxrs-ri-2.24.zip
jaxrs-ri-2.24.zip                                100% 4821KB    4.1MB/s   00:01
sftp> |
```

A screenshot of a Windows PowerShell window. The command 'sftp lui svela@20.110.45.110' is run, followed by 'put jaxrs-ri-2.24.zip'. The file is uploaded to the '/home/luisvela/jaxrs-ri-2.24.zip' path on the remote host. The system tray at the bottom shows the date and time as 16/03/2025 10:02 p.m.

- Desempacando el .zip de "Jersey"

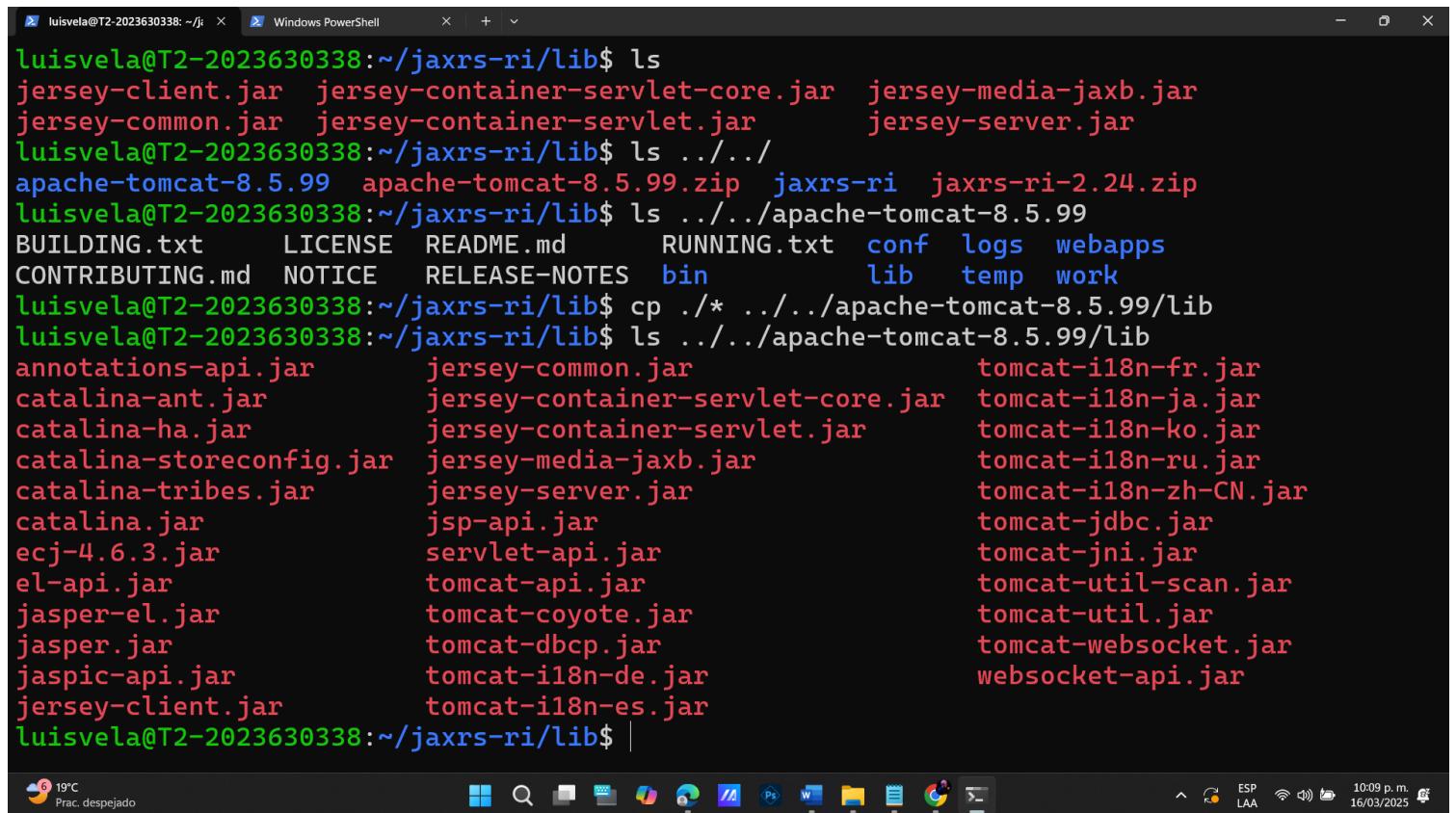


```

luisvela@T2-2023630338:~$ ls
apache-tomcat-8.5.99 apache-tomcat-8.5.99.zip jaxrs-ri-2.24.zip
luisvela@T2-2023630338:~$ unzip jaxrs-ri-2.24.zip
Archive: jaxrs-ri-2.24.zip
  creating: jaxrs-ri/
  inflating: jaxrs-ri/Jersey-LICENSE.txt
  inflating: jaxrs-ri/third-party-license-readme.txt
  creating: jaxrs-ri/api/
extracting: jaxrs-ri/api/javax.ws.rs-api-2.0.1.jar
  creating: jaxrs-ri/lib/
extracting: jaxrs-ri/lib/jersey-common.jar
extracting: jaxrs-ri/lib/jersey-media-jaxb.jar
extracting: jaxrs-ri/lib/jersey-client.jar
extracting: jaxrs-ri/lib/jersey-server.jar
extracting: jaxrs-ri/lib/jersey-container-servlet-core.jar
extracting: jaxrs-ri/lib/jersey-container-servlet.jar
  creating: jaxrs-ri/ext/
extracting: jaxrs-ri/ext/javax.inject-2.5.0-b05.jar
extracting: jaxrs-ri/ext/osgi-resource-locator-1.0.1.jar
extracting: jaxrs-ri/ext/javax.annotation-api-1.2.jar
extracting: jaxrs-ri/ext/jersey-guava-2.24.jar
extracting: jaxrs-ri/ext/hk2-api-2.5.0-b05.jar
extracting: jaxrs-ri/ext/hk2-utils-2.5.0-b05.jar

```

- Copiando todos los archivos .jar que se encuentran en el directorio /bin de "Jersey" al directorio /bin de Tomcat y comprobando que se copiaron



```

luisvela@T2-2023630338:~/jaxrs-ri/lib$ ls
jersey-client.jar jersey-container-servlet-core.jar jersey-media-jaxb.jar
jersey-common.jar jersey-container-servlet.jar jersey-server.jar
luisvela@T2-2023630338:~/jaxrs-ri/lib$ ls ../../
apache-tomcat-8.5.99 apache-tomcat-8.5.99.zip jaxrs-ri jaxrs-ri-2.24.zip
luisvela@T2-2023630338:~/jaxrs-ri/lib$ ls ../../apache-tomcat-8.5.99
BUILDING.txt LICENSE README.md RUNNING.txt conf logs webapps
CONTRIBUTING.md NOTICE RELEASE-NOTES bin lib temp work
luisvela@T2-2023630338:~/jaxrs-ri/lib$ cp ./../../apache-tomcat-8.5.99/lib
luisvela@T2-2023630338:~/jaxrs-ri/lib$ ls ../../apache-tomcat-8.5.99/lib
annotations-api.jar jersey-common.jar tomcat-i18n-fr.jar
catalina-ant.jar jersey-container-servlet-core.jar tomcat-i18n-ja.jar
catalina-ha.jar jersey-container-servlet.jar tomcat-i18n-ko.jar
catalina-storeconfig.jar jersey-media-jaxb.jar tomcat-i18n-ru.jar
catalina-tribes.jar jersey-server.jar tomcat-i18n-zh-CN.jar
catalina.jar jsp-api.jar tomcat-jdbc.jar
ecj-4.6.3.jar servlet-api.jar tomcat-jni.jar
el-api.jar tomcat-api.jar tomcat-util-scan.jar
jasper-el.jar tomcat-coyote.jar tomcat-util.jar
jasper.jar tomcat-dbcp.jar tomcat-websocket.jar
jaspic-api.jar tomcat-i18n-de.jar websocket-api.jar
jersey-client.jar tomcat-i18n-es.jar
luisvela@T2-2023630338:~/jaxrs-ri/lib$

```

- Copiando el archivo .jar al directorio ./jaxrs-ri/api al directorio lib de Tomcat y comprobando que se haya copiado correctamente y comprobando que se haya copiado adecuadamente.

```

luisvela@T2-2023630338:~/jaxrs-ri/api$ ls
javax.ws.rs-api-2.0.1.jar
luisvela@T2-2023630338:~/jaxrs-ri/api$ ls ..../
apache-tomcat-8.5.99 apache-tomcat-8.5.99.zip jaxrs-ri jaxrs-ri-2.24.zip
luisvela@T2-2023630338:~/jaxrs-ri/api$ ls ..../apache-tomcat-8.5.99
BUILDING.txt LICENSE README.md RUNNING.txt conf logs webapps
CONTRIBUTING.md NOTICE RELEASE-NOTES bin lib temp work
luisvela@T2-2023630338:~/jaxrs-ri/api$ cp ./javax.ws.rs-api-2.0.1.jar ..../apache-tomcat-8.5.99/lib
luisvela@T2-2023630338:~/jaxrs-ri/api$ ls ..../apache-tomcat-8.5.99/lib
annotations-api.jar jersey-client.jar tomcat-i18n-es.jar
catalina-ant.jar jersey-common.jar tomcat-i18n-fr.jar
catalina-ha.jar jersey-container-servlet-core.jar tomcat-i18n-ja.jar
catalina-storeconfig.jar jersey-container-servlet.jar tomcat-i18n-ko.jar
catalina-tribes.jar jersey-media-jaxb.jar tomcat-i18n-ru.jar
catalina.jar jersey-server.jar tomcat-i18n-zh-CN.jar
ecj-4.6.3.jar jsp-api.jar tomcat-jdbc.jar
el-api.jar servlet-api.jar tomcat-jni.jar
jasper-el.jar tomcat-api.jar tomcat-util-scan.jar
jasper.jar tomcat-coyote.jar tomcat-util.jar
jaspic-api.jar tomcat-dbcp.jar tomcat-websocket.jar
javax.ws.rs-api-2.0.1.jar tomcat-i18n-de.jar websocket-api.jar
luisvela@T2-2023630338:~/jaxrs-ri/api$ |

```

The screenshot shows a Windows PowerShell window with the title "luisvela@T2-2023630338: ~/j". It displays the command-line steps to copy the javax.ws.rs-api-2.0.1.jar file from the jaxrs-ri/api directory to the apache-tomcat-8.5.99/lib directory. The terminal shows the current directory (~/jaxrs-ri/api), lists the contents of the parent directory (~/..), and then uses the cp command to move the jar file. Finally, it lists the contents of the apache-tomcat-8.5.99/lib directory, which now includes the copied jar file.

- Copiando el archivo .jar al directorio ./jaxrs-ri/ext al directorio lib de Tomcat y comprobando que se haya copiado correctamente

```

luisvela@T2-2023630338:~/jaxrs-ri/ext$ ls
aopalliance-repackaged-2.5.0-b05.jar javax.servlet-api-3.0.1.jar
hk2-api-2.5.0-b05.jar jaxb-api-2.2.7.jar
hk2-locator-2.5.0-b05.jar jersey-guava-2.24.jar
hk2-utils-2.5.0-b05.jar org.osgi.core-4.2.0.jar
javassist-3.20.0-GA.jar osgi-resource-locator-1.0.1.jar
javax.annotation-api-1.2.jar persistence-api-1.0.jar
javax.inject-2.5.0-b05.jar validation-api-1.1.0.Final.jar
luisvela@T2-2023630338:~/jaxrs-ri/ext$ ls ..../
apache-tomcat-8.5.99 apache-tomcat-8.5.99.zip jaxrs-ri jaxrs-ri-2.24.zip
luisvela@T2-2023630338:~/jaxrs-ri/ext$ ls ..../apache-tomcat-8.5.99
BUILDING.txt LICENSE README.md RUNNING.txt conf logs webapps
CONTRIBUTING.md NOTICE RELEASE-NOTES bin lib temp work
luisvela@T2-2023630338:~/jaxrs-ri/ext$ cp ./.* ..../apache-tomcat-8.5.99/lib
luisvela@T2-2023630338:~/jaxrs-ri/ext$ ls ..../apache-tomcat-8.5.99/lib
annotations-api.jar jersey-guava-2.24.jar
aopalliance-repackaged-2.5.0-b05.jar jersey-media-jaxb.jar
catalina-ant.jar jersey-server.jar
catalina-ha.jar jsp-api.jar
catalina-storeconfig.jar org.osgi.core-4.2.0.jar
catalina-tribes.jar osgi-resource-locator-1.0.1.jar
catalina.jar persistence-api-1.0.jar
ecj-4.6.3.jar servlet-api.jar
el-api.jar tomcat-api.jar
hk2-api-2.5.0-b05.jar tomcat-coyote.jar
hk2-locator-2.5.0-b05.jar tomcat-dbcp.jar
hk2-utils-2.5.0-b05.jar tomcat-i18n-de.jar
jasper-el.jar tomcat-i18n-es.jar
jasper.jar tomcat-i18n-fr.jar
jaspic-api.jar tomcat-i18n-ja.jar
javassist-3.20.0-GA.jar tomcat-i18n-ko.jar
javax.annotation-api-1.2.jar tomcat-i18n-ru.jar
javax.inject-2.5.0-b05.jar tomcat-i18n-zh-CN.jar
javax.servlet-api-3.0.1.jar tomcat-jdbc.jar
javax.ws.rs-api-2.0.1.jar tomcat-jni.jar
jaxb-api-2.2.7.jar tomcat-util-scan.jar
jersey-client.jar tomcat-util.jar
jersey-common.jar tomcat-websocket.jar
jersey-container-servlet-core.jar validation-api-1.1.0.Final.jar
jersey-container-servlet.jar websocket-api.jar
luisvela@T2-2023630338:~/jaxrs-ri/ext$ |

```

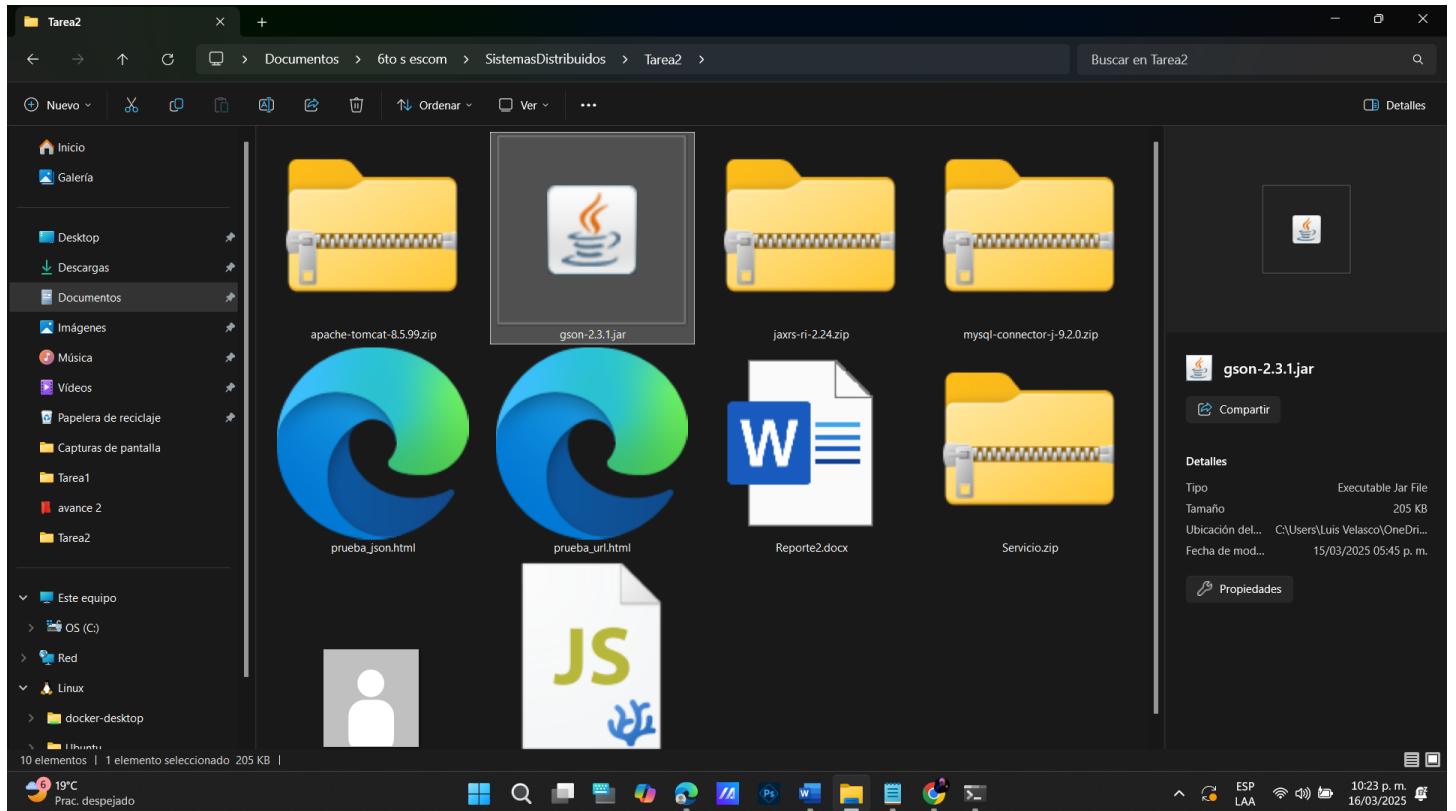
The screenshot shows a Windows PowerShell window with the title "luisvela@T2-2023630338: ~/j". It displays the command-line steps to copy multiple jars from the jaxrs-ri/ext directory to the apache-tomcat-8.5.99/lib directory. The terminal shows the current directory (~/jaxrs-ri/ext), lists the contents of the parent directory (~/..), and then uses the cp command to move all files (indicated by the asterisk) to the apache-tomcat-8.5.99/lib directory. Finally, it lists the contents of the apache-tomcat-8.5.99/lib directory, which now includes the copied jars.

8 .Borrar el archivo javax.servlet-api-3.0.1.jar del directorio lib de Tomcat y comprobando que se eliminó.

