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Course/Section: CPE31S2	Date Submitted: August 24, 2024
Instructor: Engr. Robin Valenzuela	Semester and SY: 1st Sem (2024-2025)

Activity 1: Configure Network using Virtual Machines

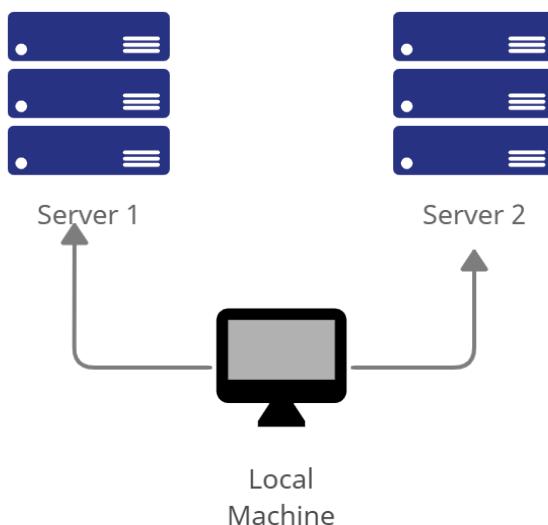
1. Objectives:

- 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:

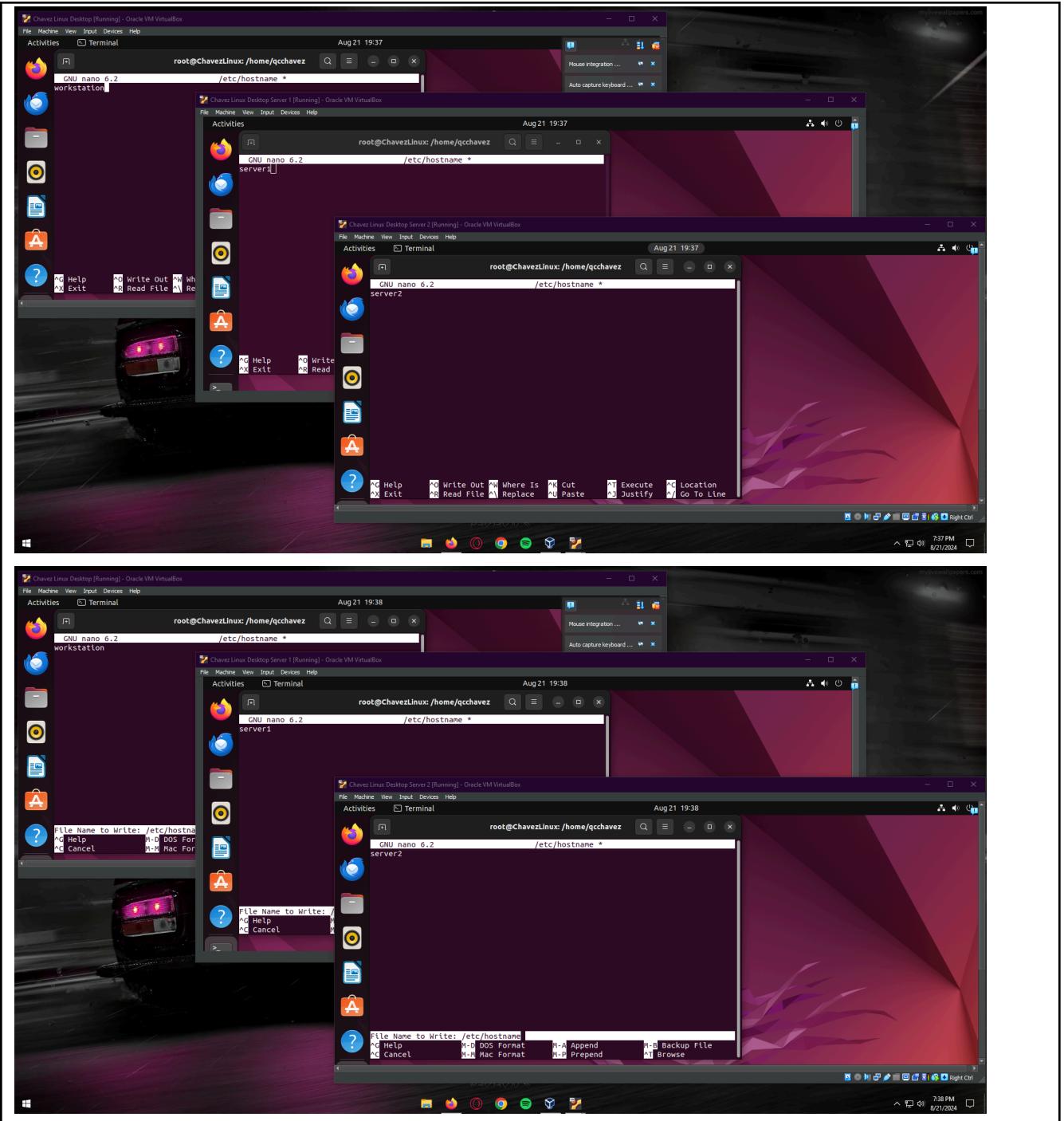
Network Topology:

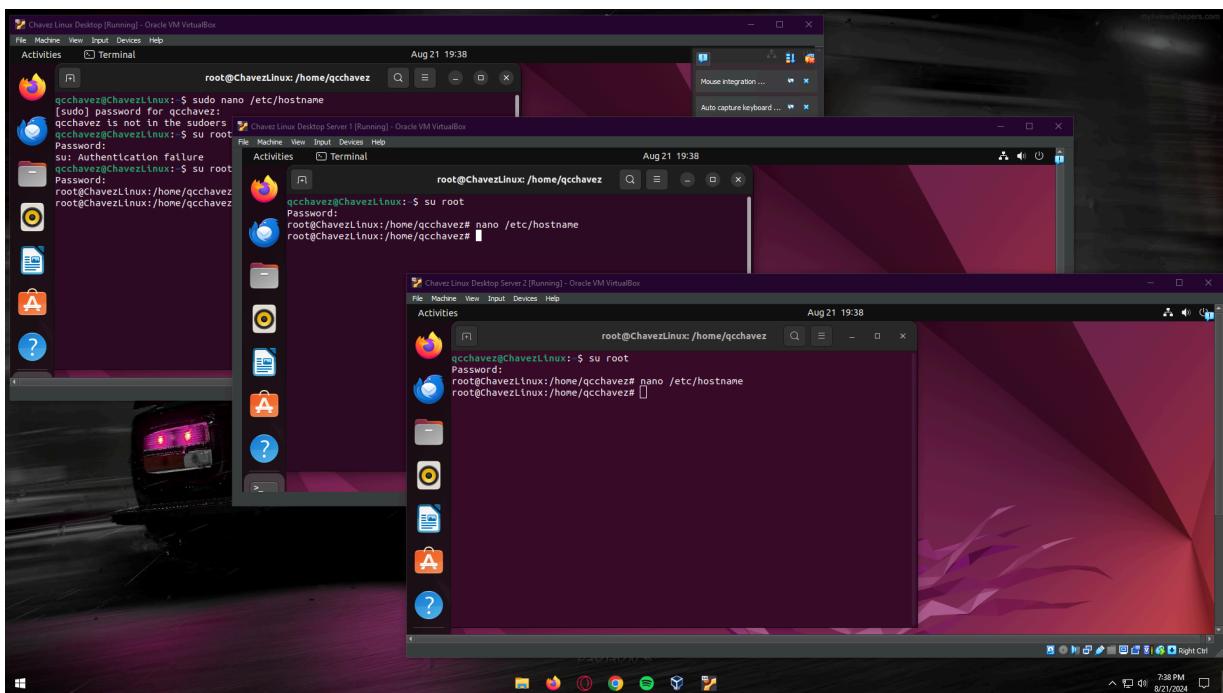
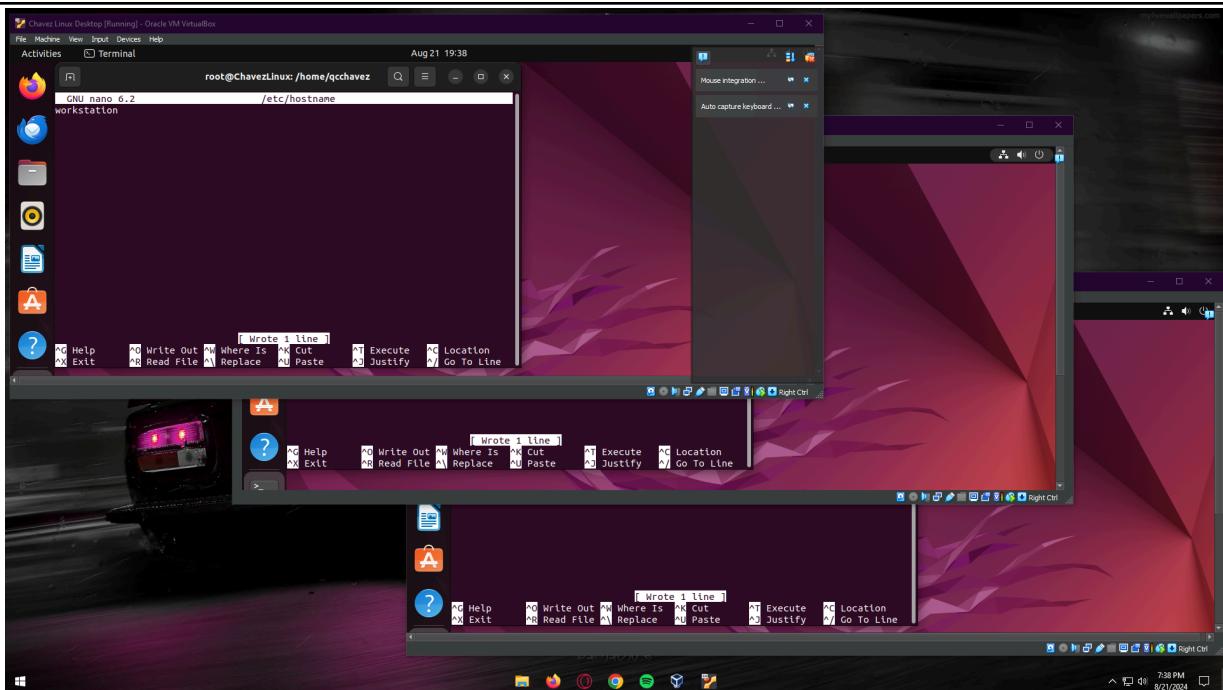
Assume that you have created the following network topology in Virtual Machines, **provide screenshots for each task.** (Note: *it is assumed that you have the prior knowledge of cloning and creating snapshots in a virtual machine*).



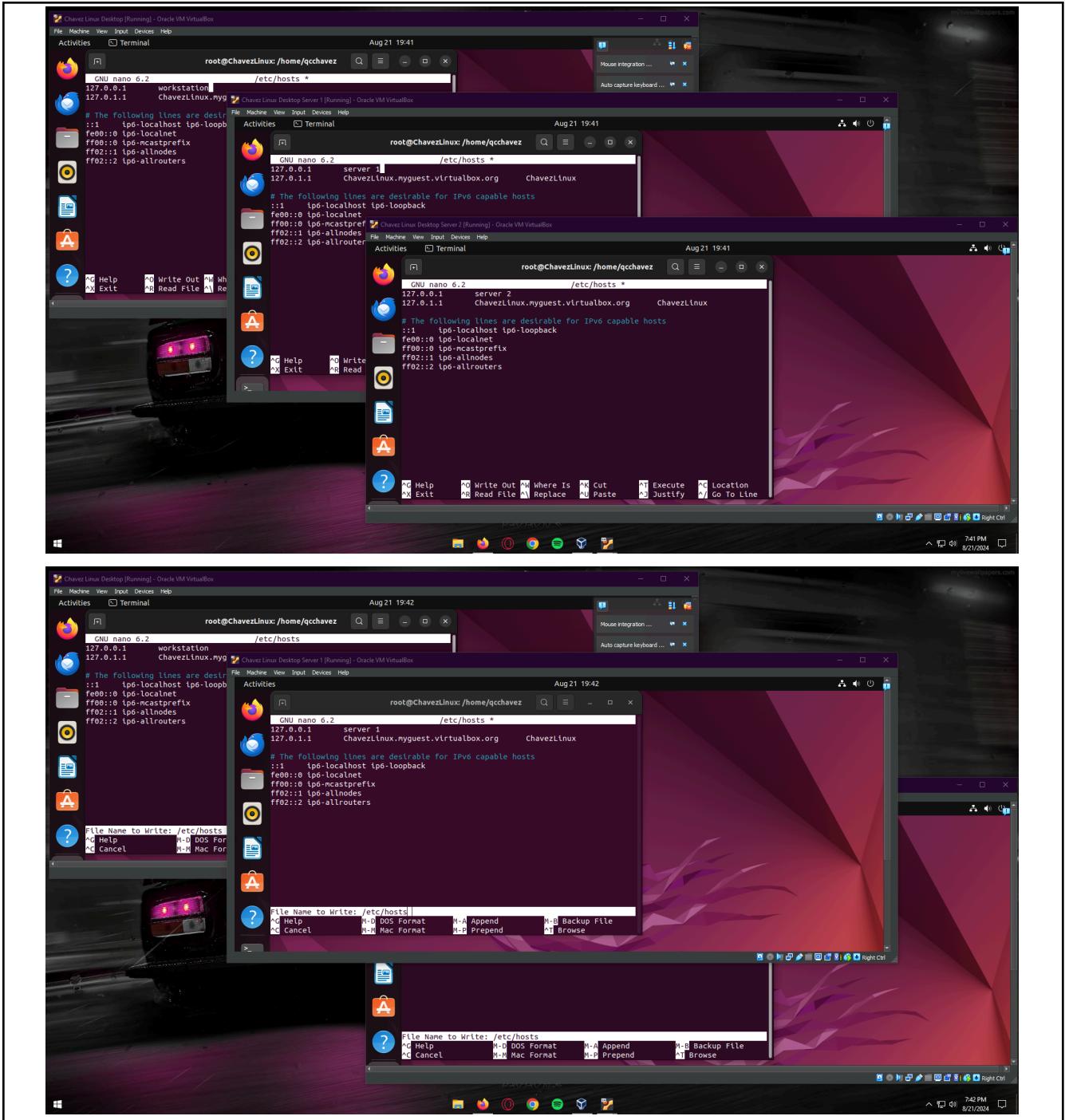
Task 1: Do the following on Server 1, Server 2, and Local Machine. In editing the file using nano command, press control + O to write out (save the file). Press enter when asked for the name of the file. Press control + X to end.

