Parte teórica

1. Investigue qué es un manejador de paquetes para Linux, elabore los siguientes conceptos (10pts):

¿Qué es un manejador de paquetes para Linux?

"Un administrador de paquetes de Linux es un software que simplifica la instalación, actualización, configuración y eliminación de paquetes de software." (Zenarmor, 2024)
Asimismo, los administradores (manejadores) de paquetes en Linux automatizan la gestión de software mediante repositorios centralizados, resolviendo dependencias, controlando versiones, detectando conflictos y permitiendo reversiones. (Zenarmor, 2024)

1.1 RPM y DEB

"RPM es un sistema de gestión de paquetes que se ejecuta en Red Hat Enterprise Linux (RHEL), CentOS y Fedora. Puede utilizar RPM para distribuir, gestionar y actualizar el software que cree para cualquiera de estos sistemas operativos." (Red Hat, s. f.)

"Los paquetes DEB son utilizados por sistemas como Debian, y en distribuciones derivadas de Debian, como Ubuntu y Mint." (Jonathan Aquilina, 2024)

1.2 DNF y APT

"DNF (Dandified YUM): El administrador de paquetes de próxima generación para distribuciones basadas en Red Hat, que reemplaza a YUM." (Zenarmor, 2024)

"APT (Herramienta de paquetes avanzada): Utilizado por distribuciones basadas en Debian como Ubuntu y Mint." (Zenarmor, 2024)

2. Investigue qué es un ambiente sandbox en el sistema operativo, para qué sirve y brinde dos ejemplos de formas de implementar un sandbox en Debian (10pts).

¿Qué es un ambiente sandbox en el sistema operativo?
"Un sandbox, también conocido como entorno de pruebas, es una tecnología de seguridad informática que proporciona un entorno aislado donde se puede ejecutar software, códigos o programas sin afectar el sistema operativo anfitrión." (Nava, 2024)
¿Para qué sirve sandbox en el sistema operativo?
Mediante la creación de entornos virtuales controlados que emulan el sistema principal, el sandboxing restringe el acceso al hardware y recursos reales. Esta contención posibilita pruebas de software sin riesgos, siendo crucial para el análisis de seguridad de aplicaciones sospechosas y las fases de testing en desarrollo. (Nava, 2024)
Dos ejemplos de formas de implementar un sandbox en Debian:
a. Sandboxing con systemd en Debian: Debian permite aislar servicios mediante las opciones de

seguridad integradas en systemd, como ProtectSystem, PrivateTmp y NoNewPrivileges, que restringen el acceso del proceso al sistema y reducen sus privilegios. Esto crea un entorno controlado que limita el impacto de vulnerabilidades en los servicios (Debian Project, 2024).
b. Sandboxing de aplicaciones con Firejail: Firejail es una herramienta ligera que ejecuta aplicaciones en entornos aislados usando namespaces y filtros de seguridad del kernel Linux. Se instala fácilmente con APT y permite lanzar programas confinados, protegiendo el sistema de accesos no autorizados (Vlythr, 2023).

3. Investigue qué es un ambiente de contenedores en el sistema operativo, para qué sirve y brinde dos ejemplos de formas para implementar containers en Debian (10pts).

¿Qué es un ambiente de contenedores en el sistema operativo?
Los contenedores empaquetan aplicaciones y dependencias en entornos aislados, usando características del kernel para gestionar recursos eficientemente y garantizar portabilidad entre sistemas. (Susnjara & Smalley, s. f.)
¿Para qué sirve en los contenedores en el sistema operativo?
Los contenedores utilizan virtualización del SO para aislar procesos y controlar recursos, ofreciendo mayor portabilidad y eficiencia que las máquinas virtuales. Son la base de las aplicaciones cloud modernas y facilitan la implementación en entornos híbridos y multinube, integrando infraestructuras locales con múltiples proveedores de nube. (Susnjara & Smalley, s. f.)
Dos ejemplos de formas de implementar contenedores en Debian:
a. Contenedores con Docker en Debian: Docker se implementa en Debian instalando el paquete Docker Engine desde los repositorios oficiales, lo que permite crear y ejecutar contenedores de aplicaciones de manera aislada mediante comandos como docker run. Esta herramienta facilita el despliegue reproducible de entornos sin interferir con el sistema base (Docker Inc, s.f.).
b. Contenedores con LXC en Debian: LXC (Linux Containers) proporciona un entorno de virtualización a nivel de sistema operativo que usa namespaces y cgroups para aislar procesos. En Debian se instala con APT y permite crear contenedores ligeros similares a máquinas virtuales con lxc-create y lxc-start (Linux Containers Project, s.f.).

Parte práctica

4. Implemente un Hola Mundo en Java usando JavaFX. Su Hola Mundo debe poder crear una ventana sencilla con el mensaje Hola Mundo en el centro, y debe incorporar un botón que cierre la aplicación (0pts).

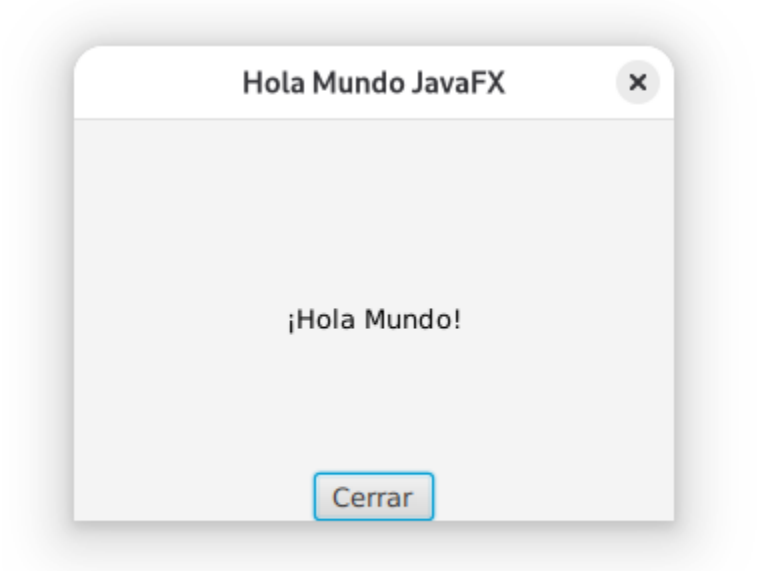
Se utilizó la documentación de Oracle (s. f.) como guía:

```
laura@Debian:~$ java -version
openjdk version "21.0.8" 2025-07-15
OpenJDK Runtime Environment (build 21.0.8+9-Debian-1)
OpenJDK 64-Bit Server VM (build 21.0.8+9-Debian-1, mixed mode, sharing)
laura@Debian:~$ wget https://download2.gluonhq.com/openjfx/22/openjfx-22_linux-x64_bin-sdk.zip
unzip openjfx-22_linux-x64_bin-sdk.zip
sudo mv javafx-sdk-22 /opt/
--2025-11-02 17:00:21--  https://download2.gluonhq.com/openjfx/22/openjfx-22_linux-x64_bin-sdk.zip
Resolving download2.gluonhq.com (download2.gluonhq.com)... 178.128.135.159
Connecting to download2.gluonhq.com (download2.gluonhq.com)|178.128.135.159|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 56333977 (54M) [application/zip]
Saving to: 'openjfx-22_linux-x64_bin-sdk.zip'

openjfx-22_linux-x64_bin-sdk.zip                    33%[=====================================>                                                                                                                ]  18.09M  6.64MB/s
openjfx-22_linux-x64_bin-sdk.zip                   100%[=============================================================================================================================>]  53.72M  12.9MB/s    in 5.7s

2025-11-02 17:00:28 (9.51 MB/s) - 'openjfx-22_linux-x64_bin-sdk.zip' saved [56333977/56333977]

Archive:  openjfx-22_linux-x64_bin-sdk.zip
   creating: javafx-sdk-22/
   creating: javafx-sdk-22/legal/
   creating: javafx-sdk-22/legal/javafx.graphics/
  inflating: javafx-sdk-22/legal/javafx.graphics/ADDITIONAL_LICENSE_INFO
  inflating: javafx-sdk-22/legal/javafx.graphics/ASSEMBLY_EXCEPTION
  inflating: javafx-sdk-22/legal/javafx.graphics/jpeg_fx.md
  inflating: javafx-sdk-22/legal/javafx.graphics/mesa3d.md
  inflating: javafx-sdk-22/legal/javafx.graphics/LICENSE
   creating: javafx-sdk-22/legal/javafx.fxml/
  inflating: javafx-sdk-22/legal/javafx.fxml/ADDITIONAL_LICENSE_INFO
  inflating: javafx-sdk-22/legal/javafx.fxml/ASSEMBLY_EXCEPTION
  inflating: javafx-sdk-22/legal/javafx.fxml/LICENSE
  inflating: javafx-sdk-22/lib/libavplugin-57.so
laura@Debian:~$ mkdir ~/HolaMundoFX
cd ~/HolaMundoFX
laura@Debian:~/HolaMundoFX$
```

