

Name: Aquino, John Kennedy A.	Date Performed: August 16, 2022
Course/Section: CPE31S22	Date Submitted: August 23, 2022
Instructor: Jonathan V. Taylor	Semester and SY: 1st Sem 2022 - 2023

Activity 1: Configure Network using Virtual Machines

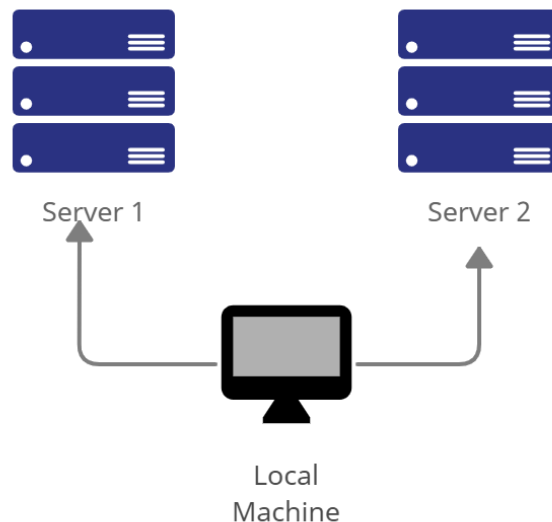
1. Objectives:

- 1.1. Create and configure Virtual Machines in Microsoft Azure or VirtualBox
- 1.2. Set-up a Virtual Network and Test Connectivity of VMs

2. Discussion:

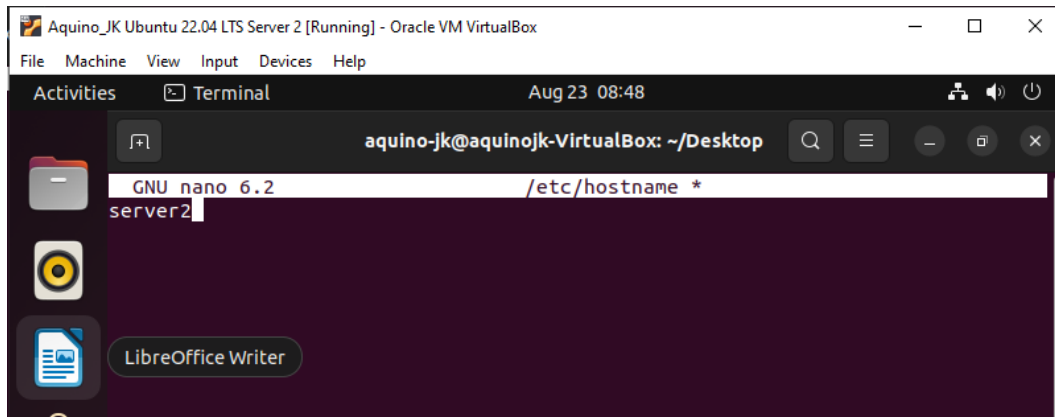
Network Topology:

Assume that you have created the following network topology in Virtual Machines, *provide screenshots for each task*. (Note: it is assumed that you have the prior knowledge of cloning and creating snapshots in a virtual machine).

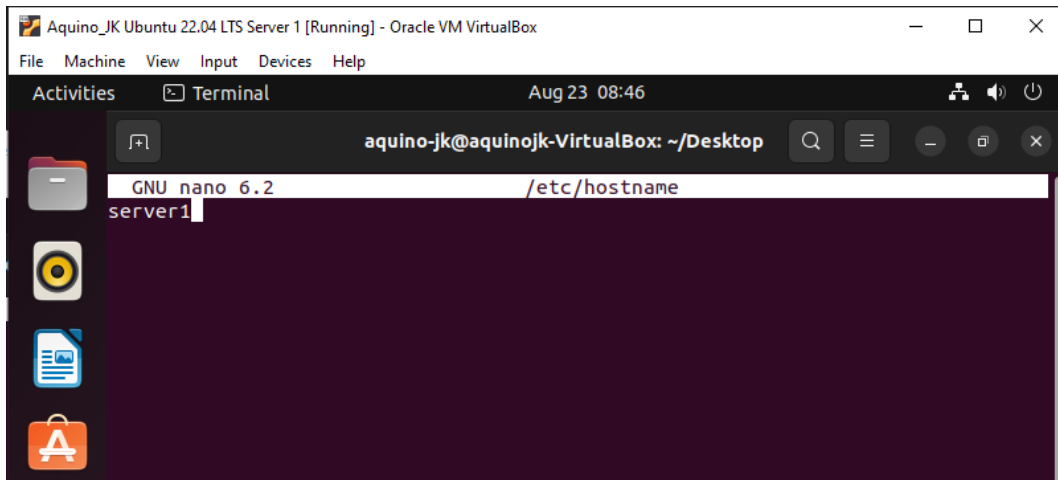


Task 1: Do the following on Server 1, Server 2, and Local Machine. In editing the file using nano command, press control + O to write out (save the file). Press enter when asked for the name of the file. Press control + X to end.

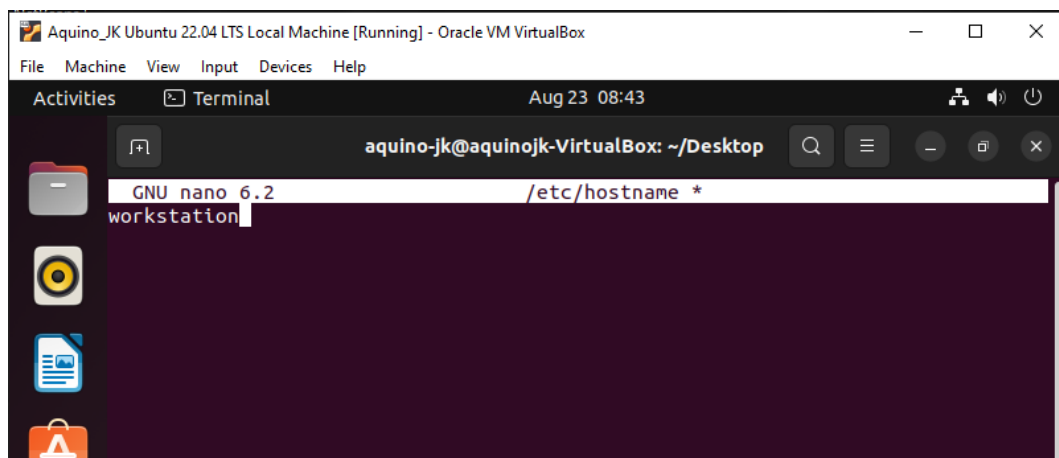
1. Change the hostname using the command *sudo nano /etc/hostname*
 - 1.1 Use server1 for Server 1



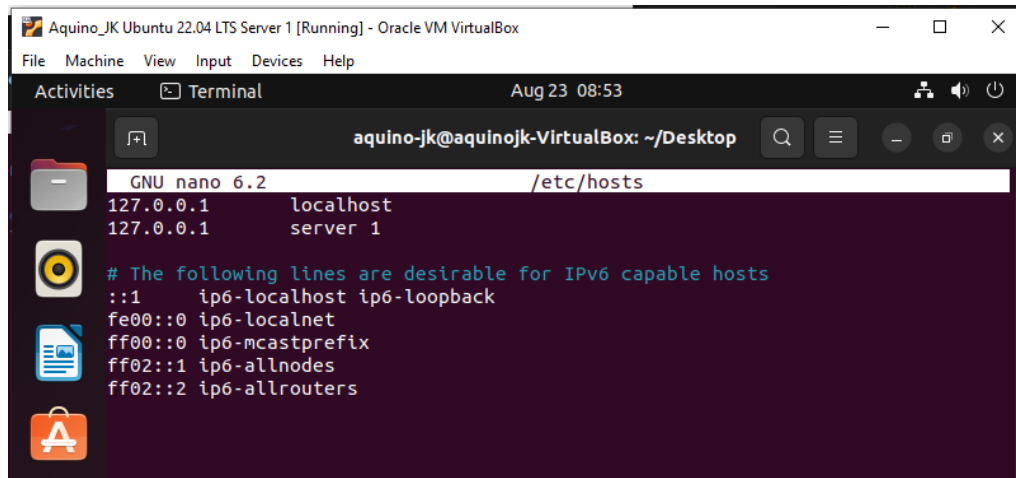
1.2 Use server2 for Server 2



1.3 Use workstation for the Local Machine

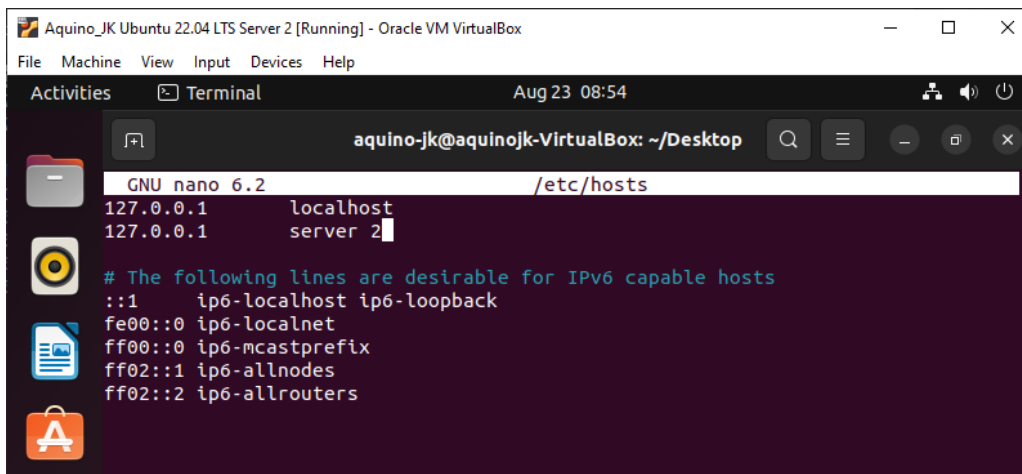


2. Edit the hosts using the command *sudo nano /etc/hosts*. Edit the second line.
2.1 Type 127.0.0.1 server 1 for Server 1



