



UNIDAD DE APRENDIZAJE

“DESARROLLO DE SISTEMAS DISTRIBUIDOS”

“TAREA 3. MULTIPLICACIÓN DE MATRICES”



ALUMNO:

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GRUPO 4CV13

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Desarrollo de la practica

La multiplicación de matrices es un problema que dependiendo del tamaño de estas pueden llevar un gran tiempo para un equipo de cómputo común. Aun con un equipo de computo potente si el tamaño de la matriz es muy grande podría tardar u ocasionar algún problema con la memoria de la máquina.

Para la solución de este problema podemos optar con dividir la matriz en pequeñas partes y que estas sean resultas en un equipo aparte.

Teniendo el caso en que tenemos 2 maquinas aparte de nuestro cliente, vamos a dividir la matriz de tal forma que la primera maquina resuelva la parte superior de la matriz y la segunda la parte inferior.

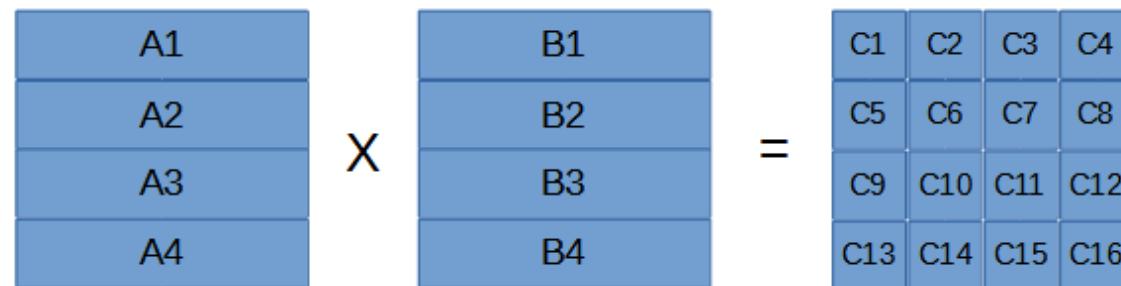


Ilustración 1: Diagrama de referencia

De tal forma:

- Servidor 1: C1, ..., C8.
- Servidor 2: C9, ..., C16.

Para la creación de nuestras máquinas virtuales se hará en la plataforma de Azure con una cuenta para estudiantes.

Buscaremos el recurso que queremos crear y lo seleccionaremos.

The screenshot shows the Microsoft Azure portal interface. The top navigation bar includes links for Project Zomboid Map Pro, ESCOM/AutomataThompson, Todos los servicios - Microsoft, Ver Anime Online HD, and several other tabs. The user's name, amorench1400@alumno.ipn.mx, is visible in the top right corner. The main dashboard is titled 'Todos los servicios' (All services). On the left, there is a sidebar with categories like General, Compute, Storage, Network, Analytics, AI + aprendizaje automático, Internet of things, Realidad mixta, Integración, Identidad, Seguridad, DevOps, Migración, Monitor, Management and governance, Intune, Híbrido y multinube, and Otro. The 'Compute' section is expanded, showing sub-categories such as General (18), Compute (25), and Redes (34). The 'Redes' section is also expanded, showing sub-categories like Redes virtuales, Equilibradores de carga, Grupos de seguridad de red, Interfaces de red, and so on. The 'Máquinas virtuales' icon is highlighted with a blue box. The bottom of the screen shows the Windows taskbar with various pinned icons and the system tray indicating the date and time as 09:09 p.m. on 22/10/2022.

Ilustración 2 : Creación de máquina virtual

Después de esto llenaremos los datos que nos piden (Grupo de recursos, Nombre de la máquina virtual, Imagen de SO, Tamaño de la maquina) , para la autenticación usaremos una por usuario y contraseña para una conexión SSH.