laura@Debian: ~/HolaMundoFX

```
 GNU nano 8.4                                                    HolaMundo.java
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.scene.control.Button;
import javafx.scene.layout.StackPane;
import javafx.scene.text.Text;
import javafx.stage.Stage;

public class HolaMundo extends Application {

    @Override
    public void start(Stage primaryStage) {
        Text texto = new Text("¡Hola Mundo!");
        Button boton = new Button("Cerrar");
        boton.setOnAction(e -> primaryStage.close());

        StackPane root = new StackPane();
        root.getChildren().addAll(texto, boton);
        StackPane.setAlignment(texto, javafx.geometry.Pos.CENTER);
        StackPane.setAlignment(boton, javafx.geometry.Pos.BOTTOM_CENTER);

        Scene scene = new Scene(root, 300, 200);
        primaryStage.setTitle("Hola Mundo JavaFX");
        primaryStage.setScene(scene);
        primaryStage.show();
    }

    public static void main(String[] args) {
        launch(args);
    }
}
```

```
laura@Debian:~/HolaMundoFX$ nano HolaMundo.java
laura@Debian:~/HolaMundoFX$ nano HolaMundo.java
laura@Debian:~/HolaMundoFX$ javac --module-path /opt/javafx-sdk-22/lib --add-modules javafx.controls HolaMundo.java
laura@Debian:~/HolaMundoFX$ java --module-path /opt/javafx-sdk-22/lib --add-modules javafx.controls HolaMundo
```



5. Empaque su programa usando FlatPak de forma que se pueda desplegar desde cero en una máquina virtual totalmente nueva. Describa su proceso paso a paso (30pts).

Se utilizó el tutorial de Flatpak (s. f.):

```
laura@Debian:~/HolaMundoFX$ sudo apt update
sudo apt install flatpak flatpak-builder -y
sudo flatpak remote-add --if-not-exists flathub https://flathub.org/repo/flathub.flatpakrepo
[sudo] password for laura:
Hit:1 http://security.debian.org/debian-security trixie-security InRelease
Hit:2 http://deb.debian.org/debian trixie InRelease
Hit:3 http://deb.debian.org/debian trixie-updates InRelease
Hit:4 https://packages.microsoft.com/repos/code stable InRelease
Hit:5 https://deb.nodesource.com/node_20.x nodistro InRelease
57 packages can be upgraded. Run 'apt list --upgradable' to see them.
Warning: https://deb.nodesource.com/node_20.x/dists/nodistro/InRelease: Policy will reject signature within a year, see --audit for details
Upgrading:
  libavcodec61  libavfilter10  libavformat61  libavutil59  libpostproc58  libswresample5  libswscale8

Installing:
  flatpak  flatpak-builder

Installing dependencies:
  appstream-compose  debugedit  elfutils  ffmpeg  gir1.2-flatpak-1.0  libappstream-compose0  libasm1t64  libavdevice61  libdebuginfod-common  libdebuginfod1t64  optipng  ostree

Suggested packages:
  ffmpeg-doc  brz  subversion

Summary:
  Upgrading: 7, Installing: 14, Removing: 0, Not Upgrading: 50
  Download size: 4,882 kB / 16.8 MB
  Space needed: 16.9 MB / 40.7 GB available

Get:1 http://security.debian.org/debian-security trixie-security/main amd64 libavdevice61 amd64 7:7.1.2-0+deb13u1 [118 kB]
Get:2 http://deb.debian.org/debian trixie/main amd64 libdebuginfod-common all 0.192-4 [23.7 kB]
Get:3 http://deb.debian.org/debian trixie/main amd64 libappstream-compose0 amd64 1.0.5-1 [84.5 kB]
Get:4 http://deb.debian.org/debian trixie/main amd64 appstream-compose amd64 1.0.5-1 [31.7 kB]
Get:5 http://deb.debian.org/debian trixie/main amd64 debugedit amd64 1:5.1-2 [43.2 kB]
Get:6 http://deb.debian.org/debian trixie/main amd64 libasm1t64 amd64 0.192-4 [28.4 kB]
Get:7 http://security.debian.org/debian-security trixie-security/main amd64 ffmpeg amd64 7:7.1.2-0+deb13u1 [1,994 kB]
Get:8 http://deb.debian.org/debian trixie/main amd64 libdebuginfod1t64 amd64 0.192-4 [32.4 kB]
Get:9 http://deb.debian.org/debian trixie/main amd64 elfutils amd64 0.192-4 [505 kB]
Get:10 http://deb.debian.org/debian trixie/main amd64 flatpak amd64 1.16.1-1 [1,529 kB]
Get:11 http://deb.debian.org/debian trixie/main amd64 gir1.2-flatpak-1.0 amd64 1.16.1-1 [25.4 kB]
Get:12 http://deb.debian.org/debian trixie/main amd64 ostree amd64 2025.2-1 [192 kB]
Get:13 http://deb.debian.org/debian trixie/main amd64 flatpak-builder amd64 1.4.4-2 [166 kB]
Get:14 http://deb.debian.org/debian trixie/main amd64 optipng amd64 0.7.8+ds-1+b1 [109 kB]
Fetched 4,882 kB in 1s (4,733 kB/s)
apt-listchanges: Reading changelogs...
```