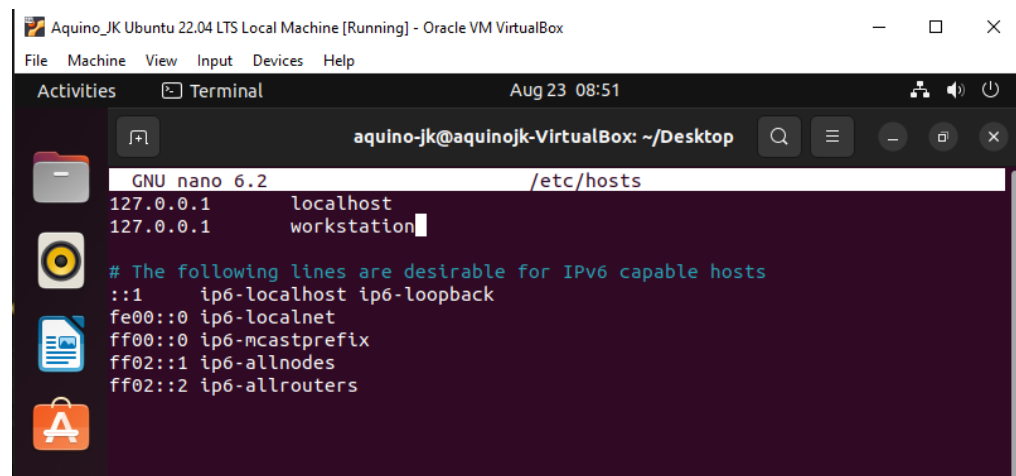
```
Aquino_JK Ubuntu 22.04 LTS Server 1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 08:53
aquino-jk@aquinojk-VirtualBox: ~/Desktop
GNU nano 6.2 /etc/hosts
127.0.0.1 localhost
127.0.0.1 server 1
# The following lines are desirable for IPv6 capable hosts
::1 ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
```

- 2.2 Type 127.0.0.1 server 2 for Server 2



```
Aquino_JK Ubuntu 22.04 LTS Server 2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 08:54
aquino-jk@aquinojk-VirtualBox: ~/Desktop
GNU nano 6.2 /etc/hosts
127.0.0.1 localhost
127.0.0.1 server 2
# The following lines are desirable for IPv6 capable hosts
::1 ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
```

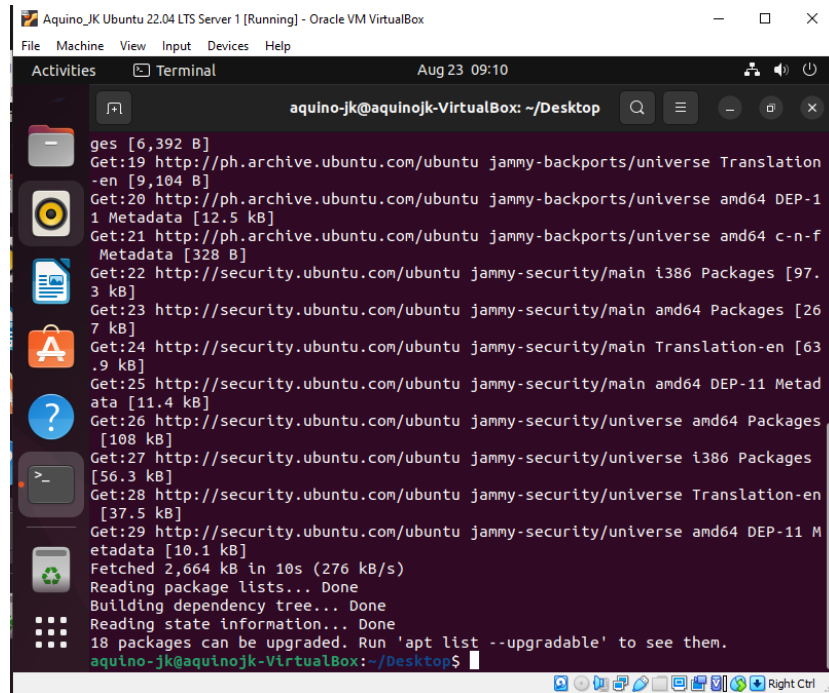
- 2.3 Type 127.0.0.1 workstation for the Local Machine



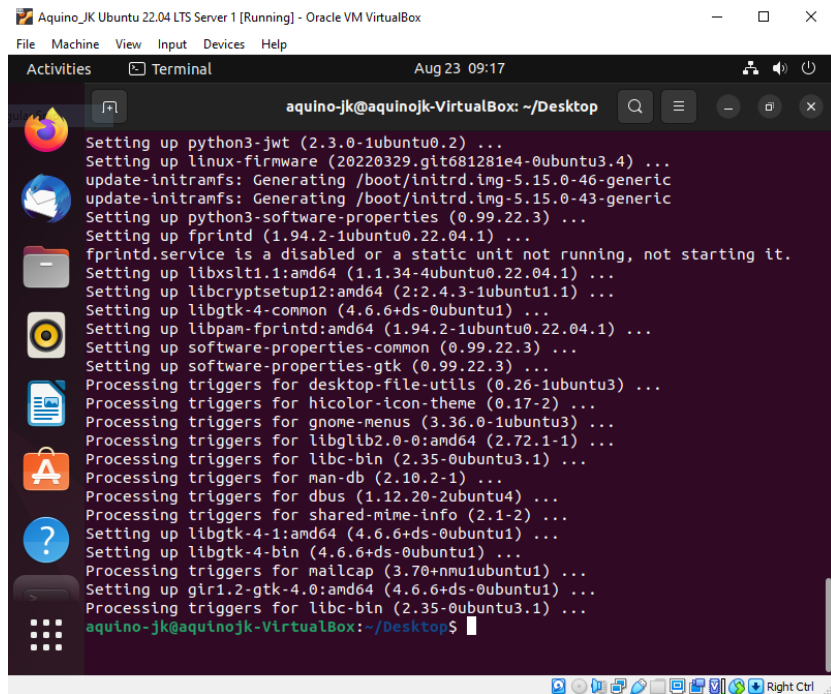
```
Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 08:51
aquino-jk@aquinojk-VirtualBox: ~/Desktop
GNU nano 6.2 /etc/hosts
127.0.0.1 localhost
127.0.0.1 workstation
# The following lines are desirable for IPv6 capable hosts
::1 ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
```

Task 2: Configure SSH on Server 1, Server 2, and Local Machine. Do the following:

1. Upgrade the packages by issuing the command *sudo apt update* and *sudo apt upgrade* respectively.



```
Aquino_JK Ubuntu 22.04 LTS Server 1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 09:10
aquino-jk@aquinojk-VirtualBox: ~/Desktop
ges [6,392 B]
Get:19 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe Translation
-en [9,104 B]
Get:20 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 DEP-1
1 Metadata [12.5 kB]
Get:21 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 c-n-f
Metadata [328 B]
Get:22 http://security.ubuntu.com/ubuntu jammy-security/main i386 Packages [97.
3 kB]
Get:23 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages [26
7 kB]
Get:24 http://security.ubuntu.com/ubuntu jammy-security/main Translation-en [63
.9 kB]
Get:25 http://security.ubuntu.com/ubuntu jammy-security/main amd64 DEP-11 Metad
ata [11.4 kB]
Get:26 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages
[108 kB]
Get:27 http://security.ubuntu.com/ubuntu jammy-security/universe i386 Packages
[56.3 kB]
Get:28 http://security.ubuntu.com/ubuntu jammy-security/universe Translation-en
[37.5 kB]
Get:29 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 DEP-11 M
etadata [10.1 kB]
Fetched 2,664 kB in 10s (276 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
18 packages can be upgraded. Run 'apt list --upgradable' to see them.
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```



```
Aquino_JK Ubuntu 22.04 LTS Server 1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 09:17
aquino-jk@aquinojk-VirtualBox: ~/Desktop
Setting up python3-jwt (2.3.0-1ubuntu0.2) ...
Setting up linux-firmware (20220329.git681281e4-0ubuntu3.4) ...
update-initramfs: Generating /boot/initrd.img-5.15.0-46-generic
update-initramfs: Generating /boot/initrd.img-5.15.0-43-generic
Setting up python3-software-properties (0.99.22.3) ...
Setting up fprintd (1.94.2-1ubuntu0.22.04.1) ...
fprintd.service is a disabled or a static unit not running, not starting it.
Setting up libxslt1.1:amd64 (1.1.34-4ubuntu0.22.04.1) ...
Setting up libcryptsetup12:amd64 (2:2.4.3-1ubuntu1.1) ...
Setting up libgtk-4-common (4.6.6+ds-0ubuntu1) ...
Setting up libpam-fprintd:amd64 (1.94.2-1ubuntu0.22.04.1) ...
Setting up software-properties-common (0.99.22.3) ...
Setting up software-properties-gtk (0.99.22.3) ...
Processing triggers for desktop-file-utils (0.26-1ubuntu3) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for gnome-menus (3.36.0-1ubuntu3) ...
Processing triggers for libgl1:amd64 (2.72.1-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for dbus (1.12.20-2ubuntu4) ...
Processing triggers for shared-mime-info (2.1-2) ...
Setting up libgtk-4-1:amd64 (4.6.6+ds-0ubuntu1) ...
Setting up libgtk-4-bin (4.6.6+ds-0ubuntu1) ...
Processing triggers for mailcap (3.70+nmu1ubuntu1) ...
Setting up gir1.2-gtk-4.0:amd64 (4.6.6+ds-0ubuntu1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

```
Aquino_JK Ubuntu 22.04 LTS Server 2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 09:13
aquino-jk@aquinojk-VirtualBox: ~/Desktop

ges [6,392 B]
Get:19 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe i386 Packag
es [4,812 B]
Get:20 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe Translation
-en [9,104 B]
Get:21 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 DEP-1
1 Metadata [12.5 kB]
Get:22 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 c-n-f
Metadata [328 B]
Get:23 http://security.ubuntu.com/ubuntu jammy-security/main i386 Packages [97.
3 kB]
Get:24 http://security.ubuntu.com/ubuntu jammy-security/main Translation-en [63
.9 kB]
Get:25 http://security.ubuntu.com/ubuntu jammy-security/main amd64 DEP-11 Metad
ata [11.4 kB]
Get:26 http://security.ubuntu.com/ubuntu jammy-security/universe i386 Packages
[56.3 kB]
Get:27 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages
[108 kB]
Get:28 http://security.ubuntu.com/ubuntu jammy-security/universe Translation-en
[37.5 kB]
Get:29 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 DEP-11 M
etadata [10.1 kB]
Fetched 2,664 kB in 9s (281 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
18 packages can be upgraded. Run 'apt list --upgradable' to see them.
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