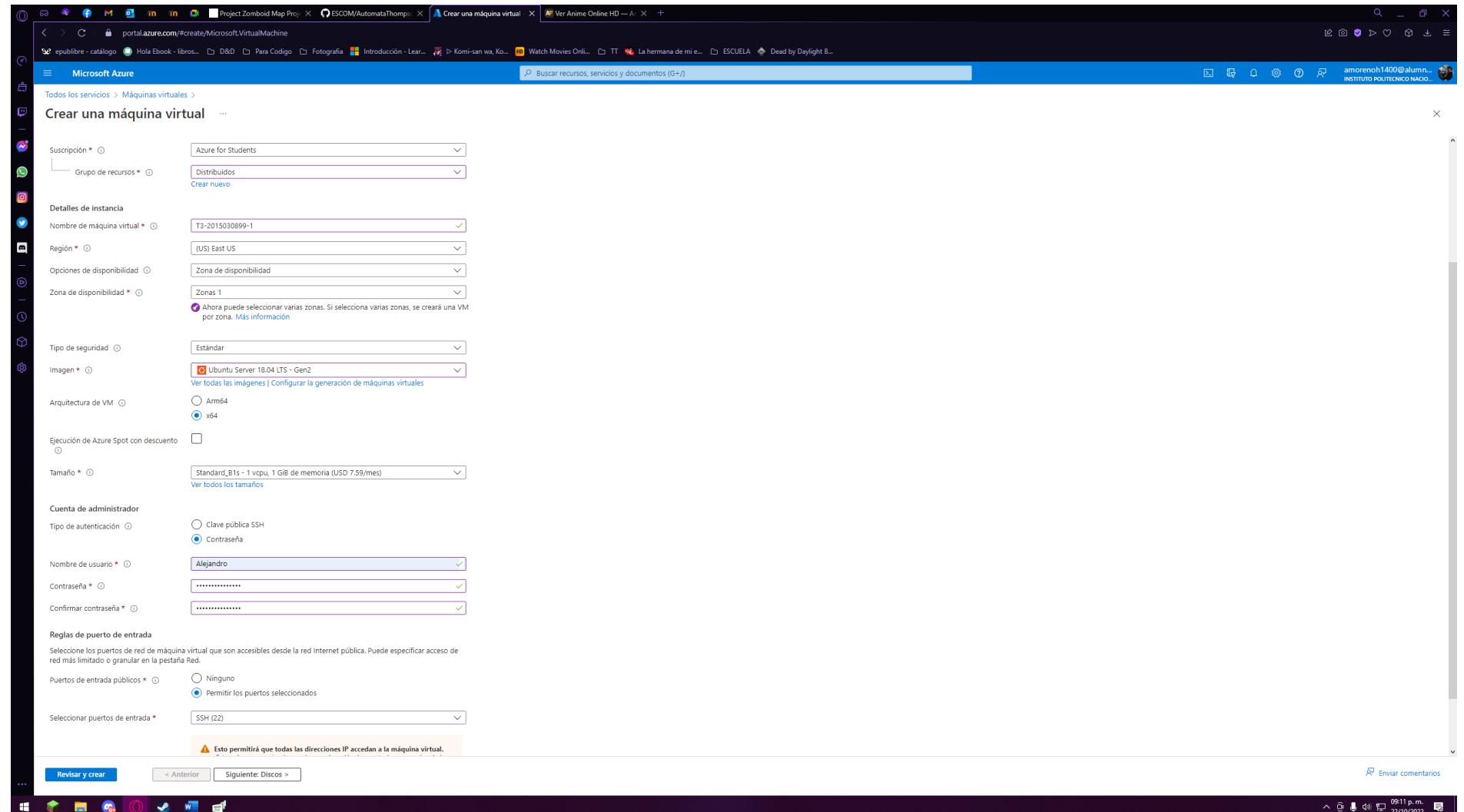


Ilustración 3 : Parámetros de la máquina virtual.

Para el tipo de almacenamiento usaremos un HDD estándar.

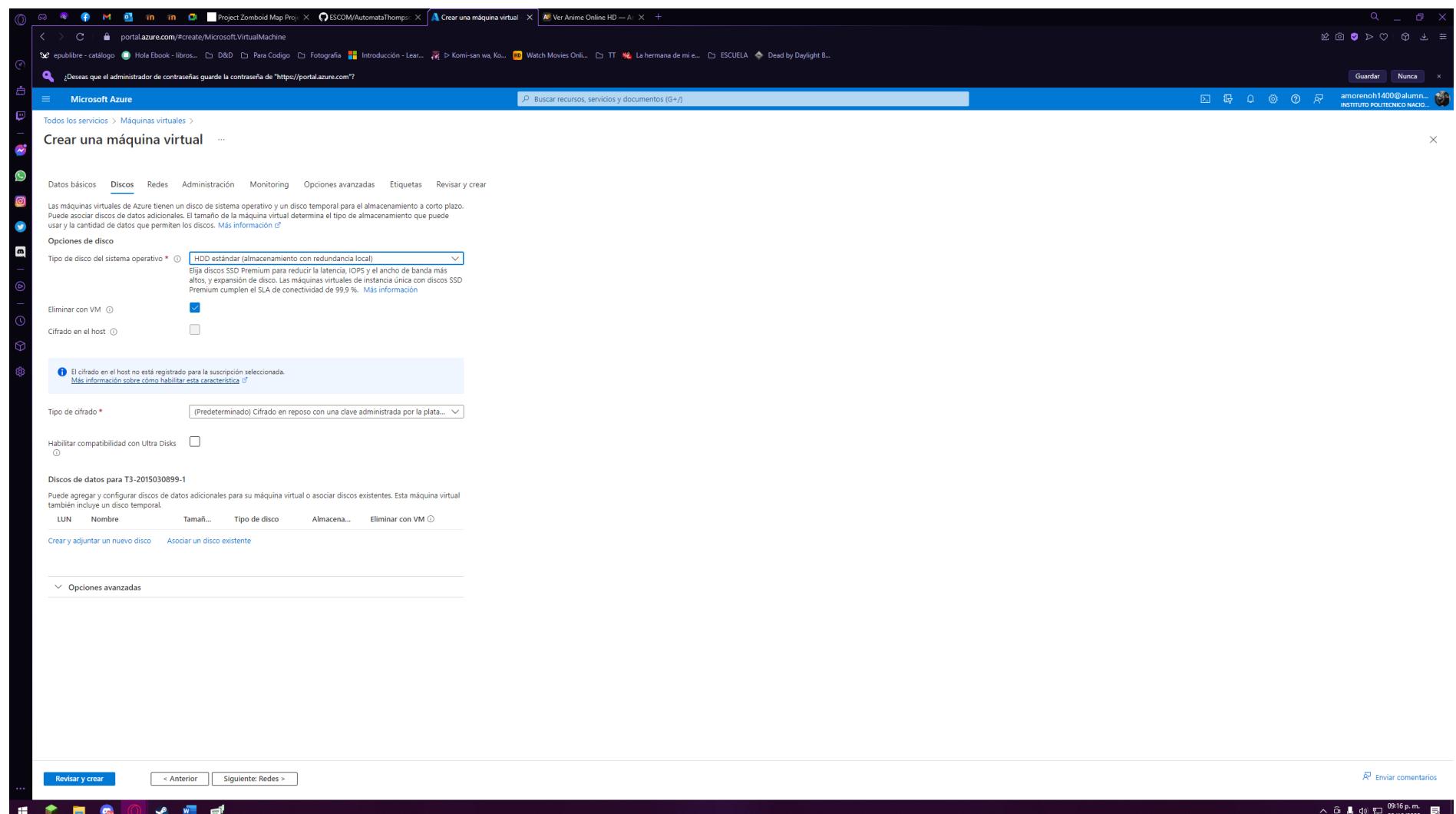


Ilustración 4 : Discos de MV

Nos aseguramos que el puerto SSH(22) este seleccionado ya que eso nos dará acceso a la máquina.

The screenshot shows the Microsoft Azure portal interface for creating a new virtual machine. The current step is 'Create a virtual machine' under the 'Network' tab. Key configuration details include:

- Red virtual:** Distribuidos-vnet
- Subred:** default (10.0.0.0/24)
- IP pública:** (nuevo) T3-2015030899-1-ip
- Grupo de seguridad de red de NIC:** Básico (selected)
- Puertos de entrada públicos:** Permitir los puertos seleccionados (selected), with SSH (22) listed.
- Equilibrio de carga:** Ninguno (selected)

A warning message is displayed regarding public IP access:

Este permitirá que todas las direcciones IP accedan a la máquina virtual.
Este solo se recomienda para las pruebas. Use los controles avanzados de la pestaña Redes a fin de crear reglas para limitar el tráfico entrante a las direcciones IP conocidas.

At the bottom, there are buttons for 'Revisar y crear' (Review and Create) and 'Siguiente: Administración >' (Next: Administration).

