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Course/Section: CPE31S5	Date Submitted: August 23, 2023
Instructor: Engr. Roman Richard	Semester and SY: First Semester, 2023- 2024

Activity 1: Configure Network using Virtual Machines

1. Objectives:

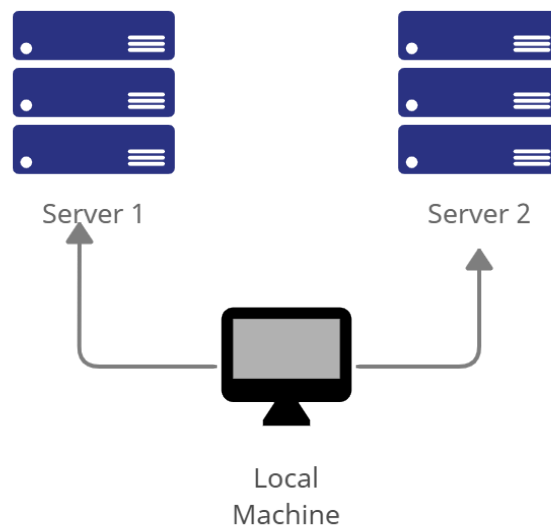
- 1.1. Create and configure Virtual Machines in Microsoft Azure or VirtualBox
- 1.2. Set-up a Virtual Network and Test Connectivity of VMs

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 prior knowledge of cloning and creating snapshots in a virtual machine).