```
Aquino_JK Ubuntu 22.04 LTS Server 2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 09:23
aquino-jk@aquinojk-VirtualBox: ~/Desktop

Setting up python3-jwt (2.3.0-1ubuntu0.2) ...
Setting up linux-firmware (20220329.git681281e4-0ubuntu3.4) ...
update-initramfs: Generating /boot/initrd.img-5.15.0-46-generic
update-initramfs: Generating /boot/initrd.img-5.15.0-43-generic
Setting up python3-software-properties (0.99.22.3) ...
Setting up fprintd (1.94.2-1ubuntu0.22.04.1) ...
fprintd.service is a disabled or a static unit not running, not starting it.
Setting up libxslt1.1:amd64 (1.1.34-4ubuntu0.22.04.1) ...
Setting up libcryptsetup12:amd64 (2:2.4.3-1ubuntu1.1) ...
Setting up libgtk-4-common (4.6.6+ds-0ubuntu1) ...
Setting up libpam-fprintd:amd64 (1.94.2-1ubuntu0.22.04.1) ...
Setting up software-properties-common (0.99.22.3) ...
Setting up software-properties-gtk (0.99.22.3) ...
Processing triggers for desktop-file-utils (0.26-1ubuntu3) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for gnome-menus (3.36.0-1ubuntu3) ...
Processing triggers for libgl1:amd64 (2.72.1-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for dbus (1.12.20-2ubuntu4) ...
Processing triggers for shared-mime-info (2.1-2) ...
Setting up libgtk-4-1:amd64 (4.6.6+ds-0ubuntu1) ...
Setting up libgtk-4-bin (4.6.6+ds-0ubuntu1) ...
Processing triggers for mailcap (3.70+nmuiubuntu1) ...
Setting up gir1.2-gtk-4.0:amd64 (4.6.6+ds-0ubuntu1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

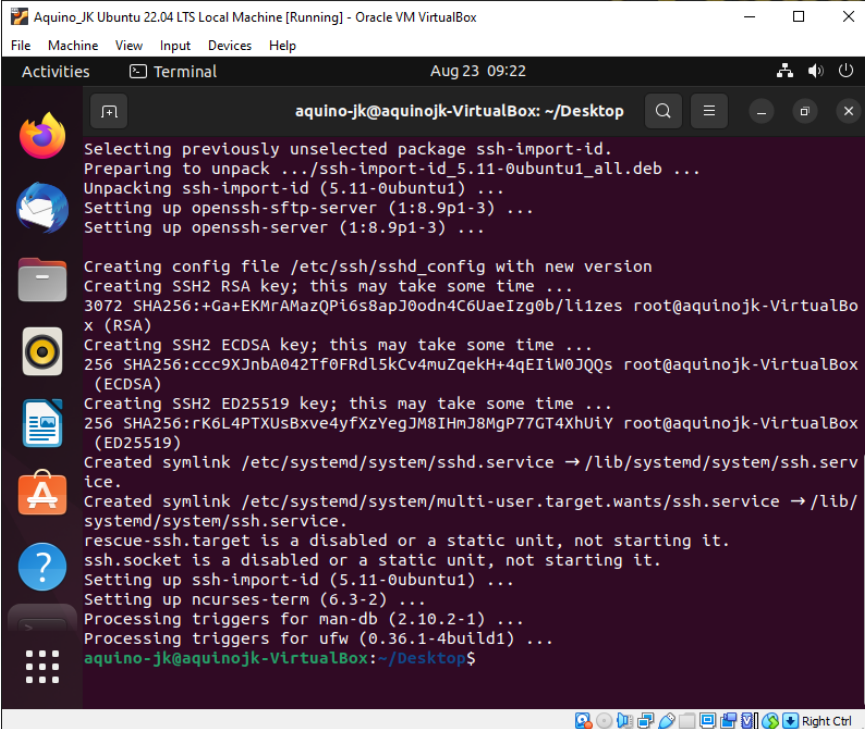
```
Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 08:59
aquino-jk@aquinojk-VirtualBox: ~/Desktop

ges [6,392 B]
Get:19 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe i386 Packag
es [4,812 B]
Get:20 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe Translation
-en [9,104 B]
Get:21 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 DEP-1
1 Metadata [12.5 kB]
Get:22 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 c-n-f
Metadata [328 B]
Get:23 http://security.ubuntu.com/ubuntu jammy-security/main i386 Packages [97.
3 kB]
Get:24 http://security.ubuntu.com/ubuntu jammy-security/main Translation-en [63
.9 kB]
Get:25 http://security.ubuntu.com/ubuntu jammy-security/main amd64 DEP-11 Metad
ata [11.4 kB]
Get:26 http://security.ubuntu.com/ubuntu jammy-security/universe i386 Packages
[56.3 kB]
Get:27 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages
[108 kB]
Get:28 http://security.ubuntu.com/ubuntu jammy-security/universe Translation-en
[37.5 kB]
Get:29 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 DEP-11 M
etadata [10.1 kB]
Fetched 2,664 kB in 7s (357 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
18 packages can be upgraded. Run 'apt list --upgradable' to see them.
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

```
Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 09:06
aquino-jk@aquinojk-VirtualBox: ~/Desktop

Setting up python3-jwt (2.3.0-1ubuntu0.2) ...
Setting up linux-firmware (20220329.git681281e4-0ubuntu3.4) ...
update-initramfs: Generating /boot/initrd.img-5.15.0-46-generic
update-initramfs: Generating /boot/initrd.img-5.15.0-43-generic
Setting up python3-software-properties (0.99.22.3) ...
Setting up fprintd (1.94.2-1ubuntu0.22.04.1) ...
fprintd.service is a disabled or a static unit not running, not starting it.
Setting up libxslt1.1:amd64 (1.1.34-4ubuntu0.22.04.1) ...
Setting up libcryptsetup12:amd64 (2:2.4.3-1ubuntu1.1) ...
Setting up libgtk-4-common (4.6.6+ds-0ubuntu1) ...
Setting up libpam-fprintd:amd64 (1.94.2-1ubuntu0.22.04.1) ...
Setting up software-properties-common (0.99.22.3) ...
Setting up software-properties-gtk (0.99.22.3) ...
Processing triggers for desktop-file-utils (0.26-1ubuntu3) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for gnome-menus (3.36.0-1ubuntu3) ...
Processing triggers for libglib2.0-0:amd64 (2.72.1-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for dbus (1.12.20-2ubuntu4) ...
Processing triggers for shared-mime-info (2.1-2) ...
Help g up libgtk-4-1:amd64 (4.6.6+ds-0ubuntu1) ...
Setting up libgtk-4-bin (4.6.6+ds-0ubuntu1) ...
Processing triggers for mailcap (3.70+nmu1ubuntu1) ...
Setting up gir1.2-gtk-4.0:amd64 (4.6.6+ds-0ubuntu1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