```
luisvela@T2-2023630338:~ $ ls apache-tomcat-8.5.99/lib
annotations-api.jar           jasper.jar          jersey-media-jaxb.jar      tomcat-i18n-ja.jar
aopalliance-repackaged-2.5.0-b05.jar jaspic-api.jar    jersey-server.jar        tomcat-i18n-ko.jar
catalina-ant.jar               javassist-3.20.0-GA.jar  jsp-api.jar            tomcat-i18n-ru.jar
catalina-ha.jar                javax.annotation-api-1.2.jar org.osgi.core-4.2.0.jar   tomcat-i18n-zh-CN.jar
catalina-storeconfig.jar       javax.inject-2.5.0-b05.jar osgi-resource-locator-1.0.1.jar tomcat-jdbc.jar
catalina-tribes.jar            javax.servlet-api-3.0.1.jar persistence-api-1.0.jar  tomcat-jni.jar
catalina.jar                  javax.ws.rs-api-2.0.1.jar  servlet-api.jar        tomcat-util-scan.jar
ecj-4.6.3.jar                 jaxb-api-2.2.7.jar     tomcat-api.jar        tomcat-util.jar
el-api.jar                    jersey-client.jar    tomcat-coyote.jar     tomcat-websocket.jar
hk2-api-2.5.0-b05.jar          jersey-common.jar   tomcat-dbcp.jar      validation-api-1.1.0.Final.jar
ar
hk2-locator-2.5.0-b05.jar
hk2-utils-2.5.0-b05.jar
jasper-el.jar
luisvela@T2-2023630338:~ $ rm apache-tomcat-8.5.99/lib/javax.servlet-api-3.0.1.jar
luisvela@T2-2023630338:~ $ ls apache-tomcat-8.5.99/lib
annotations-api.jar           jasper.jar          jersey-server.jar      tomcat-i18n-ko.jar
aopalliance-repackaged-2.5.0-b05.jar jaspic-api.jar    jersey-container-servlet-core.jar tomcat-i18n-ru.jar
catalina-ant.jar               javassist-3.20.0-GA.jar  jersey-container-servlet.jar  tomcat-i18n-zh-CN.jar
catalina-ha.jar                javax.annotation-api-1.2.jar  jersey-guava-2.24.jar      tomcat-jdbc.jar
catalina-storeconfig.jar       javax.inject-2.5.0-b05.jar  jersey-media-jaxb.jar     tomcat-jni.jar
catalina-tribes.jar            javax.ws.rs-api-2.0.1.jar  jersey-client.jar       tomcat-util-scan.jar
catalina.jar                  jaxb-api-2.2.7.jar     jersey-common.jar      tomcat-util.jar
ecj-4.6.3.jar                 jersey-common.jar   tomcat-coyote.jar     tomcat-websocket.jar
el-api.jar
ar
hk2-api-2.5.0-b05.jar
hk2-locator-2.5.0-b05.jar
hk2-utils-2.5.0-b05.jar
jasper-el.jar
luisvela@T2-2023630338:~ $ |
```

9 .Descargar el archivo gson-2.3.1.jar

- Primero descargando en mi maquina local



- Pasando pro SFTP el .jar

```

PS C:\Users\Luis Velasco\OneDrive\Documentos\6to semestre\SistemasDistribuidos\Tarea2> sftp luisvela@20.110.45.110
luisvela@20.110.45.110's password:
Connected to 20.110.45.110.
sftp> put gson-2.3.1.jar
Uploading gson-2.3.1.jar to /home/luisvela/gson-2.3.1.jar
gson-2.3.1.jar                                100% 206KB 735.4KB/s  00:00
sftp>

```

10. Copiar el archivo gson al directorio "lib" de Tomcat

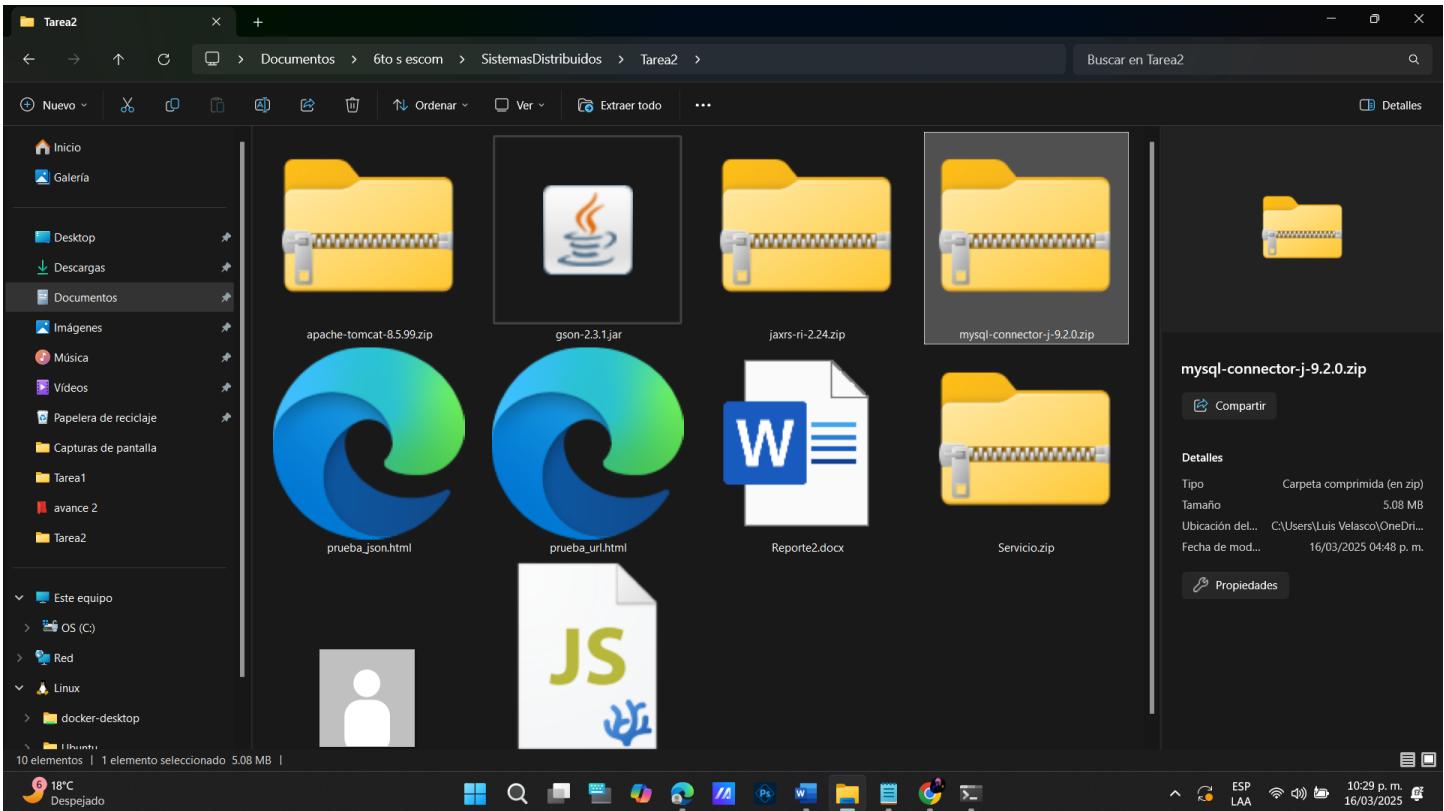
- Copiando el archivo y comprobando que se copió, tirando un ls

```

luisvela@T2-2023630338:~$ ls
apache-tomcat-8.5.99 apache-tomcat-8.5.99.zip gson-2.3.1.jar jaxrs-ri  jaxrs-ri-2.24.zip
luisvela@T2-2023630338:~$ cp gson-2.3.1.jar ./apache-tomcat-8.5.99/lib
luisvela@T2-2023630338:~$ ls ./apache-tomcat-8.5.99/lib
annotations-api.jar          javax.annotation-api-1.2.jar      tomcat-coyote.jar
aopalliance-repackaged-2.5.0-b05.jar javax.inject-2.5.0-b05.jar    tomcat-dbcp.jar
catalina-ant.jar             javax.ws.rs-api-2.0.1.jar    tomcat-i18n-de.jar
catalina-ha.jar              jaxb-api-2.2.7.jar       tomcat-i18n-es.jar
catalina-storeconfig.jar     jersey-client.jar        tomcat-i18n-fr.jar
catalina-tribes.jar          jersey-common.jar       tomcat-i18n-ja.jar
catalina.jar                 jersey-container-servlet-core.jar tomcat-i18n-ko.jar
ecj-4.6.3.jar                jersey-container-servlet.jar tomcat-i18n-ru.jar
el-api.jar                  jersey-guava-2.24.jar     tomcat-i18n-zh-CN.jar
gson-2.3.1.jar               jersey-media-jaxb.jar   tomcat-jdbc.jar
hk2-api-2.5.0-b05.jar        jersey-server.jar       tomcat-jni.jar
hk2-locator-2.5.0-b05.jar    jsp-api.jar           tomcat-util-scan.jar
hk2-utils-2.5.0-b05.jar      org.osgi.core-4.2.0.jar   tomcat-util.jar
jasper-el.jar                osgi-resource-locator-1.0.1.jar tomcat-websocket.jar
jasper.jar                  persistence-api-1.0.jar    validation-api-1.1.0.Final.jar
jaspic-api.jar               servlet-api.jar        websocket-api.jar
javassist-3.20.0-GA.jar      tomcat-api.jar
luisvela@T2-2023630338:~$ |

```

11. Instalando el driver de JDBC para MySQL



12. Copiar el archivo descargado a la máquina virtual, desempacarlo y copiar el archivo mysql-connector.jar al directorio "lib" de Tomcat

- Desempacando el archivo comprimido de mysql

```
luisvela@T2-2023630338:~$ ls
apache-tomcat-8.5.99      gson-2.3.1.jar    jaxrs-ri-2.24.zip
apache-tomcat-8.5.99.zip   jaxrs-ri          mysql-connector-j-9.2.0.zip
luisvela@T2-2023630338:~$ unzip mysql-connector-j-9.2.0.zip
Archive: mysql-connector-j-9.2.0.zip
  creating: mysql-connector-j-9.2.0/
  creating: mysql-connector-j-9.2.0/src/
  creating: mysql-connector-j-9.2.0/src/build/
  creating: mysql-connector-j-9.2.0/src/build/java/
  creating: mysql-connector-j-9.2.0/src/build/java/documentation/
  creating: mysql-connector-j-9.2.0/src/build/java/instrumentation/
  creating: mysql-connector-j-9.2.0/src/build/misc/
  creating: mysql-connector-j-9.2.0/src/build/misc/debian.in/
  creating: mysql-connector-j-9.2.0/src/build/misc/debian.in/source/
  creating: mysql-connector-j-9.2.0/src/demo/
  creating: mysql-connector-j-9.2.0/src/demo/java/
  creating: mysql-connector-j-9.2.0/src/demo/java/demo/
  creating: mysql-connector-j-9.2.0/src/demo/java/demo/x/
  creating: mysql-connector-j-9.2.0/src/demo/java/demo/x/devapi/
  creating: mysql-connector-j-9.2.0/src/generated/
  creating: mysql-connector-j-9.2.0/src/generated/java/
  creating: mysql-connector-j-9.2.0/src/generated/java/com/
  creating: mysql-connector-j-9.2.0/src/generated/java/com/mysql/
  creating: mysql-connector-j-9.2.0/src/generated/java/com/mysql/cj/
  creating: mysql-connector-j-9.2.0/src/generated/java/com/mysql/cj/x/
  creating: mysql-connector-j-9.2.0/src/generated/java/com/mysql/cj/x/protobuf/
  creating: mysql-connector-j-9.2.0/src/legacy/
  creating: mysql-connector-j-9.2.0/src/legacy/java/
  creating: mysql-connector-j-9.2.0/src/legacy/java/com/
  creating: mysql-connector-j-9.2.0/src/legacy/java/com/mysql/
  creating: mysql-connector-j-9.2.0/src/legacy/java/com/mysql/jdbc/
```

- Copiando el archivo .jar al directorio lib de Tomcat y comprobando que se haya copiado correctamente tirando un ls en dicho directorio