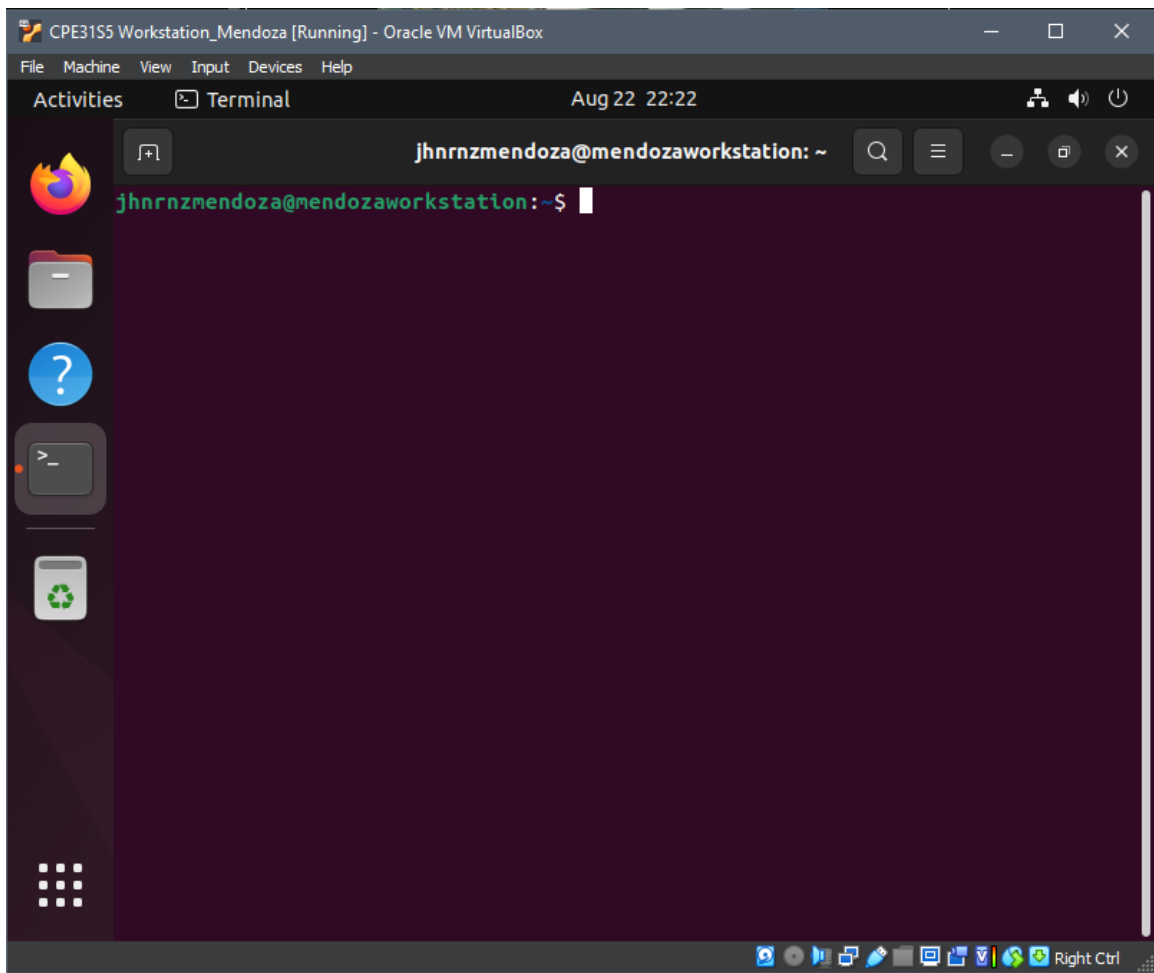


Image 1.1.2. Screenshot of the Installed of the Workstation

```
CPE31S5 Server 1_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

Starting Execute cloud user/final scripts...
Starting Record Runlevel Change in UTMF...
[ OK ] Finished Record Runlevel Change in UTMF.
[ 22.367975] cloud-init[1499]: Cloud-init v. 23.1.2-0ubuntu0~22.04.1 running 'modules:final' at Tue, 22 Aug 2023 15:06:41 +0000. Up 22.31 seconds.
ci-info: no authorized SSH keys fingerprints found for user jhnrnmendoza.
<14>Aug 22 15:06:41 cloud-init: #####
<14>Aug 22 15:06:41 cloud-init: -----BEGIN SSH HOST KEY FINGERPRINTS-----
<14>Aug 22 15:06:41 cloud-init: 1024 SHA256:Pn0zuHEmcMf6rNk38a/6S/H10QJC1K5/k9K9B2oH2l0 root@mendozaserver1 (DSA)
<14>Aug 22 15:06:41 cloud-init: 256 SHA256:0A98Mzgv1MEYnfH5xS32HHJfnu8nm4y7Fz0C2S9HrRg root@mendozaserver1 (ECDSA)
<14>Aug 22 15:06:41 cloud-init: 256 SHA256:K7JL2jn/KLSugnUf1YhFuaSTT/L+Fndou9GdkLkHyspE root@mendozaserver1 (ED25519)
<14>Aug 22 15:06:41 cloud-init: 3072 SHA256:gsIgZvYwqBFhswtaoj/LeEBJs3imkRGOMGTv7UPyeUI root@mendozaserver1 (RSA)
<14>Aug 22 15:06:41 cloud-init: -----END SSH HOST KEY FINGERPRINTS-----
<14>Aug 22 15:06:41 cloud-init: #####
-----BEGIN SSH HOST KEY KEYS-----
ecdsa-sha2-nistp256 AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAAIbmlzdHAyNTYAAABBB0af3CHugg4GyYh0wnUan19kkk69U4xLGpJZhGwA5K6cdXt7sQK77SuARK62YF905bgYxJ610Dm2yTM/2FvcTo= root@mendozaserver1
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIDZJNd+vGpVq9RDb9xBHbcwMyL+EDLYkhT1PNYLkhJzJ root@mendozaserver1
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQGDVU7/Ki1BXaa0Q1zdXzVfy3Jte9S1wDrToQonKWWVDzYfzuhm7VkkXPP3Mj0/SDoME/2dx7CTgFTJD0E5vHd+WqQUR29ofuxKTiek8Up4e3fb7UzvPzJ0SAa56oskqXs8fb0CaNbctuuC1djqk7epE0rd6QfG8vyT15RYXLnDORmaYjDkkoeFGIws1VVMTCPOwbBp5HB2GvLQ10X4UC/kIKY/242Qdtc6GgcQ9t7dPdgi7a4DourB+RTKxFVmdtkKBcCU/GZSSpJ3xu8RH7MeU1DSqSy89eFzjjyYA+6jo28dJL08bnRcBwG55/AmTzGu7E9TWzE5Ghm8e1sSeWeXa0z7leq6raxy3VFdm2fXbTe0EGJ30AxcFurjQqpf6gr1jw12td3S4FnY1WtoACMJHtXrDPwanQh0H0yEaxq7Nb+RJjH0ZWP1itHI108MjJXgAKCkZ87KLQQRjhvfzUxbWB5TkSUvqQLw2ZyyJ21BJb6JFW3x0UhggeCKIoAjQM= root@mendozaserver1
-----END SSH HOST KEY KEYS-----
[ 22.485545] cloud-init[1499]: Cloud-init v. 23.1.2-0ubuntu0~22.04.1 finished at Tue, 22 Aug 2023 15:06:41 +0000. DataSource DataSourceNone. Up 22.48 seconds
[ 22.487366] cloud-init[1499]: 2023-08-22 15:06:41,457 - cc_final_message.py[WARNING]: Used fallback datasource
[ OK ] Finished Execute cloud user/final scripts.
[ OK ] Reached target Cloud-init target.

mendozaserver1 login: _
```

```
mendozaserver1 login: jhnrnmendoza
Password:
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-79-generic x86_64)

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

System information as of Tue Aug 22 03:14:36 PM UTC 2023

System load:  0.05615234375      Processes:            111
Usage of /:   44.1% of 11.21GB   Users logged in:     0
Memory usage: 5%                IPv4 address for enp0s3: 10.0.2.15
Swap usage:   0%

91 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

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.
```