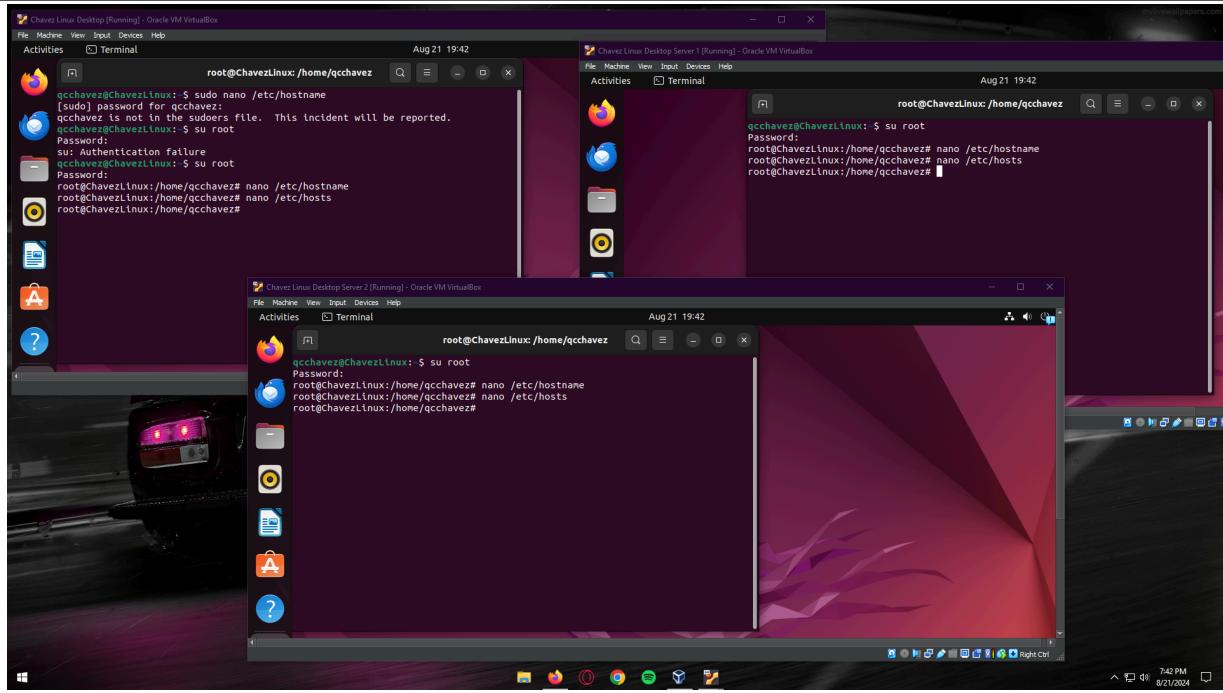
1. Change the hostname using the command *sudo nano /etc/hostname*
 - 1.1 Use server1 for Server 1
 - 1.2 Use server2 for Server 2
- 1.3 Use workstation for the Local Machine





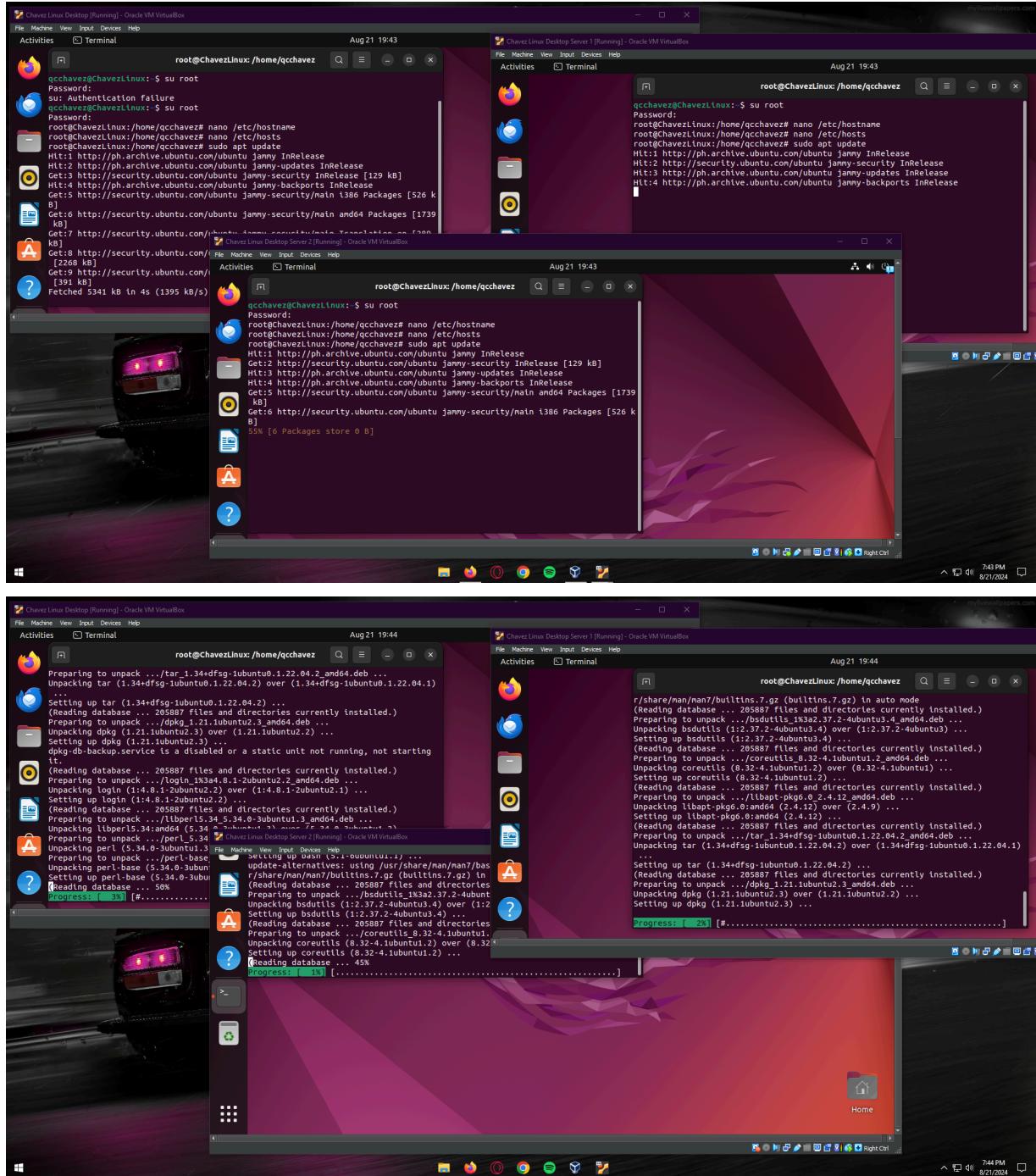
2. Edit the hosts using the command ***sudo nano /etc/hosts***. Edit the second line.
 - 2.1 Type 127.0.0.1 server 1 for Server 1
 - 2.2 Type 127.0.0.1 server 2 for Server 2
 - 2.3 Type 127.0.0.1 workstation for the Local Machine