Se utilizó la guía de Docile (2025):

```
Processing triggers for desktop-file-utils (0.28-1) ...
laura@Debian:~/HolaMundoFX$ mkdir -p com.example.HolaMundoFX/{build,files}
laura@Debian:~/HolaMundoFX$ cp HolaMundo.class com.example.HolaMundoFX/files/
cp HolaMundo.java com.example.HolaMundoFX/files/
laura@Debian:~/HolaMundoFX$ nano com.example.HolaMundoFX.yml
laura@Debian:~/HolaMundoFX$
```

```
cp HolaMundo.java com.example.HolaMundoFX/files/
laura@Debian:~/HolaMundoFX$ nano com.example.HolaMundoFX.yml
laura@Debian:~/HolaMundoFX$ nano run.sh
laura@Debian:~/HolaMundoFX$
```

laura@Debian: ~/HolaMundoFX

GNU nano 8.4 com.example.HolaMundoFX.yml

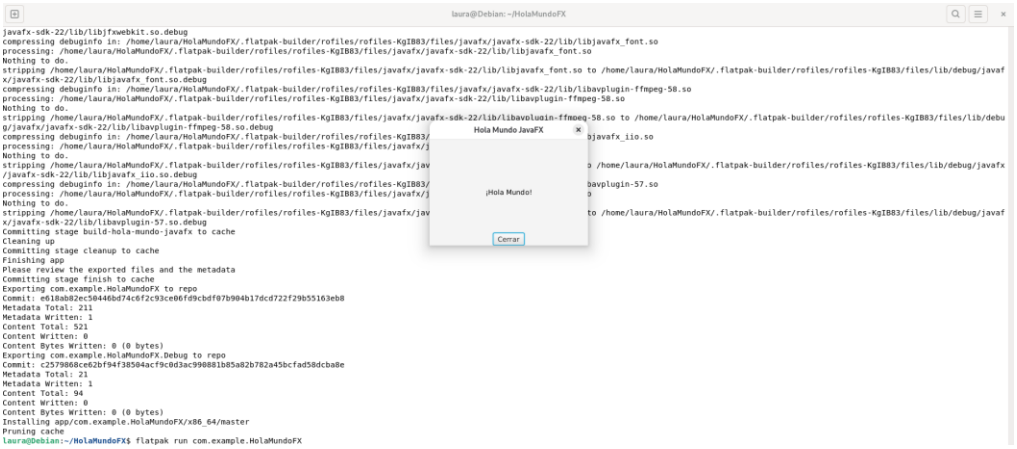
```yaml
app-id: com.example.HolaMundoFX
runtime: org.freedesktop.Platform
runtime-version: "23.08"
sdk: org.freedesktop.Sdk

build-options:
  env:
    JAVA_HOME: /app/openjdk
    PATH: /app/openjdk/bin:/usr/bin:/app/bin

command: run.sh
finish-args:
  - --share=network
  - --socket=x11
  - --filesystem=home

modules:
  - name: openjdk
    buildsystem: simple
    build-commands:
      - mkdir -p /app/openjdk
      - tar --strip-components=1 -xzf $(find . -type f -name "*.tar.gz") -C /app/openjdk
    sources:
      - type: file
        url: https://github.com/adoptium/temurin21-binaries/releases/download/jdk-21.0.5%2B11/OpenJDK21U-jdk_x64_linux_hotspot_21.0.5_11.tar.gz
        sha256: 3c654d98404c073b8a7e66bffb27f4ae3e7ede47d13284c132d40a83144bfd8c
  - name: hola-mundo-javafx
    buildsystem: simple
    build-commands:
      - mkdir -p /app/javafx
      - cp -r javafx-sdk-22 /app/javafx/
      - /app/openjdk/bin/javac --module-path /app/javafx/javafx-sdk-22/lib --add-modules javafx.controls HolaMundo.java
      - install -D HolaMundo.class /app/bin/HolaMundo.class
      - install -D HolaMundo.java /app/bin/HolaMundo.java
      - install -D run.sh /app/bin/run.sh

    sources:
      - type: dir
        path: .
```

laura@Debian: ~/HolaMundoFX

GNU nano 8.4 run.sh

```
#!/bin/bash
# Ejecutar usando el JDK empaquetado
/app/openjdk/bin/java --module-path /app/javafx/javafx-sdk-22/lib --add-modules javafx.controls -cp /app/bin HolaMundo
```

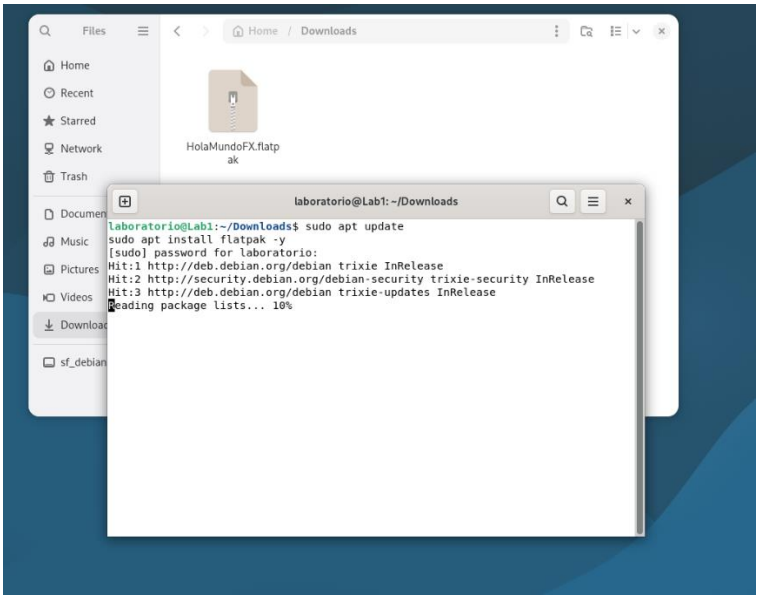
```
laura@Debian:~/HolaMundoFX$ flatpak-builder --user --install --force-clean build-dir com.example.HolaMundoFX.yml
Emptying app dir 'build-dir'
Downloading sources
Starting build of com.example.HolaMundoFX
Cache hit for openjdk, skipping build
Cache miss, checking out last cache hit
========================================================================
Building module hola-mundo-javafx in /home/laura/HolaMundoFX/.flatpak-builder/build/hola-mundo-javafx-22
========================================================================
Running: mkdir -p /app/javafx
Running: cp -r javafx-sdk-22 /app/javafx/
Running: /app/openjdk/bin/javac --module-path /app/javafx/javafx-sdk-22/lib --add-modules javafx.controls HolaMundo.java
Running: install -D HolaMundo.class /app/bin/HolaMundo.class
Running: install -D HolaMundo.java /app/bin/HolaMundo.java
Running: install -D run.sh /app/bin/run.sh
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libavplugin-54.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libavplugin-54.so
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libavplugin-54.so to /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/debug/javaf
x/javafx-sdk-22/lib/libavplugin-54.so.debug
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libprism_common.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libprism_common.so
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libprism_common.so to /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/debug/java
fx/javafx-sdk-22/lib/libprism_common.so.debug
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libjavafx_font_pango.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libjavafx_font_pango.so
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libjavafx_font_pango.so to /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/debug
/javafx/javafx-sdk-22/lib/libjavafx_font_pango.so.debug
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libglassgtk3.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libglassgtk3.so
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libglassgtk3.so to /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/debug/javafx/
javafx-sdk-22/lib/libglassgtk3.so.debug
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libjavafx_font_freetype.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libjavafx_font_freetype.so
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libjavafx_font_freetype.so to /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/de
bug/javafx/javafx-sdk-22/lib/libjavafx_font_freetype.so.debug
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libprism_es2.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libprism_es2.so
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libprism_es2.so to /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/debug/javafx/
```