```

luisvela@T2-2023630338:~/n  Windows PowerShell
luisvela@T2-2023630338:~$ ls
apache-tomcat-8.5.99      gson-2.3.1.jar  jaxrs-ri-2.24.zip      mysql-connector-j-9.2.0.zip
apache-tomcat-8.5.99.zip   jaxrs-ri        mysql-connector-j-9.2.0
luisvela@T2-2023630338:~$ cd mysql-connector-j-9.2.0
luisvela@T2-2023630338:~/mysql-connector-j-9.2.0$ ls
CHANGES  INFO_BIN  LICENSE  README  build.xml  mysql-connector-j-9.2.0.jar  src
luisvela@T2-2023630338:~/mysql-connector-j-9.2.0$ cp ./mysql-connector-j-9.2.0.jar ..../apache-tomcat-8.5.99/lib
luisvela@T2-2023630338:~/mysql-connector-j-9.2.0$ ls ..../apache-tomcat-8.5.99/lib
annotations-api.jar          javax.annotation-api-1.2.jar           tomcat-api.jar
aopalliance-repackaged-2.5.0-b05.jar  javax.inject-2.5.0-b05.jar       tomcat-coyote.jar
catalina-ant.jar             javax.ws.rs-api-2.0.1.jar       tomcat-dbcp.jar
catalina-ha.jar              jaxb-api-2.2.7.jar           tomcat-i18n-de.jar
catalina-storeconfig.jar     jersey-client.jar         tomcat-i18n-es.jar
catalina-tribes.jar          jersey-common.jar        tomcat-i18n-fr.jar
catalina.jar                 jersey-container-servlet-core.jar tomcat-i18n-ja.jar
ecj-4.6.3.jar                jersey-container-servlet.jar  tomcat-i18n-ko.jar
el-api.jar                  jersey-guava-2.24.jar       tomcat-i18n-ru.jar
gson-2.3.1.jar               jersey-media-jaxb.jar    tomcat-i18n-zh-CN.jar
hk2-api-2.5.0-b05.jar        jersey-server.jar        tomcat-jdbc.jar
hk2-locator-2.5.0-b05.jar   jsp-api.jar            tomcat-jni.jar
hk2-utils-2.5.0-b05.jar     mysql-connector-j-9.2.0.jar  tomcat-util-scan.jar
jasper-el.jar                org.osgi.core-4.2.0.jar     tomcat-util.jar
jasper.jar                  osgi-resource-locator-1.0.1.jar tomcat-websocket.jar
jaspic-api.jar               persistence-api-1.0.jar   validation-api-1.1.0.Final.jar
javassist-3.20.0-GA.jar      servlet-api.jar        websocket-api.jar
luisvela@T2-2023630338:~/mysql-connector-j-9.2.0$ |

```

The screenshot shows a Windows PowerShell window titled "Windows PowerShell". The command `ls` is run in the current directory, which is the MySQL connector distribution. It lists various JAR files. Then, the command `cp ./mysql-connector-j-9.2.0.jar/apache-tomcat-8.5.99/lib` is run to copy the MySQL connector JAR to the Tomcat lib directory. Finally, another `ls` command is run in the Tomcat lib directory to verify the presence of the copied JAR file.

Iniciar/detener el servidor Tomcat

1. Definiendo las variables de entorno

 - Definiendo el directorio de CATALINA_HOME

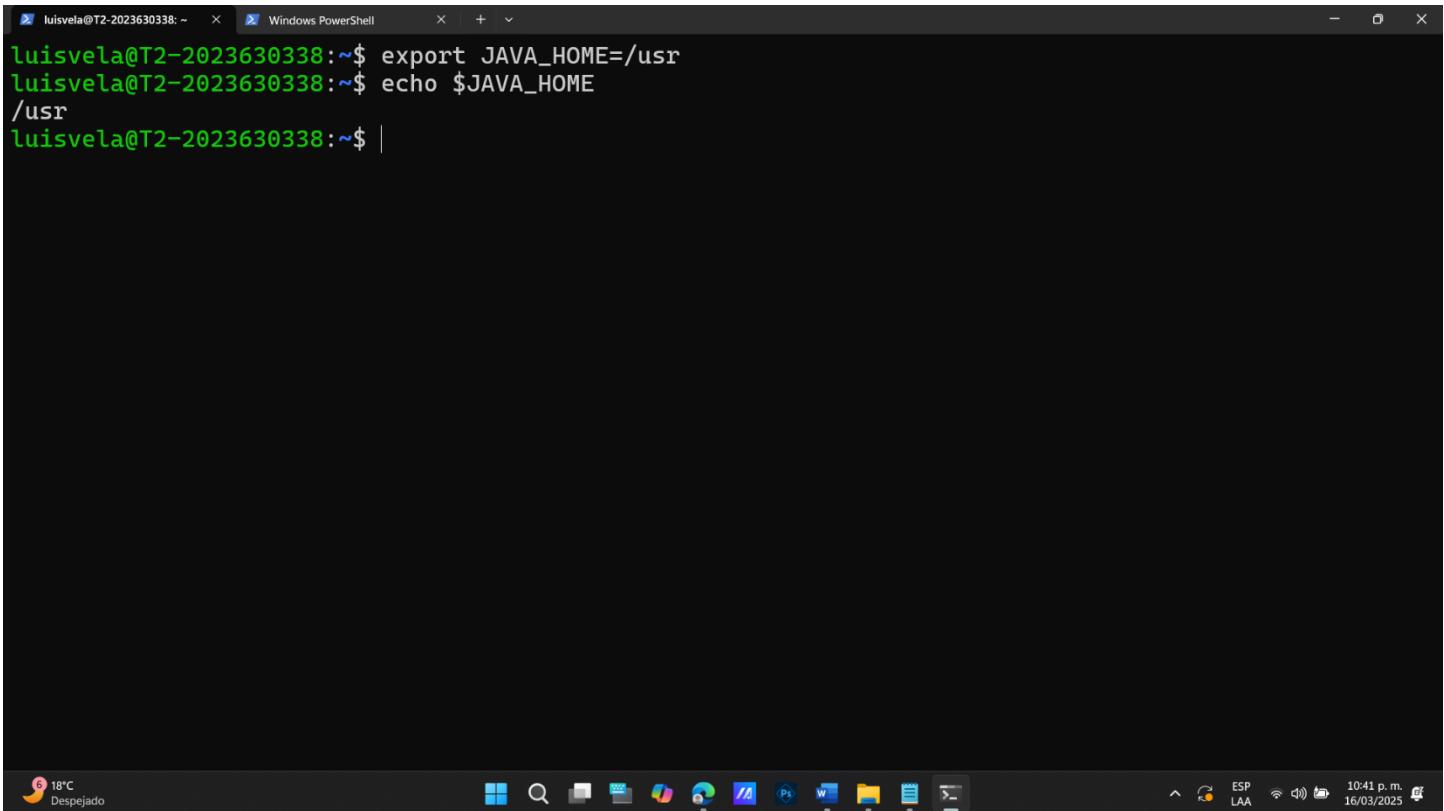
```

luisvela@T2-2023630338:~/n  Windows PowerShell
luisvela@T2-2023630338:~$ ls
apache-tomcat-8.5.99      gson-2.3.1.jar  jaxrs-ri-2.24.zip      mysql-connector-j-9.2.0.zip
apache-tomcat-8.5.99.zip   jaxrs-ri        mysql-connector-j-9.2.0
luisvela@T2-2023630338:~$ pwd
/home/luisvela
luisvela@T2-2023630338:~$ export CATALINA_HOME=/home/luisvela/apache-tomcat-8.5.99
luisvela@T2-2023630338:~$ echo $CATALINA_HOME
/home/luisvela/apache-tomcat-8.5.99
luisvela@T2-2023630338:~$ |

```

The screenshot shows a Windows PowerShell window titled "Windows PowerShell". The user runs `ls` to list the contents of the current directory, which contains the Tomcat 8.5.99 distribution and the MySQL connector distribution. Then, the command `export CATALINA_HOME=/home/luisvela/apache-tomcat-8.5.99` is run to set the `CATALINA_HOME` environment variable to the path of the Tomcat distribution. Finally, the command `echo \$CATALINA_HOME` is run to verify that the variable has been correctly set.

- Definiendo JAVA_HOME

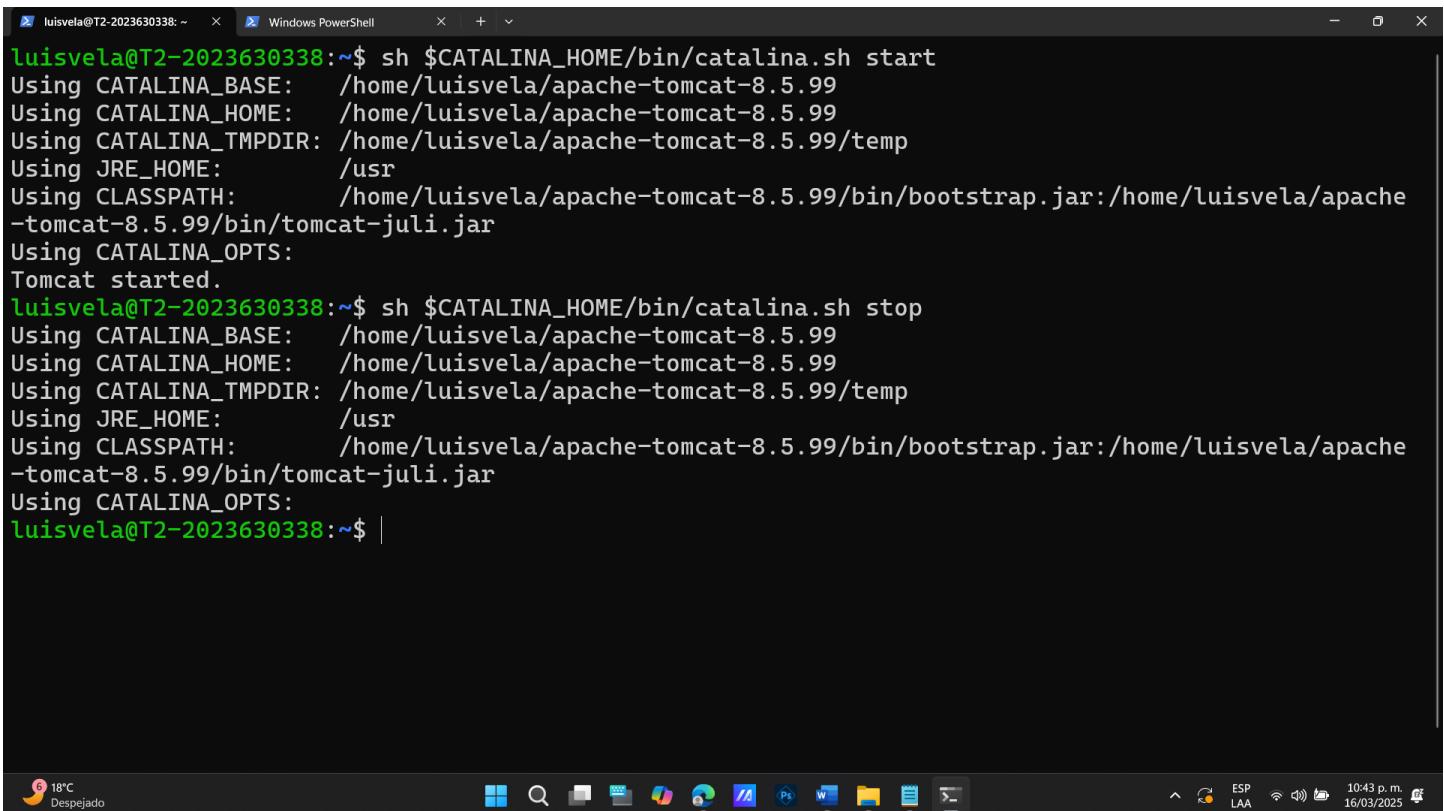


```
luisvela@T2-2023630338:~$ export JAVA_HOME=/usr
luisvela@T2-2023630338:~$ echo $JAVA_HOME
/usr
luisvela@T2-2023630338:~$ |
```

2 Iniciar la ejecución de Tomcat

3 Detener Tomcat

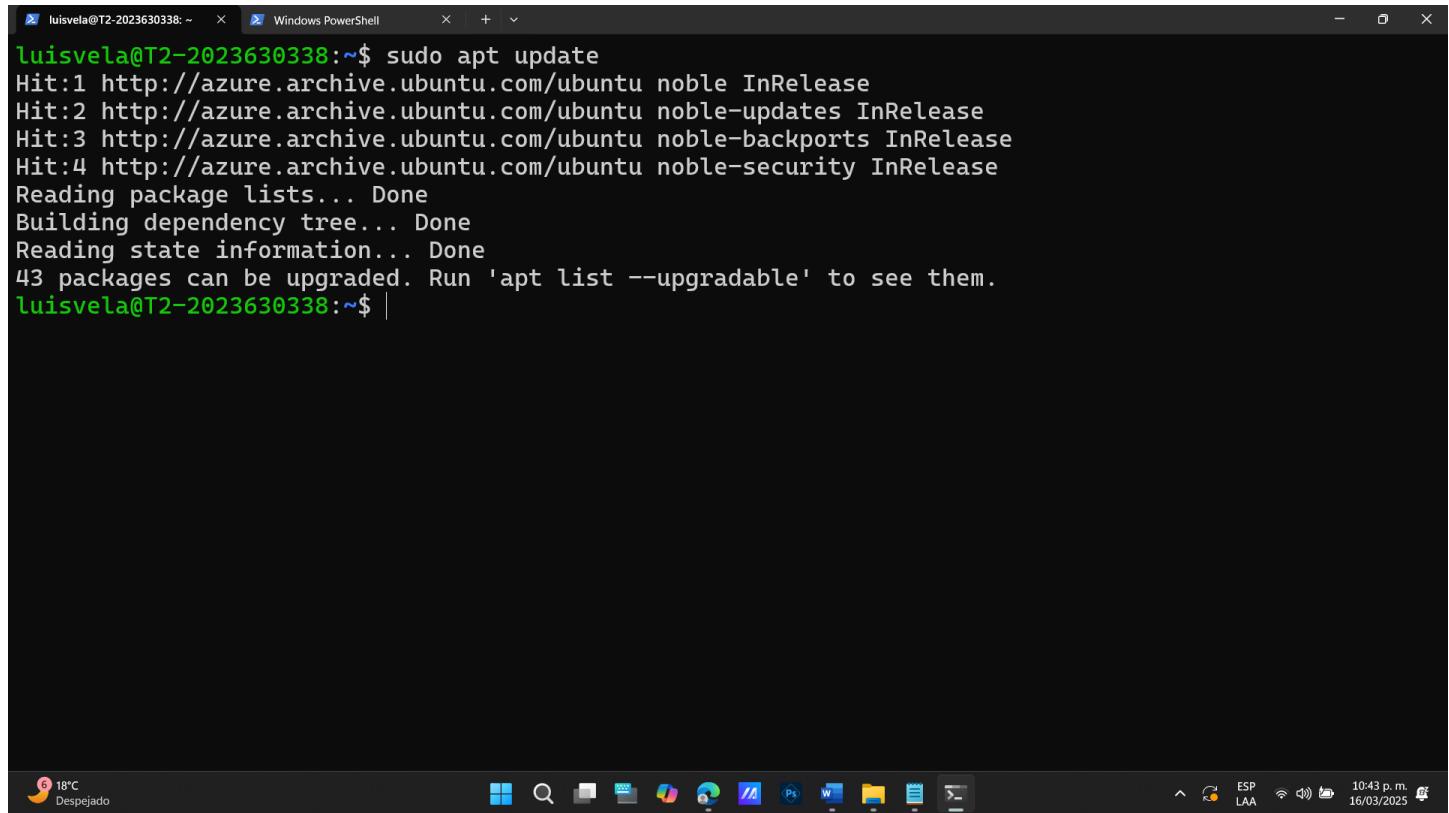
- Iniciando Tomcat



```
luisvela@T2-2023630338:~$ sh $CATALINA_HOME/bin/catalina.sh start
Using CATALINA_BASE:      /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_HOME:      /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_TMPDIR:   /home/luisvela/apache-tomcat-8.5.99/temp
Using JRE_HOME:          /usr
Using CLASSPATH:         /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/tomcat-juli.jar
Using CATALINA_OPTS:
Tomcat started.
luisvela@T2-2023630338:~$ sh $CATALINA_HOME/bin/catalina.sh stop
Using CATALINA_BASE:      /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_HOME:      /home/luisvela/apache-tomcat-8.5.99
Using CATALINA_TMPDIR:   /home/luisvela/apache-tomcat-8.5.99/temp
Using JRE_HOME:          /usr
Using CLASSPATH:         /home/luisvela/apache-tomcat-8.5.99/bin/bootstrap.jar:/home/luisvela/apache-tomcat-8.5.99/bin/tomcat-juli.jar
Using CATALINA_OPTS:
luisvela@T2-2023630338:~$ |
```

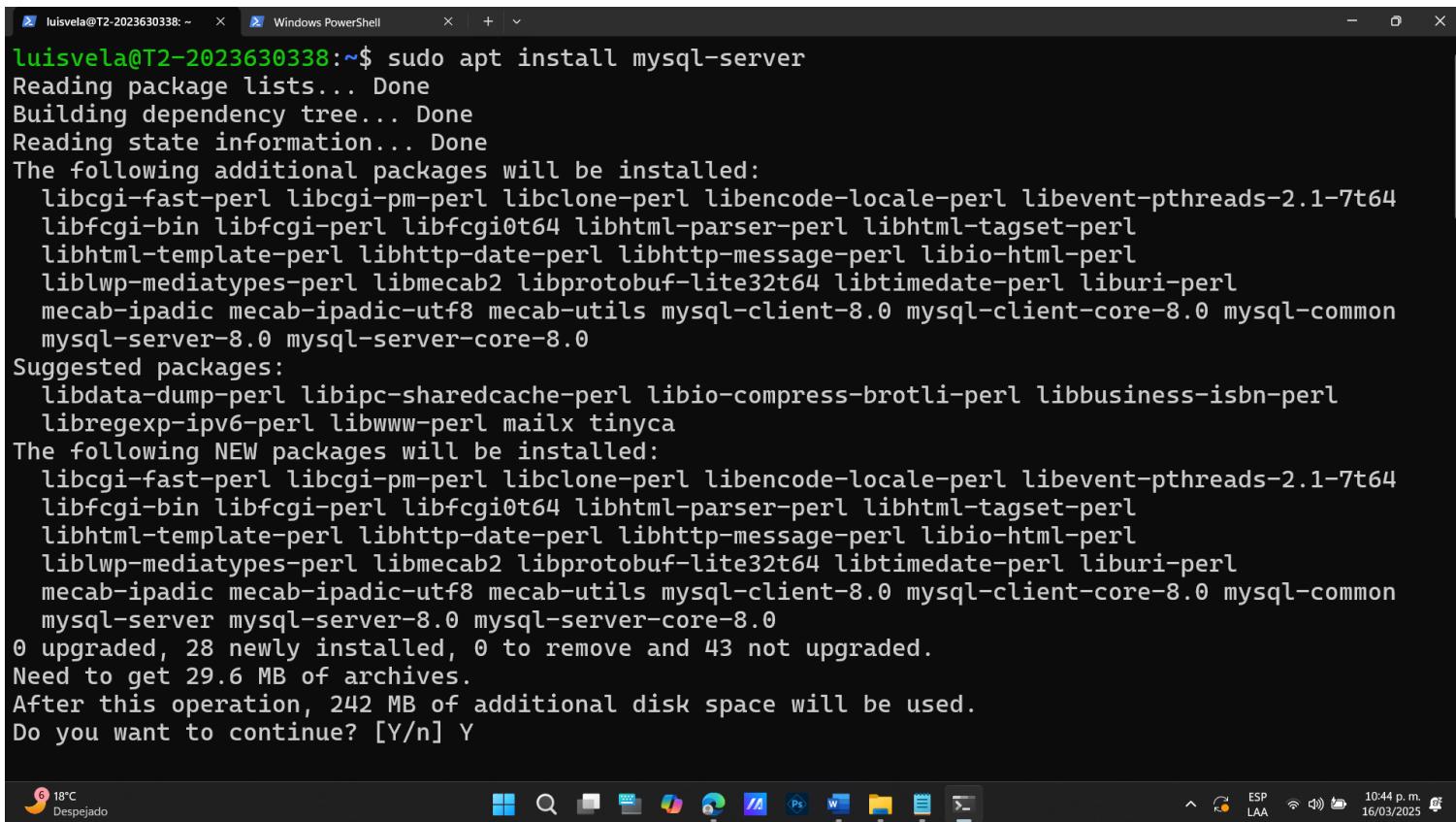
Instalación de MySQL

1. Actualizar los paquetes de la maquina virtual ejecutando sudo apt update