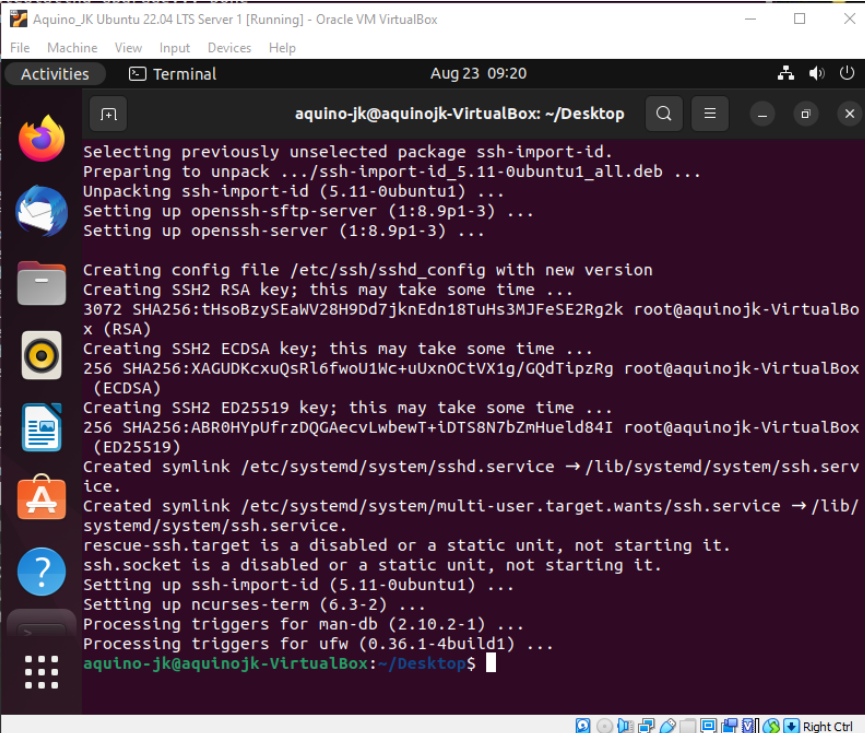
2. Install the SSH server using the command *sudo apt install openssh-server*.



```
Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 09:22
aquino-jk@aquinojk-VirtualBox: ~/Desktop

Selecting previously unselected package ssh-import-id.
Preparing to unpack .../ssh-import-id_5.11-0ubuntu1_all.deb ...
Unpacking ssh-import-id (5.11-0ubuntu1) ...
Setting up openssh-sftp-server (1:8.9p1-3) ...
Setting up openssh-server (1:8.9p1-3) ...

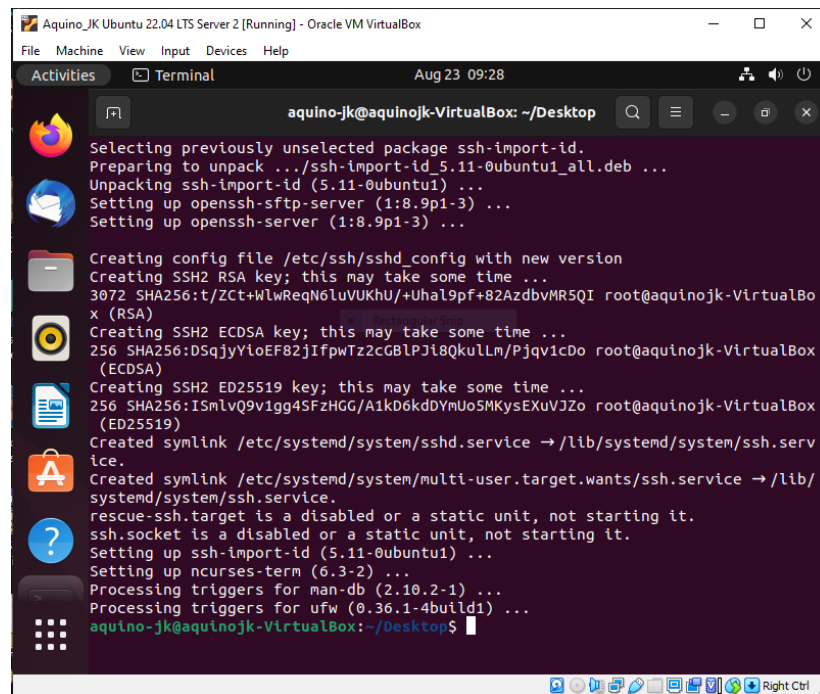
Creating config file /etc/ssh/sshd_config with new version
Creating SSH2 RSA key; this may take some time ...
3072 SHA256:+Ga+EKMfAMazQP16s8apJ0odn4C6UaeIzg0b/liizes root@aquinojk-VirtualBox
x (RSA)
Creating SSH2 ECDSA key; this may take some time ...
256 SHA256:ccc9XJnbA042Tf0FRdL5Kcv4muZqekH+4qEiLW0JQqs root@aquinojk-VirtualBox
(ECDSA)
Creating SSH2 ED25519 key; this may take some time ...
256 SHA256:rK6L4PTXUsBxve4yfXzYegJM8IHmJ8MgP77GT4XhUiY root@aquinojk-VirtualBox
(ED25519)
Created symlink /etc/systemd/system/ssh.service → /lib/systemd/system/ssh.serv
ice.
Created symlink /etc/systemd/system/multi-user.target.wants/ssh.service → /lib/
systemd/system/ssh.service.
rescue-ssh.target is a disabled or a static unit, not starting it.
ssh.socket is a disabled or a static unit, not starting it.
Setting up ssh-import-id (5.11-0ubuntu1) ...
Setting up ncurses-term (6.3-2) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for ufw (0.36.1-4build1) ...
aquino-jk@aquinojk-VirtualBox: ~/Desktop$
```



```
Aquino_JK Ubuntu 22.04 LTS Server 1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 09:20
aquino-jk@aquinojk-VirtualBox: ~/Desktop

Selecting previously unselected package ssh-import-id.
Preparing to unpack .../ssh-import-id_5.11-0ubuntu1_all.deb ...
Unpacking ssh-import-id (5.11-0ubuntu1) ...
Setting up openssh-sftp-server (1:8.9p1-3) ...
Setting up openssh-server (1:8.9p1-3) ...

Creating config file /etc/ssh/sshd_config with new version
Creating SSH2 RSA key; this may take some time ...
3072 SHA256:tHsoBzysEaWV28H9Dd7jknEdn18TuHs3MJFeSE2Rg2k root@aquinojk-VirtualBox
x (RSA)
Creating SSH2 ECDSA key; this may take some time ...
256 SHA256:XAGUDKcxuQsRl6fwoU1Wc+uUxnOCtVX1g/GQdTipzRg root@aquinojk-VirtualBox
(ECDSA)
Creating SSH2 ED25519 key; this may take some time ...
256 SHA256:ABR0HYpUfrzDQGAecvLwbewT+iDTS8N7bZmHuel84I root@aquinojk-VirtualBox
(ED25519)
Created symlink /etc/systemd/system/ssh.service → /lib/systemd/system/ssh.serv
ice.
Created symlink /etc/systemd/system/multi-user.target.wants/ssh.service → /lib/
systemd/system/ssh.service.
rescue-ssh.target is a disabled or a static unit, not starting it.
ssh.socket is a disabled or a static unit, not starting it.
Setting up ssh-import-id (5.11-0ubuntu1) ...
Setting up ncurses-term (6.3-2) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for ufw (0.36.1-4build1) ...
aquino-jk@aquinojk-VirtualBox: ~/Desktop$
```

```
Aquino_JK Ubuntu 22.04 LTS Server 2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 09:28
aquino-jk@aquinojk-VirtualBox: ~/Desktop

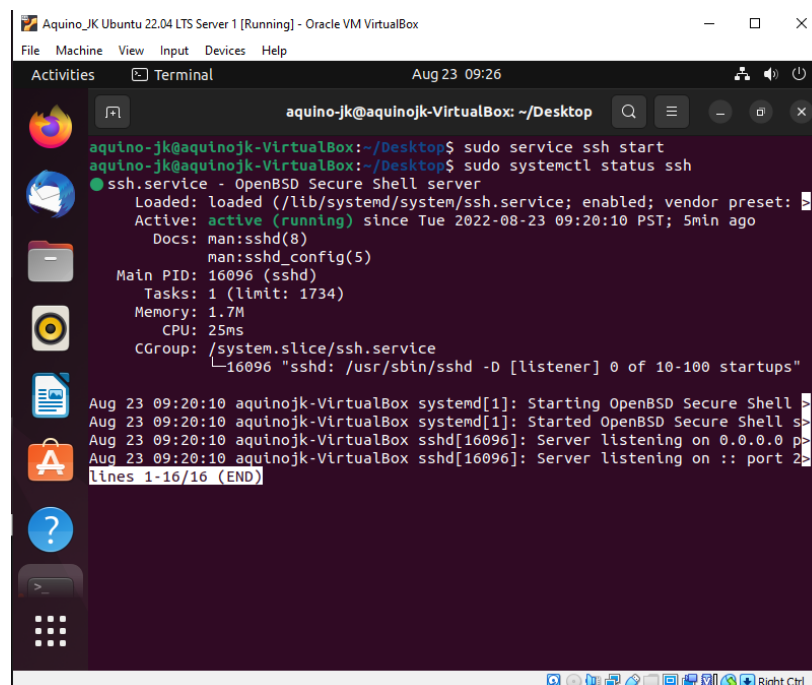
Selecting previously unselected package ssh-import-id.
Preparing to unpack .../ssh-import-id_5.11-0ubuntu1_all.deb ...
Unpacking ssh-import-id (5.11-0ubuntu1) ...
Setting up openssh-sftp-server (1:8.9p1-3) ...
Setting up openssh-server (1:8.9p1-3) ...

Creating config file /etc/ssh/sshd_config with new version
Creating SSH2 RSA key; this may take some time ...
3072 SHA256:t/ZCt+WLwReqN6LuVUKhU/+Uha19pf+82AzbvMR5QI root@aquinojk-VirtualBox
x (RSA)
Creating SSH2 ECDSA key; this may take some time ...
256 SHA256:DSqjyYioEF82jIfpwTz2cGB1PJi8QkulM/Pjqv1cDo root@aquinojk-VirtualBox
(ECDSA)
Creating SSH2 ED25519 key; this may take some time ...
256 SHA256:ISmLvQ9v1gg4SFzHGG/A1kD6kdDYmUo5MKysEXuVJZo root@aquinojk-VirtualBox
(ED25519)
Created symlink /etc/systemd/system/ssh.service → /lib/systemd/system/ssh.serv
ice.
Created symlink /etc/systemd/system/multi-user.target.wants/ssh.service → /lib/
systemd/system/ssh.service.
rescue-ssh.target is a disabled or a static unit, not starting it.
ssh.socket is a disabled or a static unit, not starting it.
Setting up ssh-import-id (5.11-0ubuntu1) ...
Setting up ncurses-term (6.3-2) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for ufw (0.36.1-4build1) ...
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

3. Verify if the SSH service has started by issuing the following commands:

3.1 *sudo service ssh start*

3.2 *sudo systemctl status ssh*



```
Aquino_JK Ubuntu 22.04 LTS Server 1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 09:26
aquino-jk@aquinojk-VirtualBox: ~/Desktop

aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo service ssh start
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
   Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset:
   Active: active (running) since Tue 2022-08-23 09:20:10 PST; 5min ago
     Docs: man:sshd(8)
           man:sshd_config(5)
    Main PID: 16096 (sshd)
      Tasks: 1 (limit: 1734)
     Memory: 1.7M
        CPU: 25ms
    CGroup: /system.slice/ssh.service
            └─16096 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Aug 23 09:20:10 aquinojk-VirtualBox systemd[1]: Starting OpenBSD Secure Shell
Aug 23 09:20:10 aquinojk-VirtualBox systemd[1]: Started OpenBSD Secure Shell s
Aug 23 09:20:10 aquinojk-VirtualBox sshd[16096]: Server listening on 0.0.0.0 p
Aug 23 09:20:10 aquinojk-VirtualBox sshd[16096]: Server listening on :: port 2
lines 1-16/16 (END)
```