Image 1.1.3. Screenshot of the Installed of the Server 1

```
CPE31S5 Server 2_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

Starting Execute cloud user/final scripts...
Starting Record Runlevel Change in UTM...
[ OK ] Finished Record Runlevel Change in UTM.
[ 22.364326] cloud-init[1510]: Cloud-init v. 23.1.2-0ubuntu0~22.04.1 running 'modules:final' at Tue, 22 Aug 2023 15:06:42 +0000. Up 22.31 seconds.
ci-info: no authorized SSH keys fingerprints found for user jhnrnmendoza.
<14>Aug 22 15:06:42 cloud-init: #####
<14>Aug 22 15:06:42 cloud-init: -----BEGIN SSH HOST KEY FINGERPRINTS-----
<14>Aug 22 15:06:42 cloud-init: 1024 SHA256:6odgUjwIkHP1IruYIue7vLnGS2ZQicTAc/FRZMDK2hM root@mendozaserver2 (DSA)
<14>Aug 22 15:06:42 cloud-init: 256 SHA256:6o76JDWWhv5RNwPeD310pQuYyLQLYXtjJlw20KR4ZE root@mendozaserver2 (ECDSA)
<14>Aug 22 15:06:42 cloud-init: 256 SHA256:47V08JD6iQqaqPUAy4gnwBdrKaevsND2ruD/M+Yrjwo root@mendozaserver2 (ED25519)
<14>Aug 22 15:06:42 cloud-init: 3072 SHA256:RhueVf3aGG4WBLXPaxky/MYsn09h9x0cdYgQ14LySj0 root@mendozaserver2 (RSA)
<14>Aug 22 15:06:42 cloud-init: -----END SSH HOST KEY FINGERPRINTS-----
<14>Aug 22 15:06:42 cloud-init: #####
-----BEGIN SSH HOST KEY KEYS-----
ecdsa-sha2-nistp256 AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAAIbmlzdHAyNTYAAABBBdJ4QhIMX3GjVeJ2dh3emHP0x18I
p0afvzk4G0o20Xni4dp0tGUTND9ig4Wc09bfXJVvu3pYPhvMPB2f1D70g0I= root@mendozaserver2
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIDr1qCpaZQ6c2oQkNVtp6KafJS7C1/LEsLjH8NgIFaHL root@mendozaserver2
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQGCjkU5Pnc2LcS0pekdr0qZcxh0CTWtEY5bSWfuABazU2dPaqgNd959Q8Rry1aEy
U9hHzmuio2JoXGItTcGTcEk+Qan/Bi2CIJCiQCe3nn7a1FjfbNReS90anp0eot201wbKj1TP0S0frm+jpXFDLQULT9o7d0n7j+XG
B5CAuvmKYfvI5oUPCris6bwJKiLL56Fh0+Eu3tyUeIiapXYJSW14ttYC4BLyH4u6NgeU4TT9+kH6ej0A9HEEK762QYPXJENfsYU5
pRU3ApeairhmnN0Ema2jrS1WqG2i6Led40+5YWpWkeIMH2pMfrYVHG2KWPb6wGXihhojDXHDuPH1eEDILq6EibmBJB9D0j+vy22b
E2FfdcIbsnoVCeFznXzb1MKpax84D1c271IL3ieCrnKJ2Ax91NPARvkV1Ti6D//HoFC/troI551+qauCgA3SomSVAcBNTt1jcgM3
A20XK8W5Fb4Cz0HT3ibWhAfbGT62Y12wlb+Dcvxk7Dqp1nr9dk= root@mendozaserver2
-----END SSH HOST KEY KEYS-----
[ 22.481122] cloud-init[1510]: Cloud-init v. 23.1.2-0ubuntu0~22.04.1 finished at Tue, 22 Aug 2023
15:06:42 +0000. Datasource DataSourceNone. Up 22.47 seconds
[ 22.482961] cloud-init[1510]: 2023-08-22 15:06:42,450 - cc_final_message.py[WARNING]: Used fallback
ck datasource
[ OK ] Finished Execute cloud user/final scripts.
[ OK ] Reached target Cloud-init target.

mendozaserver2 login:

Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-79-generic x86_64)

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

System information as of Tue Aug 22 03:14:53 PM UTC 2023

System load:  0.015625      Processes:            110
Usage of /:   44.1% of 11.21GB Users logged in:      0
Memory usage: 5%           IPv4 address for enp0s3: 10.0.2.15
Swap usage:   0%

91 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

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.
```