```
luisvela@T2-2023630338:~$ sudo apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://azure.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 http://azure.archive.ubuntu.com/ubuntu noble-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
43 packages can be upgraded. Run 'apt list --upgradable' to see them.
luisvela@T2-2023630338:~$ |
```

2. Instalar el paquete default de MySQL



```
luisvela@T2-2023630338:~$ sudo apt install mysql-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libcgi-fast-perl libcgi-pm-perl libclone-perl libencode-locale-perl libevent-pthreads-2.1-7t64
  libfcgi-bin libfcgi-perl libfcgi0t64 libhtml-parser-perl libhtml-tagset-perl
  libhtml-template-perl libhttp-date-perl libhttp-message-perl libio-html-perl
  liblwp-mediatypes-perl libmecab2 libprotobuf-lite32t64 libtimedate-perl liburi-perl
  mecab-ipadic mecab-ipadic-utf8 mecab-utils mysql-client-8.0 mysql-client-core-8.0 mysql-common
  mysql-server-8.0 mysql-server-core-8.0
Suggested packages:
  libdata-dump-perl libipc-sharedcache-perl libio-compress-brotli-perl libbusiness-isbn-perl
  libregexp-ipv6-perl libwww-perl mailx tinyca
The following NEW packages will be installed:
  libcgi-fast-perl libcgi-pm-perl libclone-perl libencode-locale-perl libevent-pthreads-2.1-7t64
  libfcgi-bin libfcgi-perl libfcgi0t64 libhtml-parser-perl libhtml-tagset-perl
  libhtml-template-perl libhttp-date-perl libhttp-message-perl libio-html-perl
  liblwp-mediatypes-perl libmecab2 libprotobuf-lite32t64 libtimedate-perl liburi-perl
  mecab-ipadic mecab-ipadic-utf8 mecab-utils mysql-client-8.0 mysql-client-core-8.0 mysql-common
  mysql-server mysql-server-8.0 mysql-server-core-8.0
0 upgraded, 28 newly installed, 0 to remove and 43 not upgraded.
Need to get 29.6 MB of archives.
After this operation, 242 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
```

3. Ejecutar el script de seguridad

```
luisvela@T2-2023630338:~$ sudo mysql_secure_installation
Securing the MySQL server deployment.

Connecting to MySQL using a blank password.

VALIDATE PASSWORD COMPONENT can be used to test passwords
and improve security. It checks the strength of password
and allows the users to set only those passwords which are
secure enough. Would you like to setup VALIDATE PASSWORD component?

Press y|Y for Yes, any other key for No: N

Skipping password set for root as authentication with auth_socket is used by default.
If you would like to use password authentication instead, this can be done with the "ALTER_USER" command.
See https://dev.mysql.com/doc/refman/8.0/en/alter-user.html#alter-user-password-management for more information.

By default, a MySQL installation has an anonymous user,
allowing anyone to log into MySQL without having to have
a user account created for them. This is intended only for
testing, and to make the installation go a bit smoother.
You should remove them before moving into a production
environment.

Remove anonymous users? (Press y|Y for Yes, any other key for No) : Y
Success.

Normally, root should only be allowed to connect from
'localhost'. This ensures that someone cannot guess at
the root password from the network.
```

4. Ejecutar el monitor de mysql
5. Modificando la contraseña de root
6. Actualizar los privilegios con el comando FLUSH PRIVILEGES;
7. Ejecutar el comando QUIT para salir del monitor de mysql.
- En la siguiente imagen, se pueden ver los 4 pasos anteriores.

```
luisvela@T2-2023630338:~$ sudo mysql
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 10
Server version: 8.0.41-Ubuntu0.24.04.1 (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> ALTER USER 'root'@'localhost' IDENTIFIED WITH mysql_native_password BY 'J7m!P9$kQ2z#B1';
Query OK, 0 rows affected (0.03 sec)

mysql> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.03 sec)

mysql> quit
Bye
luisvela@T2-2023630338:~$ |
```

Creando un usuario en MySQL

1. Ejecutando el monitor de MySQL con el comando mysql -u root -p
2. Creando el usuario "hugo"
3. Otorgar todos los permisos al usuario "hugo" sobre la base de datos "servicio_Web"
4. Salir del monitor de MySQL con el comando quit.

- En la siguiente imagen, se puede ver el procedimiento de los 4 pasos anteriores.

```
luisvela@T2-2023630338:~$ 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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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> create user hugo@localhost identified by "CloudPass#456";
Query OK, 0 rows affected (0.06 sec)

mysql> grant all on servicio_web.* to hugo@localhost;
Query OK, 0 rows affected (0.03 sec)

mysql> quit
Bye
luisvela@T2-2023630338:~$ |
```

The screenshot shows a Windows PowerShell window titled "Windows PowerShell". The command entered was "mysql -u root -p", followed by the MySQL prompt. The user creates a new user "hugo" with a password "CloudPass#456" and grants them all privileges on the database "servicio_web". Finally, the user exits the MySQL monitor with the "quit" command. The taskbar at the bottom shows various open applications and system status icons.

Crear la base de datos

1. Ejecutar el monitor de MySQL con el usuario hugo
 2. Crear la base de datos "servicio_web" con create database servicio_web;
 3. Conectar a la base de datos creada anteriormente.
- En la siguiente imagen se ve el procedimiento de los 3 pasos anteriores.

The screenshot shows a Windows terminal window titled "Windows PowerShell". The command entered is "mysql -u hugo -p". The MySQL monitor starts, displaying connection details: Welcome to the MySQL monitor, Your MySQL connection id is 12, Server version: 8.0.41-0ubuntu0.24.04.1 (Ubuntu). It also shows copyright information and a note about Oracle trademarks. The user then runs "create database servicio_web;" which is successful, returning "Query OK, 1 row affected (0.04 sec)". Finally, the user runs "use servicio_web;" changing the database context.

```
luisvela@T2-2023630338:~$ mysql -u hugo -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> create database servicio_web;
Query OK, 1 row affected (0.04 sec)

mysql> use servicio_web;
Database changed
mysql> |
```

4. Crear las tablas usuarios y fotos_usuarios .
5. Salir del monitor de MySQL con el comando quit.

```
luisvela@T2-2023630338: ~ x Windows PowerShell x + 
mysql> create table usuarios
-> (
->     id_usuario integer auto_increment primary key,
->     email varchar(100) not null,
->     nombre varchar(100) not null,
->     apellido_paterno varchar(100) not null,
->     apellido_materno varchar(100),
-> );
References usuarios(id_usuario);

create unique index usuarios_1 on usuarios(email)      ->    fecha_nacimiento datetime not null,
->     telefono bigint,
->     genero char(1)
-> );
Query OK, 0 rows affected (0.16 sec)

mysql>
mysql> create table fotos_usuarios
-> (
->     id_foto integer auto_increment primary key,
->     foto longblob,
->     id_usuario integer not null
-> );
Query OK, 0 rows affected (0.13 sec)

mysql>
mysql> alter table fotos_usuarios add foreign key (id_usuario) references usuarios(id_usuario);
Query OK, 0 rows affected (0.42 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
mysql> create unique index usuarios_1 on usuarios(email);
Query OK, 0 rows affected (0.14 sec)
Records: 0  Duplicates: 0  Warnings: 0
```

6. "Editar el archivo "context.xml" que está en el directorio "META-INF" (este directorio se crea al desempaquetar el archivo Servicio.zip, el cual se descarga de la plataforma) y definir el username de la base de datos y el password correspondiente (el usuario que fue creado en el paso 2 de la sección **Crear un usuario en MySQL**)."• Moviendo el archivo comprimido de Servicio.zip a la VM por SFTP (en la siguiente imagen es el ultimo PUT)

```
luisvela@T2-2023630338: ~ x Windows PowerShell x + 
PS C:\Users\Luis Velasco\OneDrive\Documentos\6to semestre\SistemasDistribuidos\Tarea2> sftp luisvela@20.110.45.110
luisvela@20.110.45.110's password:
Connected to 20.110.45.110.
sftp> put mysql-connector-j-9.2.0.zip
Uploading mysql-connector-j-9.2.0.zip to /home/luisvela/mysql-connector-j-9.2.0.zip
mysql-connector-j-9.2.0.zip                                100% 5213KB   4.2MB/s   00:01
sftp> put Servicio.zip
Uploading Servicio.zip to /home/luisvela/Servicio.zip
Servicio.zip                                         100%    25KB 356.3KB/s   00:00
sftp> |
```

- Desempacando el archivo comprimido

```

luisvela@T2-2023630338:~$ ls
Servicio.zip          apache-tomcat-8.5.99.zip  jaxrs-ri           mysql-connector-j-9.2.0
apache-tomcat-8.5.99   gson-2.3.1.jar        jaxrs-ri-2.24.zip  mysql-connector-j-9.2.0.zip
luisvela@T2-2023630338:~$ unzip Servicio.zip
Archive:  Servicio.zip
  creating: Servicio/
  creating: Servicio/compila_json.sh
  inflating: Servicio/compila_url.sh
  creating: Servicio/META-INF/
  inflating: Servicio/META-INF/context.xml
  inflating: Servicio/Servicio.war
  creating: Servicio/servicio_json/
  inflating: Servicio/servicio_json/AdaptadorGsonBase64.java
  inflating: Servicio/servicio_json/Error.java
  inflating: Servicio/servicio_json/ParamAltaUsuario.java
  inflating: Servicio/servicio_json/ParamBorraUsuario.java
  inflating: Servicio/servicio_json/ParamConsultaUsuario.java
  inflating: Servicio/servicio_json/ParamModificaUsuario.java
  inflating: Servicio/servicio_json/Servicio.java
  inflating: Servicio/servicio_json/Usuario.java
  creating: Servicio/servicio_url/
  inflating: Servicio/servicio_url/AdaptadorGsonBase64.java
  inflating: Servicio/servicio_url/Error.java
  inflating: Servicio/servicio_url/Servicio.java
  inflating: Servicio/servicio_url/Usuario.java
  creating: Servicio/WEB-INF/
  creating: Servicio/WEB-INF/classes/
  creating: Servicio/WEB-INF/classes/servicio_json/
  creating: Servicio/WEB-INF/classes/servicio_url/
  inflating: Servicio/WEB-INF/classes/servicio_url/AdaptadorGsonBase64.class
  inflating: Servicio/WEB-INF/classes/servicio_url/Error.class
  inflating: Servicio/WEB-INF/classes/servicio_url/Servicio.class
  inflating: Servicio/WEB-INF/classes/servicio_url/Usuario.class

```

- Abriendo el archivo con VIM

```

luisvela@T2-2023630338:~$ ls
Servicio              jaxrs-ri
Servicio.zip          jaxrs-ri-2.24.zip
apache-tomcat-8.5.99  mysql-connector-j-9.2.0
apache-tomcat-8.5.99.zip mysql-connector-j-9.2.0.zip
gson-2.3.1.jar
luisvela@T2-2023630338:~$ ls ./Servicio
META-INF      WEB-INF          compila_url.sh  servicio_url
Servicio.war  compila_json.sh  servicio_json
luisvela@T2-2023630338:~$ vi ./Servicio/META-INF/context.xml

```

- Cambiando el usuario y el password por el del usuario hugo

```
<Context>
    <Resource name="jdbc/datasource_Servicio" auth="Container" type="javax.sql.DataSource"
        maxActive="100" maxIdle="30" maxWait="10000"
        username="hugo" password="CloudPass#456"
        driverClassName="com.mysql.cj.jdbc.Driver"
        url="jdbc:mysql://localhost/servicio_web?serverTimezone=UTC"/>
</Context>
: wq|
```

Publicar el cliente en Tomcat

1. Copiar el archivo usuario_sin_foto.png al subdirectorio webapps/ROOT de Tomcat.
 2. Copiar el archivo WSClient.js al directorio webapps/ROOT de Tomcat.
 3. Copiar los archivos prueba_json.html y prueba_url.html al directorio webapps/ROOT de Tomcat.
- Usando SFTP para mandar el archivo .png, WSClient.js, prueba_json.html y prueba_url.html al directorio /webapps/ROOT a la VM

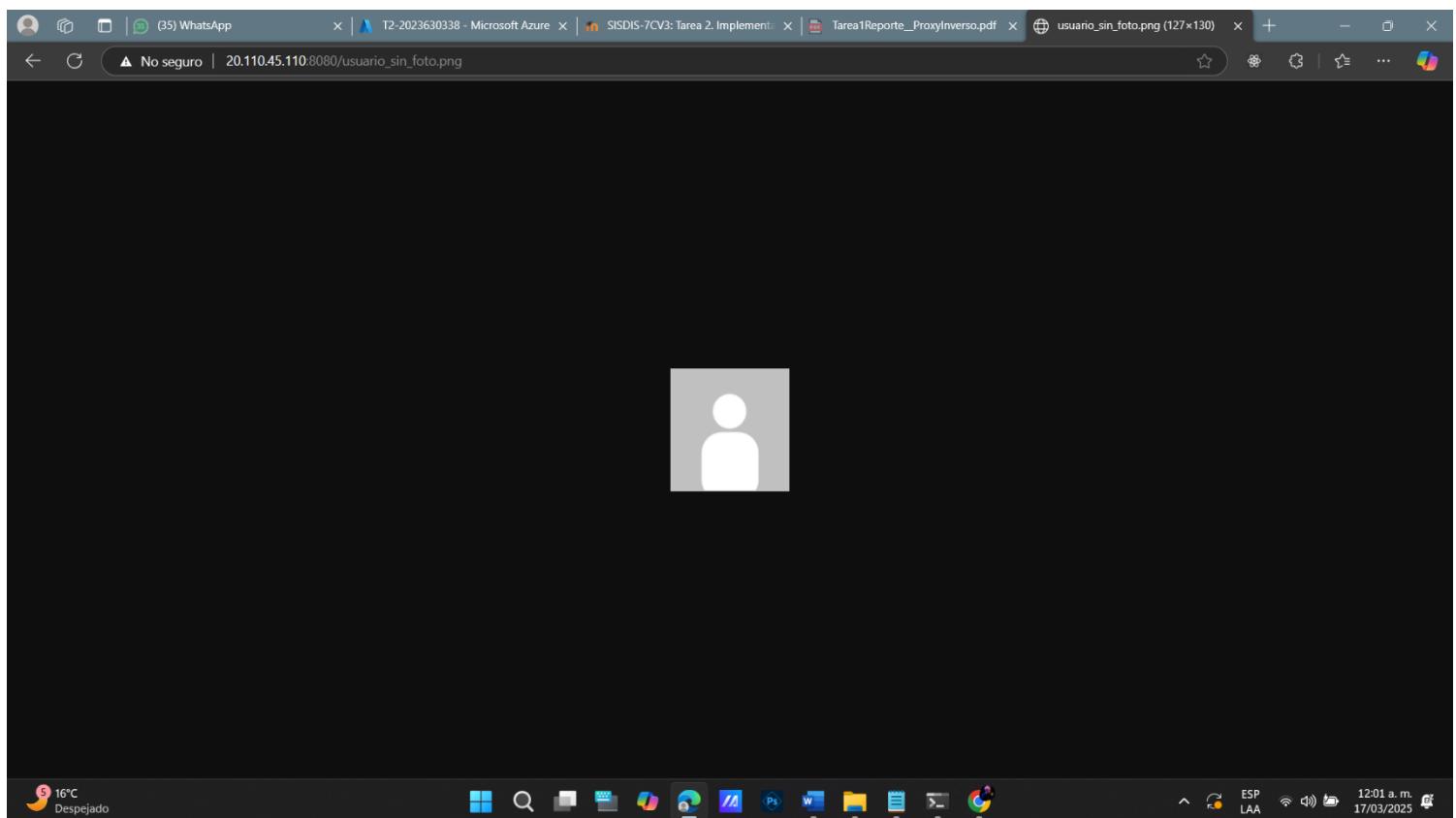
```
PS C:\Users\Luis Velasco\OneDrive\Documentos\6to semestre\escom\SistemasDistribuidos\Tarea2> sftp luisvela@20.110.45.110
luisvela@20.110.45.110's password:
Connected to 20.110.45.110.
sftp> put usuario_sin_foto.png
Uploading usuario_sin_foto.png to /home/luisvela/usuario_sin_foto.png
usuario_sin_foto.png                                100% 1662      32.5KB/s   00:00
sftp> put WSClient.js
Uploading WSClient.js to /home/luisvela/WSClient.js
WSClient.js    0%    0      0.0KB/s  --:-- EWSClient.js 100% 3632      70.9KB/s   00:00
sftp> put prueba_json.html
Uploading prueba_json.html to /home/luisvela/prueba_json.html
prueba_json.html    0%    0      0.0KB/s  --prueba_json.html 100%   13KB 214.7KB/s   00:00
sftp> put prueba_url.html
Uploading prueba_url.html to /home/luisvela/prueba_url.html
prueba_url.html    0%    0      0.0KB/s  --:prueba_url.html 100%   13KB 220.9KB/s   00:00
sftp> |
```

- Copiando el archivo .png, WSClient.js, prueba_json.html y prueba_url.html al directorio /webapps/ROOT de Tomcat