Ilustración 5 : Redes de MV

En monitoreo vamos a deshabilitar el diagnostico de arranque y daremos procedemos a crear la maquina

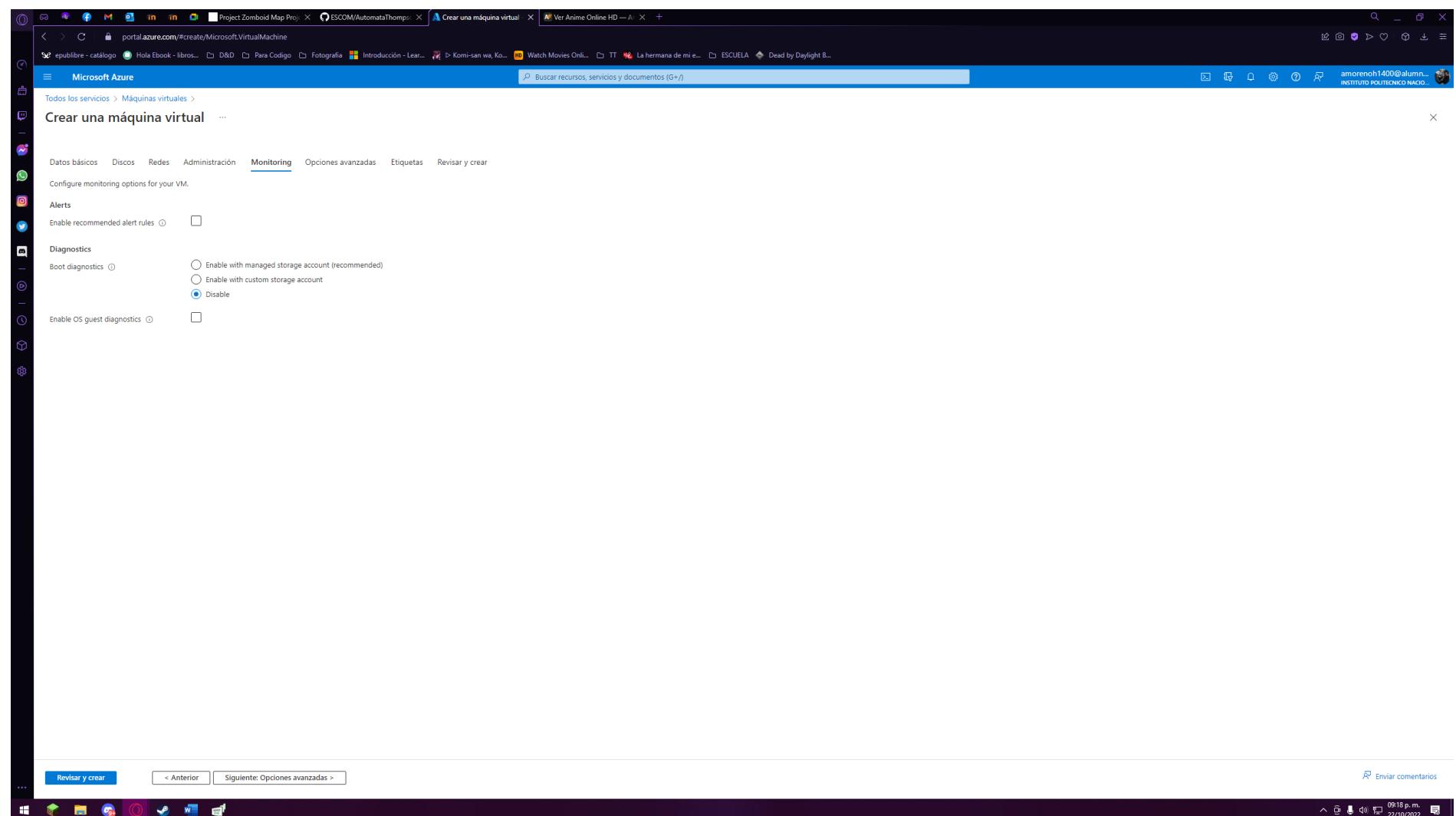


Ilustración 6 : Monitoreo

Revisemos que todos los parámetros relacionas sean correctos antes de crear nuestra máquina virtual.