```
Aquino_JK Ubuntu 22.04 LTS Server 2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Aug 23 09:29
aquino-jk@aquinojk-VirtualBox: ~/Desktop
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo service ssh start
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
   Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset:
   Active: active (running) since Tue 2022-08-23 09:25:24 PST; 3min 55s ago
     Docs: man:sshd(8)
           man:sshd_config(5)
    Main PID: 16227 (sshd)
      Tasks: 1 (limit: 1668)
    Memory: 1.7M
       CPU: 23ms
    CGroup: /system.slice/ssh.service
            └─16227 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Aug 23 09:25:24 aquinojk-VirtualBox systemd[1]: Starting OpenBSD Secure Shell
Aug 23 09:25:24 aquinojk-VirtualBox systemd[1]: Started OpenBSD Secure Shell s
Aug 23 09:25:24 aquinojk-VirtualBox sshd[16227]: Server listening on 0.0.0.0 p
Aug 23 09:25:24 aquinojk-VirtualBox sshd[16227]: Server listening on :: port 2
lines 1-16/16 (END)
```

```
Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Aug 23 09:27
aquino-jk@aquinojk-VirtualBox: ~/Desktop
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo service ssh start
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
   Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset:
   Active: active (running) since Tue 2022-08-23 09:22:36 PST; 4min 43s ago
     Docs: man:sshd(8)
           man:sshd_config(5)
    Main PID: 16286 (sshd)
      Tasks: 1 (limit: 1700)
    Memory: 1.7M
       CPU: 23ms
    CGroup: /system.slice/ssh.service
            └─16286 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

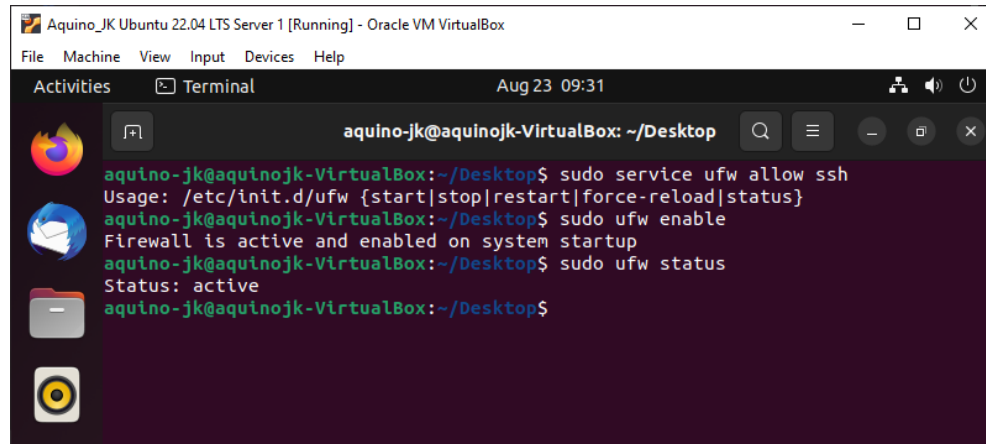
Aug 23 09:22:36 aquinojk-VirtualBox systemd[1]: Starting OpenBSD Secure Shell
Aug 23 09:22:36 aquinojk-VirtualBox sshd[16286]: Server listening on 0.0.0.0 p
Aug 23 09:22:36 aquinojk-VirtualBox sshd[16286]: Server listening on :: port 2
Aug 23 09:22:36 aquinojk-VirtualBox systemd[1]: Started OpenBSD Secure Shell s
lines 1-16/16 (END)
```

4. Configure the firewall to all port 22 by issuing the following commands:

4.1 *sudo ufw allow ssh*

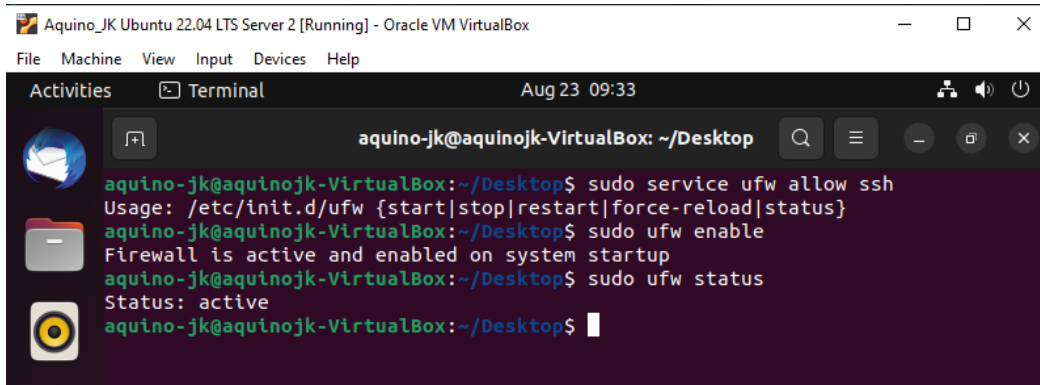
4.2 *sudo ufw enable*

4.3 *sudo ufw status*



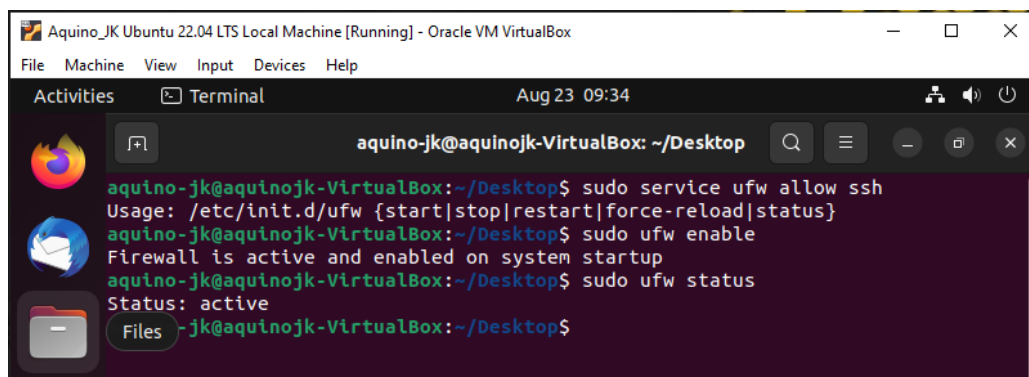
A screenshot of a terminal window titled "Aquino_JK Ubuntu 22.04 LTS Server 1 [Running] - Oracle VM VirtualBox". The terminal shows the following commands and output:

```
aquino-jk@aquinojk-VirtualBox: ~/Desktop
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo service ufw allow ssh
Usage: /etc/init.d/ufw {start|stop|restart|force-reload|status}
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo ufw enable
Firewall is active and enabled on system startup
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo ufw status
Status: active
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```



A screenshot of a terminal window titled "Aquino_JK Ubuntu 22.04 LTS Server 2 [Running] - Oracle VM VirtualBox". The terminal shows the following commands and output:

```
aquino-jk@aquinojk-VirtualBox: ~/Desktop
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo service ufw allow ssh
Usage: /etc/init.d/ufw {start|stop|restart|force-reload|status}
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo ufw enable
Firewall is active and enabled on system startup
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo ufw status
Status: active
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```



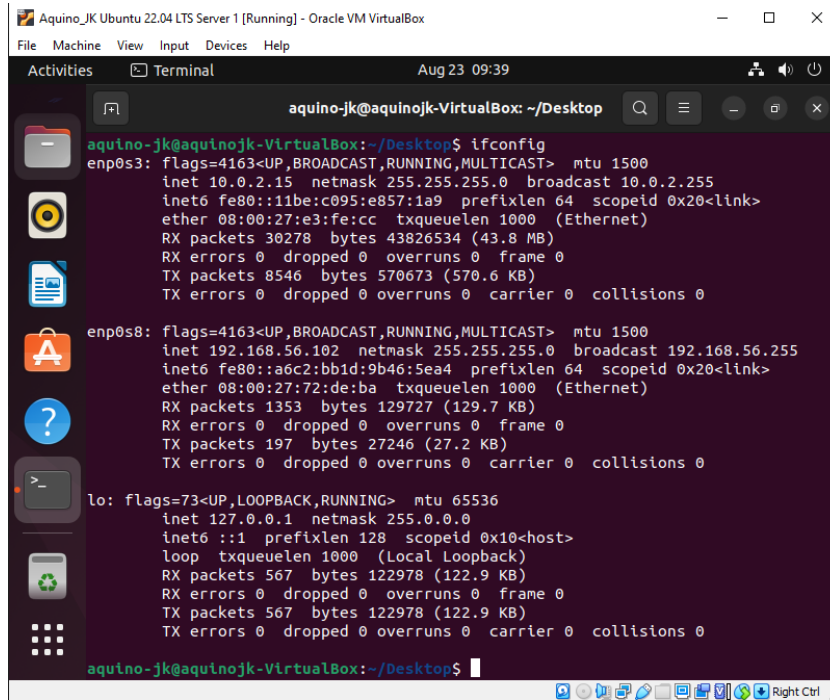
A screenshot of a terminal window titled "Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox". The terminal shows the following commands and output:

```
aquino-jk@aquinojk-VirtualBox: ~/Desktop
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo service ufw allow ssh
Usage: /etc/init.d/ufw {start|stop|restart|force-reload|status}
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo ufw enable
Firewall is active and enabled on system startup
aquino-jk@aquinojk-VirtualBox:~/Desktop$ sudo ufw status
Status: active
Files -jk@aquinojk-VirtualBox:~/Desktop$
```

Task 3: Verify network settings on Server 1, Server 2, and Local Machine. On each device, do the following:

1. Record the ip address of Server 1, Server 2, and Local Machine. Issue the command *ifconfig* and check network settings. Note that the ip addresses of all the machines are in this network 192.168.56.XX.

1.1 Server 1 IP address: 192.168.56.102



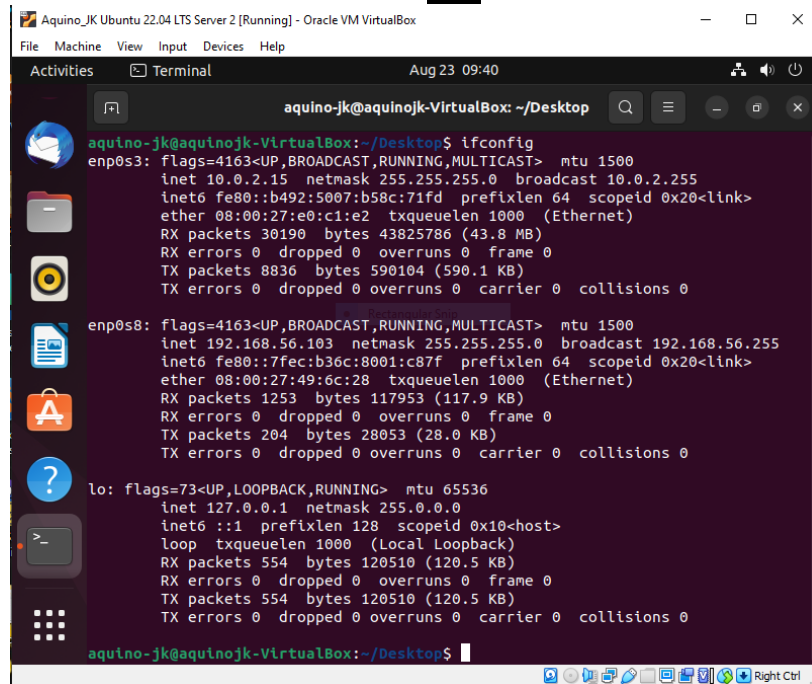
```
Aquino_JK Ubuntu 22.04 LTS Server 1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Aug 23 09:39
aquino-jk@aquinojk-VirtualBox: ~/Desktop
aquino-jk@aquinojk-VirtualBox:~/Desktop$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
    inet6 fe80::11be:c095:e857:1a9 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:e3:fe:cc txqueuelen 1000 (Ethernet)
    RX packets 30278 bytes 43826534 (43.8 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 8546 bytes 570673 (570.6 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.56.102 netmask 255.255.255.0 broadcast 192.168.56.255
    inet6 fe80::a6c2:bb1d:9b46:5ea4 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:72:de:ba txqueuelen 1000 (Ethernet)
    RX packets 1353 bytes 129727 (129.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 197 bytes 27246 (27.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 567 bytes 122978 (122.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 567 bytes 122978 (122.9 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

1.2 Server 2 IP address: 192.168.56.103



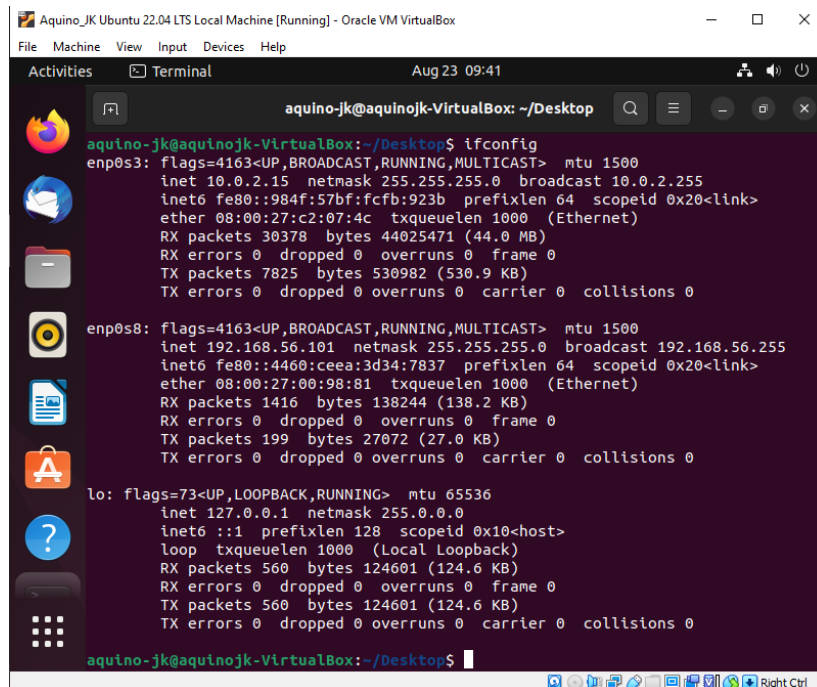
```
Aquino_JK Ubuntu 22.04 LTS Server 2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Aug 23 09:40
aquino-jk@aquinojk-VirtualBox: ~/Desktop
aquino-jk@aquinojk-VirtualBox:~/Desktop$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
    inet6 fe80::b492:5007:b58c:71fd prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:e0:c1:e2 txqueuelen 1000 (Ethernet)
    RX packets 30190 bytes 43825786 (43.8 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 8836 bytes 590104 (590.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.56.103 netmask 255.255.255.0 broadcast 192.168.56.255
    inet6 fe80::7fec:b36c:8001:c87f prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:49:6c:28 txqueuelen 1000 (Ethernet)
    RX packets 1253 bytes 117953 (117.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 204 bytes 28053 (28.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 554 bytes 120510 (120.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 554 bytes 120510 (120.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

1.3 Server 3 IP address: 192.168.56.101



```
aquino-jk@aquinojk-VirtualBox: ~/Desktop$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
    inet6 fe80::984f:57bf:fcfb:923b prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:c2:07:4c txqueuelen 1000 (Ethernet)
    RX packets 30378 bytes 44025471 (44.0 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 7825 bytes 530982 (530.9 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

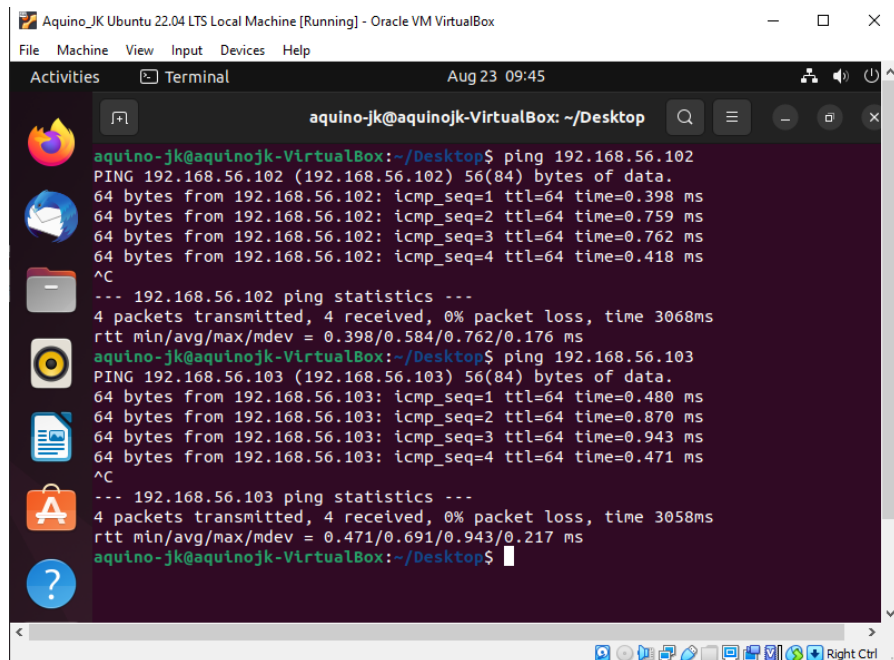
enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.56.101 netmask 255.255.255.0 broadcast 192.168.56.255
    inet6 fe80::4460:ceea:3d34:7837 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:00:98:81 txqueuelen 1000 (Ethernet)
    RX packets 1416 bytes 138244 (138.2 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 199 bytes 27072 (27.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 560 bytes 124601 (124.6 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 560 bytes 124601 (124.6 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

aquino-jk@aquinojk-VirtualBox: ~/Desktop$
```

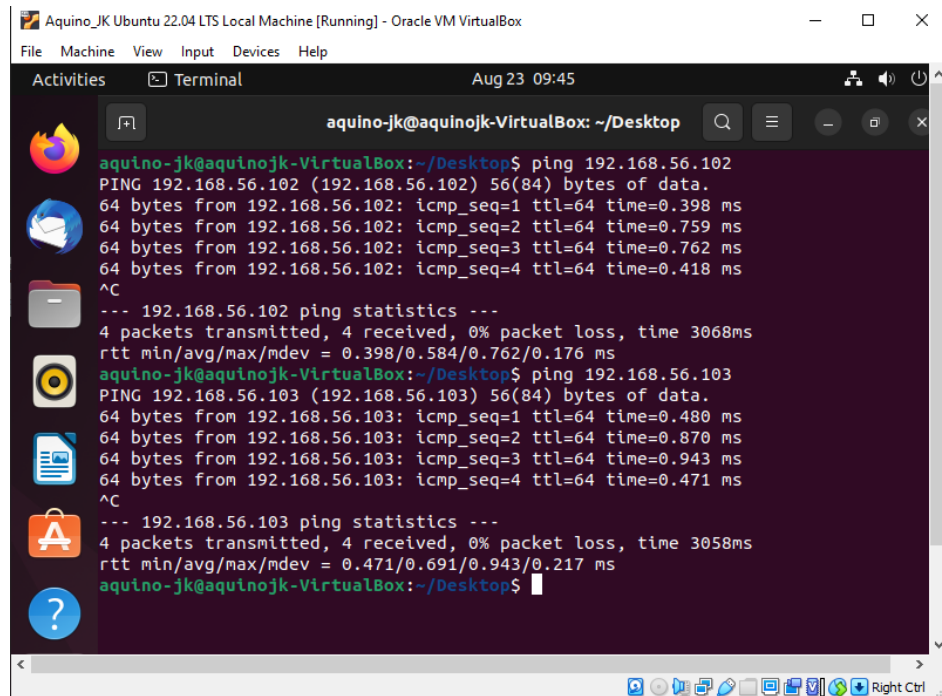
2. Make sure that they can ping each other.

2.1 Connectivity test for Local Machine 1 to Server 1: ☐ Successful ☒ Not Successful