```
luisvela@T2-2023630338:~$ ls
Servicio           jaxrs-ri-2.24.zip
Servicio.zip       mysql-connector-j-9.2.0
WSClient.js        mysql-connector-j-9.2.0.zip
apache-tomcat-8.5.99  prueba_json.html
apache-tomcat-8.5.99.zip  prueba_url.html
gson-2.3.1.jar      usuario_sin_foto.png
jaxrs-ri

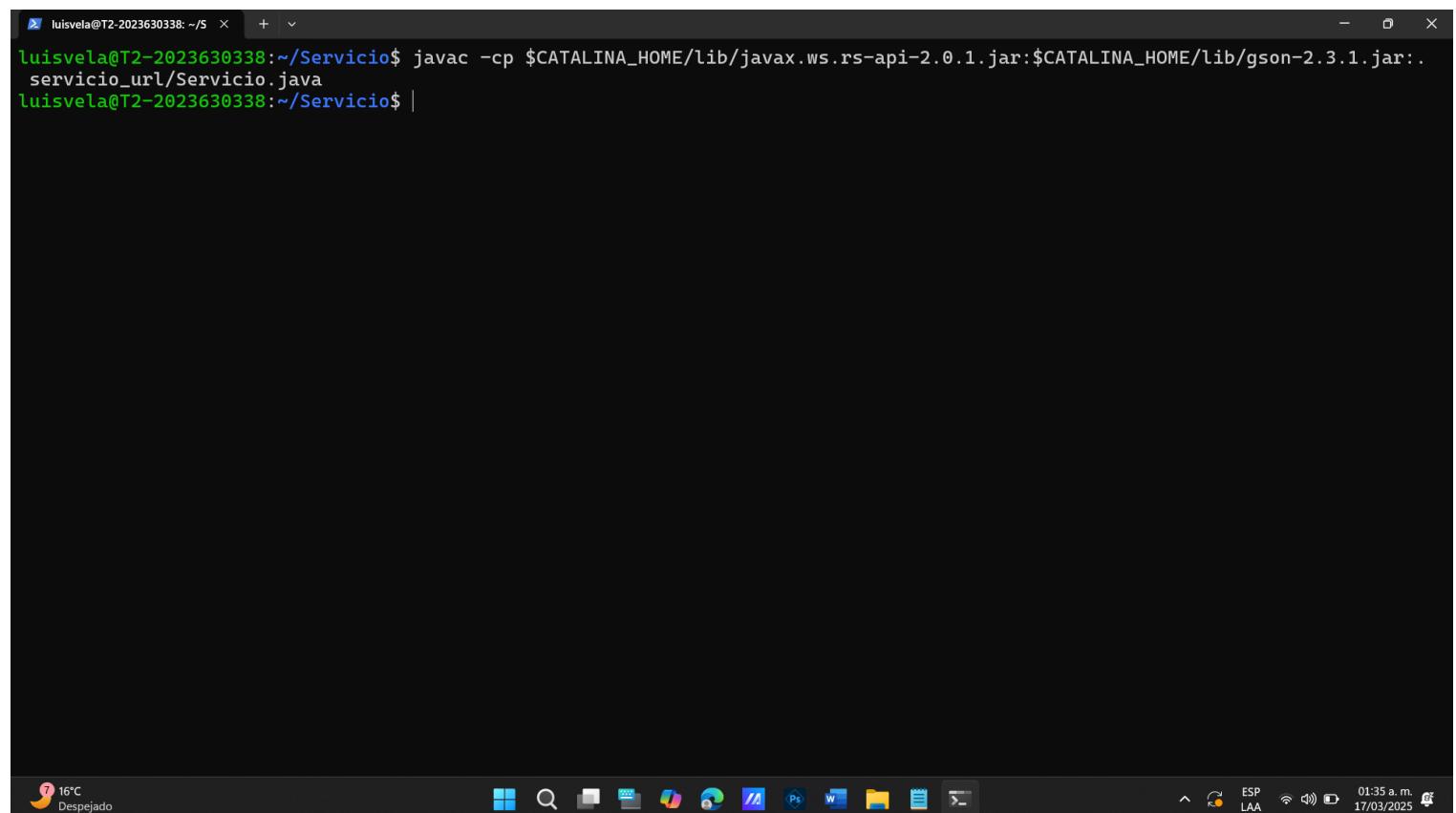
luisvela@T2-2023630338:~$ cp usuario_sin_foto.png WSClient.js prueba_json.html prueba_url.html ./apache-tomcat-8.5.99
/webapps/ROOT
luisvela@T2-2023630338:~$ ls ./apache-tomcat-8.5.99/webapps/ROOT
WSClient.js  prueba_json.html  prueba_url.html  usuario_sin_foto.png
luisvela@T2-2023630338:~$ |
```

Para probar que Tomcat esté en línea y el puerto 8080 este abierto, ingresar la URL al navegador.



Compilar, empacar y desplegar el servicio web (versión URL)

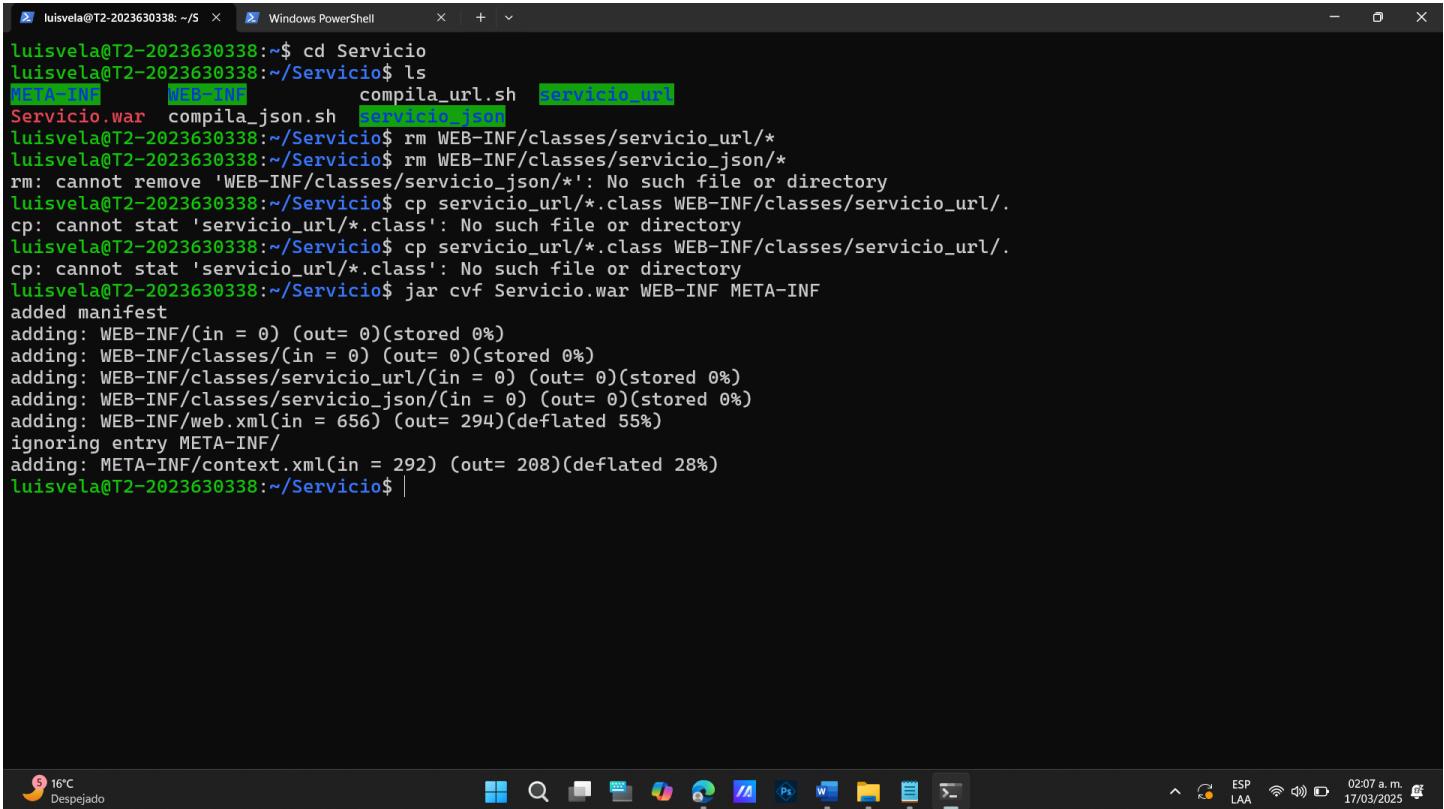
1. Descargar de la plataforma y desempacar el archivo Servicio.zip (este paso ya se había hecho pasos atrás)
2. Definir la variable de ambiente CATALINA_HOME (también ya se realizó anteriormente)
3. Cambiar al directorio donde se encuentran los directorios "servicio_url" y "servicio_json"
4. Compilar el servicio web



```
luisvela@T2-2023630338:~/Servicio$ javac -cp $CATALINA_HOME/lib/javax.ws.rs-api-2.0.1.jar:$CATALINA_HOME/lib/gson-2.3.1.jar:.. servicio_url/Servicio.java
luisvela@T2-2023630338:~/Servicio$ |
```

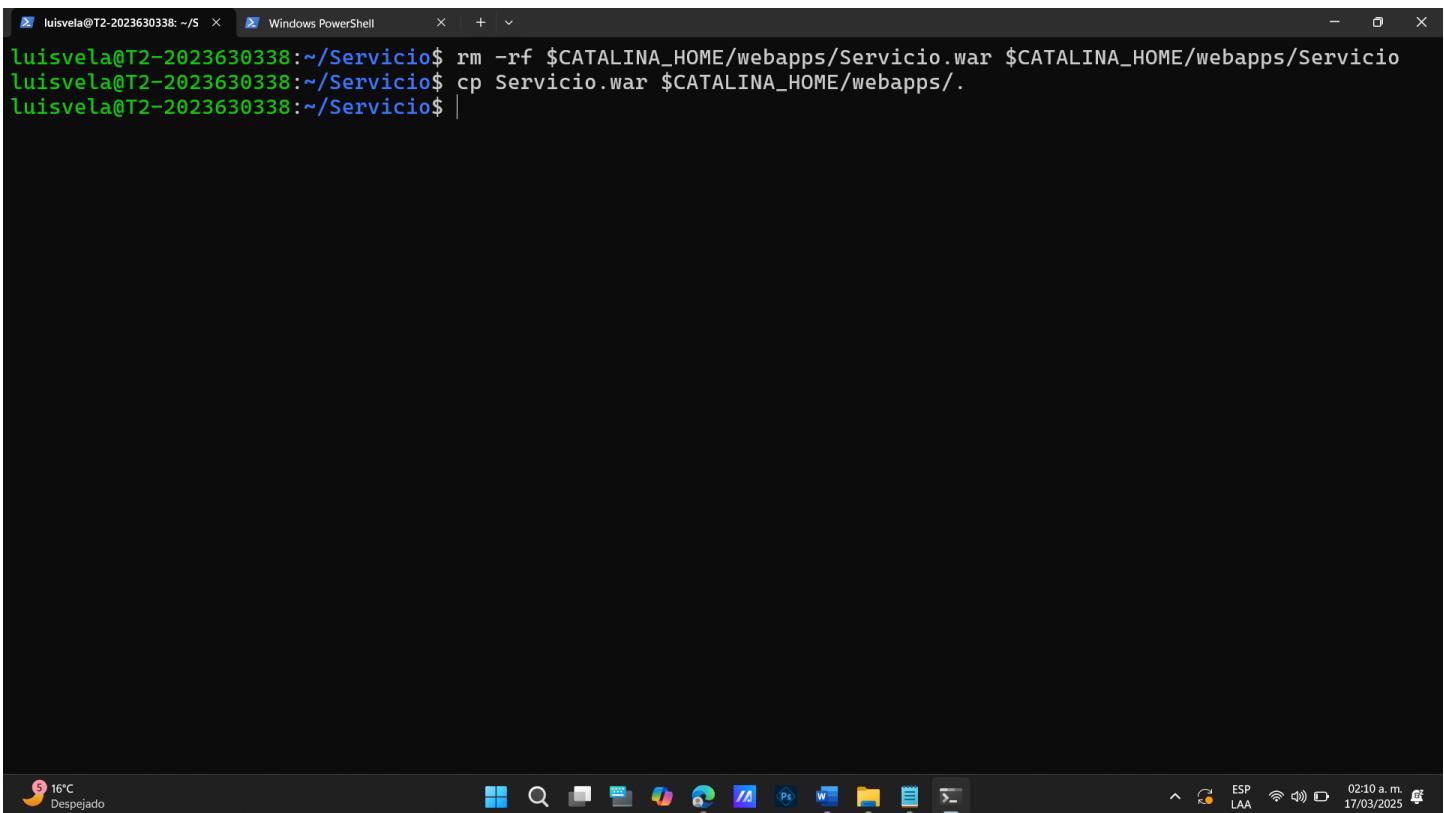
The screenshot shows a terminal window on a Windows operating system. The command `javac` is run with the classpath set to include `javax.ws.rs-api-2.0.1.jar` and `gson-2.3.1.jar` from the `CATALINA_HOME` directory, along with the `Servicio.java` file located in the `servicio_url` directory. The output of the command is shown below the command line. The taskbar at the bottom of the screen includes icons for weather (16°C), search, file explorer, and other system applications, along with system status indicators like battery level and network connection.

5. Crear el archivo Servicio.war.



```
luisvela@T2-2023630338:~/S > Windows PowerShell > + >
luisvela@T2-2023630338:~/S > cd Servicio
luisvela@T2-2023630338:~/Servicio$ ls
META-INF WEB-INF compila_url.sh servicio_url
Servicio.war compila_json.sh servicio_json
luisvela@T2-2023630338:~/Servicio$ rm WEB-INF/classes/servicio_url/*
luisvela@T2-2023630338:~/Servicio$ rm WEB-INF/classes/servicio_json/*
rm: cannot remove 'WEB-INF/classes/servicio_json/*': No such file or directory
luisvela@T2-2023630338:~/Servicio$ cp servicio_url/*.class WEB-INF/classes/servicio_url/.
cp: cannot stat 'servicio_url/*.class': No such file or directory
luisvela@T2-2023630338:~/Servicio$ cp servicio_url/*.class WEB-INF/classes/servicio_url/.
cp: cannot stat 'servicio_url/*.class': No such file or directory
luisvela@T2-2023630338:~/Servicio$ jar cvf Servicio.war WEB-INF META-INF
added manifest
adding: WEB-INF/(in = 0) (out= 0)(stored 0%)
adding: WEB-INF/classes/(in = 0) (out= 0)(stored 0%)
adding: WEB-INF/classes/servicio_url/(in = 0) (out= 0)(stored 0%)
adding: WEB-INF/classes/servicio_json/(in = 0) (out= 0)(stored 0%)
adding: WEB-INF/web.xml(in = 656) (out= 294)(deflated 55%)
ignoring entry META-INF/
adding: META-INF/context.xml(in = 292) (out= 208)(deflated 28%)
luisvela@T2-2023630338:~/Servicio$ |
```

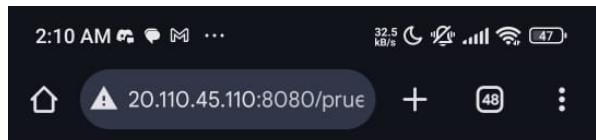
6. Para remover (undeploy) y desplegar (deploy) el servicio web, se deberá eliminar el archivo Servicio.war y el directorio Servicio (en ese orden), y luego copiar el archivo Servicio.war al directorio webapps de Tomcat.