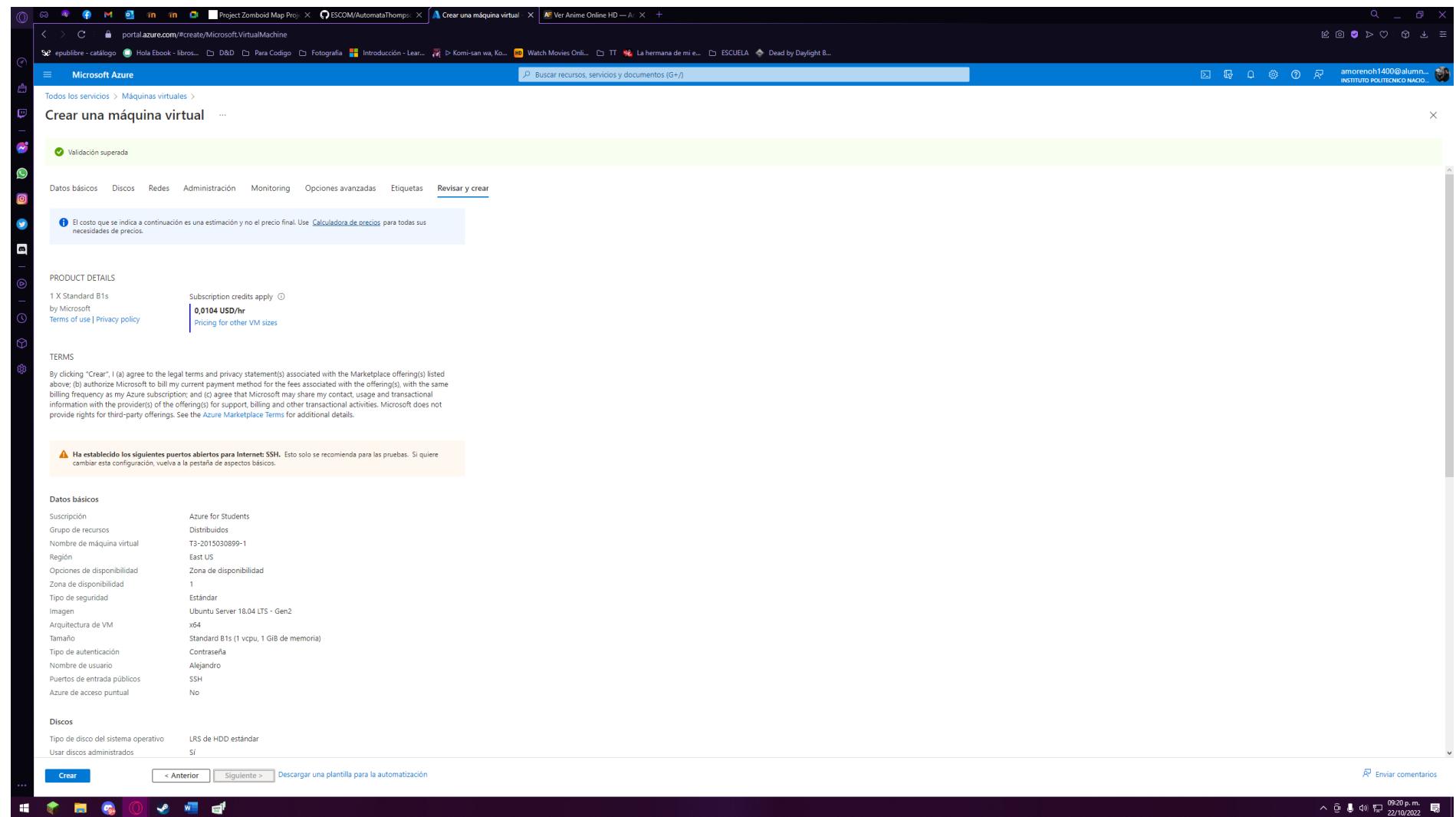


Ilustración 7 : Creación de la máquina virtual

Una vez creada nuestra maquina virtual podemos proceder a utilizarla, pero para esta practica primero demos configurar el puerto por el cual se conectara nuestro programa para multiplicar matrices.

The screenshot shows the Microsoft Azure portal interface. At the top, there's a navigation bar with various icons and links. Below it, the main header reads "CreateVm-Canonical.UbuntuServer-18_04-Its-gen2-2022102221105 | Información general". On the left, a sidebar lists "Todos los servicios >" and "CreateVm-Canonical.UbuntuServer-18_04-Its-gen2-2022102221105 | Implementación". The main content area displays a green checkmark indicating "Se completó la implementación". It shows details like the implementation name, start time (22/10/2022, 21:21:40), subscription (Azure for Students), resource group (Distribuidos), and correlation ID (8c439e65-e288-4457-9181-8dd6b4bf0fca). Below this, sections for "Detalles de implementación" and "Pasos siguientes" are visible, each with several recommended steps. At the bottom of the main content, there are buttons for "Ir al recurso" and "Crear otra VM". To the right, there are promotional cards for "Cost Management", "Microsoft Defender for Cloud", "Tutoriales gratuitos de Microsoft", and "Trabajar con un experto". The bottom of the screen shows the Windows taskbar with various pinned icons and the system tray.

Ilustración 8 : Máquina Virtual creada

Para abrir el puerto que queremos utilizar iremos al recurso de la maquina virtual>Redes y seleccionaremos la opción de “Aregar regla de puerto de entrada”

The screenshot shows the Microsoft Azure portal interface for managing a virtual machine named T3-2015030899-1. The left sidebar navigation bar includes links for Project Zomboid Map Project, ESCOM/AutomataThompson, T3-2015030899-1 - Microsoft, Ver Anime Online HD - Al...+, portal.azure.com, and various pinned items like epublibre - catálogo, Hola Ebook - libros..., D&D, Para Código, Fotografía, Introducción - Lear..., Komi-san wa, Ko..., Watch Movies Online, TT, La hermana de mi e..., ESCUELA, and Dead by Daylight B... . The main content area displays the 'Redes' (Network) settings for the VM. It shows the IP configuration (ipconfig1 (Principal)) and lists several existing inbound security rules. At the bottom right of the rules table, there is a blue-outlined button labeled 'Agregar regla de puerto de entrada' (Add inbound port rule), which is highlighted with a blue oval.

Prioridad	Nombre	Puerto	Protocolo	Origen	Destino	Acción	...
300	SSH	22	TCP	Cualquiera	Cualquiera	Permitir	...
65000	AllowVnetInbound	Cualquiera	Cualquiera	VirtualNetwork	VirtualNetwork	Permitir	...
65001	AllowAzureLoadBalancerInbound	Cualquiera	Cualquiera	AzureLoadBalancer	Cualquiera	Permitir	...
65500	DenyAllInbound	Cualquiera	Cualquiera	Cualquiera	Cualquiera	Denegar	...

Ilustración 9 : Agregar regla de puerto de entrada

Seleccionaremos el puerto o el rango de puerto a abrir para después agregar la regla.

The screenshot shows the Microsoft Azure portal interface. On the left, the navigation menu is open, showing options like 'Redes' (Network) under 'Configuración' (Configuration). The main content area displays the 'Redes' (Network) settings for a VM named 'T3-2015030899-1'. Under 'Interfaz de red: t3-2015030899-1129_z1', it lists existing security rules. A modal dialog box titled 'Agregar regla de seguridad de entrada' (Add Network Security Rule) is open on the right, allowing the creation of a new rule. The dialog fields include:

- Origen:** Any
- Intervalos de puertos de origen:** 50000
- Destino:** Any
- Servicio:** Custom
- Intervalos de puertos de destino:** 50000
- Protocolo:** TCP (selected)
- Acción:** Permitir (selected)
- Prioridad:** 310
- Nombre:** Puerto_50000
- Descripción:** (empty)

At the bottom of the dialog are 'Agregar' (Add) and 'Cancelar' (Cancel) buttons.

Ilustración 10 : Creando la regla de puerto

Una vez creada la máquina virtual y con la configuración necesaria para que sea nuestro servidor, empezaremos a instalar el JDK para la ejecución de nuestro programa.

Nos conectaremos a nuestra maquina por SSH de la siguiente manera: ssh *usuario@ip*

```
Alejandro@T3-2015030899-1: ~
ssh Alejandro@T3-20...
Matriz ➜ ssh Alejandro@4.227.185.167
The authenticity of host '4.227.185.167 (4.227.185.167)' can't be established.
ECDSA key fingerprint is SHA256:wvjf42FCir9eGnS8z+EzcPKZ9+it1/SdNt3JmvyzMxo.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '4.227.185.167' (ECDSA) to the list of known hosts.
Alejandro@4.227.185.167's password:
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1094-azure x86_64)

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

 System information as of Sun Oct 23 02:32:08 UTC 2022

System load:  0.0          Processes:      98
Usage of /:   4.8% of 28.89GB  Users logged in:  0
Memory usage: 20%           IP address for eth0: 10.0.0.5
Swap usage:   0%

0 updates can be applied immediately.

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.

Alejandro@T3-2015030899-1:~$ |
```



Ilustración 11 : Conexión SSH

Una vez ingresemos la contraseña tendremos acceso a nuestra maquina virtual por medio de SSH.