Image 1.1.4. Screenshot of the Installed of the Server 2

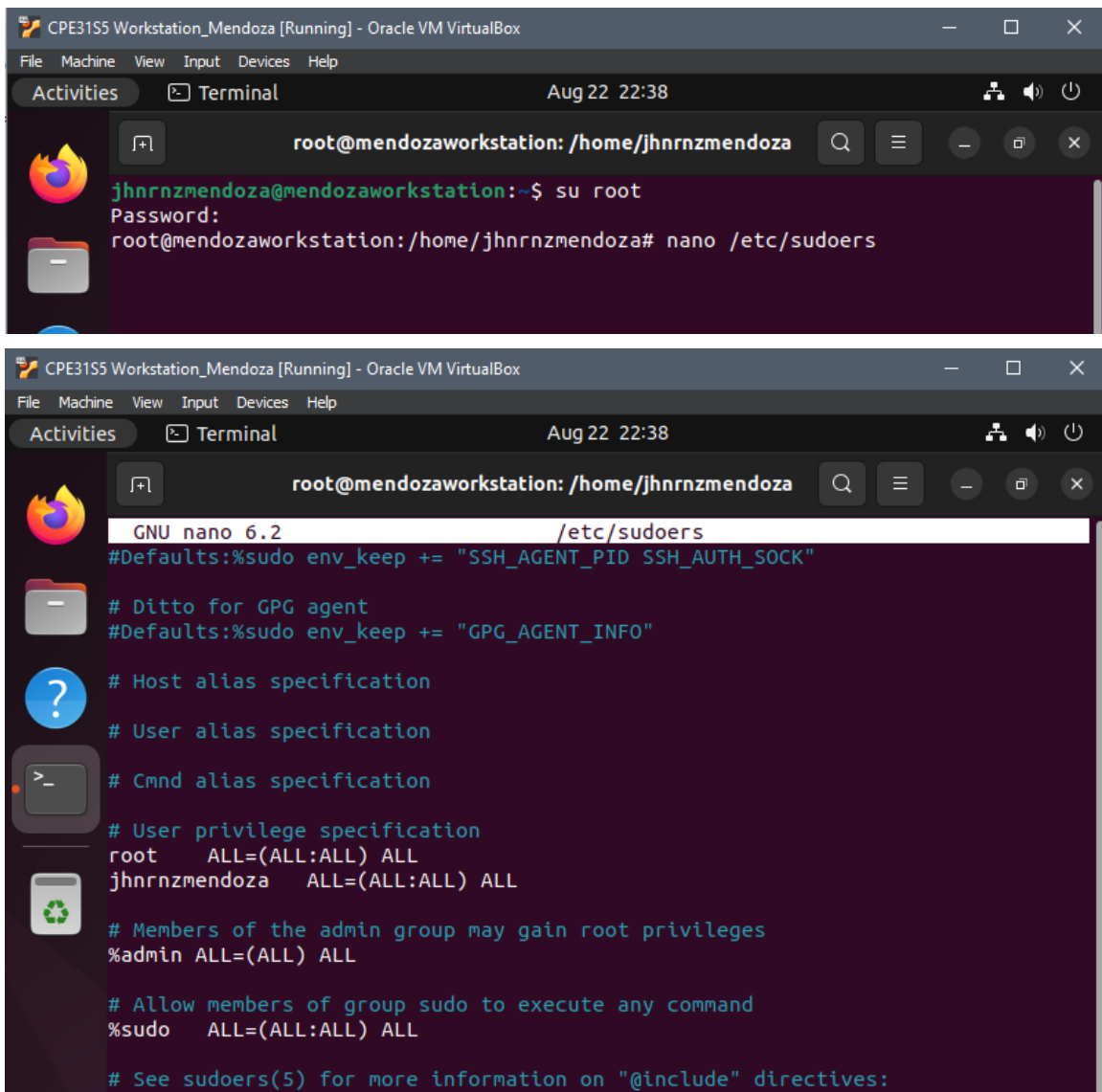


Image 1.1.5. Adding user as a sudoer (sudoer file)

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

```
jhnrmendoza@mendozaserver1:~$ sudo nano /etc/hostname_

CPE31S5 Server 1_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

Ubuntu 22.04.1 LTS server1 tty1

server1 login: jhnrmendoza
Password:
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-79-generic x86_64)

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

System information as of Tue Aug 22 03:20:56 PM UTC 2023

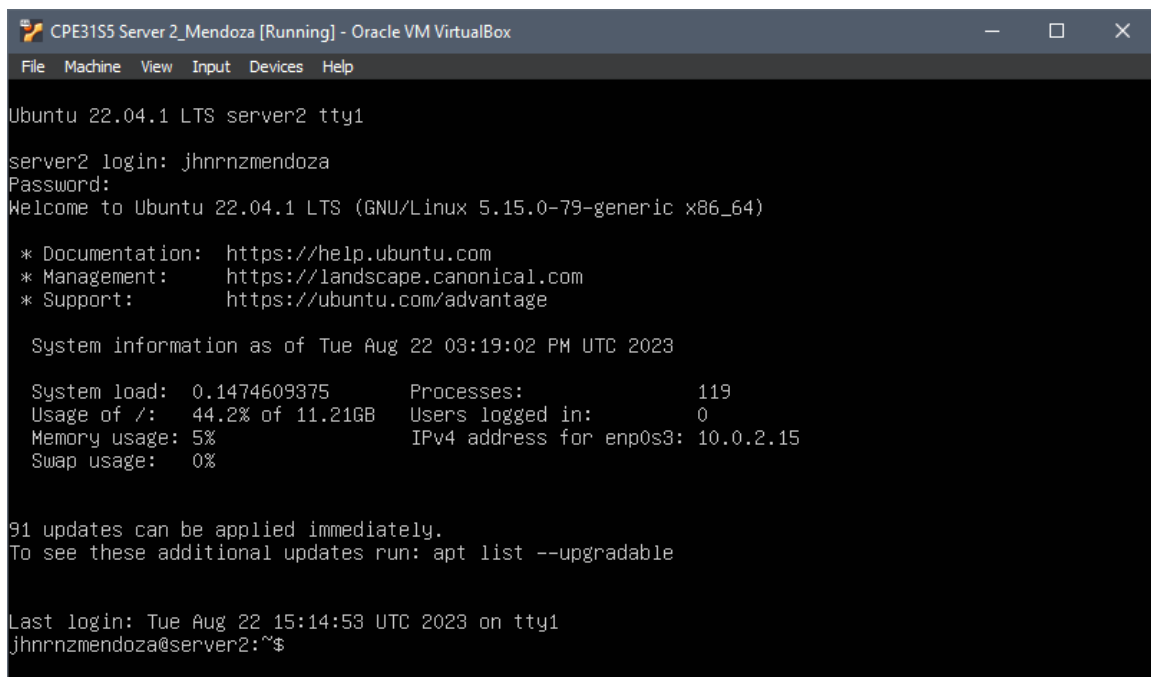
System load:  0.0732421875   Processes:           119
Usage of /:   44.2% of 11.21GB Users logged in:           0
Memory usage: 6%            IPv4 address for enp0s3: 10.0.2.15
Swap usage:   0%

91 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Last login: Tue Aug 22 15:19:31 UTC 2023 on tty1
jhnrmendoza@server1:~$ _
```