```
luisvela@T2-2023630338:~/S > Windows PowerShell > + >
luisvela@T2-2023630338:~/Servicio$ rm -rf $CATALINA_HOME/webapps/Servicio.war $CATALINA_HOME/webapps/Servicio
luisvela@T2-2023630338:~/Servicio$ cp Servicio.war $CATALINA_HOME/webapps/.
luisvela@T2-2023630338:~/Servicio$ |
```

7. Usando un teléfono, ingresar la URL en un navegador.

http://20.110.45.110:8080/prueba_url.html



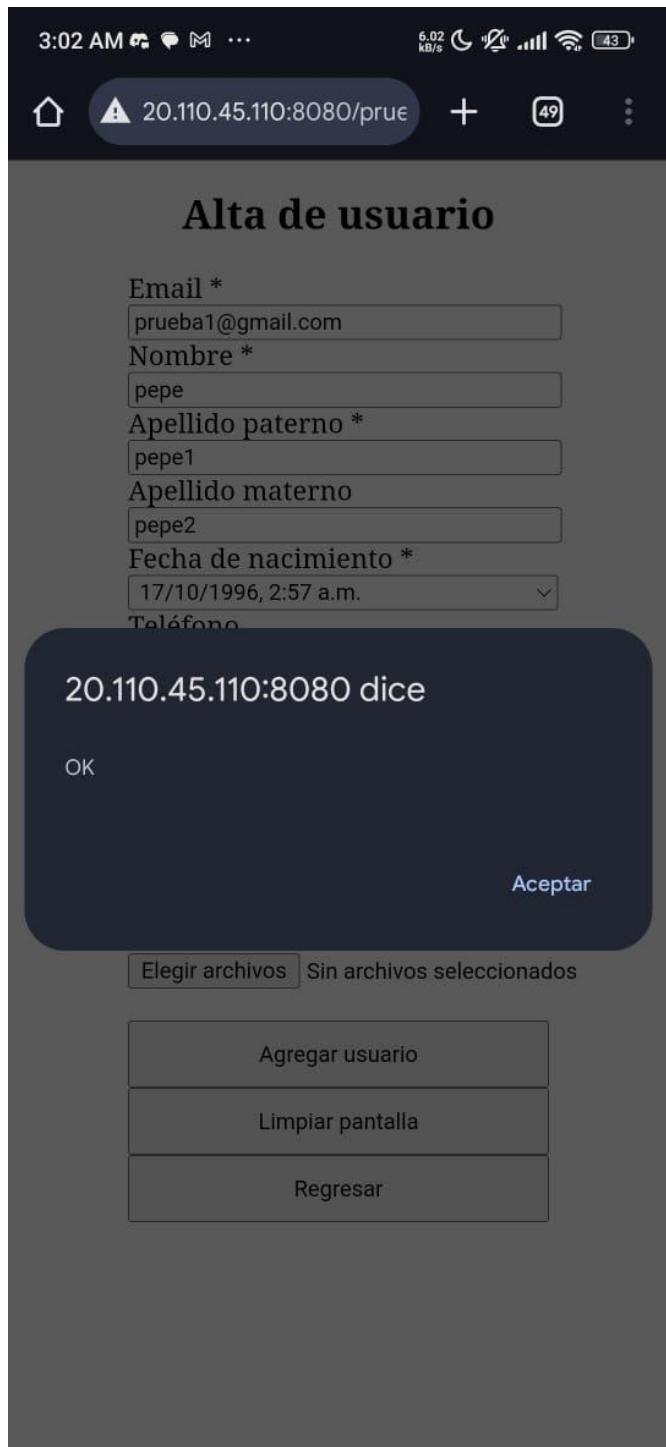
Alta usuario
Consulta usuario
Borra usuario

Probar el servicio web usando el cliente HTML-JavaScript

1. Usando un celular, ingresar la URL al navegador

http://20.110.45.110:8080/prueba_url.html

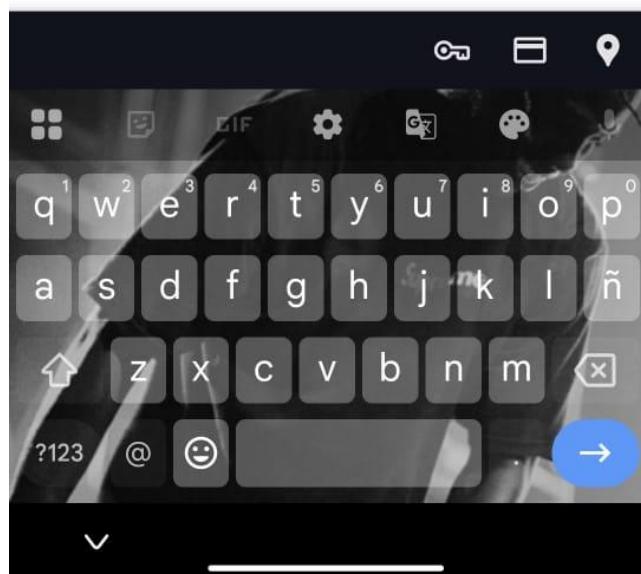
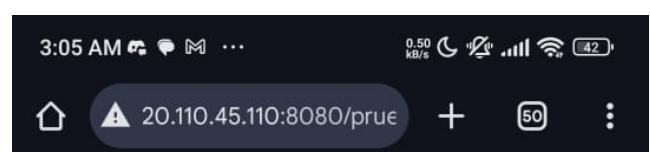
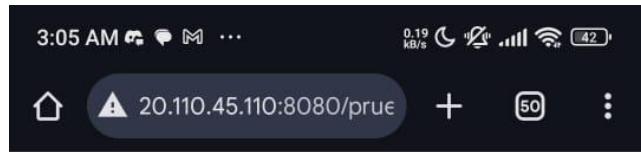
2. Dar clic en el botón "Alta Usuario". Capturar los campos y dar clic en el botón "Alta"



3. Intentar dar de alta otro usuario con el mismo email (se deberá de mostrar una ventana de error indicando que el email ya existe)

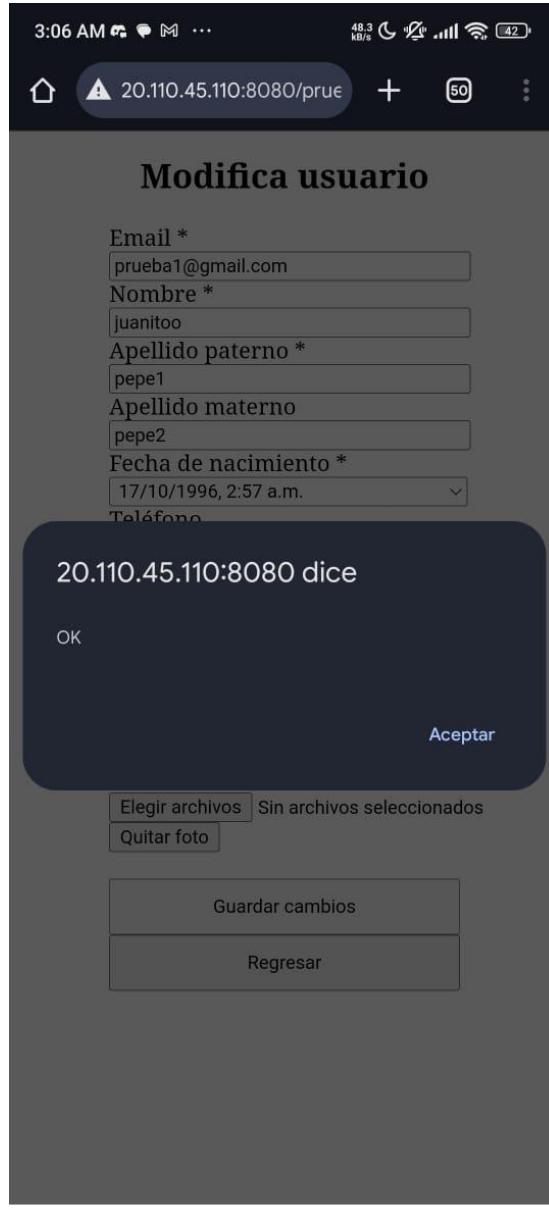


4. Dar clic en el botón “Consulta usuario” para consultar el usuario dado de alta en el paso 2. Capturar el email y dar clic en el botón “Consulta”.

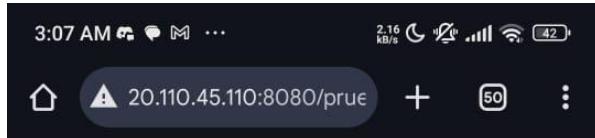


5. Modificar algún dato del usuario y dar clic en el botón “Modifica”.

- En la siguiente imagen, modificamos el nombre del usuario a "juanitoo"



6. Recargar la página actual y consultar el usuario modificado, para verificar que la modificación se realizó.
- Primero recargamos la pagina
- En la siguiente imagen vamos a buscar al usuario por su email para verificar que se hizo el cambio al nombre "juanitoo"



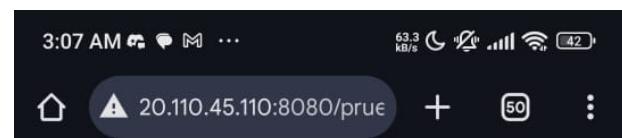
Consulta usuario

Email *

prueba1@gmail.com

Buscar usuario

Regresar



Modifica usuario

Email *

prueba1@gmail.com

Nombre *

juanitoo

Apellido paterno *

pepe1

Apellido materno

pepe2

Fecha de nacimiento *

17/10/1996, 2:57 a.m.

Teléfono

5511223366

Género

Masculino



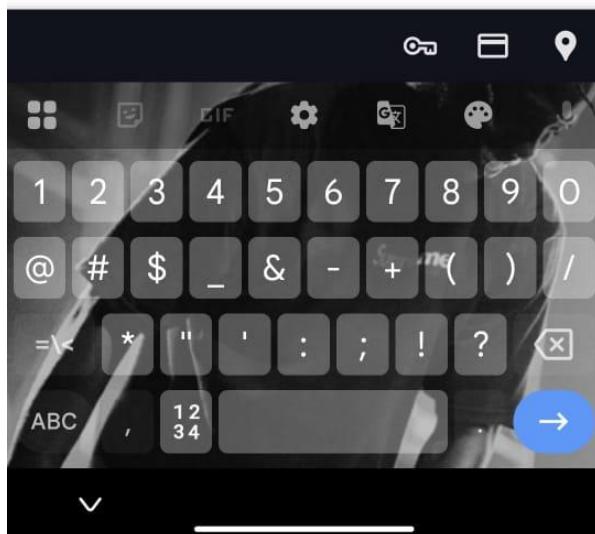
Elegir archivos

Sin archivos seleccionados

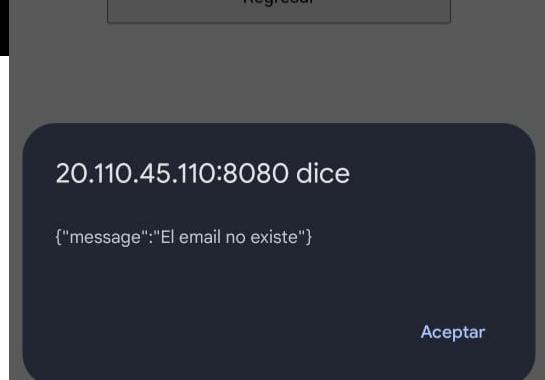
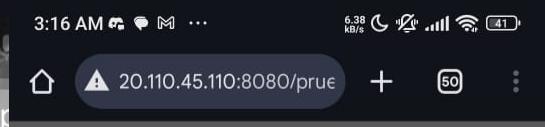
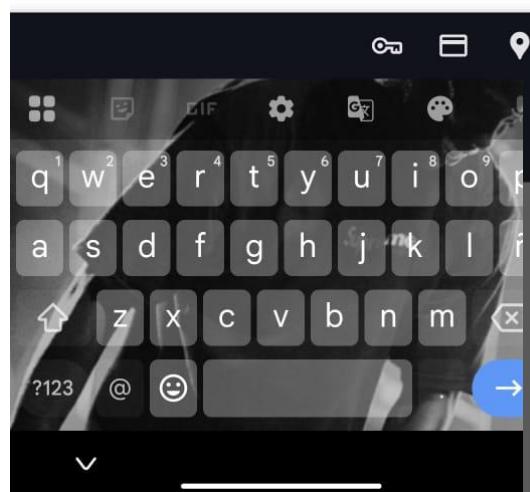
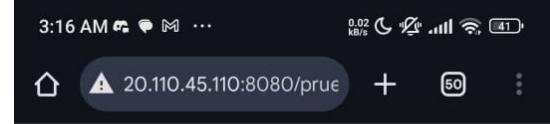
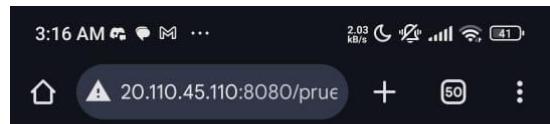
Quitar foto

Guardar cambios

Regresar



7. Dar clic en el botón "Borrar usuario". Capturar el email del usuario borrado y dar clic en el botón "Consulta".



Compilar, empacar y desplegar el servicio web (versión JSON)

1. Remover (undeploy) el servicio web anterior.

```
Windows PowerShell luisvela@T2-2023630338: ~/Servicio$ ls
META-INF WEB-INF compila_url.sh servicio_url
Servicio.war compila_json.sh servicio_json
luisvela@T2-2023630338: ~/Servicio$ rm Servicio.war
luisvela@T2-2023630338: ~/Servicio$ ls
META-INF WEB-INF compila_json.sh compila_url.sh servicio_json servicio_url
luisvela@T2-2023630338: ~/Servicio$ |
```

The screenshot shows a Windows PowerShell window titled "Windows PowerShell". The command `ls` is run, showing directory contents: META-INF, WEB-INF, compila_url.sh, servicio_url, and Servicio.war. The file Servicio.war is then removed with the command `rm Servicio.war`. Finally, another `ls` command is run, showing the remaining files: META-INF, WEB-INF, compila_json.sh, compila_url.sh, servicio_json, and servicio_url.

2. Cambiar al directorio donde se encuentran los directorios "servicio_url" y "servicio_json"
3. Compilar la clase Servicio.java

```
Windows PowerShell luisvela@T2-2023630338: ~/Servicio$ javac -cp $CATALINA_HOME/lib/javax.ws.rs-api-2.0.1.jar:$CATALINA_HOME/lib/gson-2.3.1.jar:. servicio_json/Servicio.java
luisvela@T2-2023630338: ~/Servicio$ |
```

The screenshot shows a Windows PowerShell window titled "Windows PowerShell". The command `javac -cp \$CATALINA_HOME/lib/javax.ws.rs-api-2.0.1.jar:\$CATALINA_HOME/lib/gson-2.3.1.jar:. servicio_json/Servicio.java` is run to compile the Servicio.java class. The output of the compilation process is shown below the command.

4. Ejecutar los siguientes comandos para crear el servicio web para Tomcat