Para la instalacion de JDK primero tendremos que actualizar las dependencias de nuestra maquina recién instalada con el comando:

```
sudo apt update
```



```
Alejandro@T3-2015030899-1:~$ sudo apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu bionic InRelease
Get:2 http://azure.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Get:3 http://azure.archive.ubuntu.com/ubuntu bionic-backports InRelease [83.3 kB]
Get:4 http://azure.archive.ubuntu.com/ubuntu bionic-security InRelease [88.7 kB]
Get:5 http://azure.archive.ubuntu.com/ubuntu bionic/universe amd64 Packages [8570 kB]
Get:6 http://azure.archive.ubuntu.com/ubuntu bionic/universe Translation-en [4941 kB]
Get:7 http://azure.archive.ubuntu.com/ubuntu bionic/multiverse amd64 Packages [151 kB]
Get:8 http://azure.archive.ubuntu.com/ubuntu bionic/multiverse Translation-en [108 kB]
Get:9 http://azure.archive.ubuntu.com/ubuntu bionic-updates/main amd64 Packages [2785 kB]
Get:10 http://azure.archive.ubuntu.com/ubuntu bionic-updates/main Translation-en [513 kB]
Get:11 http://azure.archive.ubuntu.com/ubuntu bionic-updates/universe amd64 Packages [1853 kB]
Get:12 http://azure.archive.ubuntu.com/ubuntu bionic-updates/universe Translation-en [401 kB]
Get:13 http://azure.archive.ubuntu.com/ubuntu bionic-updates/multiverse amd64 Packages [24.9 kB]
Get:14 http://azure.archive.ubuntu.com/ubuntu bionic-updates/multiverse Translation-en [6012 B]
Get:15 http://azure.archive.ubuntu.com/ubuntu bionic-backports/main amd64 Packages [53.3 kB]
Get:16 http://azure.archive.ubuntu.com/ubuntu bionic-backports/main Translation-en [14.5 kB]
Get:17 http://azure.archive.ubuntu.com/ubuntu bionic-backports/universe amd64 Packages [18.1 kB]
Get:18 http://azure.archive.ubuntu.com/ubuntu bionic-backports/universe Translation-en [8668 B]
Get:19 http://azure.archive.ubuntu.com/ubuntu bionic-security/main amd64 Packages [2445 kB]
Get:20 http://azure.archive.ubuntu.com/ubuntu bionic-security/main Translation-en [422 kB]
Get:21 http://azure.archive.ubuntu.com/ubuntu bionic-security/restricted amd64 Packages [943 kB]
Get:22 http://azure.archive.ubuntu.com/ubuntu bionic-security/restricted Translation-en [131 kB]
Get:23 http://azure.archive.ubuntu.com/ubuntu bionic-security/universe amd64 Packages [1239 kB]
Get:24 http://azure.archive.ubuntu.com/ubuntu bionic-security/universe Translation-en [284 kB]
Get:25 http://azure.archive.ubuntu.com/ubuntu bionic-security/multiverse amd64 Packages [19.0 kB]
Get:26 http://azure.archive.ubuntu.com/ubuntu bionic-security/multiverse Translation-en [3836 B]
Fetched 25.2 MB in 5s (5194 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
6 packages can be upgraded. Run 'apt list --upgradable' to see them.
Alejandro@T3-2015030899-1:~$ |
```

Ilustración 12 : Actualización de dependencias

Una vez con las dependencias actualizadas procedemos a la instalacion de java con los comandos de:

sudo apt install default-jre

sudo apt install default-jdk

```
Alejandro@T3-2015030899-1:~$ 
Alejandro@T3-2015030899-1:~$ 
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/javac to provide /usr/bin/javac (javac) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/javadoc to provide /usr/bin/javadoc (javadoc) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/javap to provide /usr/bin/javap (javap) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jcmd to provide /usr/bin/jcmd (jcmd) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jdb to provide /usr/bin/jdb (jdb) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jdeprscan to provide /usr/bin/jdeprscan (jdeprscan) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jdeps to provide /usr/bin/jdeps (jdeps) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jfr to provide /usr/bin/jfr (jfr) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jimage to provide /usr/bin/jimage (jimage) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jinfo to provide /usr/bin/jinfo (jinfo) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jlink to provide /usr/bin/jlink (jlink) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jmap to provide /usr/bin/jmap (jmap) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jmod to provide /usr/bin/jmod (jmod) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jps to provide /usr/bin/jps (jps) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jrunscript to provide /usr/bin/jrunscript (jrunscript) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jshell to provide /usr/bin/jshell (jshell) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jstack to provide /usr/bin/jstack (jstack) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jstat to provide /usr/bin/jstat (jstat) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jstard to provide /usr/bin/jstard (jstard) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/rmic to provide /usr/bin/rmic (rmic) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/serialver to provide /usr/bin/serialver (serialver) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jaotc to provide /usr/bin/jaotc (jaotc) in auto mode
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jhsdb to provide /usr/bin/jhsdb (jhsdb) in auto mode
Setting up x11proto-dev (2018.4-4) ...
Setting up xtrans-dev (1.3.5-1) ...
Setting up libxdmcp-dev:amd64 (1:1.1.2-3) ...
Setting up libice-dev:amd64 (2:1.0.9-2) ...
Setting up libx11-doc (2:1.6.4-3ubuntu0.4) ...
Setting up openjdk-11-jdk:amd64 (11.0.16+8-0ubuntu1~18.04) ...
update-alternatives: using /usr/lib/jvm/java-11-openjdk-amd64/bin/jconsole to provide /usr/bin/jconsole (jconsole) in auto mode
Setting up default-jdk-headless (2:1.11-68ubuntu1~18.04.1) ...
Setting up libsm-dev:amd64 (2:1.2.2-1) ...
Setting up x11proto-core-dev (2018.4-4) ...
Setting up libxau-dev:amd64 (1:1.0.8-1ubuntu1) ...
Setting up libxcb1-dev:amd64 (1.13-2~ubuntu18.04) ...
Setting up libx11-dev:amd64 (2:1.6.4-3ubuntu0.4) ...
Setting up default-jdk (2:1.11-68ubuntu1~18.04.1) ...
Setting up libxt-dev:amd64 (1:1.1.5-1) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
Alejandro@T3-2015030899-1:~$ java --version
openjdk 11.0.16 2022-07-19
OpenJDK Runtime Environment (build 11.0.16+8-post-Ubuntu-0ubuntu118.04)
OpenJDK 64-Bit Server VM (build 11.0.16+8-post-Ubuntu-0ubuntu118.04, mixed mode, sharing)
Alejandro@T3-2015030899-1:~$ javac --version
javac 11.0.16
Alejandro@T3-2015030899-1:~$ |
```