1.2 Use server2 for Server 2

```
jhnrmendoza@mendozaserver2:~$ sudo nano /etc/hostname
```



Ubuntu 22.04.1 LTS server2 tty1

server2 login: jhnrmendoza

Password:

Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-79-generic x86_64)

* Documentation: <https://help.ubuntu.com>

* Management: <https://landscape.canonical.com>

* Support: <https://ubuntu.com/advantage>

System information as of Tue Aug 22 03:19:02 PM UTC 2023

System load:	0.1474609375	Processes:	119
Usage of /:	44.2% of 11.21GB	Users logged in:	0
Memory usage:	5%	IPv4 address for enp0s3:	10.0.2.15
Swap usage:	0%		

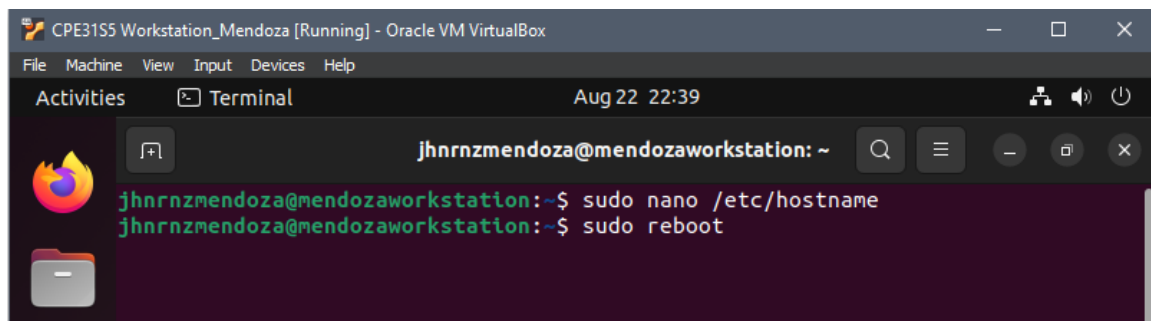
91 updates can be applied immediately.

To see these additional updates run: `apt list --upgradable`

Last login: Tue Aug 22 15:14:53 UTC 2023 on tty1

jhnrmendoza@server2:~\$

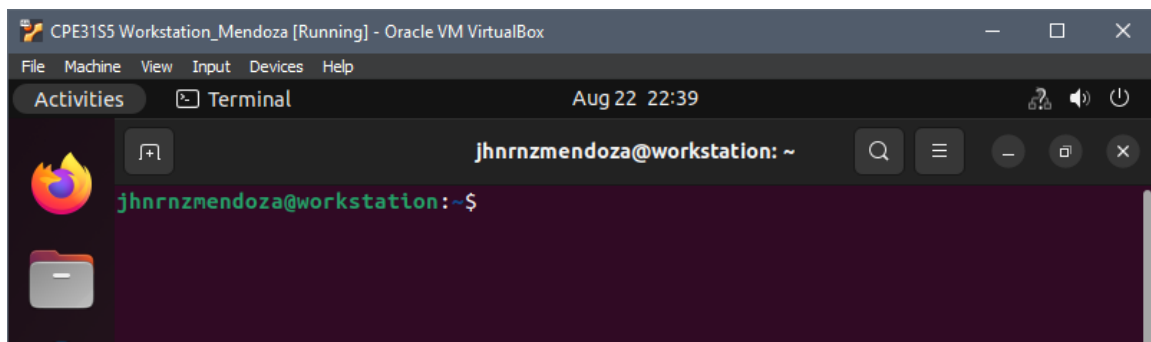
1.3 Use workstation for the Local Machine



```
jhnrmendoza@mendozaworkstation:~$ sudo nano /etc/hostname
```

```
jhnrmendoza@mendozaworkstation:~$ sudo reboot
```

After Reboot:

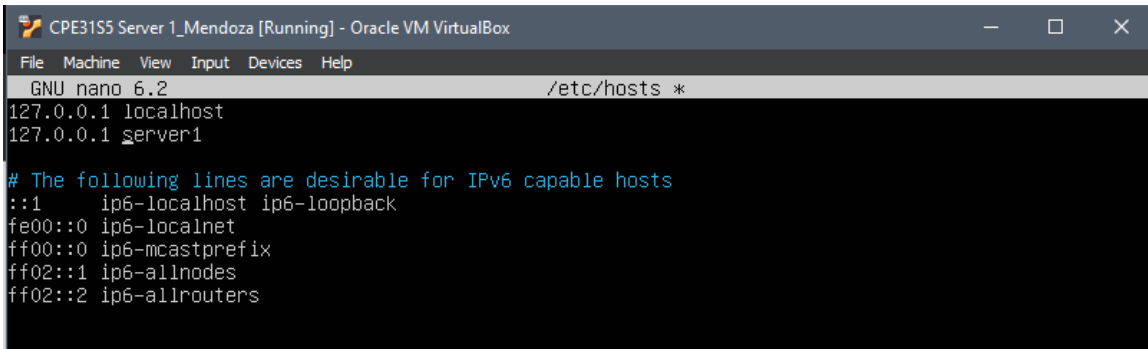


```
jhnrmendoza@workstation:~$
```


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

```
jhnrmendoza@server1:~$ sudo nano /etc/hosts_
```