```
luisvela@T2-2023630338:~/Servicio$ rm WEB-INF/classes/servicio_json/*
rm: cannot remove 'WEB-INF/classes/servicio_json/*': No such file or directory
luisvela@T2-2023630338:~/Servicio$ rm WEB-INF/classes/servicio_url/*
luisvela@T2-2023630338:~/Servicio$ cp servicio_json/*.class WEB-INF/classes/servicio_json/.
luisvela@T2-2023630338:~/Servicio$ jar cvf Servicio.war WEB-INF META-INF
added manifest
adding: WEB-INF/(in = 0) (out= 0)(stored 0%)
adding: WEB-INF/classes/(in = 0) (out= 0)(stored 0%)
adding: WEB-INF/classes/servicio_url/(in = 0) (out= 0)(stored 0%)
adding: WEB-INF/classes/servicio_json/(in = 0) (out= 0)(stored 0%)
adding: WEB-INF/classes/servicio_json/ParamBorraUsuario.class(in = 259) (out= 206)(deflated 20%)
adding: WEB-INF/classes/servicio_json/AdaptadorGsonBase64.class(in = 1805) (out= 741)(deflated 58%
)
adding: WEB-INF/classes/servicio_json/Usuario.class(in = 435) (out= 295)(deflated 32%)
adding: WEB-INF/classes/servicio_json/ParamAltaUsuario.class(in = 264) (out= 198)(deflated 25%)
adding: WEB-INF/classes/servicio_json/ParamModificaUsuario.class(in = 272) (out= 205)(deflated 24%
)
adding: WEB-INF/classes/servicio_json/Error.class(in = 284) (out= 220)(deflated 22%)
adding: WEB-INF/classes/servicio_json/ParamConsultaUsuario.class(in = 265) (out= 208)(deflated 21%
)
adding: WEB-INF/classes/servicio_json/Servicio.class(in = 8683) (out= 3999)(deflated 53%)
adding: WEB-INF/web.xml(in = 656) (out= 294)(deflated 55%)
ignoring entry META-INF/
adding: META-INF/context.xml(in = 309) (out= 221)(deflated 28%)
luisvela@T2-2023630338:~/Servicio$ |
```

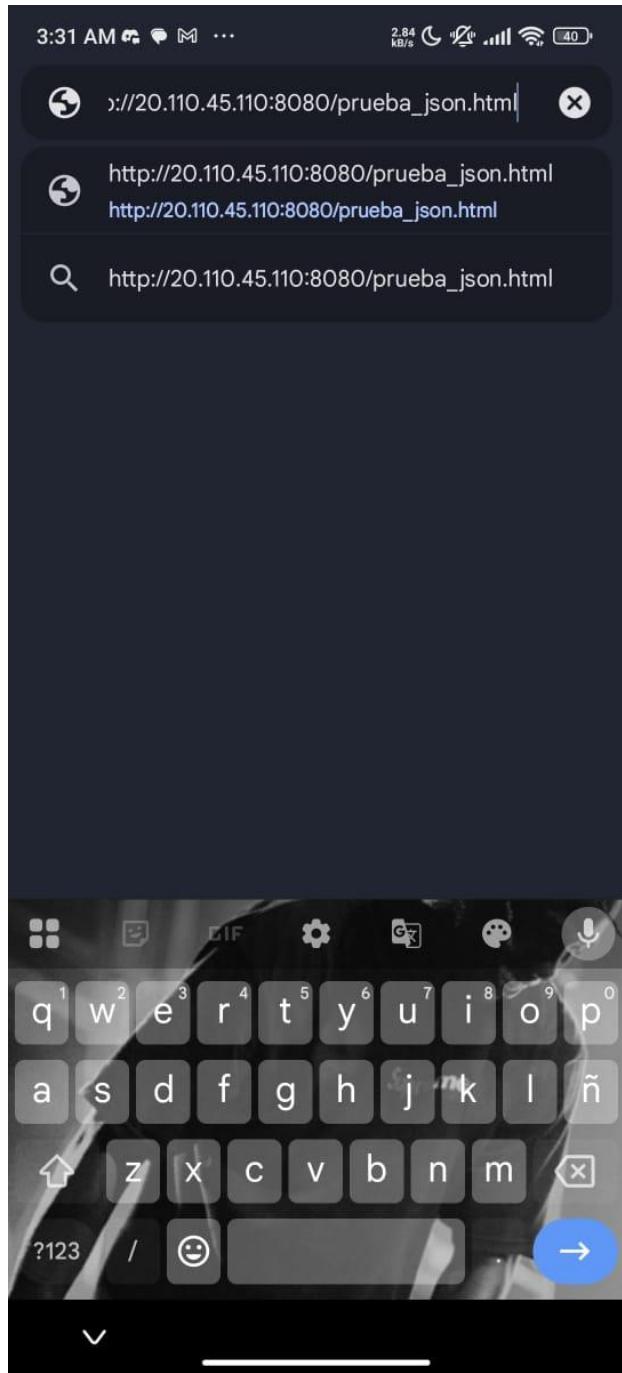
5. Para remover (undeploy) y desplegar (deploy) el servicio web, se deberá eliminar el archivo Servicio.war y el directorio Servicio (en este orden), y luego copiar el archivo Servicio.war al directorio webapps de Tomcat.

```
luisvela@T2-2023630338:~/Servicio$ rm -rf $CATALINA_HOME/webapps/Servicio.war $CATALINA_HOME/webap
ps/Servicio
luisvela@T2-2023630338:~/Servicio$ cp Servicio.war $CATALINA_HOME/webapps/ .
luisvela@T2-2023630338:~/Servicio$ |
```

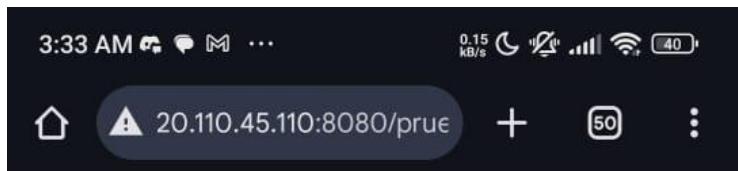
Probar el servicio web usando el cliente JSON

1. Usando un celular ingresar la URL en un navegador.

http://20.110.45.110:8080/prueba_url.html



2. Dar clic en el botón "Alta Usuario". Capturar los campos y dar clic en el botón "Alta"



Alta de usuario

Email *

Nombre *

Apellido paterno *

Apellido materno

Fecha de nacimiento *

Teléfono

Genero

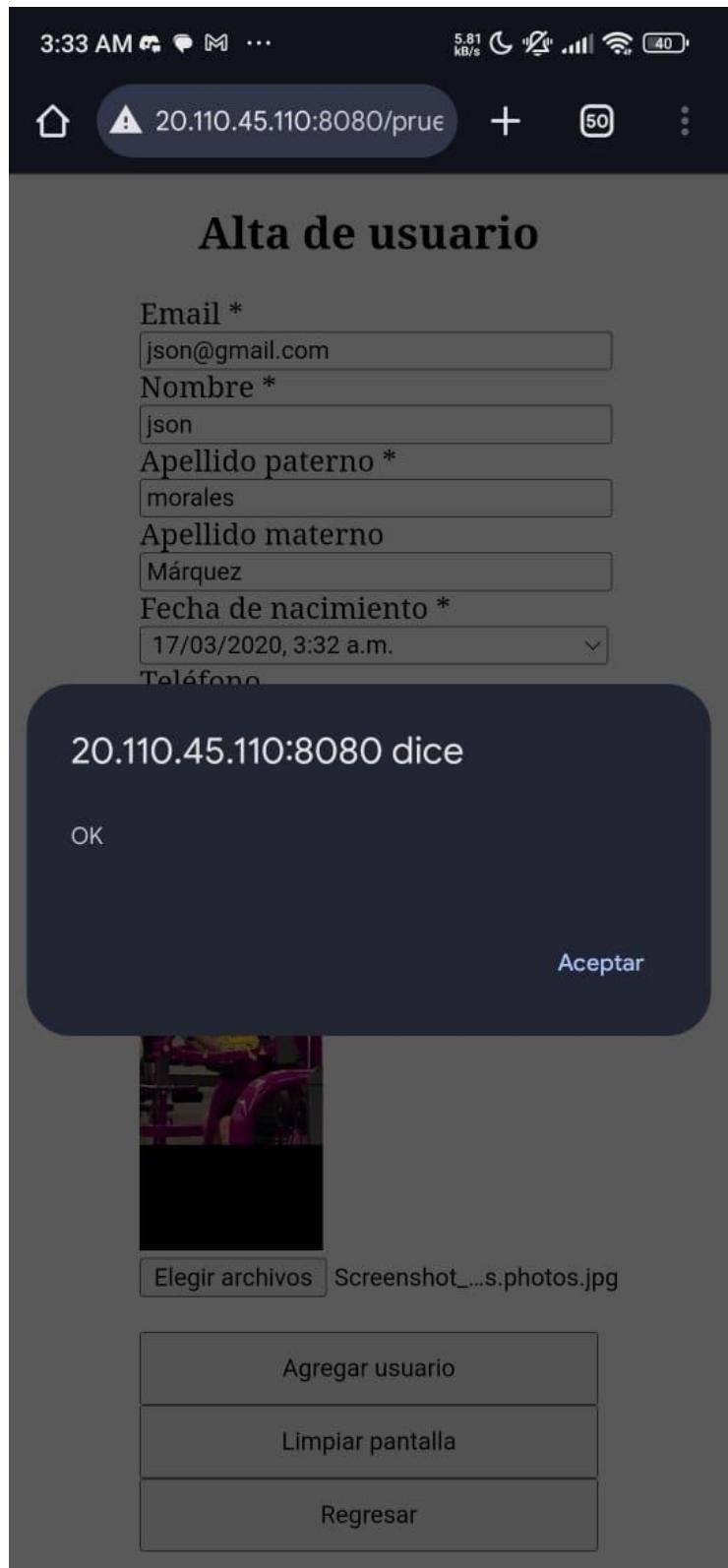


Elegir archivos Screenshot_...s.photos.jpg

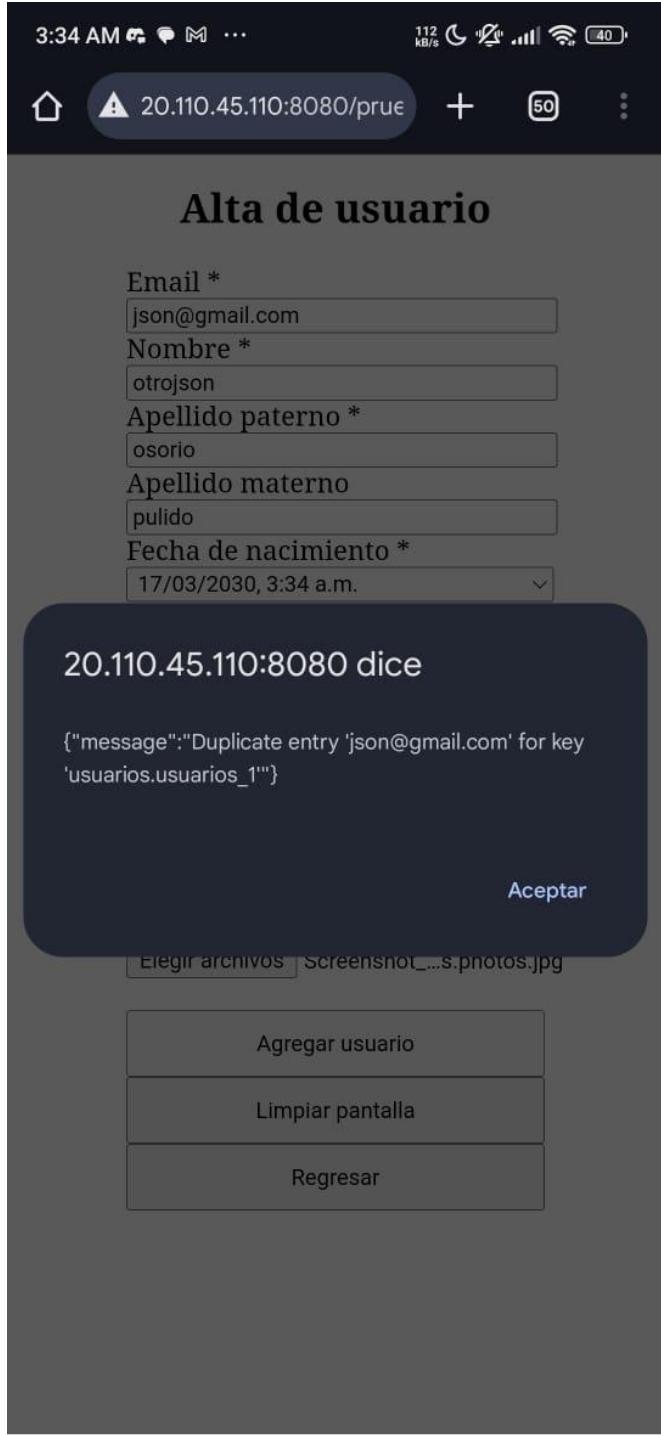
Agregar usuario

Limpiar pantalla

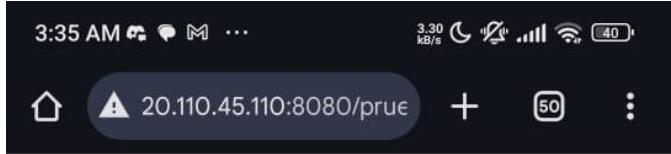
Regresar



3. Intentar dar de alta otro usuario con el mismo email (se deberá de mostrar una ventana de error indicando que el email ya existe)



4. Dar clic en el botón "Consulta usuario" para consultar el usuario dado de alta en el paso 2. Capturar el email y dar clic en el botón "Consulta".

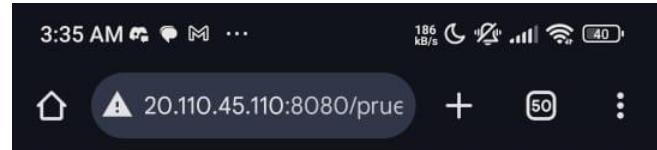


Consulta usuario

Email *

Buscar usuario

Regresar



Modifica usuario

Email *

Nombre *

Apellido paterno *

Apellido materno

Fecha de nacimiento *

Teléfono

Genero

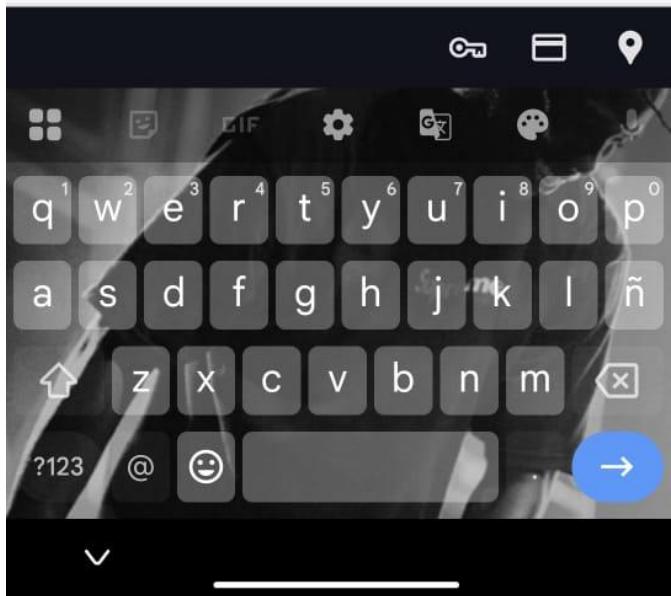


Elegir archivos Sin archivos seleccionados

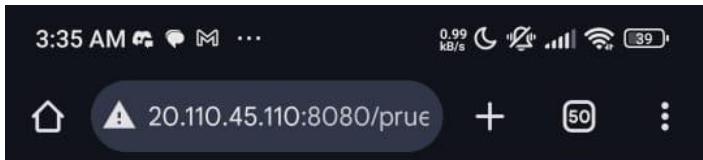
Quitar foto

Guardar cambios

Regresar



5. Modificar algún dato del usuario y dar clic en el botón "Modifica".
 - En la siguiente imagen, modificamos el nombre a "José Manuel"



Modifica usuario

Email *

json@gmail.com

Nombre *

José Manuel

Apellido paterno *

morales

Apellido materno

Márquez

Fecha de nacimiento *

17/03/2020, 3:32 a.m.

Teléfono

5544778801

Genero

Femenino



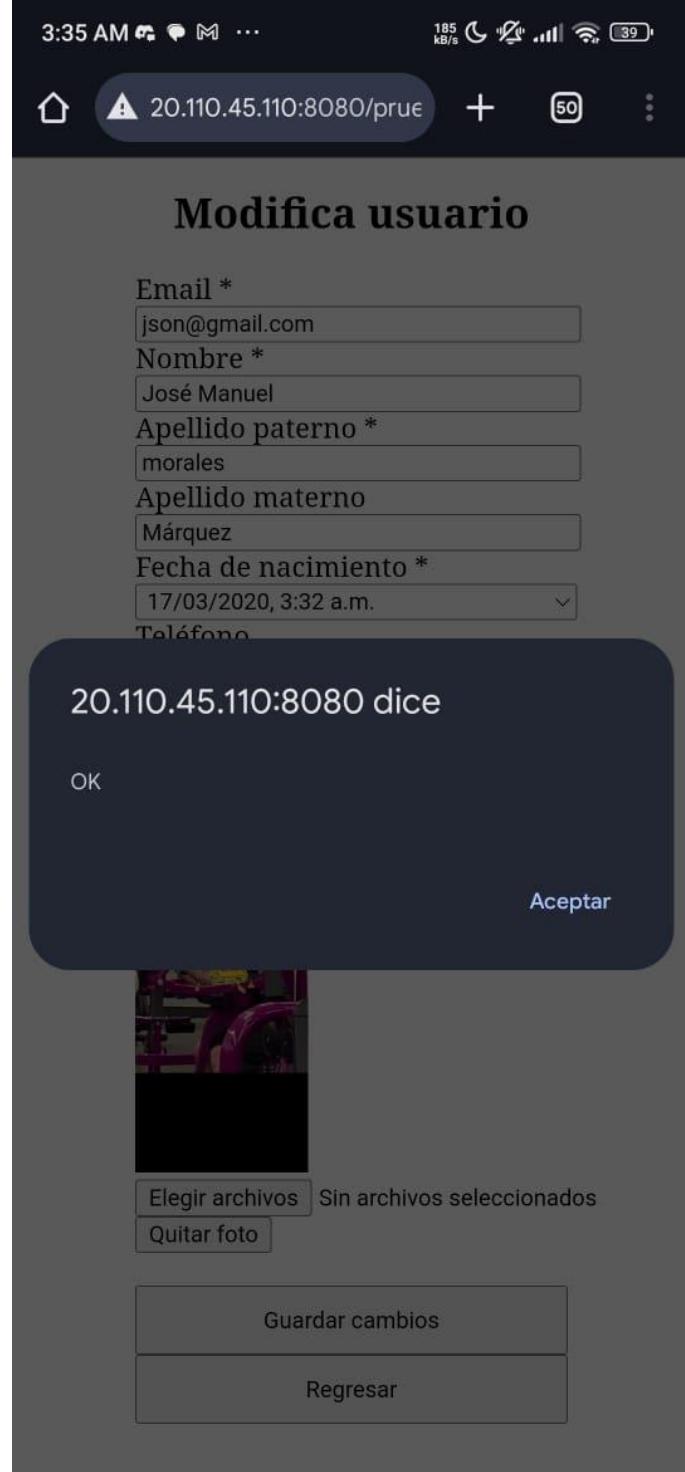
Elegir archivos

Sin archivos seleccionados

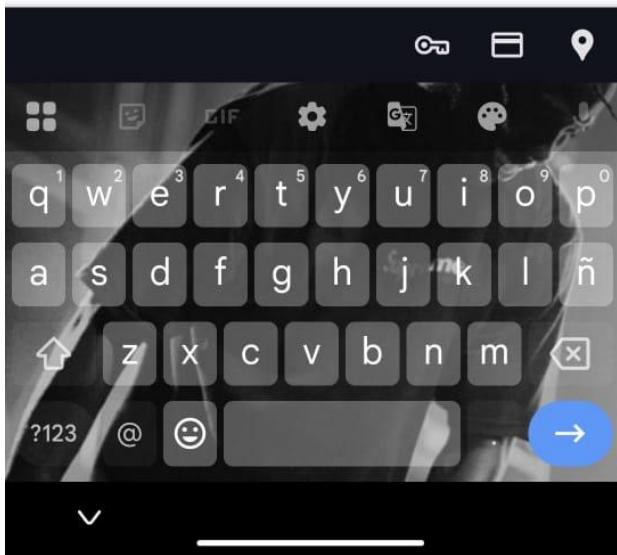
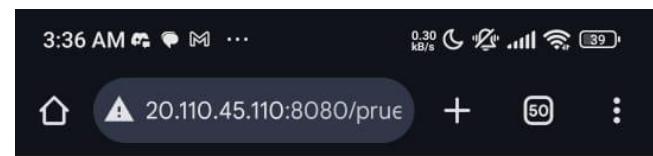
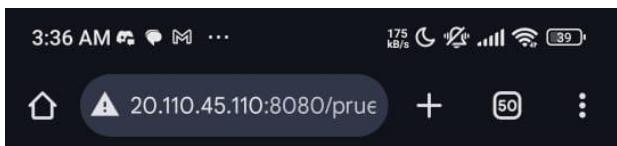
Quitar foto

Guardar cambios

Regresar



6. Recargar la página actual y consultar el usuario modificado, para verificar que la modificación se realizó.



Email *

Nombre *

Apellido paterno *

Apellido materno

Fecha de nacimiento *

Teléfono

Genero

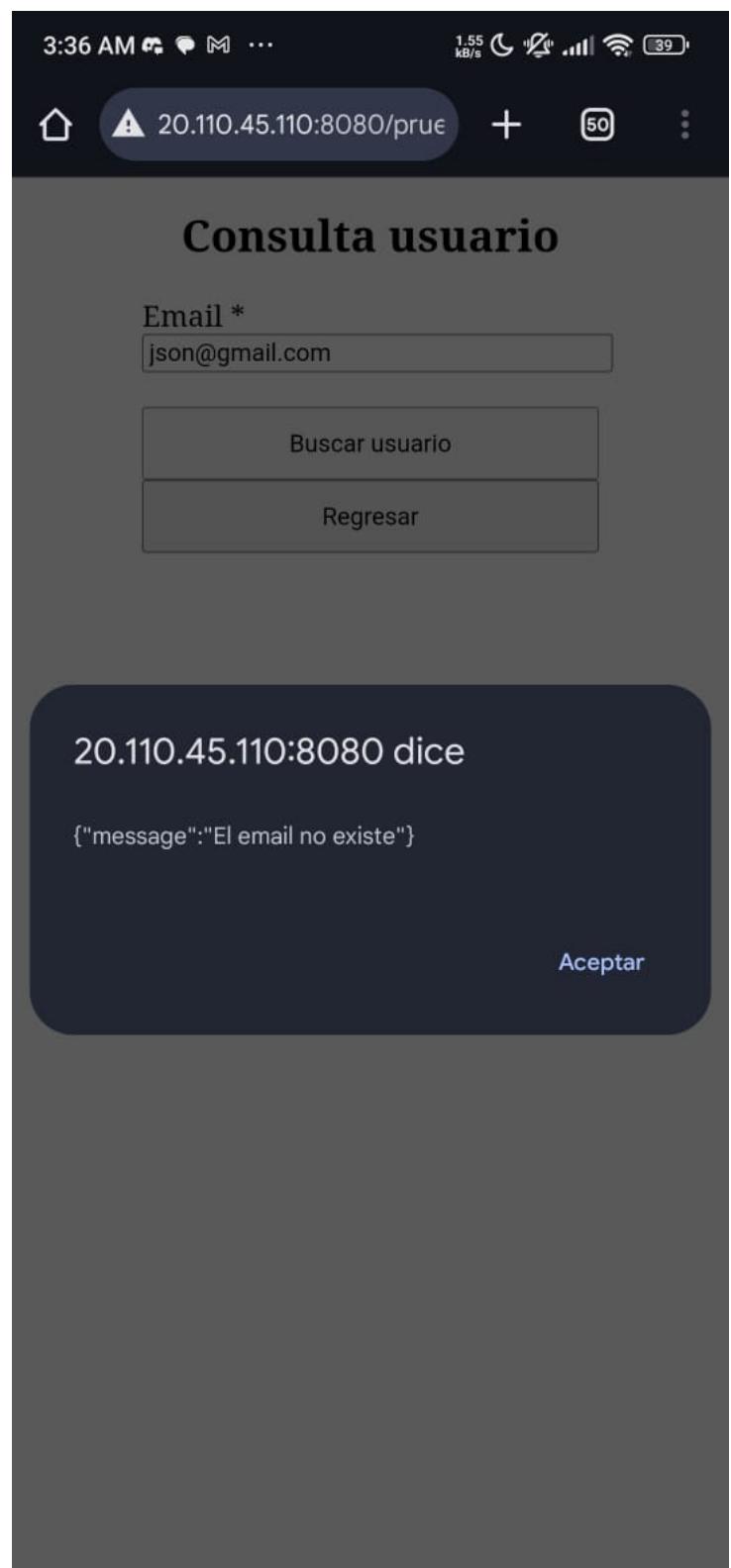
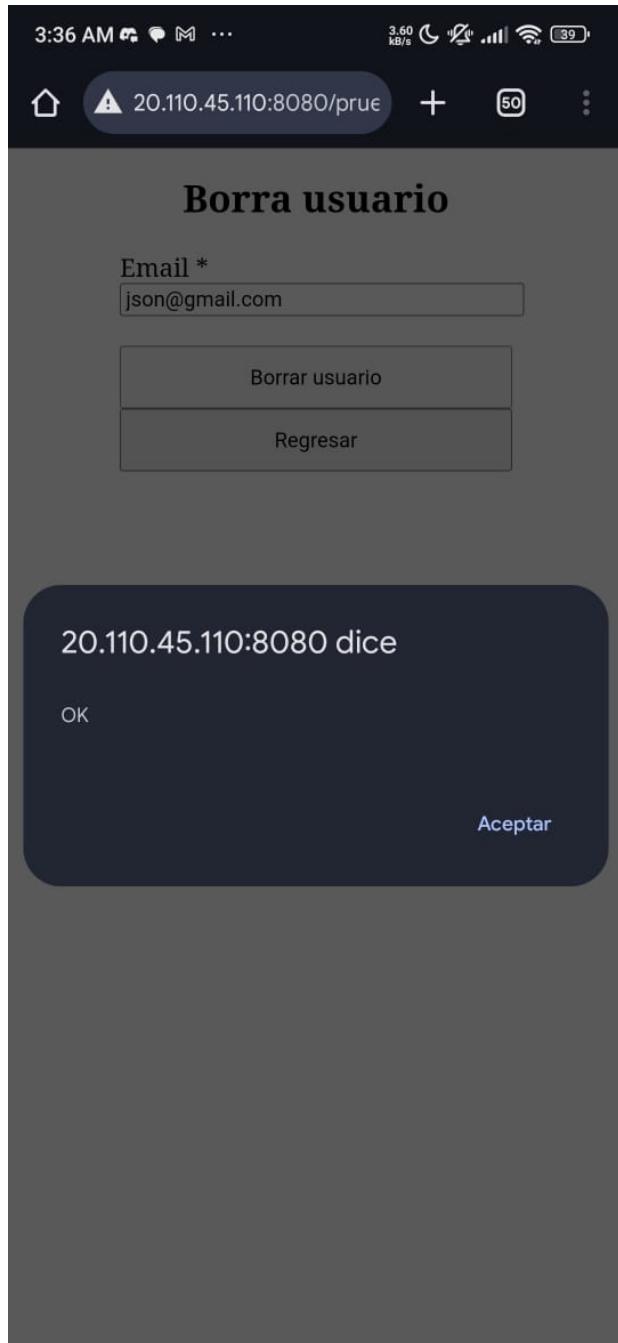


Elegir archivos Sin archivos seleccionados
Quitar foto

Guardar cambios

Regresar

7. Dar clic en el botón “Borrar usuario”. Capturar el email del usuario borrado y dar clic en el botón “Consulta”.



Iniciar Tomcat cuando se encienda la máquina virtual

Para que Tomcat inicie automáticamente cuando encienda la VM:

1. Crear el archivo /etc/rc.local ejecutando el siguiente comando