Ilustración 13 : Instalación de java

Una vez terminada la instalación nos deberá reconocer las variables de java

Una vez terminada la instalacion de java procedemos a enviar el código fuente de nuestro programa a nuestra maquina vía sftp.
Para eso haremos la conexión con el comando:

```
sftp usuario@ip
```

```
Alejandro@T3-2015030899-1: ~$ sftp Alejandro@4.227.185.167
The authenticity of host '4.227.185.167 (4.227.185.167)' can't be established.
ECDSA key fingerprint is SHA256:wvjf42FCir9eGnS8z+EzcPKZ9+it1/SdNt3JmvyzMxo.
Are you sure you want to continue connecting (yes/no)? y
Please type 'yes' or 'no': y
Please type 'yes' or 'no': yes
Warning: Permanently added '4.227.185.167' (ECDSA) to the list of known hosts.
Alejandro@4.227.185.167's password:
Permission denied, please try again.
Alejandro@4.227.185.167's password:
Connected to 4.227.185.167.
sftp> |
```



Ilustración 14 : Conexión sftp

Al igual que SSH ingresaremos nuestra contraseña y nos dará conexión a nuestra máquina virtual.

Para enviar un archivo de nuestro equipo local a nuestro servidor remoto usaremos el comando de `put` seguido de la dirección de nuestro archivo en nuestra maquina local. Si no estamos seguros de en que parte de nuestra maquina virtual nos encontramos podemos ejecutar el comando `lpwd` y para saber a que carpeta de nuestro servidor nos conectamos podemos usar el comando `pwd`

A screenshot of a terminal window titled "pwsh in Matriz". The window shows an SFTP session with the command "sftp Alejandro@4.227.185.167". The password is entered, and the connection is established to the remote host. The local working directory is "d:\pc\escritorio\curso en linea\ultimo-semestre\cliente-servidor\matrix" and the remote working directory is "/home/Alejandro". The session ends with "sftp> |". The background of the desktop is a dark blue image of the Pokémon Gengar.

Ilustración 15: Comando para saber ruta

Buscamos nuestro archivo en nuestra maquina local con el comando `lls` y con el comando `put` lo enviamos a nuestro servidor remoto.

Para verificar esto solo debemos ejecutar el comando `ls` para mostrar los archivos en nuestro directorio de conexión.



```
pswh in Matriz
-> sftp Alejandro@4.227.185.167
Alejandro@4.227.185.167's password:
Connected to 4.227.185.167.
sftp> lpwd
Local working directory: d:\pc\escritorio\curso en linea\ultimo-semestre\cliente-servidor\matriz
sftp> pwd
Remote working directory: /home/Alejandro
sftp> ll
El volumen de la unidad D es Disco local
El n mero de serie del volumen es: A6AB-8EC2

Directorio de D:\PC\Escritorio\Curso en linea\Ultimo-Semestre\Cliente-Servidor\Matriz

22/10/2022 08:53 p. m.    <DIR>      .
22/10/2022 08:53 p. m.    <DIR>      ..
18/10/2022 01:02 p. m.  2,212,981 AlejandroMorenoHurtado_Tarea1.docx
21/10/2022 05:15 p. m.   2,616 Matriz.class
22/10/2022 05:35 p. m.  1,312 mMatriз$Cliente.class
22/10/2022 05:35 p. m.  2,570 mMatriз$Matriz.class
22/10/2022 05:35 p. m.  1,194 mMatriз$Servidor.class
22/10/2022 05:35 p. m.  1,737 mMatriз.class
22/10/2022 05:34 p. m.  7,256 mMatriз.java
22/10/2022 12:30 a. m. 1,466 mulMatriз$Cliente.class
22/10/2022 12:30 a. m. 2,576 mulMatriз$Matriz.class
22/10/2022 12:30 a. m. 1,435 mulMatriз$Servidor.class
22/10/2022 12:30 a. m. 1,825 mulMatriз.class
22/10/2022 12:35 a. m. 7,630 mulMatriз.java
          12 archivos     2,244,598 bytes
          2 dirs   397,411,053,568 bytes libres
sftp> put mMatriз.java
Uploading mMatriз.java to /home/Alejandro/mMatriз.java
mMatriз.java
sftp> ls
mMatriз.java
sftp> |
```

Ilustraci n 16 : Subida de archivo por sftp

Procedemos a la ejecución de nuestro programa con una matriz de 12.