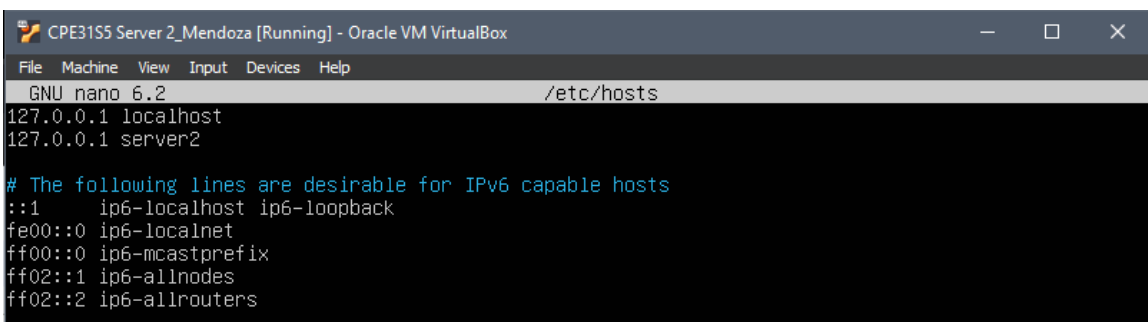


```
GNU nano 6.2 /etc/hosts *
127.0.0.1 localhost
127.0.0.1 server1

# 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

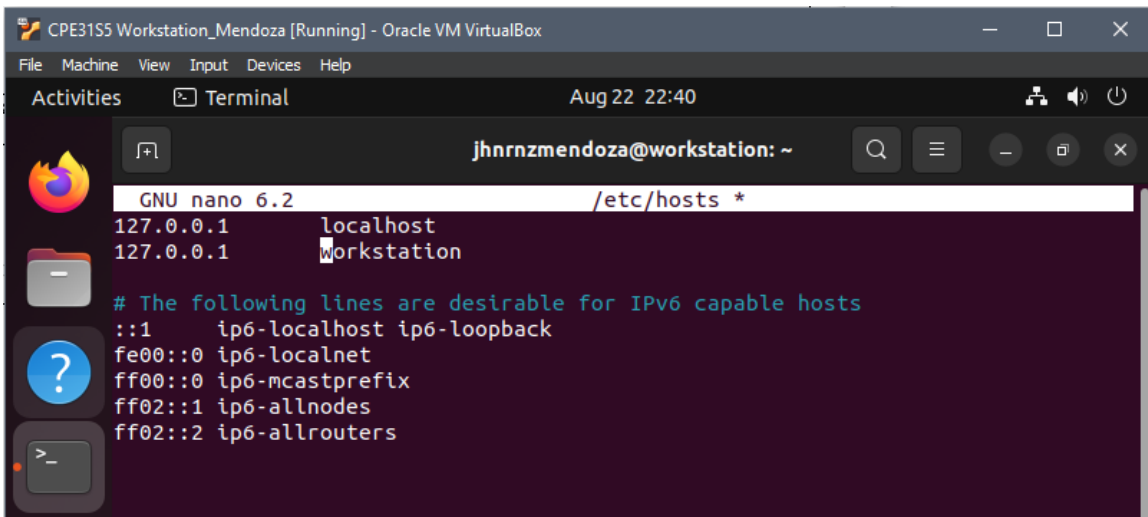
```
jhnrmendoza@server2:~$ sudo nano /etc/hosts
```