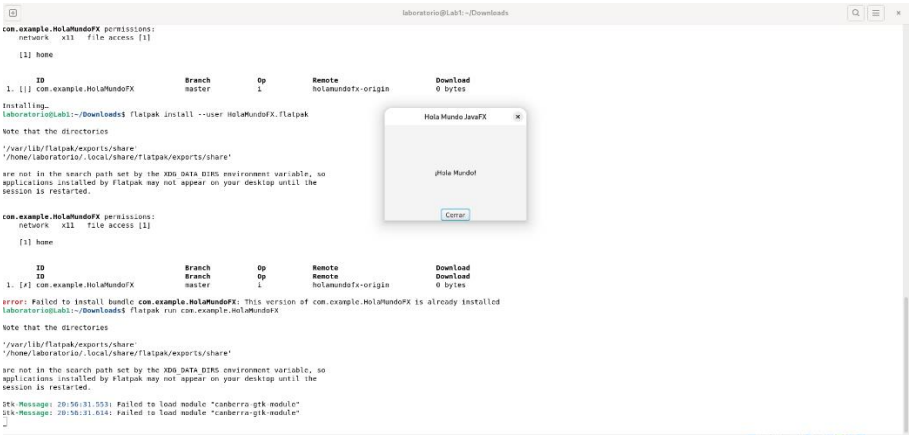

```
javafx-sdk-22/lib/libjfxwebkit.so.debug
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libjavafx_font.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libjavafx_font.so
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libjavafx_font.so to /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/debug/javaf
x/javafx-sdk-22/lib/libjavafx_font.so.debug
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libavplugin-ffmpeg-58.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libavplugin-ffmpeg-58.so
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/javafx-sdk-22/lib/libavplugin-ffmpeg-58.so to /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/debu
g/javafx/javafx-sdk-22/lib/libavplugin-ffmpeg-58.so.debug
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/                    bjavafx_iio.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/j
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/jav                    o /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/debug/javafx
/javafx-sdk-22/lib/libjavafx_iio.so.debug
compressing debuginfo in: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/                    bavplugin-57.so
processing: /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/j                    o
Nothing to do.
stripping /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/javafx/jav                    to /home/laura/HolaMundoFX/.flatpak-builder/rofiles/rofiles-KgIB83/files/lib/debug/javaf
x/javafx-sdk-22/lib/libavplugin-57.so.debug
Committing stage build-hola-mundo-javafx to cache
Cleaning up
Committing stage cleanup to cache
Finishing app
Please review the exported files and the metadata
Committing stage finish to cache
Exporting com.example.HolaMundoFX to repo
Commit: e618ab82ec50446bd74c6f2c93ce06fd9cbdf07b904b17dcd722f29b55163eb8
Metadata Total: 211
Metadata Written: 1
Content Total: 521
Content Written: 0
Content Bytes Written: 0 (0 bytes)
Exporting com.example.HolaMundoFX.Debug to repo
Commit: c2579868ce62bf94f38504acf9c0d3ac990881b85a82b782a45bcfad58dcba8e
Metadata Total: 21
Metadata Written: 1
Content Total: 94
Content Written: 0
Content Bytes Written: 0 (0 bytes)
Installing app/com.example.HolaMundoFX/x86_64/master
Pruning cache
laura@Debian:~/HolaMundoFX$ flatpak run com.example.HolaMundoFX
```

```
laura@Debian:~/HolaMundoFX$ flatpak build-export repo build-dir
Commit: 979a5ed5a3a71cb53b9c9d69e8294f89447de525c3c4a0802cad12a3724ce837
Metadata Total: 227
Metadata Written: 54
Content Total: 614
Content Written: 389
Content Bytes Written: 487545359 (487.5 MB)
laura@Debian:~/HolaMundoFX$ flatpak build-bundle repo HolaMundoFX.flatpak com.example.HolaMundoFX
laura@Debian:~/HolaMundoFX$ ls
build-dir  com.example.HolaMundoFX  com.example.HolaMundoFX.yml  HolaMundo.class  HolaMundoFX.flatpak  HolaMundo.java  javafx-sdk-22  openjfx-22_linux-x64_bin-sdk.zip  repo  run.sh
laura@Debian:~/HolaMundoFX$
```

Pasamos el archivo a la nueva máquina virtual:




```
laboratorio@Lab1:~/Downloads$ sudo flatpak remote-add --if-not-exists flathub https://flathub.org/repo/flathub.flatpakrepo
laboratorio@Lab1:~/Downloads$ flatpak update

Note that the directories

'/var/lib/flatpak/exports/share'
'/home/laboratorio/.local/share/flatpak/exports/share'

are not in the search path set by the XDG_DATA_DIRS environment variable, so
applications installed by Flatpak may not appear on your desktop until the
session is restarted.

Looking for updates…

Nothing to do.
laboratorio@Lab1:~/Downloads$ flatpak install flathub org.freedesktop.Platform//23.08 -y

Note that the directories

'/var/lib/flatpak/exports/share'
'/home/laboratorio/.local/share/flatpak/exports/share'

are not in the search path set by the XDG_DATA_DIRS environment variable, so
applications installed by Flatpak may not appear on your desktop until the
session is restarted.

Looking for matches…

Info: runtime org.freedesktop.Platform branch 23.08 is end-of-life, with reason:
   org.freedesktop.Platform 23.08 is no longer receiving fixes and security updates. Please update to a supported runtime version.

Info: runtime org.freedesktop.Platform.GL.default branch 23.08-extra is end-of-life, with reason:
   org.freedesktop.Platform 23.08 is no longer receiving fixes and security updates. Please update to a supported runtime version.

Info: runtime org.freedesktop.Platform.GL.default branch 23.08 is end-of-life, with reason:
   org.freedesktop.Platform 23.08 is no longer receiving fixes and security updates. Please update to a supported runtime version.
        ID                                      Branch          Op          Remote            Download
 1. [\] org.freedesktop.Platform.GL.default     23.08           i           flathub             57.6 MB / 170.0 MB
 2. [ ] org.freedesktop.Platform.GL.default     23.08-extra     i           flathub           < 170.0 MB
 3. [ ] org.freedesktop.Platform.Locale         23.08           i           flathub           < 379.4 MB (partial)
 4. [ ] org.freedesktop.Platform                23.08           i           flathub           < 233.3 MB

Installing 1/4… ████████            37%  6.4 MB/s  00:15
```



6. Empaque su programa usando Docker de forma que se pueda desplegar desde cero en una máquina virtual totalmente nueva. Describa su proceso paso a paso (30pts).