pwsh in Matriz

```
<1> pwsh in Matriz <2> Alejandro@T3-20... <3> Alejandro@T3-20...
Alejandro@T3-2015030899-1:~$ exit
logout
Connection to 4.227.185.167 closed.
Matriz > javac .\mMatriz.java;java mMatriz 0 12
----- Matriz A -----
| 0.0   3.0   6.0   9.0   12.0  15.0  18.0  21.0  24.0  27.0  30.0  33.0 |
| 1.0   4.0   7.0  10.0  13.0  16.0  19.0  22.0  25.0  28.0  31.0  34.0 |
| 2.0   5.0   8.0  11.0  14.0  17.0  20.0  23.0  26.0  29.0  32.0  35.0 |
| 3.0   6.0   9.0  12.0  15.0  18.0  21.0  24.0  27.0  30.0  33.0  36.0 |
| 4.0   7.0  10.0  13.0  16.0  19.0  22.0  25.0  28.0  31.0  34.0  37.0 |
| 5.0   8.0  11.0  14.0  17.0  20.0  23.0  26.0  29.0  32.0  35.0  38.0 |
| 6.0   9.0  12.0  15.0  18.0  21.0  24.0  27.0  30.0  33.0  36.0  39.0 |
| 7.0  10.0  13.0  16.0  19.0  22.0  25.0  28.0  31.0  34.0  37.0  40.0 |
| 8.0  11.0  14.0  17.0  20.0  23.0  26.0  29.0  32.0  35.0  38.0  41.0 |
| 9.0  12.0  15.0  18.0  21.0  24.0  27.0  30.0  33.0  36.0  39.0  42.0 |
| 10.0 13.0  16.0  19.0  22.0  25.0  28.0  31.0  34.0  37.0  40.0  43.0 |
| 11.0 14.0  17.0  20.0  23.0  26.0  29.0  32.0  35.0  38.0  41.0  44.0 |
----- Matriz B -----
| 0.0  -1.0  -2.0  -3.0  -4.0  -5.0  -6.0  -7.0  -8.0  -9.0  -10.0 -11.0 |
| 2.0   1.0   0.0  -1.0  -2.0  -3.0  -4.0  -5.0  -6.0  -7.0  -8.0  -9.0 |
| 4.0   3.0   2.0   1.0   0.0  -1.0  -2.0  -3.0  -4.0  -5.0  -6.0  -7.0 |
| 6.0   5.0   4.0   3.0   2.0   1.0   0.0  -1.0  -2.0  -3.0  -4.0  -5.0 |
| 8.0   7.0   6.0   5.0   4.0   3.0   2.0   1.0   0.0  -1.0  -2.0  -3.0 |
| 10.0  9.0   8.0   7.0   6.0   5.0   4.0   3.0   2.0   1.0   0.0  -1.0 |
| 12.0  11.0  10.0   9.0   8.0   7.0   6.0   5.0   4.0   3.0   2.0   1.0 |
| 14.0  13.0  12.0  11.0  10.0   9.0   8.0   7.0   6.0   5.0   4.0   3.0 |
| 16.0  15.0  14.0  13.0  12.0  11.0  10.0   9.0   8.0   7.0   6.0   5.0 |
| 18.0  17.0  16.0  15.0  14.0  13.0  12.0  11.0  10.0   9.0   8.0   7.0 |
| 20.0  19.0  18.0  17.0  16.0  15.0  14.0  13.0  12.0  11.0  10.0  9.0 |
| 22.0  21.0  20.0  19.0  18.0  17.0  16.0  15.0  14.0  13.0  12.0  11.0 |
----- Matriz C -----
| 3036.0 2838.0 2640.0 2442.0 2244.0 2046.0 1848.0 1650.0 1452.0 1254.0 1056.0 858.0 |
| 3168.0 2958.0 2748.0 2538.0 2328.0 2118.0 1908.0 1698.0 1488.0 1278.0 1068.0 858.0 |
| 3300.0 3078.0 2856.0 2634.0 2412.0 2190.0 1968.0 1746.0 1524.0 1302.0 1080.0 858.0 |
| 3432.0 3198.0 2964.0 2730.0 2496.0 2262.0 2028.0 1794.0 1560.0 1326.0 1092.0 858.0 |
| 3564.0 3318.0 3072.0 2826.0 2580.0 2334.0 2088.0 1842.0 1596.0 1350.0 1104.0 858.0 |
| 3696.0 3438.0 3180.0 2922.0 2664.0 2406.0 2148.0 1890.0 1632.0 1374.0 1116.0 858.0 |
| 3828.0 3558.0 3288.0 3018.0 2748.0 2478.0 2208.0 1938.0 1668.0 1398.0 1128.0 858.0 |
| 3960.0 3678.0 3396.0 3114.0 2832.0 2550.0 2268.0 1986.0 1704.0 1422.0 1140.0 858.0 |
| 4092.0 3798.0 3504.0 3210.0 2916.0 2622.0 2328.0 2034.0 1740.0 1446.0 1152.0 858.0 |
| 4224.0 3918.0 3612.0 3306.0 3000.0 2694.0 2388.0 2082.0 1776.0 1470.0 1164.0 858.0 |
| 4356.0 4038.0 3720.0 3402.0 3084.0 2766.0 2448.0 2130.0 1812.0 1494.0 1176.0 858.0 |
| 4488.0 4158.0 3828.0 3498.0 3168.0 2838.0 2508.0 2178.0 1848.0 1518.0 1188.0 858.0 |
----- Matriz C -----
Checksum:332640.0
PC >■ Matriz > o ?main = o ?3 ~3 > |
```

in pwsh at 21:59:26

PC > ssh Alejandro@4.227.185.167
Alejandro@4.227.185.167's password:
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1094-azure x86_64)
* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/advantage
System information as of Sun Oct 23 02:58:18 UTC 2022
System load: 0.0 Processes: 98
Usage of /: 7.2% of 28.89GB Users logged in: 0
Memory usage: 22% IP address for eth0: 10.0.0.5
Swap usage: 0%
6 updates can be applied immediately.
5 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable
New release '20.04.5 LTS' available.
Run 'do-release-upgrade' to upgrade to it.
Last login: Sun Oct 23 02:55:18 2022 from 187.190.230.253
Alejandro@T3-2015030899-1:~\$ javac mMatriz.java;java mMatriz 1 12
Alejandro@T3-2015030899-1:~\$

PC > ssh Alejandro@20.83.153.8
Alejandro@20.83.153.8's password:
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1094-azure x86_64)
* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/advantage
System information as of Sun Oct 23 02:58:30 UTC 2022
System load: 0.1 Processes: 102
Usage of /: 7.2% of 28.89GB Users logged in: 0
Memory usage: 20% IP address for eth0: 10.0.0.4
Swap usage: 0%
6 updates can be applied immediately.
5 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable
New release '20.04.5 LTS' available.
Run 'do-release-upgrade' to upgrade to it.
Last login: Sat Oct 22 22:33:49 2022 from 187.190.230.253
Alejandro@T3-2015030899-2:~\$ javac mMatriz.java;java mMatriz 2 12
Alejandro@T3-2015030899-2:~\$