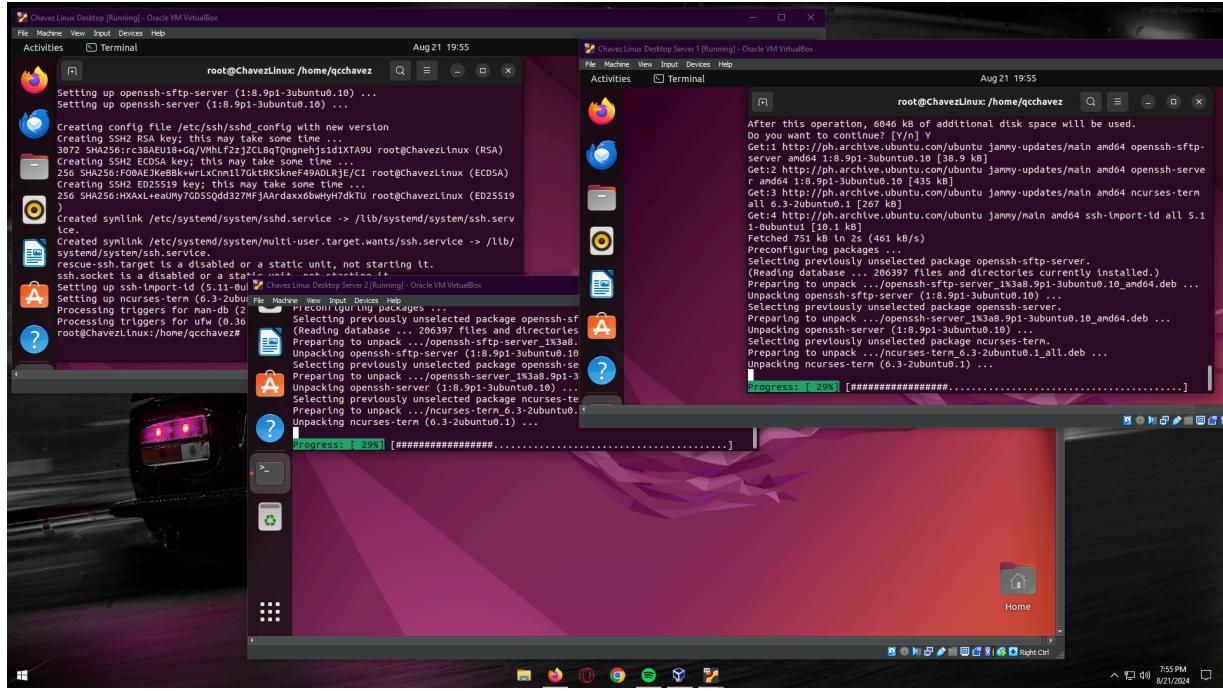


Task 2: Configure SSH on Server 1, Server 2, and Local Machine. Do the following:

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

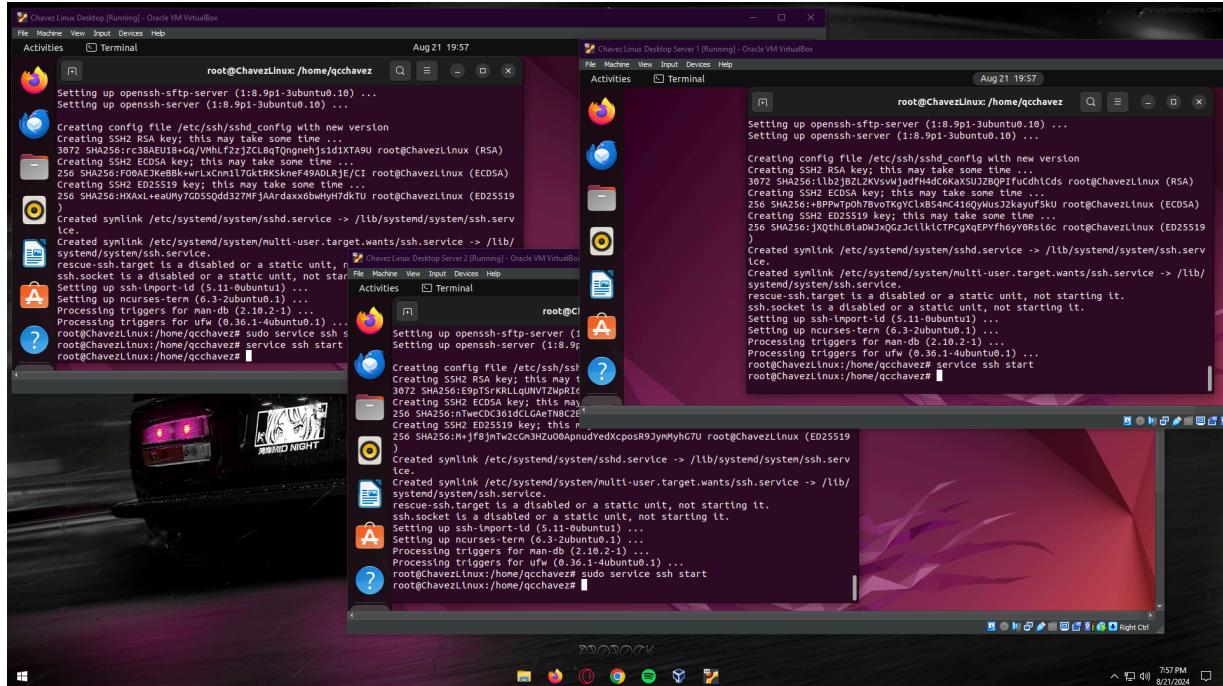


2. Install the SSH server using the command *sudo apt install openssh-server*.

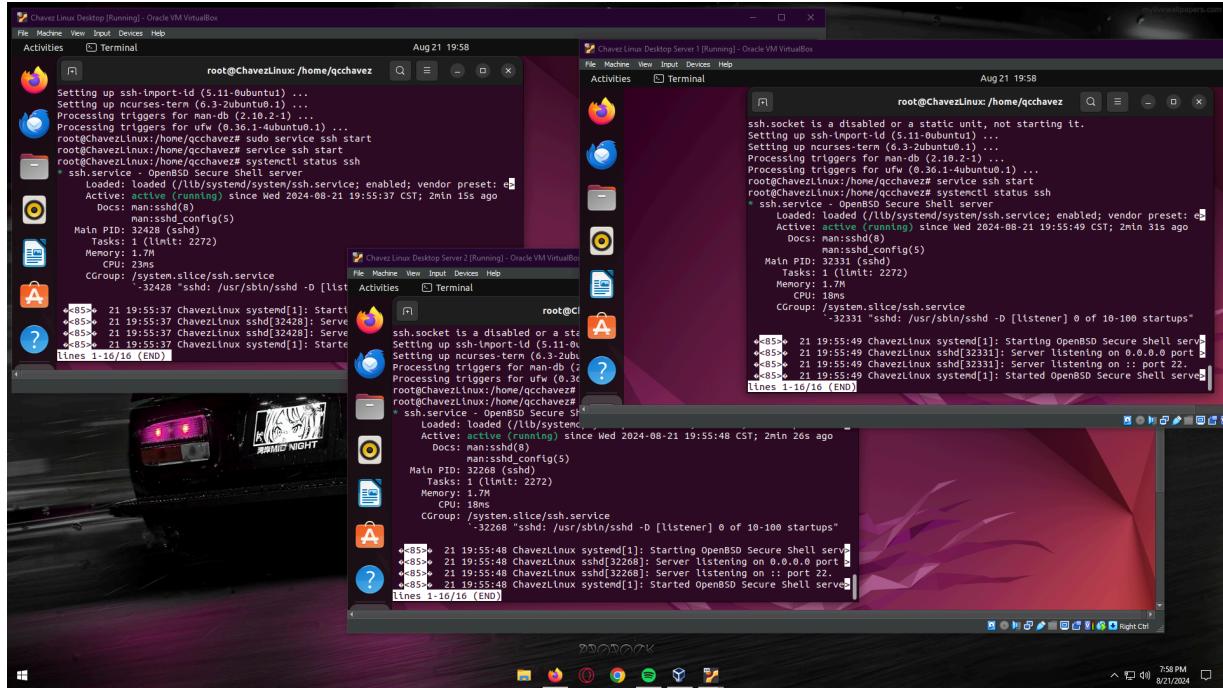


3. Verify if the SSH service has started by issuing the following commands:

3.1 *sudo service ssh start*



3.2 *sudo systemctl status ssh*

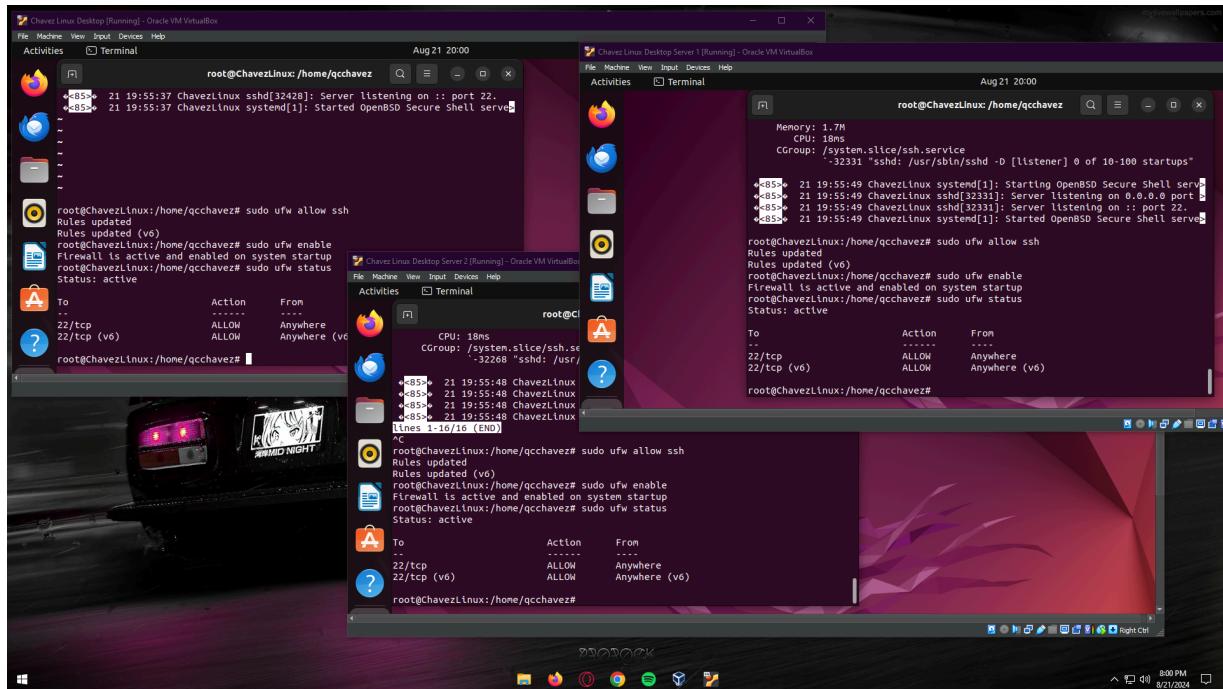


4. Configure the firewall to all port 22 by issuing the following commands:

4.1 ***sudo ufw allow ssh***

4.2 ***sudo ufw enable***

4.3 ***sudo ufw status***



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: 192.168.56.20
 - 1.2 Server 2 IP address: 192.168.56.30
 - 1.3 Local Machine IP address: 192.168.56.101

```
Chaves Linux Desktop [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 21 21:48
qcchavez@workstation: ~ ifconfig
enp0s3: flags=16384 UP,BROADCAST,RUNNING,MULTICAST  mtu 1500
        inet 192.168.56.101 brd 255.255.255.0 broadcast 192.168.56.255
          netmask 255.255.255.0
          broadcast 192.168.56.255
          ...
lo: flags=73 UP,LOOPBACK,RUNNING  mtu 65536
        inet 127.0.0.1 brd 255.255.255.0
          netmask 255.255.255.0
          broadcast 127.0.0.1
          ...
inet6 fe80::1%lo: flags=4163 UP,BROADCAST,NOARP  mtu 128
          netmask 256.0.0.0
          ...
qcchavez@workstation: ~ ping 192.168.56.20
PING 192.168.56.20 (192.168.56.20) 56(84) bytes of data.
64 bytes from 192.168.56.20: icmp_seq=1 ttl=64 time=0.785 ms
64 bytes from 192.168.56.20: icmp_seq=2 ttl=64 time=0.491 ms
64 bytes from 192.168.56.20: icmp_seq=3 ttl=64 time=0.501 ms
64 bytes from 192.168.56.20: icmp_seq=4 ttl=64 time=0.532 ms
64 bytes from 192.168.56.20: icmp_seq=5 ttl=64 time=0.548 ms
64 bytes from 192.168.56.20: icmp_seq=6 ttl=64 time=0.301 ms
64 bytes from 192.168.56.20: icmp_seq=7 ttl=64 time=0.562 ms
...
Chaves Linux Desktop Server 1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 21 21:48
qcchavez@server1: ~ ifconfig
enp0s3: flags=4163 UP,BROADCAST,RUNNING,MULTICAST  mtu 1500
        inet 192.168.56.30 brd 255.255.255.0 broadcast 192.168.56.255
          netmask 255.255.255.0
          broadcast 192.168.56.255
          ...
lo: flags=73 UP,LOOPBACK,RUNNING  mtu 65536
        inet 127.0.0.1 brd 255.255.255.0
          netmask 255.255.255.0
          broadcast 127.0.0.1
          ...
inet6 fe80::1%lo: flags=4163 UP,BROADCAST,NOARP  mtu 128
          netmask 256.0.0.0
          ...
qcchavez@server1: ~ 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=0.785 ms
64 bytes from 192.168.56.101: icmp_seq=2 ttl=64 time=0.491 ms
64 bytes from 192.168.56.101: icmp_seq=3 ttl=64 time=0.501 ms
64 bytes from 192.168.56.101: icmp_seq=4 ttl=64 time=0.532 ms
64 bytes from 192.168.56.101: icmp_seq=5 ttl=64 time=0.548 ms
64 bytes from 192.168.56.101: icmp_seq=6 ttl=64 time=0.301 ms
64 bytes from 192.168.56.101: icmp_seq=7 ttl=64 time=0.562 ms
...
Chaves Linux Desktop Server 2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 21 21:48
qcchavez@server2: ~ ifconfig
enp0s3: flags=4163 UP,BROADCAST,RUNNING,MULTICAST  mtu 1500
        inet 192.168.56.20 brd 255.255.255.0 broadcast 192.168.56.255
          netmask 255.255.255.0
          broadcast 192.168.56.255
          ...
lo: flags=73 UP,LOOPBACK,RUNNING  mtu 65536
        inet 127.0.0.1 brd 255.255.255.0
          netmask 255.255.255.0
          broadcast 127.0.0.1
          ...
inet6 fe80::1%lo: flags=4163 UP,BROADCAST,NOARP  mtu 128
          netmask 256.0.0.0
          ...
qcchavez@server2: ~ 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=0.785 ms
64 bytes from 192.168.56.101: icmp_seq=2 ttl=64 time=0.491 ms
64 bytes from 192.168.56.101: icmp_seq=3 ttl=64 time=0.501 ms
64 bytes from 192.168.56.101: icmp_seq=4 ttl=64 time=0.532 ms
64 bytes from 192.168.56.101: icmp_seq=5 ttl=64 time=0.548 ms
64 bytes from 192.168.56.101: icmp_seq=6 ttl=64 time=0.301 ms
64 bytes from 192.168.56.101: icmp_seq=7 ttl=64 time=0.562 ms
...
```

2. Make sure that they can ping each other.

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