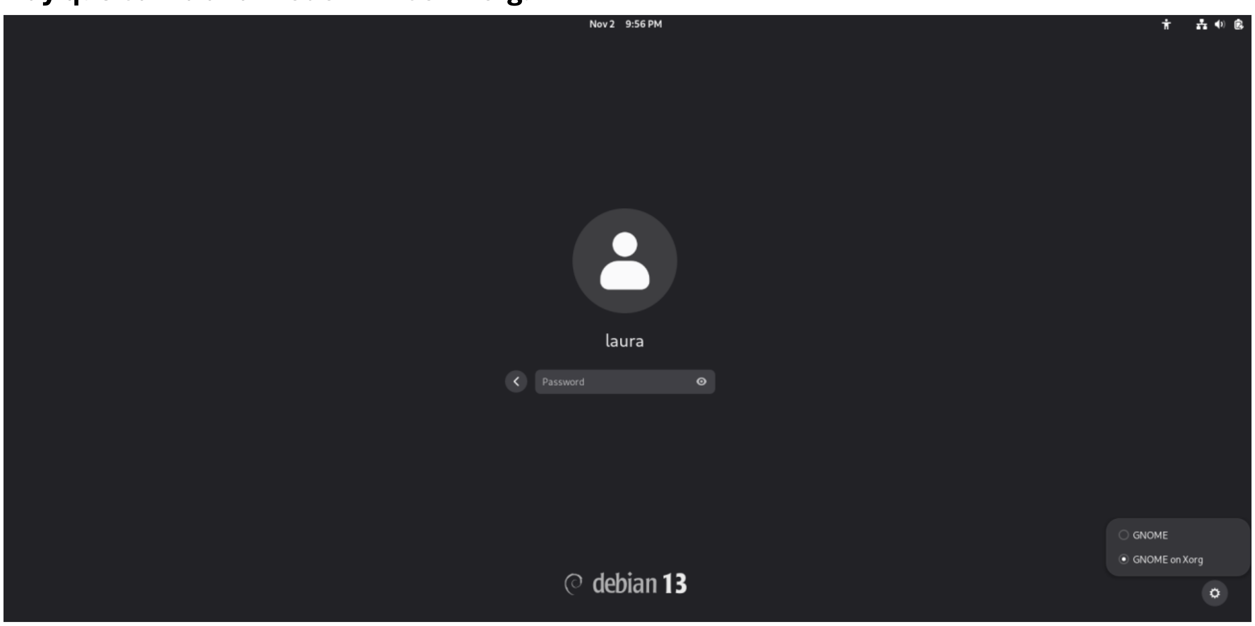
```
laura@Debian:~/HolaMundoFX$ docker build -t holamundofx .
bash: docker: command not found
laura@Debian:~/HolaMundoFX$ sudo apt install -y ca-certificates curl gnupg
[sudo] password for laura:
ca-certificates is already the newest version (20250419).
curl is already the newest version (8.14.1-2).
gnupg is already the newest version (2.4.7-21).
Summary:
  Upgrading: 0, Installing: 0, Removing: 0, Not Upgrading: 0
laura@Debian:~/HolaMundoFX$ sudo install -m 0755 -d /etc/apt/keyrings
curl -fsSL https://download.docker.com/linux/debian/gpg | sudo gpg --dearmor -o /etc/apt/keyrings/docker.gpg
sudo chmod a+r /etc/apt/keyrings/docker.gpg
laura@Debian:~/HolaMundoFX$ echo \
  "deb [arch=$(dpkg --print-architecture) signed-by=/etc/apt/keyrings/docker.gpg] \
  https://download.docker.com/linux/debian \
  $(. /etc/os-release && echo "$VERSION_CODENAME") stable" | \
  sudo tee /etc/apt/sources.list.d/docker.list > /dev/null
laura@Debian:~/HolaMundoFX$ sudo apt update
sudo apt install -y docker-ce docker-ce-cli containerd.io docker-buildx-plugin docker-compose-plugin
Hit:1 http://security.debian.org/debian-security trixie-security InRelease
Hit:2 http://deb.debian.org/debian trixie InRelease
Get:3 https://download.docker.com/linux/debian trixie InRelease [32.5 kB]
Get:4 http://deb.debian.org/debian trixie-updates InRelease [47.3 kB]
Hit:5 https://packages.microsoft.com/repos/code stable InRelease
Hit:6 https://deb.nodesource.com/node_20.x nodistro InRelease
Get:7 https://download.docker.com/linux/debian trixie/stable amd64 Packages [14.3 kB]
Fetched 94.1 kB in 1s (108 kB/s)
Reading package lists... 97%
```

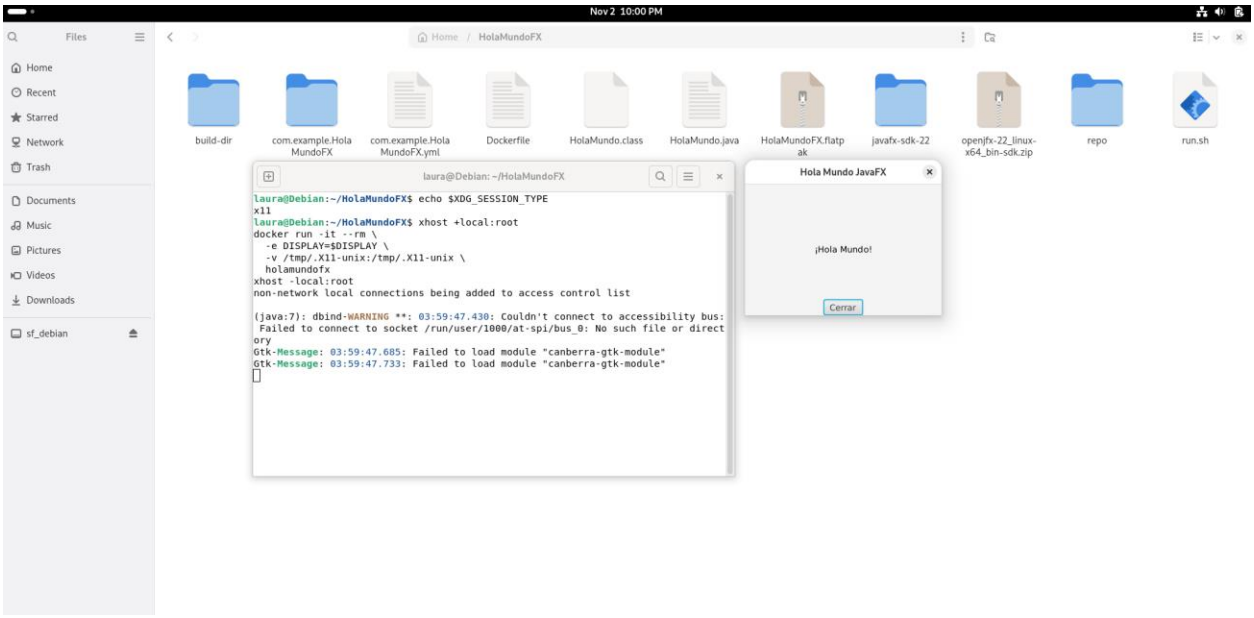
```
laura@Debian: ~
Laura@Debian:~$ sudo systemctl status docker
[sudo] password for laura:
● docker.service - Docker Application Container Engine
     Loaded: loaded (/usr/lib/systemd/system/docker.service; enabled; preset: e
     Active: active (running) since Sun 2025-11-02 21:29:46 CST; 1min 39s ago
 Invocation: 6770404cde344793800d033b5f061d0a
TriggeredBy: ● docker.socket
       Docs: https://docs.docker.com
   Main PID: 1252 (dockerd)
      Tasks: 10
     Memory: 103M (peak: 104.2M)
        CPU: 4.887s
     CGroup: /system.slice/docker.service
             └─1252 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/cont

Nov 02 21:29:43 Debian dockerd[1252]: time="2025-11-02T21:29:43.121620796-06:00"
Nov 02 21:29:43 Debian dockerd[1252]: time="2025-11-02T21:29:43.545872629-06:00"
Nov 02 21:29:43 Debian dockerd[1252]: time="2025-11-02T21:29:43.564214874-06:00"
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.066551969-06:00"
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.318515743-06:00"
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.322523151-06:00"
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.497550423-06:00"
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.521144190-06:00"
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.521367617-06:00"
Nov 02 21:29:46 Debian systemd[1]: Started docker.service - Docker Application C
lines 1-23...skipping...
● docker.service - Docker Application Container Engine
     Loaded: loaded (/usr/lib/systemd/system/docker.service; enabled; preset: enabled)
     Active: active (running) since Sun 2025-11-02 21:29:46 CST; 1min 39s ago
 Invocation: 6770404cde344793800d033b5f061d0a
TriggeredBy: ● docker.socket
       Docs: https://docs.docker.com
   Main PID: 1252 (dockerd)
      Tasks: 10
     Memory: 103M (peak: 104.2M)
        CPU: 4.887s
     CGroup: /system.slice/docker.service
             └─1252 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/containerd.sock

Nov 02 21:29:43 Debian dockerd[1252]: time="2025-11-02T21:29:43.121620796-06:00" level=info msg="Creating a containerd client" address=/run/containerd/containerd.sock timeout=1m0s
Nov 02 21:29:43 Debian dockerd[1252]: time="2025-11-02T21:29:43.545872629-06:00" level=info msg="[graphdriver] using prior storage driver: overlay2"
Nov 02 21:29:43 Debian dockerd[1252]: time="2025-11-02T21:29:43.564214874-06:00" level=info msg="Loading containers: start."
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.066551969-06:00" level=info msg="Loading containers: done."
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.318515743-06:00" level=info msg="Docker daemon" commit=f8215cc containerd-snapshotter=false storage-driver=overlay2 version=28.5.1
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.322523151-06:00" level=info msg="Initializing buildkit"
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.497550423-06:00" level=info msg="Completed buildkit initialization"
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.521144190-06:00" level=info msg="Daemon has completed initialization"
Nov 02 21:29:46 Debian dockerd[1252]: time="2025-11-02T21:29:46.521367617-06:00" level=info msg="API listen on /run/docker.sock"
```