```
aquino-jk@aquinojk-VirtualBox: ~/Desktop$ ping 192.168.56.102
PING 192.168.56.102 (192.168.56.102) 56(84) bytes of data:
64 bytes from 192.168.56.102: icmp_seq=1 ttl=64 time=0.398 ms
64 bytes from 192.168.56.102: icmp_seq=2 ttl=64 time=0.759 ms
64 bytes from 192.168.56.102: icmp_seq=3 ttl=64 time=0.762 ms
64 bytes from 192.168.56.102: icmp_seq=4 ttl=64 time=0.418 ms
^C
--- 192.168.56.102 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3068ms
rtt min/avg/max/mdev = 0.398/0.584/0.762/0.176 ms
aquino-jk@aquinojk-VirtualBox: ~/Desktop$ ping 192.168.56.103
PING 192.168.56.103 (192.168.56.103) 56(84) bytes of data:
64 bytes from 192.168.56.103: icmp_seq=1 ttl=64 time=0.480 ms
64 bytes from 192.168.56.103: icmp_seq=2 ttl=64 time=0.870 ms
64 bytes from 192.168.56.103: icmp_seq=3 ttl=64 time=0.943 ms
64 bytes from 192.168.56.103: icmp_seq=4 ttl=64 time=0.471 ms
^C
--- 192.168.56.103 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3058ms
rtt min/avg/max/mdev = 0.471/0.691/0.943/0.217 ms
aquino-jk@aquinojk-VirtualBox: ~/Desktop$
```

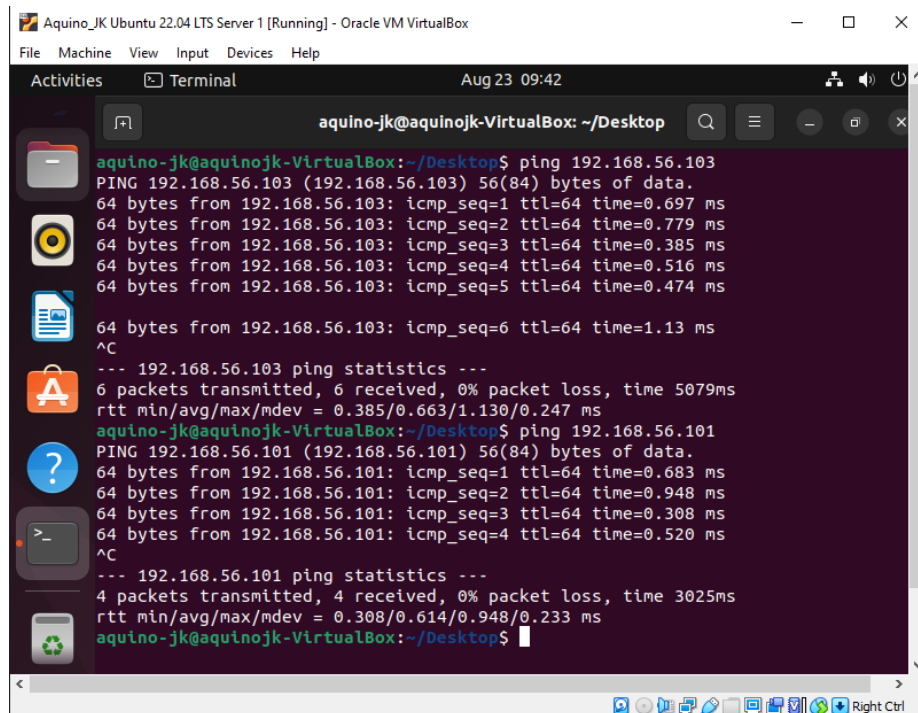
2.2 Connectivity test for Local Machine 1 to Server 2: ☒ Successful ☐ Not Successful



The screenshot shows a terminal window titled "Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox". The terminal output shows two successful ping tests. The first test is to 192.168.56.102, showing 4 packets transmitted, 4 received, 0% packet loss, and a time of 3068ms. The second test is to 192.168.56.103, showing 4 packets transmitted, 4 received, 0% packet loss, and a time of 3058ms.

```
aquino-jk@aquinojk-VirtualBox: ~/Desktop
aquino-jk@aquinojk-VirtualBox:~/Desktop$ ping 192.168.56.102
PING 192.168.56.102 (192.168.56.102) 56(84) bytes of data:
64 bytes from 192.168.56.102: icmp_seq=1 ttl=64 time=0.398 ms
64 bytes from 192.168.56.102: icmp_seq=2 ttl=64 time=0.759 ms
64 bytes from 192.168.56.102: icmp_seq=3 ttl=64 time=0.762 ms
64 bytes from 192.168.56.102: icmp_seq=4 ttl=64 time=0.418 ms
^C
--- 192.168.56.102 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3068ms
rtt min/avg/max/mdev = 0.398/0.584/0.762/0.176 ms
aquino-jk@aquinojk-VirtualBox:~/Desktop$ ping 192.168.56.103
PING 192.168.56.103 (192.168.56.103) 56(84) bytes of data:
64 bytes from 192.168.56.103: icmp_seq=1 ttl=64 time=0.480 ms
64 bytes from 192.168.56.103: icmp_seq=2 ttl=64 time=0.870 ms
64 bytes from 192.168.56.103: icmp_seq=3 ttl=64 time=0.943 ms
64 bytes from 192.168.56.103: icmp_seq=4 ttl=64 time=0.471 ms
^C
--- 192.168.56.103 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3058ms
rtt min/avg/max/mdev = 0.471/0.691/0.943/0.217 ms
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

2.3 Connectivity test for Server 1 to Server 2: ☒ Successful ☐ Not Successful



The screenshot shows a terminal window titled "Aquino_JK Ubuntu 22.04 LTS Server 1 [Running] - Oracle VM VirtualBox". The terminal output shows two successful ping tests. The first test is to 192.168.56.103, showing 6 packets transmitted, 6 received, 0% packet loss, and a time of 5079ms. The second test is to 192.168.56.101, showing 4 packets transmitted, 4 received, 0% packet loss, and a time of 3025ms.

```
aquino-jk@aquinojk-VirtualBox: ~/Desktop
aquino-jk@aquinojk-VirtualBox:~/Desktop$ ping 192.168.56.103
PING 192.168.56.103 (192.168.56.103) 56(84) bytes of data:
64 bytes from 192.168.56.103: icmp_seq=1 ttl=64 time=0.697 ms
64 bytes from 192.168.56.103: icmp_seq=2 ttl=64 time=0.779 ms
64 bytes from 192.168.56.103: icmp_seq=3 ttl=64 time=0.385 ms
64 bytes from 192.168.56.103: icmp_seq=4 ttl=64 time=0.516 ms
64 bytes from 192.168.56.103: icmp_seq=5 ttl=64 time=0.474 ms
64 bytes from 192.168.56.103: icmp_seq=6 ttl=64 time=1.13 ms
^C
--- 192.168.56.103 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5079ms
rtt min/avg/max/mdev = 0.385/0.663/1.130/0.247 ms
aquino-jk@aquinojk-VirtualBox:~/Desktop$ ping 192.168.56.101
PING 192.168.56.101 (192.168.56.101) 56(84) bytes of data:
64 bytes from 192.168.56.101: icmp_seq=1 ttl=64 time=0.683 ms
64 bytes from 192.168.56.101: icmp_seq=2 ttl=64 time=0.948 ms
64 bytes from 192.168.56.101: icmp_seq=3 ttl=64 time=0.308 ms
64 bytes from 192.168.56.101: icmp_seq=4 ttl=64 time=0.520 ms
^C
--- 192.168.56.101 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3025ms
rtt min/avg/max/mdev = 0.308/0.614/0.948/0.233 ms
aquino-jk@aquinojk-VirtualBox:~/Desktop$
```

Task 4: Verify SSH connectivity on Server 1, Server 2, and Local Machine.

1. On the Local Machine, issue the following commands:

1.1 `ssh username@ip_address_server1` for example, *ssh jvtaylor@192.168.56.120*

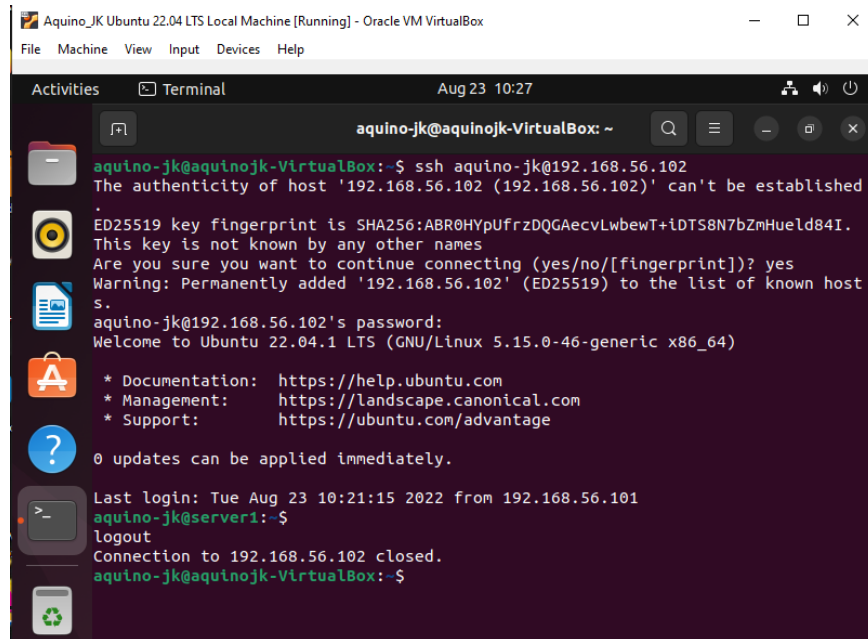
1.2 Enter the password for server 1 when prompted

1.3 Verify that you are in server 1. The user should be in this format `user@server1`.

For example, *jvtaylor@server1*

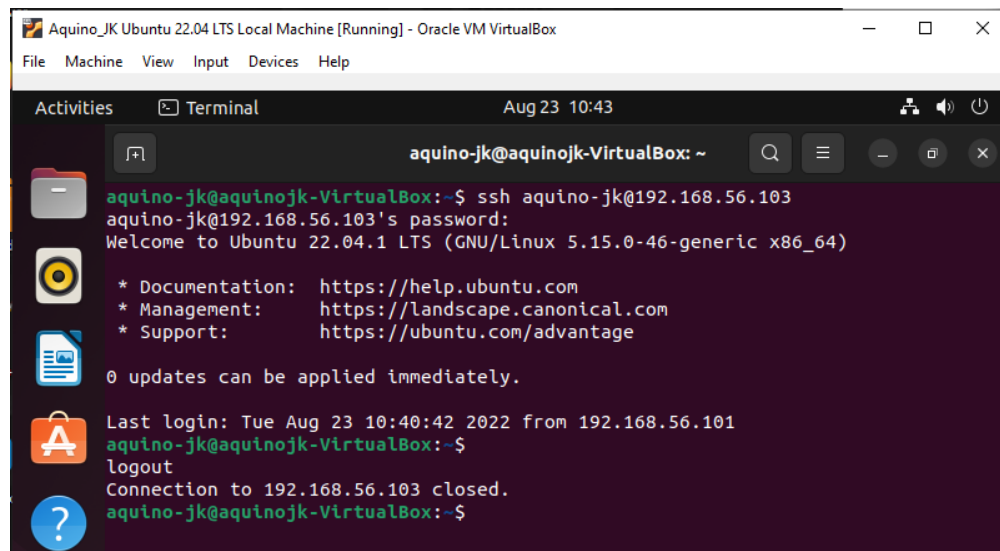
2. Logout of Server 1 by issuing the command *control + D*.