Ilustración 17 : Multiplicacion de Matrices de 12

Procedemos a la ejecución de nuestro programa con una matriz de 4000.

```
pwsh in Matriz
$ <1> pwsh in Matriz <2> Alejandro@T3-20... <3> Alejandro@T3-20...
Alejandro@T3-2015030899-1:~$ exit
logout
Connection to 4.227.185.167 closed.
Matriz > javac .\mMatriz.java;java mMatriz 0 12
----- Matriz A -----
| 0.0   3.0   6.0   9.0   12.0  15.0  18.0  21.0  24.0  27.0  30.0  33.0 |
| 1.0   4.0   7.0  10.0  13.0  16.0  19.0  22.0  25.0  28.0  31.0  34.0 |
| 2.0   5.0   8.0  11.0  14.0  17.0  20.0  23.0  26.0  29.0  32.0  35.0 |
| 3.0   6.0   9.0  12.0  15.0  18.0  21.0  24.0  27.0  30.0  33.0  36.0 |
| 4.0   7.0  10.0  13.0  16.0  19.0  22.0  25.0  28.0  31.0  34.0  37.0 |
| 5.0   8.0  11.0  14.0  17.0  20.0  23.0  26.0  29.0  32.0  35.0  38.0 |
| 6.0   9.0  12.0  15.0  18.0  21.0  24.0  27.0  30.0  33.0  36.0  39.0 |
| 7.0  10.0  13.0  16.0  19.0  22.0  25.0  28.0  31.0  34.0  37.0  40.0 |
| 8.0  11.0  14.0  17.0  20.0  23.0  26.0  29.0  32.0  35.0  38.0  41.0 |
| 9.0  12.0  15.0  18.0  21.0  24.0  27.0  30.0  33.0  36.0  39.0  42.0 |
| 10.0 13.0  16.0  19.0  22.0  25.0  28.0  31.0  34.0  37.0  40.0  43.0 |
| 11.0 14.0  17.0  20.0  23.0  26.0  29.0  32.0  35.0  38.0  41.0  44.0 |
----- Matriz B -----
| 0.0  -1.0  -2.0  -3.0  -4.0  -5.0  -6.0  -7.0  -8.0  -9.0  -10.0 -11.0 |
| 2.0   1.0  -1.0  -2.0  -3.0  -4.0  -5.0  -6.0  -7.0  -8.0  -9.0  -9.0 |
| 4.0   3.0   2.0   1.0   0.0  -1.0  -2.0  -3.0  -4.0  -5.0  -6.0  -7.0 |
| 6.0   5.0   4.0   3.0   2.0   1.0   0.0  -1.0  -2.0  -3.0  -4.0  -5.0 |
| 8.0   7.0   6.0   5.0   4.0   3.0   2.0   1.0   0.0  -1.0  -2.0  -3.0 |
| 10.0  9.0   8.0   7.0   6.0   5.0   4.0   3.0   2.0   1.0   0.0  -1.0 |
| 12.0  11.0  10.0   9.0   8.0   7.0   6.0   5.0   4.0   3.0   2.0   1.0 |
| 14.0  13.0  12.0  11.0  10.0   9.0   8.0   7.0   6.0   5.0   4.0   3.0 |
| 16.0  15.0  14.0  13.0  12.0  11.0  10.0   9.0   8.0   7.0   6.0   5.0 |
| 18.0  17.0  16.0  15.0  14.0  13.0  12.0  11.0  10.0   9.0   8.0   7.0 |
| 20.0  19.0  18.0  17.0  16.0  15.0  14.0  13.0  12.0  11.0  10.0  9.0 |
| 22.0  21.0  20.0  19.0  18.0  17.0  16.0  15.0  14.0  13.0  12.0  11.0 |
----- Matriz C -----
| 3036.0 2838.0 2640.0 2442.0 2244.0 2046.0 1848.0 1650.0 1452.0 1254.0 1056.0 858.0 |
| 3168.0 2958.0 2748.0 2538.0 2328.0 2118.0 1908.0 1698.0 1488.0 1278.0 1068.0 858.0 |
| 3300.0 3078.0 2856.0 2634.0 2412.0 2190.0 1968.0 1746.0 1524.0 1302.0 1080.0 858.0 |
| 3432.0 3198.0 2964.0 2730.0 2496.0 2262.0 2028.0 1794.0 1560.0 1326.0 1092.0 858.0 |
| 3564.0 3318.0 3072.0 2826.0 2580.0 2334.0 2088.0 1842.0 1596.0 1350.0 1104.0 858.0 |
| 3696.0 3438.0 3180.0 2922.0 2664.0 2406.0 2148.0 1890.0 1632.0 1374.0 1116.0 858.0 |
| 3828.0 3558.0 3288.0 3018.0 2748.0 2478.0 2208.0 1938.0 1668.0 1398.0 1128.0 858.0 |
| 3960.0 3678.0 3396.0 3114.0 2832.0 2550.0 2268.0 1986.0 1704.0 1422.0 1140.0 858.0 |
| 4092.0 3798.0 3504.0 3210.0 2916.0 2622.0 2328.0 2034.0 1740.0 1446.0 1152.0 858.0 |
| 4224.0 3918.0 3612.0 3306.0 3000.0 2694.0 2388.0 2082.0 1776.0 1470.0 1164.0 858.0 |
| 4356.0 4038.0 3720.0 3402.0 3084.0 2766.0 2448.0 2130.0 1812.0 1494.0 1176.0 858.0 |
| 4488.0 4158.0 3828.0 3498.0 3168.0 2838.0 2508.0 2178.0 1848.0 1518.0 1188.0 858.0 |
----- Matriz C -----
Checksum:332640.0
Matriz > javac .\mMatriz.java;java mMatriz 0 4000
Checksum:1.52523607E18
PC > Matriz > o\main ≈ ?3 ~3 > ↴
```

in pwsh at 22:09:14

```
Alejandro@4.227.185.167's password:
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1094-azure x86_64)
```

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

System information as of Sun Oct 23 02:58:18 UTC 2022

System load: 0.0          Processes:      98
Usage of /: 7.2% of 28.89GB  Users logged in: 0
Memory usage: 22%          IP address for eth0: 10.0.0.5
Swap usage: 0%
```

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

```
New release '20.04.5 LTS' available.
Run 'do-release-upgrade' to upgrade to it.
```

```
Last login: Sun Oct 23 02:55:18 2022 from 187.190.230.253
Alejandro@T3-2015030899-1:~$ javac mMatriz.java;java mMatriz 1 12
Alejandro@T3-2015030899-1:~$ javac mMatriz.java;java mMatriz 1 4000
Alejandro@T3-2015030899-1:~$
```

```
Alejandro@020.83.153.8's password:
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1094-azure x86_64)
```

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

System information as of Sun Oct 23 02:58:30 UTC 2022

System load: 0.1          Processes:      102
Usage of /: 7.2% of 28.89GB  Users logged in: 0
Memory usage: 20%          IP address for eth0: 10.0.0.4
Swap usage: 0%
```

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

```
New release '20.04.5 LTS' available.
Run 'do-release-upgrade' to upgrade to it.
```

```
Last login: Sat Oct 22 22:33:49 2022 from 187.190.230.253
Alejandro@T3-2015030899-2:~$ javac mMatriz.java;java mMatriz 2 12
Alejandro@T3-2015030899-2:~$ javac mMatriz.java;java mMatriz 2 4000
Alejandro@T3-2015030899-2:~$
```

powershell.exe[64]:3444

+ 220807[32] 1/3 [+1] NUM ImpGrip W PRI: 106x55 (45,50) 25V
^ 109 p.m.
22/10/2022

Conclusión

El crear un solo programa para cliente y servidor es una técnica muy interesante para el computo distribuido ya que solo necesitas de un parámetro para diferencias que función se ejecutara en la máquina.

Un sistema distribuido para resolver el problema de la multiplicación de matrices para una mejor velocidad de cálculo es interesante aunque tambien dependerá de la conexión que se tenga con los servidores , la potencia que cuentan estos servidores y tambien las funciones que tenga el cliente ya que este pueden recibir los datos pero aparte debe procesarlos.