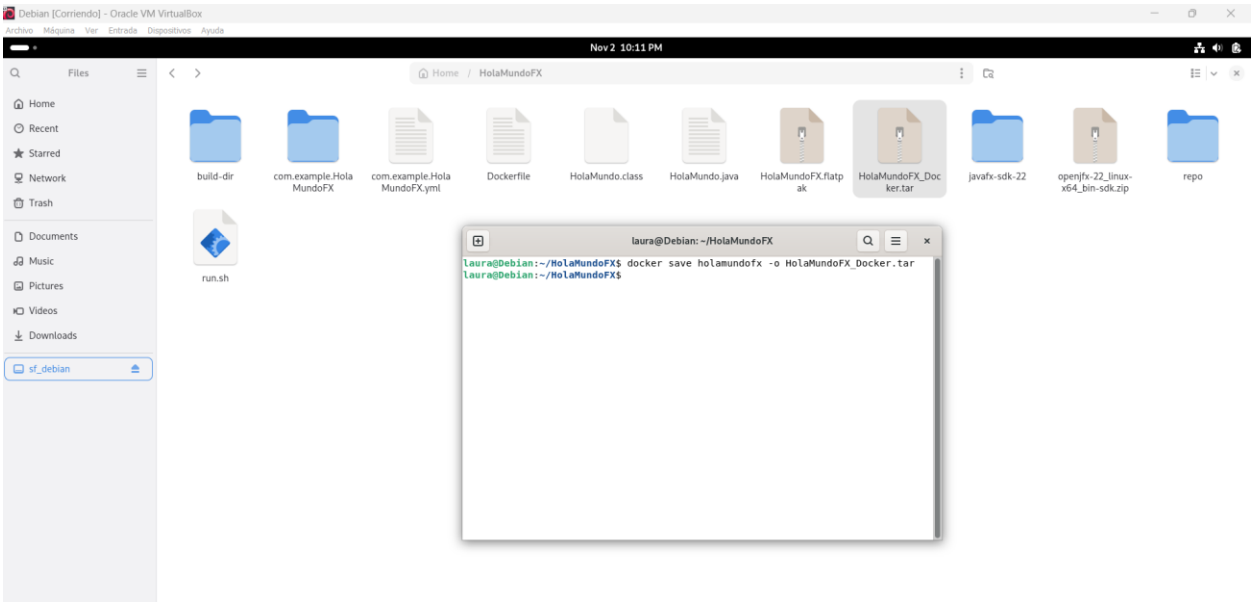
```
laura@Debian: ~/HolaMundoFX

laura@Debian:~/HolaMundoFX$ cd ~/HolaMundoFX

cat << 'EOF' > Dockerfile
# Imagen base con Java 21 (Eclipse Temurin)
FROM eclipse-temurin:21-jdk

# Instalar dependencias necesarias para JavaFX
RUN apt-get update && \
    apt-get install -y libgl1 libxext6 libxrender1 libxtst6 libgtk-3-0 unzip && \
    rm -rf /var/lib/apt/lists/*

# Crear carpeta de trabajo
WORKDIR /app

# Copiar los archivos de la aplicación al contenedor
COPY HolaMundo.java /app/
COPY run.sh /app/
COPY javafx-sdk-22 /app/javafx-sdk-22/

# Compilar el Hola Mundo
RUN javac --module-path /app/javafx-sdk-22/lib --add-modules javafx.controls HolaMundo.java

EOF ["/bin/bash", "/app/run.sh"]la app
laura@Debian:~/HolaMundoFX$ chmod +x run.sh
```

```
laura@Debian: ~/HolaMundoFX

laura@Debian:~/HolaMundoFX$ docker build -t holamundofx .
[+] Building 258.0s (13/13) FINISHED                                                    docker:default
 => [internal] load build definition from Dockerfile                                              0.2s
 => => transferring dockerfile: 732B                                                              0.0s
 => [internal] load metadata for docker.io/library/eclipse-temurin:21-jdk                         2.4s
 => [internal] load .dockerignore                                                                 0.1s
 => => transferring context: 2B                                                                   0.0s
 => [1/8] FROM docker.io/library/eclipse-temurin:21-jdk@sha256:7d1d666ddafac14da0ded6b4b076becf76cf88b31f9d7953a76555cc82f86511  82.7s
 => => resolve docker.io/library/eclipse-temurin:21-jdk@sha256:7d1d666ddafac14da0ded6b4b076becf76cf88b31f9d7953a76555cc82f86511  0.1s
 => => sha256:7d1d666ddafac14da0ded6b4b076becf76cf88b31f9d7953a76555cc82f86511 7.18kB / 7.18kB   0.0s
 => => sha256:99a8aa663868a7aeb6bef00c4ca28a80a04903203b0b05d92a996ae6dde06530 1.94kB / 1.94kB   0.0s
 => => sha256:7921d0fc61c8a5c89579cc46c49c36fe5fc8343c16ade91a99d6cf3c303d47c4 6.02kB / 6.02kB   0.0s
 => => sha256:4b3ffd8ccb5201a0fc03585952effb4ed2d1ea5e704d2e7330212fb8b16c86a3 29.72MB / 29.72MB  6.4s
 => => sha256:65b4a32fbe431639b79adda7867e30dbb873e9e3fa56316d9a2337742d88b6df 22.96MB / 22.96MB  6.0s
 => => sha256:71abb39f78a19b5f709d27618afb3c49cf897359e24fbbc7687ac47162a5cdab 157.81MB / 157.81MB  29.2s
 => => sha256:b32aac563deaabf58a971e1203a02a3fca848efbdca6e7a5bd6534167d16ce23 157B / 157B       6.7s
 => => sha256:2326993b9fe603f4efecedec459c92a6f5cbddca94dc55593db837055ac2e4e8 2.28kB / 2.28kB   6.9s
 => => extracting sha256:4b3ffd8ccb5201a0fc03585952effb4ed2d1ea5e704d2e7330212fb8b16c86a3         26.8s
 => => extracting sha256:65b4a32fbe431639b79adda7867e30dbb873e9e3fa56316d9a2337742d88b6df         12.7s
 => => extracting sha256:71abb39f78a19b5f709d27618afb3c49cf897359e24fbbc7687ac47162a5cdab         31.8s
 => => extracting sha256:b32aac563deaabf58a971e1203a02a3fca848efbdca6e7a5bd6534167d16ce23          0.0s
 => => extracting sha256:2326993b9fe603f4efecedec459c92a6f5cbddca94dc55593db837055ac2e4e8          0.0s
 => [internal] load build context                                                                21.1s
 => => transferring context: 127.49MB                                                            20.7s
 => [2/8] RUN apt-get update &&     apt-get install -y libgl1 libxext6 libxrender1 libxtst6 libgtk-3-0 unzip &&     rm -rf /var/lib/apt/lists/*  151.8s
 => [3/8] WORKDIR /app                                                                            0.5s
 => [4/8] COPY HolaMundo.java /app/                                                               0.3s
 => [5/8] COPY run.sh /app/                                                                       0.5s
 => [6/8] COPY javafx-sdk-22 /app/javafx-sdk-22/                                                  1.8s
 => [7/8] RUN javac --module-path /app/javafx-sdk-22/lib --add-modules javafx.controls HolaMundo.java  4.6s
 => [8/8] RUN chmod +x /app/run.sh                                                                1.5s
 => exporting to image                                                                           10.5s
 => => exporting layers                                                                          10.3s
 => => writing image sha256:8a0baa06b9e839fc7fd756a55c6def8a01a0469934ae3351a078f089741782c4      0.0s
 => => naming to docker.io/library/holamundofx                                                    0.1s
laura@Debian:~/HolaMundoFX$
```