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

The image shows two side-by-side Linux desktop environments running on Oracle VM VirtualBox. Both desktops have a purple and red abstract background.

Left Desktop (Workstation):

- Terminal:** qcchavez@workstation: ~
- ifconfig Output:**

```
qcchavez@workstation:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet 192.168.56.30 brd 192.168.56.255 broadcast 192.168.56.255
      netmask 255.255.255.0      scopeid 0x20<link>
      ether 08:00:27:92:04:00      brd ff:ff:ff:ff:ff:ff
      RX packets 1394 bytes 116616 (116.6 KB)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 494 bytes 49855 (49.8 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 brd 127.0.0.1      netmask 255.0.0.0
      ether 08:00:27:92:04:00      brd ff:ff:ff:ff:ff:ff
      RX packets 4085 bytes 335953 (355.9 KB)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 4085 bytes 335953 (355.9 KB)
      TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

qcchavez@workstation:~$ ping -c 6 192.168.56.30
PING 192.168.56.30 (192.168.56.30) 56(84) bytes of data.
64 bytes from 192.168.56.30: icmp_seq=1 ttl=64 time=0.233 ms
64 bytes from 192.168.56.30: icmp_seq=2 ttl=64 time=0.337 ms
64 bytes from 192.168.56.30: icmp_seq=3 ttl=64 time=0.968 ms
64 bytes from 192.168.56.30: icmp_seq=4 ttl=64 time=0.797 ms
64 bytes from 192.168.56.30: icmp_seq=5 ttl=64 time=0.249 ms
64 bytes from 192.168.56.30: icmp_seq=6 ttl=64 time=0.680 ms

--- 192.168.56.30 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5035ms
rtt min/avg/max/mdev = 0.249/0.654/0.968/0.253 ms
qcchavez@workstation:~$
```

Right Desktop (Server):

- Terminal:** qcchavez@server2: ~
- ifconfig Output:**

```
qcchavez@server2:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet 192.168.56.30 brd 192.168.56.255 broadcast 192.168.56.255
      netmask 255.255.255.0      scopeid 0x20<link>
      ether 08:00:27:92:04:00      brd ff:ff:ff:ff:ff:ff
      RX packets 142 bytes 21215 (21.2 KB)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 78 bytes 9453 (9.4 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 brd 127.0.0.1      netmask 255.0.0.0
      ether 08:00:27:92:04:00      brd ff:ff:ff:ff:ff:ff
      RX packets 494 bytes 38381 (38.3 KB)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 494 bytes 38381 (38.3 KB)
      TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

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

```
qccchavez@server1: ~
```

```
qccchavez@server1: ~
```

```
qccchavez@server2: ~
```

```
qccchavez@server2: ~
```

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.**

```
qccchavez@workstation: ~
```

```
qccchavez@server1: ~
```

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*

The screenshot shows two terminal windows side-by-side. The left window is titled "Chavez Linux Desktop [Running] - Oracle VM VirtualBox" and shows a user's session on "qcchavez@server1". The right window is titled "Chavez Linux Desktop Server 1 [Running] - Oracle VM VirtualBox" and shows a user's session on "qcchavez@server1". Both windows display terminal commands and their outputs.

Left Window (qcchavez@server1):

```
... 192.168.56.30 ping statistics ...
6 packets transmitted, 6 received, 0% packet loss, time 5035ms
rtt min/avg/max/mdev = 0.249/0.654/0.968/0.253 ms
--- 192.168.56.30 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3110ms
rtt min/avg/max/mdev = 0.305/0.490/0.808/0.191 ms
The authenticity of host '192.168.56.20' (192.168.56.20) can't be established.
ED25519 key fingerprint is SHA256:JXothL0laDNxQGz2cilkicTPCgXqEPYfhoyR8si6c.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.56.20' (ED25519) to the list of known hosts.
qcchavez@192.168.56.20's password:
Welcome to Ubuntu 22.04.4 LTS (GNU/Linux 6.8.0-40-generic x86_64)

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

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

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

The 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.

qcchavez@server1:~$
```

Right Window (qcchavez@server1):