```
GNU nano 6.2 /etc/hosts
127.0.0.1 localhost
127.0.0.1 server2

# 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



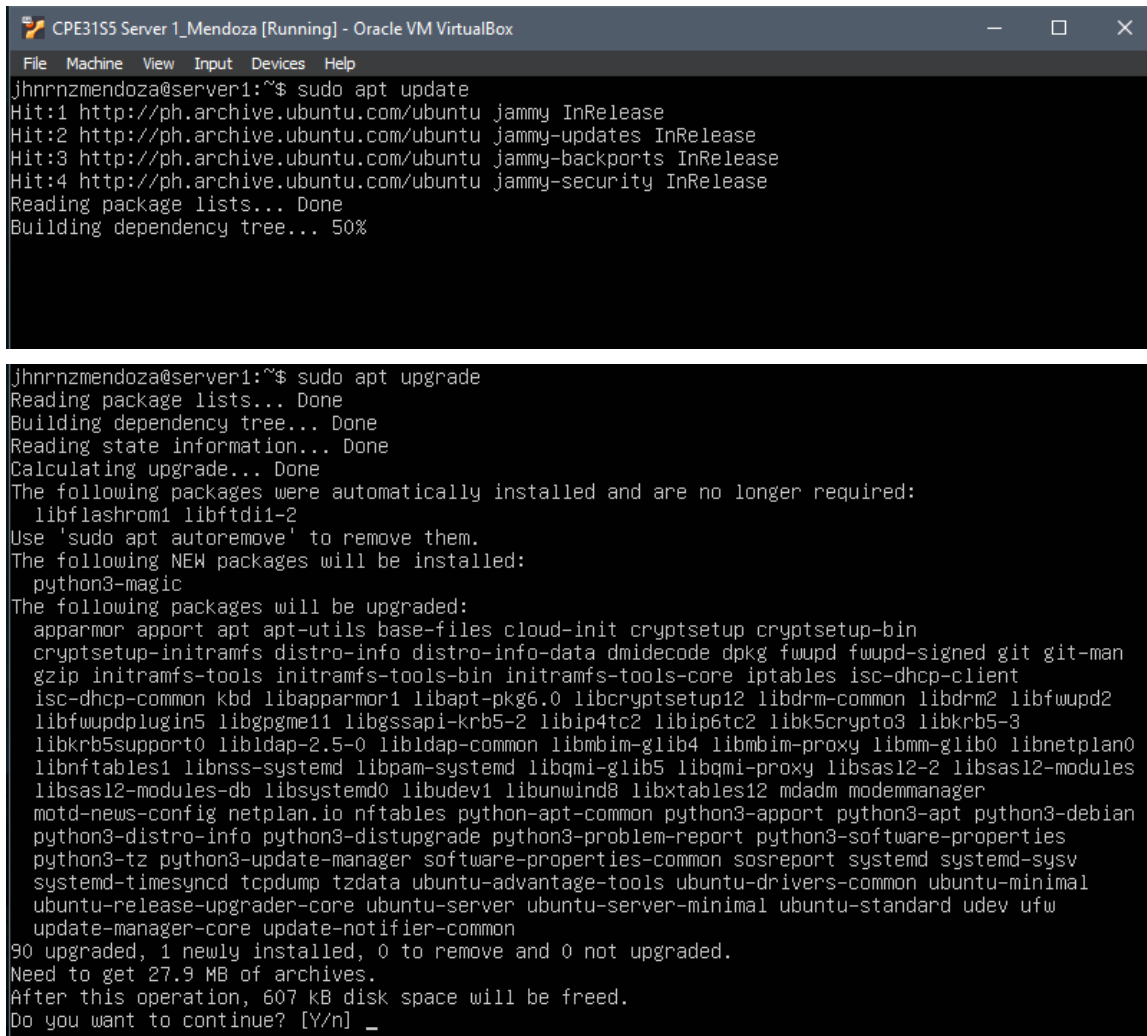
```
GNU nano 6.2 /etc/hosts *
127.0.0.1 localhost
127.0.0.1 workstation

# 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.

Server 1



```
CPE31S5 Server 1_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrmendoza@server1:~$ sudo apt update
Hit:1 http://ph.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://ph.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://ph.archive.ubuntu.com/ubuntu jammy-backports InRelease
Hit:4 http://ph.archive.ubuntu.com/ubuntu jammy-security InRelease
Reading package lists... Done
Building dependency tree... 50%