```
sudo vi /etc/rc.local
```

2. Agregar al archivo lo siguiente:

- Comprobando con el comando cat

```
luisvela@T2-2023630338:~$ cat /etc/rc.local
#!/bin/bash

iptables -t nat -A OUTPUT -o lo -p tcp --dport 80 -j REDIRECT --to-port 8080

runuser -l luisvela -c 'export JAVA_HOME=/usr;export CATALINA_HOME=/home/luisvela/apache-tomcat-8.5.63;sh $CATALINA_HOME/bin/catalina.sh start'

exit 0

luisvela@T2-2023630338:~$ |
```

- 3 Guardar el archivo.
 - 4 Ejecutar el siguiente comando para hacer ejecutable el archivo /etc/rc.local

```
Windows PowerShell x luisvela@T2-2023630338: ~ + - x
luisvela@T2-2023630338:~$ sudo chmod +x /etc/rc.local
luisvela@T2-2023630338:~$ |
```

Crear una imagen de la máquina virtual

1. Para generalizar la VM y conservar en la imagen la ultima cuneta de usuario creado, ejecutar el comando sudo waagent -deprovision

```
luisvela@T2-2023630338:~$ sudo waagent -deprovision
WARNING! The waagent service will be stopped.
WARNING! Cached DHCP leases will be deleted.
WARNING! root password will be disabled. You will not be able to login as root.
WARNING! /etc/resolv.conf will NOT be removed, this is a behavior change to earlier versions of Ubuntu.
Do you want to proceed (y/n)y
luisvela@T2-2023630338:~$ |
```

- 2 En el portal de Azure seleccionar la VM que se quiera capturar como imagen.
- 3 Seleccionar la opción captura.

The screenshot shows the Microsoft Azure portal interface. The top navigation bar includes links for WhatsApp, Microsoft Azure, Curso: Sistemas Distribuidos, and a local host URL. The main menu bar has options like Home, Virtual machines, Create, Switch to classic, Filter for any field..., Name, and T2-2023630338. The left sidebar contains sections for Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Connect, Networking (Network settings, Load balancing, Application security groups, Network manager), Settings (Disks, Extensions + applications, Operating system, Configuration, Advisor), Properties, Monitoring, Capabilities (7), Recommendations (4), and Tutorials. The central pane displays the details for the VM 'T2-2023630338'. Key information includes:

- Essentials:** Resource group (move) T2-2023630338 GROUP 03162125, Status: Running, Location: East US 2 (Zone 1), Subscription (move) Azure for Students, Subscription ID e1d319c4-9458-4992-b305-fe400976ae65, Availability zone: 1.
- Image:** Restore, Image (selected).
- Image Details:** Operating system: Linux (ubuntu 24.04), Size: Standard B1s (1 vcpu, 1 GiB memory), Public IP address: 20.110.45.110, Virtual network/subnet: T2-2023630338-vnet/default, DNS name: Not configured, Health state: -, Time created: 3/17/2025, 3:41 AM UTC.

- a. En la opción “Compartir una imagen con Shared Image Gallery” seleccionar “No, capturar solo una imagen administrada”
- 4 Marcar la casilla “Eliminar automáticamente esta máquina virtual después de crear la imagen”, ya que una VM generalizada no se puede iniciar o modificar.
- 5 Ingresar el nombre de la imagen a crear

The screenshot shows the 'Create an image' wizard in the Microsoft Azure portal. The 'Project details' section includes a subscription dropdown set to 'Azure for Students' and a resource group dropdown set to '(New) T2-2023630338-image'. The 'Instance details' section shows the region as '(US) East US 2'. Under 'Share image to Azure compute gallery', the 'No, capture only a managed image' option is selected. The 'Automatically delete this virtual machine after creating the image' checkbox is checked. A note at the bottom states: 'Before creating an image, use "waagent -deprovision+user" to prepare the Linux guest OS on the virtual machine. If you create an image from a virtual machine that hasn't been generalized, any virtual machines created from that image won't start.' The 'Name' field is filled with 'T2-2023630338-image'. At the bottom, there are 'Review + create' and 'Next : Tags >' buttons, along with a 'Give feedback' link. The browser address bar shows the URL: https://portal.azure.com/?Microsoft_Azure_Education_correlationId=a6f2c9b9-3493-417a-a886-0e558214746d&Microsoft_Azure_Education_newA4E=true&Microsoft_Azure_Education_asoSubGuid=e1d319c4-9458-4992-b305-fe400976ae65#.

6 Dar clic en el botón “Revisar y crear”

The screenshot shows the 'Create an image' wizard in the Microsoft Azure portal. The 'Review + create' tab is selected. A green success message at the top says 'Validation passed'. Below it, the 'Basics' section displays the following configuration:

Subscription	Azure for Students
Resource group	(new) T2-2023630338-image
Region	East US 2
Share image to Azure compute gallery	No
Automatically delete this virtual machine after creating the image	Yes
Name	T2-2023630338-image
Zone resiliency	Off

At the bottom, there are 'Create' and 'Next >' buttons, along with a link to 'Download a template for automation'.

The screenshot shows the 'Overview' page for the virtual machine 'Microsoft.Compute-CaptureVM-20250317041618'. The left sidebar shows tabs for 'Overview', 'Inputs', 'Outputs', and 'Template'. The main area displays a green checkmark icon and the message 'Your deployment is complete'. Deployment details are listed:

- Deployment name : Microsoft.Compute-CaptureVM-20250317041618
- Subscription : Azure for Students
- Resource group : T2-2023630338-image
- Start time : 3/17/2025, 4:20:53 AM
- Correlation ID : 8d744609-3329-4f13-ad7b-e3e7d48b0b3a

Below this, there are sections for 'Deployment details' and 'Next steps', each with a 'Go to resource' button. At the bottom, there's a 'Cost management' section with a green dollar sign icon and a note about staying within budget.

On the right side, a 'Notifications' panel is open, showing three recent events:

- Successfully deleted the virtual machine** (2 minutes ago)
- Deployment succeeded** (2 minutes ago)
- Successfully generalized virtual machine** (2 minutes ago)
- Successfully stopped virtual machine** (2 minutes ago)

The status bar at the bottom shows the date and time as 04:23 a.m. 17/03/2025.

CONCLUSIONES

En esta práctica me quedaron claras algunas cosas, se necesita mucha organización para configurar cosas dentro de una VM, en este caso Tomcat, ya que no es difícil, pero para nada es fácil, ya que lo que me paso a mí, es que cometí algunos errores en unas configuraciones o pasos, los cuales eran incorrectos, y por lo tanto no podría avanzar de algunas partes de la práctica.

Yo creo que esto es algo muy útil para nosotros como devs, ya que no sabemos en qué momento vamos a tener que tocar configuraciones así sobre proveedores de nube.