Hay que cambiar a modo X11 con Xorg:



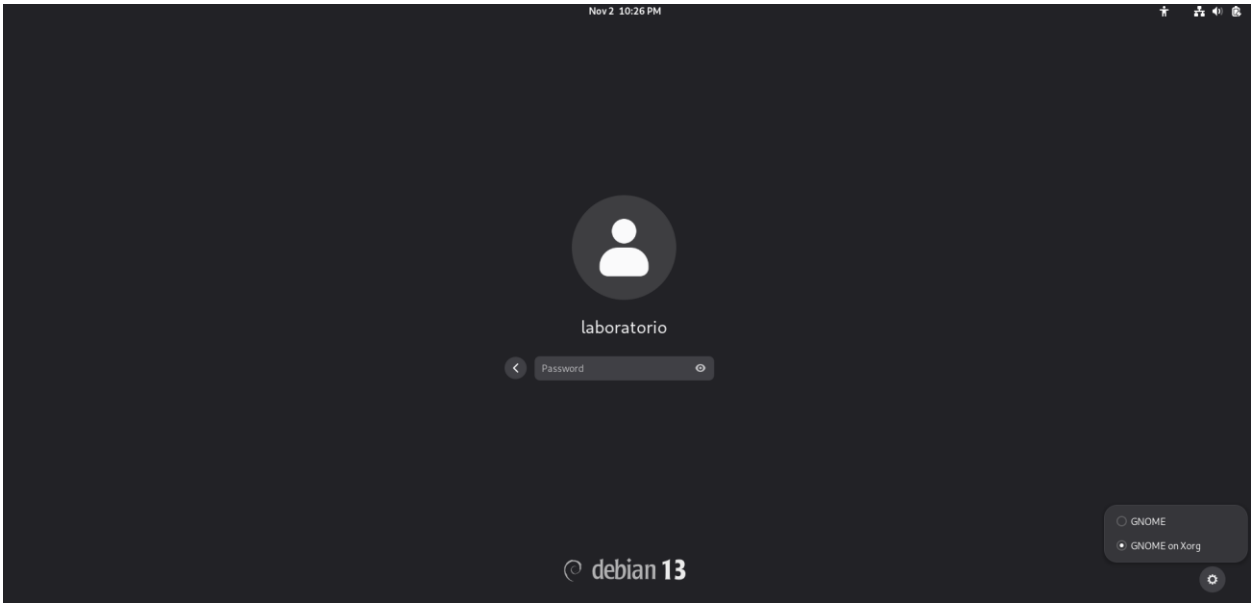


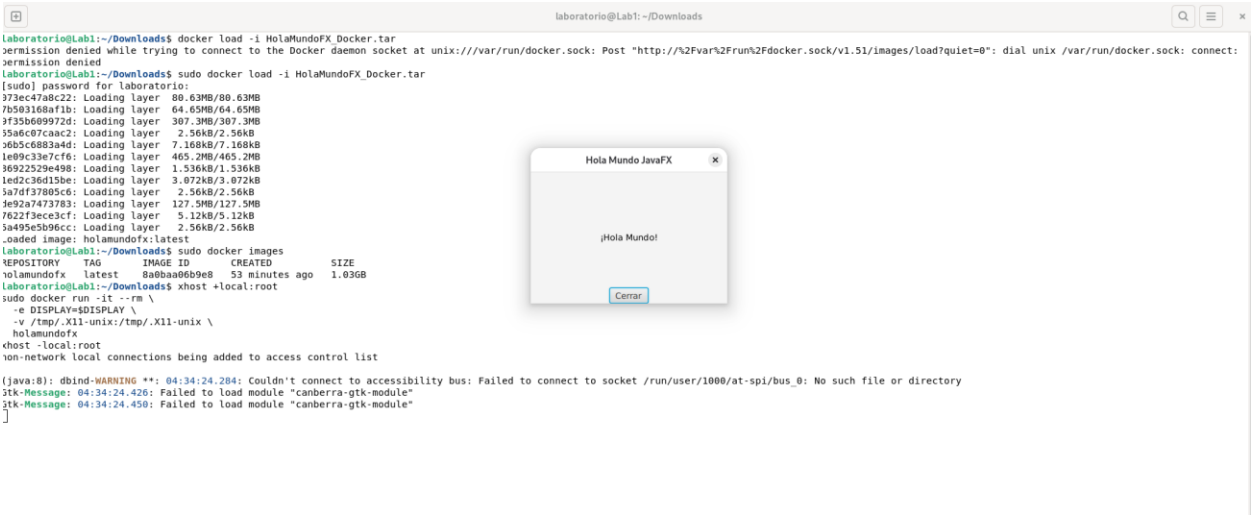


Ahora en la otra máquina virtual lo probamos

```
laboratorio@Lab1:~/Downloads$ sudo apt update
sudo apt install -y ca-certificates curl gnupg
sudo install -m 0755 -d /etc/apt/keyrings
curl -fsSL https://download.docker.com/linux/debian/gpg | sudo gpg --dearmor -o /etc/apt/keyrings/docker.gpg
echo \
  "deb [arch=$(dpkg --print-architecture) signed-by=/etc/apt/keyrings/docker.gpg] \
  https://download.docker.com/linux/debian \
  $(. /etc/os-release && echo "$VERSION_CODENAME") stable" | \
  sudo tee /etc/apt/sources.list.d/docker.list > /dev/null
sudo apt update
sudo apt install -y docker-ce docker-ce-cli containerd.io docker-buildx-plugin docker-compose-plugin
[sudo] password for laboratorio:
Hit:1 http://deb.debian.org/debian trixie InRelease
Hit:2 http://security.debian.org/debian-security trixie-security InRelease
Get:3 http://deb.debian.org/debian trixie-updates InRelease [47.3 kB]
Fetched 47.3 kB in 1s (41.2 kB/s)
20 packages can be upgraded. Run 'apt list --upgradable' to see them.
ca-certificates is already the newest version (20250419).
gnupg is already the newest version (2.4.7-21).
gnupg set to manually installed.
Installing:
  curl

Summary:
  Upgrading: 0, Installing: 1, Removing: 0, Not Upgrading: 20
  Download size: 269 kB
  Space needed: 506 kB / 6,624 MB available

Get:1 http://deb.debian.org/debian trixie/main amd64 curl amd64 8.14.1-2 [269 kB]
Fetched 269 kB in 1s (333 kB/s)
Selecting previously unselected package curl.
(Reading database ... 161126 files and directories currently installed.)
Preparing to unpack .../curl_8.14.1-2_amd64.deb ...
Unpacking curl (8.14.1-2) ...
Setting up curl (8.14.1-2) ...
Processing triggers for man-db (2.13.1-1) ...
Hit:1 http://deb.debian.org/debian trixie InRelease
Hit:2 http://security.debian.org/debian-security trixie-security InRelease
Hit:3 http://deb.debian.org/debian trixie-updates InRelease
Get:4 https://download.docker.com/linux/debian trixie InRelease [32.5 kB]
Get:5 https://download.docker.com/linux/debian trixie/stable amd64 Packages [14.3 kB]
Fetched 46.7 kB in 1s (36.4 kB/s)
20 packages can be upgraded. Run 'apt list --upgradable' to see them.
Installing:
  containerd.io  docker-buildx-plugin  docker-ce  docker-ce-cli  docker-compose-plugin

Installing dependencies:
  docker-ce-rootless-extras  git  git-man  iptables  liberror-perl  libip4tc2  libip6tc2  libslirp0  pigz  slirp4netns
```

```
Processing triggers for libc-bin (2.41-12) ...
laboratorio@Lab1:~/Downloads$ sudo systemctl status docker
● docker.service - Docker Application Container Engine
     Loaded: loaded (/usr/lib/systemd/system/docker.service; enabled; preset: enabled)
     Active: active (running) since Sun 2025-11-02 22:15:52 CST; 2min 49s ago
 Invocation: a884b5bd241d46be87584262df02130b
TriggeredBy: ● docker.socket
       Docs: https://docs.docker.com
   Main PID: 5397 (dockerd)
      Tasks: 8
     Memory: 103.4M (peak: 104.1M)
        CPU: 3.004s
     CGroup: /system.slice/docker.service
             └─5397 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/containerd.sock

Nov 02 22:15:45 Lab1 dockerd[5397]: time="2025-11-02T22:15:45.543251360-06:00" level=info msg="CDI directory does not exist, skipping: failed to monitor for changes: no such file or directory" dir=/var/run/cdi
Nov 02 22:15:45 Lab1 dockerd[5397]: time="2025-11-02T22:15:45.986236447-06:00" level=info msg="Creating a containerd client" address=/run/containerd/containerd.sock timeout=1m0s
Nov 02 22:15:46 Lab1 dockerd[5397]: time="2025-11-02T22:15:46.553434530-06:00" level=info msg="Loading containers: start."
Nov 02 22:15:49 Lab1 dockerd[5397]: time="2025-11-02T22:15:49.635938568-06:00" level=info msg="Loading containers: done."