3. Do the same for Server 2.



The screenshot shows a terminal window titled "Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox". The terminal output is as follows:

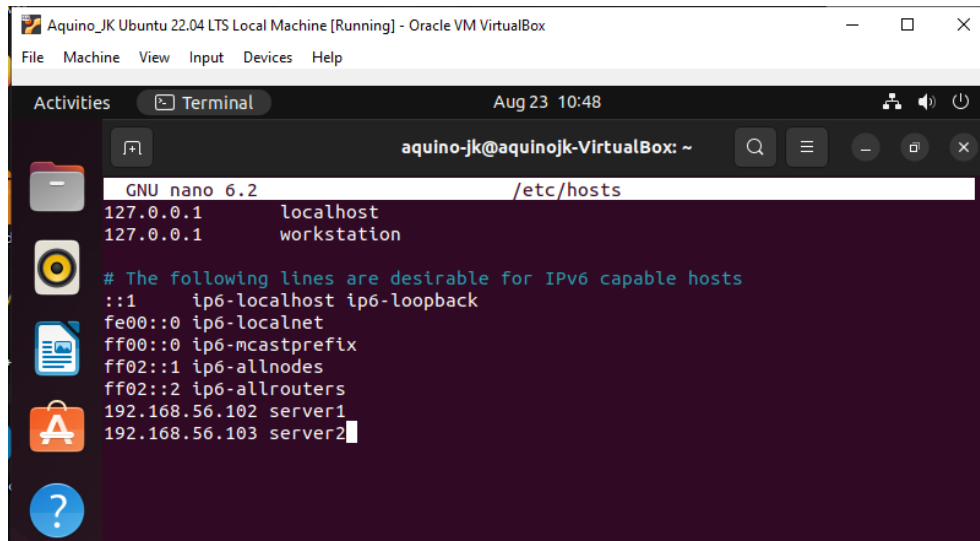
```
aquino-jk@aquinojk-VirtualBox: ~  
aquino-jk@aquinojk-VirtualBox:~$ ssh aquino-jk@192.168.56.102  
The authenticity of host '192.168.56.102 (192.168.56.102)' can't be established  
ED25519 key fingerprint is SHA256:ABR0HYpUfrzDQGAcvLwbewT+iDTS8N7bZmHuel84I.  
This key is not known by any other names  
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes  
Warning: Permanently added '192.168.56.102' (ED25519) to the list of known host s.  
aquino-jk@192.168.56.102's password:  
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-46-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:        https://ubuntu.com/advantage  
  
0 updates can be applied immediately.  
  
Last login: Tue Aug 23 10:21:15 2022 from 192.168.56.101  
aquino-jk@server1:~$  
logout  
Connection to 192.168.56.102 closed.  
aquino-jk@aquinojk-VirtualBox:~$
```



The screenshot shows a terminal window titled "Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox". The terminal output is as follows:

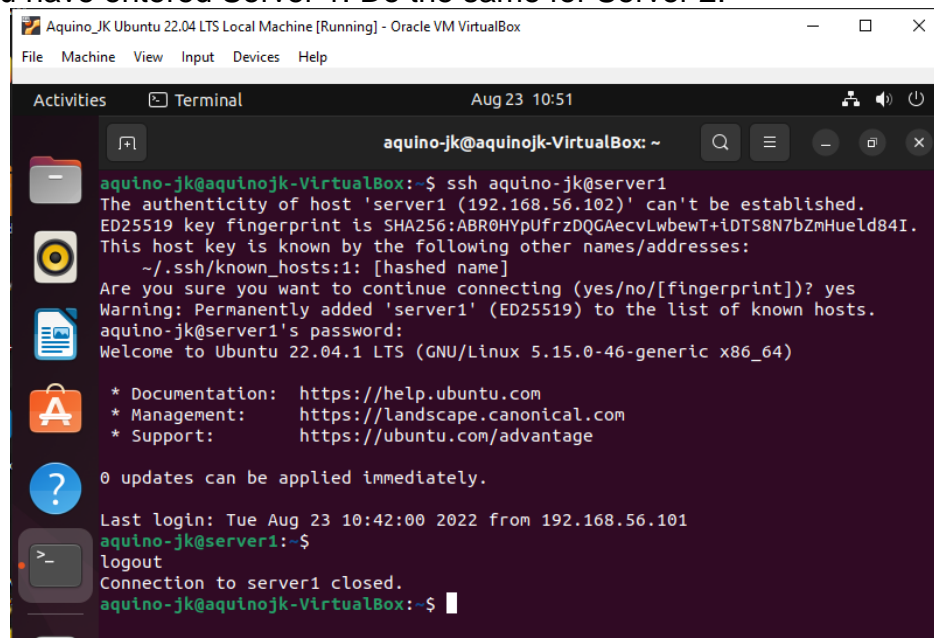
```
aquino-jk@aquinojk-VirtualBox: ~  
aquino-jk@aquinojk-VirtualBox:~$ ssh aquino-jk@192.168.56.103  
aquino-jk@192.168.56.103's password:  
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-46-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:        https://ubuntu.com/advantage  
  
0 updates can be applied immediately.  
  
Last login: Tue Aug 23 10:40:42 2022 from 192.168.56.101  
aquino-jk@aquinojk-VirtualBox:~$  
logout  
Connection to 192.168.56.103 closed.  
aquino-jk@aquinojk-VirtualBox:~$
```


4. Edit the hosts of the Local Machine by issuing the command `sudo nano /etc/hosts`. Below all texts type the following:
 - 4.1 `IP_address server 1` (provide the ip address of server 1 followed by the hostname)
 - 4.2 `IP_address server 2` (provide the ip address of server 2 followed by the hostname)
 - 4.3 Save the file and exit.



```
Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 10:48
aquino-jk@aquinojk-VirtualBox: ~
GNU nano 6.2 /etc/hosts
127.0.0.1 localhost
127.0.0.1 workstation
# The following lines are desirable for IPv6 capable hosts
::1 ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
192.168.56.102 server1
192.168.56.103 server2
```

5. On the local machine, verify that you can do the SSH command but this time, use the hostname instead of typing the IP address of the servers. For example, try to do `ssh jvtaylor@server1`. Enter the password when prompted. Verify that you have entered Server 1. Do the same for Server 2.



```
Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 23 10:51
aquino-jk@aquinojk-VirtualBox: ~
aquino-jk@aquinojk-VirtualBox:~$ ssh aquino-jk@server1
The authenticity of host 'server1 (192.168.56.102)' can't be established.
ED25519 key fingerprint is SHA256:ABR0HYpUfrzDQGAecvLwbewT+iDT58N7bZmHuelD84I.
This host key is known by the following other names/addresses:
~/.ssh/known_hosts:1: [hashed name]
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'server1' (ED25519) to the list of known hosts.
aquino-jk@server1's password:
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-46-generic x86_64)

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

0 updates can be applied immediately.

Last login: Tue Aug 23 10:42:00 2022 from 192.168.56.101
aquino-jk@server1:~$
logout
Connection to server1 closed.
aquino-jk@aquinojk-VirtualBox:~$
```



```
Aquino_JK Ubuntu 22.04 LTS Local Machine [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

Activities Terminal Aug 23 10:52
aquino-jk@aquinojk-VirtualBox: ~

aquino-jk@aquinojk-VirtualBox:~$ ssh aquino-jk@server2
The authenticity of host 'server2 (192.168.56.103)' can't be established.
ED25519 key fingerprint is SHA256:ISmLvQ9vigg4SFzHGG/A1kD6kdDYmUo5MKysEXuVJZo.
This host key is known by the following other names/addresses:
  ~/.ssh/known_hosts:2: [hashed name]
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'server2' (ED25519) to the list of known hosts.
aquino-jk@server2's password:
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-46-generic x86_64)

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

0 updates can be applied immediately.

Last login: Tue Aug 23 10:43:25 2022 from 192.168.56.101
aquino-jk@aquinojk-VirtualBox:~$
logout
Connection to server2 closed.
aquino-jk@aquinojk-VirtualBox:~$
```

Reflections:

Answer the following:

1. How are we able to use the hostname instead of IP address in SSH commands?
 - We are able to use the hostname instead of the IP address in SSH commands because I have edited the hosts of the local machine's host using the commands `sudo nano /etc/host` and in the lower part of the script, I have added the IP Addresses of the servers and put the hostnames beside it, after saving the changes in the script, we can now use the hostname of the servers instead of using the IP addresses of the servers.
2. How secured is SSH?
 - Secure Shell (SSH) is a secure type of shell which actually safer than just using the password which is not secure, SSH uses strong encryption algorithms which makes it more secure to ensure the integrity of the data transmitted.