```
qcchavez@server1:~$ ifconfig
enp0s3: flags=4163 mtu 1500
inet 192.168.56.20 brd 192.168.56.255 broadcast 192.168.56.255
      netmask 255.255.255.0
      ether 08:00:27:89:92:21 txqueuelen 1000  (Ethernet)
        RX packets 629 bytes 73688 (73.6 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 1450 bytes 107568 (107.5 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
lo: flags=73 mtu 65536
      inet 127.0.0.1 brd 127.0.0.1 netmask 255.0.0.0
      ether 00:00:00:00:00:00 txqueuelen 1000  (Local Loopback)
        RX packets 1955 bytes 157460 (157.4 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 1955 bytes 157460 (157.4 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
qcchavez@server1:~$ ping -c 4 192.168.56.30
PING 192.168.56.30 (192.168.56.30) 56(84) bytes of data.
64 bytes from 192.168.56.30: icmp_seq=1 ttl=64 time=0.808 ms
64 bytes from 192.168.56.30: icmp_seq=2 ttl=64 time=0.391 ms
64 bytes from 192.168.56.30: icmp_seq=3 ttl=64 time=0.456 ms
64 bytes from 192.168.56.30: icmp_seq=4 ttl=64 time=0.305 ms
--- 192.168.56.30 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3110ms
rtt min/avg/max/mdev = 0.305/0.490/0.808/0.191 ms
qcchavez@server1:~$
```

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

The screenshot shows two terminal windows side-by-side. The left window is titled "Chavez Linux Desktop [Running] - Oracle VM VirtualBox" and shows a user's session on "qcchavez@workstation". The right window is titled "Chavez Linux Desktop Server 1 [Running] - Oracle VM VirtualBox" and shows a user's session on "qcchavez@server1". Both windows display terminal commands and their outputs.

Left Window (qcchavez@workstation):

```
qcchavez@workstation:~$ ssh qcchavez@192.168.56.20
The authenticity of host '192.168.56.20 (192.168.56.20)' can't be established.
ED25519 key fingerprint is SHA256:JXothL0laDNxQGz2cilkicTPCgXqEPYfhoyR8si6c.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.56.20' (ED25519) to the list of known hosts.
qcchavez@192.168.56.20's password:
Welcome to Ubuntu 22.04.4 LTS (GNU/Linux 6.8.0-40-generic x86_64)

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

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

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

The 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.

qcchavez@server1:~$ logout
Connection to 192.168.56.20 closed.
qcchavez@workstation:~$
```

Right Window (qcchavez@server1):

```
qcchavez@server1:~$ ifconfig
enp0s3: flags=4163 mtu 1500
inet 192.168.56.20 brd 192.168.56.255 broadcast 192.168.56.255
      netmask 255.255.255.0
      ether 08:00:27:89:92:21 txqueuelen 1000  (Ethernet)
        RX packets 629 bytes 73688 (73.6 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 1450 bytes 107568 (107.5 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
lo: flags=73 mtu 65536
      inet 127.0.0.1 brd 127.0.0.1 netmask 255.0.0.0
      ether 00:00:00:00:00:00 txqueuelen 1000  (Local Loopback)
        RX packets 1955 bytes 157460 (157.4 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 1955 bytes 157460 (157.4 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
qcchavez@server1:~$ ping -c 4 192.168.56.30
PING 192.168.56.30 (192.168.56.30) 56(84) bytes of data.
64 bytes from 192.168.56.30: icmp_seq=1 ttl=64 time=0.808 ms
64 bytes from 192.168.56.30: icmp_seq=2 ttl=64 time=0.391 ms
64 bytes from 192.168.56.30: icmp_seq=3 ttl=64 time=0.456 ms
64 bytes from 192.168.56.30: icmp_seq=4 ttl=64 time=0.305 ms
--- 192.168.56.30 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3110ms
max/mdev = 0.305/0.490/0.808/0.191 ms
qcchavez@server1:~$
```

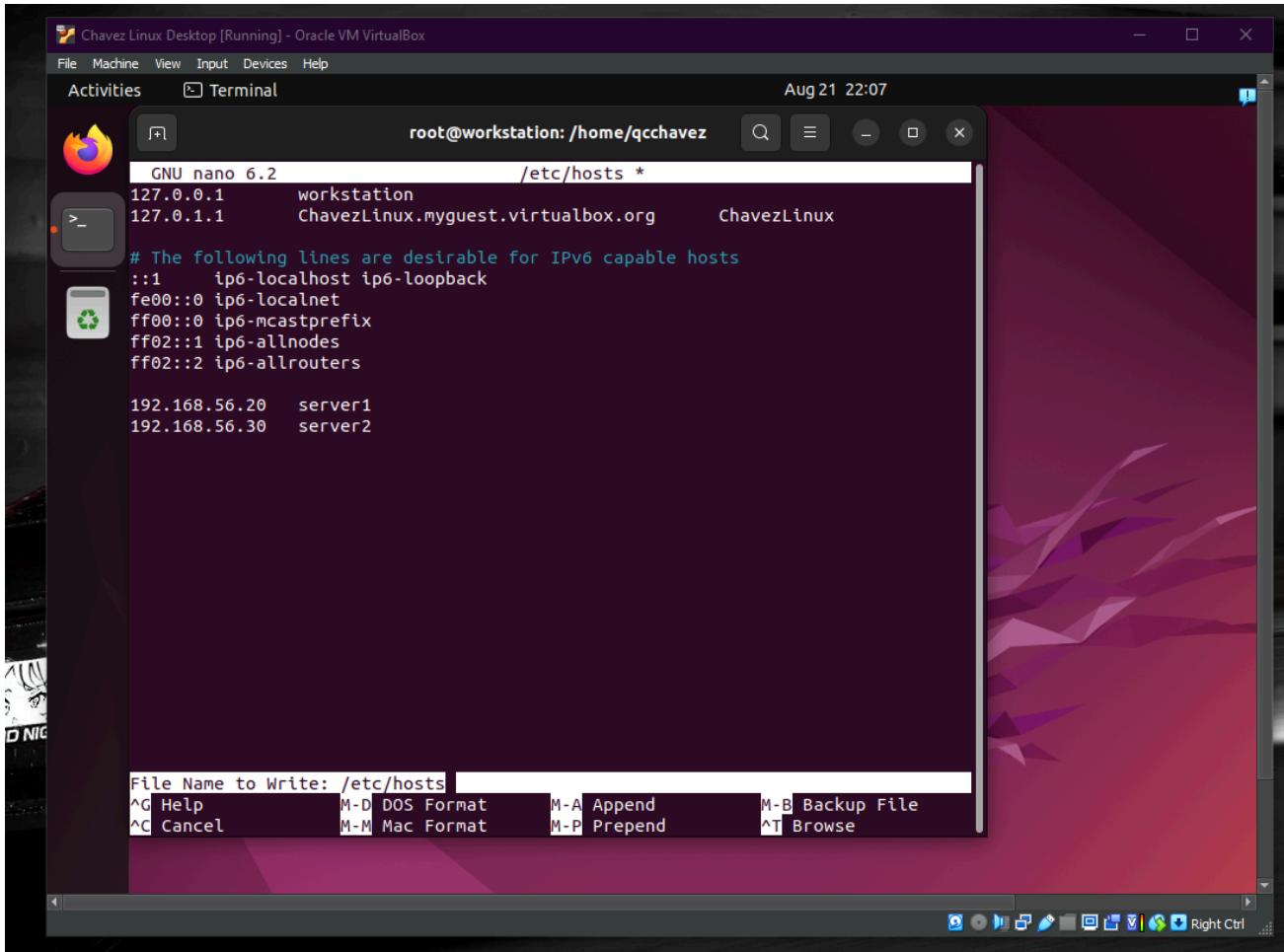
3. Do the same for Server 2.

The image shows three side-by-side terminal windows from Oracle VM VirtualBox, all running on a Linux desktop environment with a purple and black abstract background. Each window has a title bar indicating it is a 'Desktop Server 2 [Running] - Oracle VM VirtualBox' instance.

- Terminal 1 (Left):** Shows a user named 'qcchavez' logging in to 'server2'. The session includes a warning about a new host key fingerprint being added, a password prompt, and a message about ESM updates. It ends with a 'logout' command.
- Terminal 2 (Middle):** Shows the user running the 'ifconfig' command to view network interface statistics. The output includes details for 'enp0s3' (an Ethernet interface) and 'lo' (the loopback interface).
- Terminal 3 (Right):** Shows the user running the 'ifconfig' command again, providing a detailed view of the network interfaces and their statistics.

At the bottom of each terminal window, there is a standard Linux-style toolbar with icons for file operations, terminal control, and system status.

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.



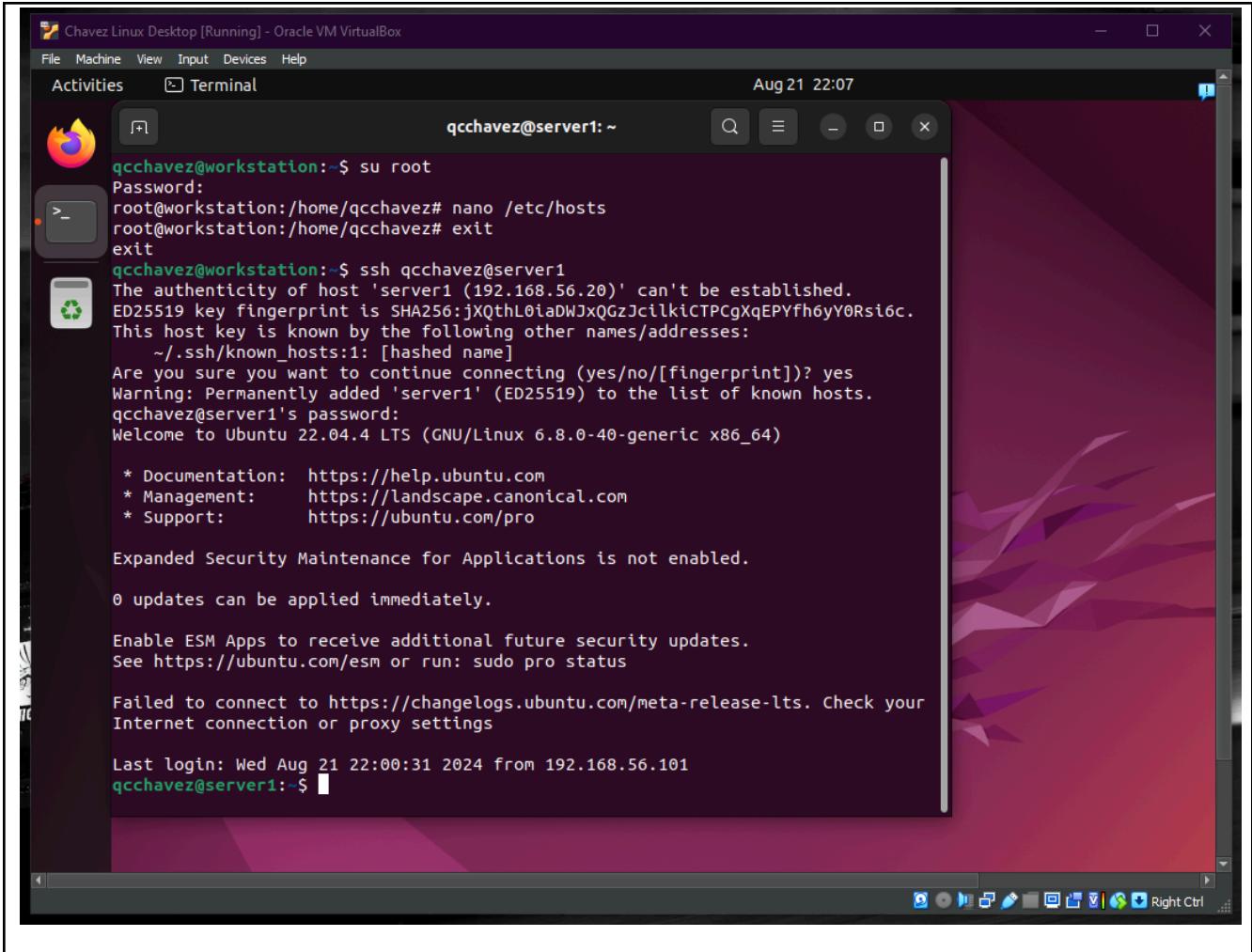
The screenshot shows a Linux desktop environment with a dark purple theme. A terminal window titled "root@workstation: /home/qcchavez" is open, showing the contents of the /etc/hosts file. The file contains the following entries:

```
GNU nano 6.2          /etc/hosts *
127.0.0.1      workstation
127.0.1.1      ChavezLinux.myguest.virtualbox.org      ChavezLinux
# 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

192.168.56.20    server1
192.168.56.30    server2
```

At the bottom of the terminal window, there is a menu bar with options like Help, DOS Format, Append, Backup File, Mac Format, Prepend, Browse, and Cancel. The "Append" option is highlighted. The status bar at the bottom right shows "Right Ctrl".

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.



```
qcchavez@server1:~$  
logout  
Connection to server1 closed.  
qcchavez@workstation:~$ ssh qcchavez@server2  
The authenticity of host 'server2 (192.168.56.30)' can't be established.  
ED25519 key fingerprint is SHA256:M+jf8jmTw2cGm3HZu00ApnudYedXcposR9JymMyhG7U.  
This host key is known by the following other names/addresses:  
    -./.ssh/known_hosts:4: [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.  
qcchavez@server2's password:  
Welcome to Ubuntu 22.04.4 LTS (GNU/Linux 6.8.0-40-generic x86_64)  
  
* Documentation: https://help.ubuntu.com  
* Management: https://landscape.canonical.com  
* Support: https://ubuntu.com/pro  
  
Expanded Security Maintenance for Applications is not enabled.  
  
0 updates can be applied immediately.  
  
Enable ESM Apps to receive additional future security updates.  
See https://ubuntu.com/esm or run: sudo pro status  
  
Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your  
Internet connection or proxy settings  
  
Last login: Wed Aug 21 22:04:02 2024 from 192.168.56.101  
qcchavez@server2:~$  
logout  
Connection to server2 closed.  
qcchavez@workstation:~$
```

Reflections:

Answer the following:

1. How are we able to use the hostname instead of IP address in SSH commands?
 - By importing the IP address of another Linux machine and its hostname, the IP address must be indicated first and after that, the hostname should follow.
Example: 192.168.56.20 server1
2. How secured is SSH?
 - **SSH** is a highly secure protocol for remote administration and communication in Linux. It offers powerful authentication methods and encryptions to prevent any unauthorized access and at the same time, provides strong security.