Nov 02 22:15:50 Lab1 dockerd[5397]: time="2025-11-02T22:15:50.502073317-06:00" level=info msg="Docker daemon" commit=f8215cc containerd-snapshotter=false storage-driver=overlay2 version=28.5.1
Nov 02 22:15:50 Lab1 dockerd[5397]: time="2025-11-02T22:15:50.509511612-06:00" level=info msg="Initializing buildkit"
Nov 02 22:15:51 Lab1 dockerd[5397]: time="2025-11-02T22:15:51.923282342-06:00" level=info msg="Completed buildkit initialization"
Nov 02 22:15:52 Lab1 dockerd[5397]: time="2025-11-02T22:15:52.154897145-06:00" level=info msg="Daemon has completed initialization"
Nov 02 22:15:52 Lab1 dockerd[5397]: time="2025-11-02T22:15:52.155368944-06:00" level=info msg="API listen on /run/docker.sock"
Nov 02 22:15:52 Lab1 systemd[1]: Started docker.service - Docker Application Container Engine.
laboratorio@Lab1:~/Downloads$
```





7. Compare FlatPak y Docker basándose en su experiencia con este ejercicio (10pts).

El proceso de contenedores en Docker fue más rápida y sencilla de configurar en comparación de FlatPak, también se encuentra más información sobre la herramienta Docker.

En el caso de FlatPak tuvimos más errores al momento de configurarlo.

Docker fue más rápido de preparar, pero necesitó cambiar la sesión del sistema a GNOME on Xorg para que se mostrara la ventana JavaFX.

Ambas opciones permitieron ejecutar el “Hola Mundo”, pero cada una tiene su enfoque: Flatpak está más orientado a aplicaciones gráficas de escritorio, y Docker es más flexible y práctico para entornos nuevos o de desarrollo.

Entonces en general Docker fue más directo de usar, aunque Flatpak ofreció una mejor integración con el entorno gráfico de Debian.

Referencias bibliográficas

Debian Project. (2024). *ServiceSandboxing*. https://wiki.debian.org/ServiceSandboxing

Docile, E. (2025, 21 septiembre). *How to create a flatpak package*. LinuxConfig.org. https://linuxconfig.org/how-to-create-a-flatpak-package

Docker Inc. (s. f.). *Install Docker Engine on Debian*. Docker Documentation. https://docs.docker.com/engine/install/debian/

Flatpak. (s. f.). *Ubuntu Quick Setup*. https://flatpak.org/setup/Ubuntu

Hogan, B. (2022, 17 marzo). *How To Install and Use Docker on Debian 10*. DigitalOcean. https://www.digitalocean.com/community/tutorials/how-to-install-and-use-docker-on-debian-10

Jonathan Aquilina. (2024, 17 enero). FAQ - What is the difference between Linux RPM & DEB packages? *Eagle Eye Technology*. https://eagleeyet.net/blog/faq/faq-what-is-the-difference-between-linux-rpm-deb-packages/

Linux Containers Project. (s. f.). *Introduction to LXC*. Linux Containers. https://linuxcontainers.org/lxc/introduction/

Nava, J. (2024, 29 abril). *¿Qué es un sandbox o entorno de pruebas, cómo funciona y para qué se utiliza?* Empower Talent. https://empowertalent.com/que-es-sandbox/

Oracle. (s. f.). *Getting started with JavaFX: 1 Hello World, JavaFX Style*. https://docs.oracle.com/javafx/2/get_started/hello_world.htm

Red Hat. (s. f.). *Chapter 1. Introduction to RPM*. https://docs.redhat.com/en/documentation/red_hat_enterprise_linux/8/html/packaging_and_distributing_software/introduction-to-rpm_packaging-and-distributing-software

Susnjara, S., & Smalley, I. (s. f.). *¿Qué son los contenedores?* IBM. https://www.ibm.com/es-es/think/topics/containers#:~:text=Los%20contenedores%20son%20unidades%20ejecutables,o%20infraestructura%20en%20la%20nube.

Vlythr. (2023). *Secure your applications with Firejail: A Linux sandbox tutorial.* DEV Community. https://dev.to/vlythr/secure-your-applications-with-firejail-a-step-by-step-linux-sandbox-tutorial-4f9b

Zenarmor. (2024, 19 julio). *Package Management in Linux: What is a Linux Package Manager?* https://www.zenarmor.com/docs/linux-tutorials/what-is-package-management-in-linux