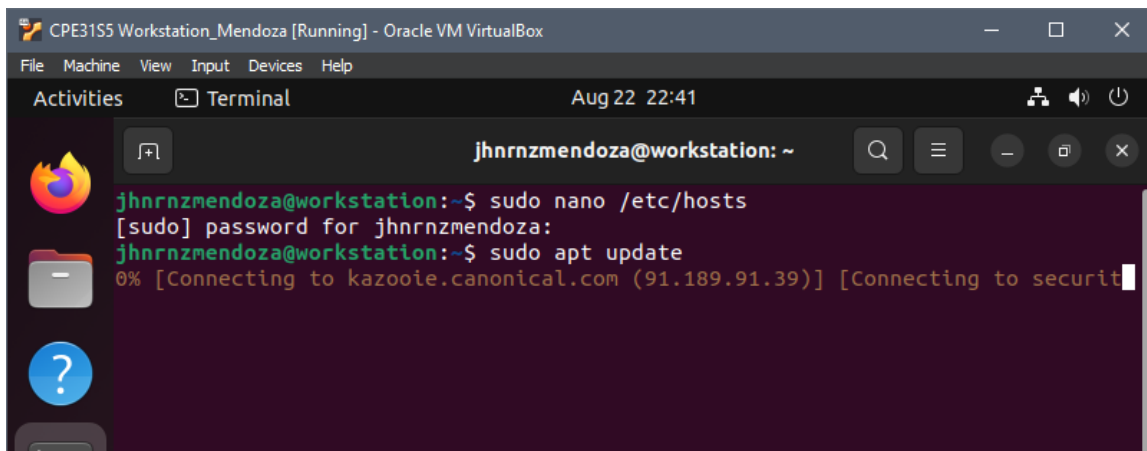
jhnrmendoza@server1:~$ sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
  libflashrom1 libftdi1-2
Use 'sudo apt autoremove' to remove them.
The following NEW packages will be installed:
  python3-magic
The following packages will be upgraded:
  apparmor apport apt apt-utils base-files cloud-init cryptsetup cryptsetup-bin
  cryptsetup-initramfs distro-info distro-info-data dmidecode dpkg fwupd fwupd-signed git git-man
  gzip initramfs-tools initramfs-tools-bin initramfs-tools-core iptables isc-dhcp-client
  isc-dhcp-common kbd libapparmor1 libapt-pkg6.0 libcryptsetup12 libdrm-common libdrm2 libfwupd2
  libfwupdplugin5 libgpgme11 libgssapi-krb5-2 libip4tc2 libip6tc2 libk5crypto3 libkrb5-3
  libkrb5support0 libldap-2.5-0 libldap-common libmbim-glib4 libmbim-proxy libmm-glib0 libnetplan0
  libnftables1 libnss-systemd libpam-systemd libqmi-glib5 libqmi-proxy libsasl2-2 libsasl2-modules
  libsasl2-modules-db libsystemd0 libudev1 libunwind8 libxtables12 mdadm modemmanager
  motd-news-config netplan.io nftables python-apt-common python3-apport python3-apt python3-debian
  python3-distro-info python3-distupgrade python3-problem-report python3-software-properties
  python3-tz python3-update-manager software-properties-common sosreport systemd systemd-sysv
  systemd-timesyncd tcpdump tzdata ubuntu-advantage-tools ubuntu-drivers-common ubuntu-minimal
  ubuntu-release-upgrader-core ubuntu-server ubuntu-server-minimal ubuntu-standard udev ufw
  update-manager-core update-notifier-common
90 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 27.9 MB of archives.
After this operation, 607 kB disk space will be freed.
Do you want to continue? [Y/n] _
```

Server 2

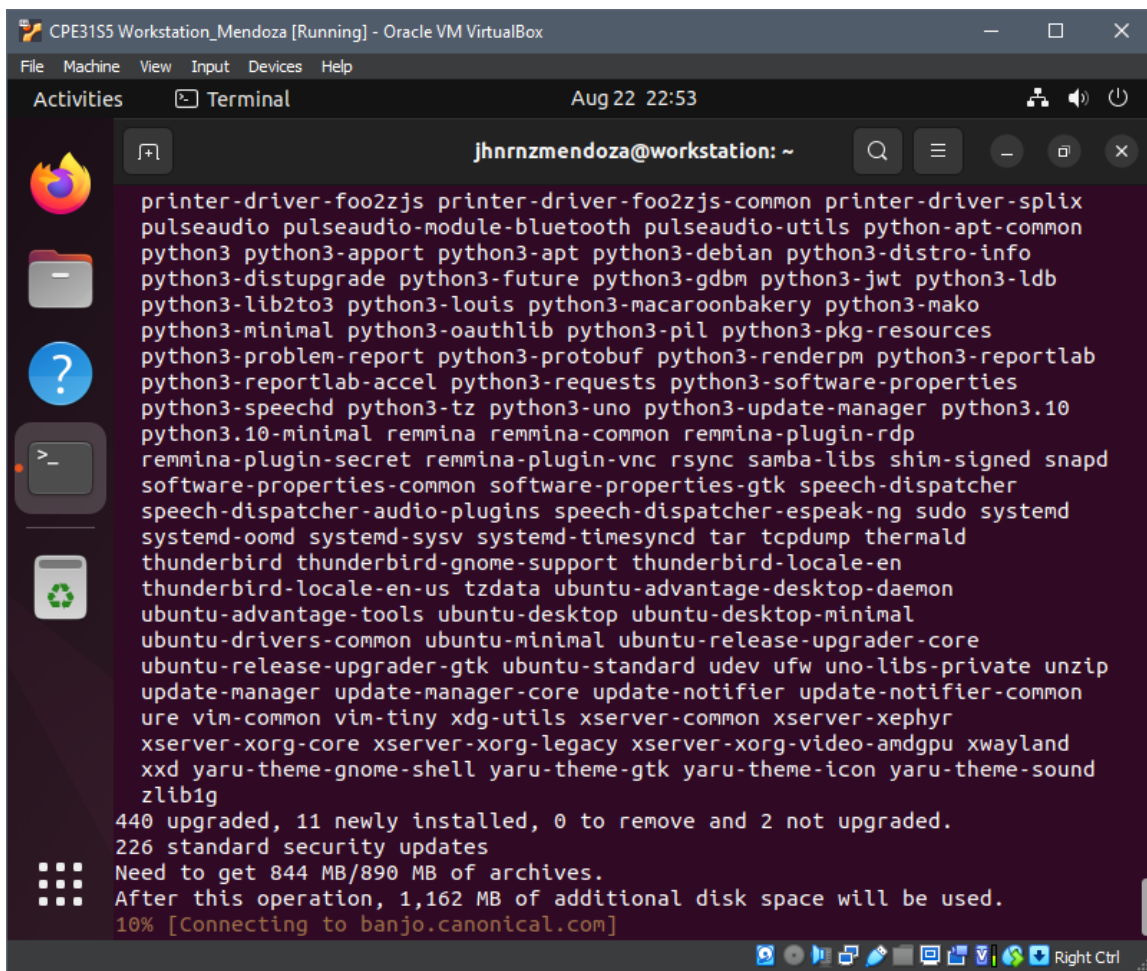
```
CPE31S5 Server 2_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrmendoza@server2:~$ sudo apt update
Hit:1 http://ph.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://ph.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://ph.archive.ubuntu.com/ubuntu jammy-backports InRelease
Hit:4 http://ph.archive.ubuntu.com/ubuntu jammy-security InRelease
Reading package lists... 71%

jhnrmendoza@server2:~$ sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
  libflashrom1 libftdi1-2
Use 'sudo apt autoremove' to remove them.
The following NEW packages will be installed:
  python3-magic
The following packages will be upgraded:
  apparmor apport apt apt-utils base-files cloud-init cryptsetup cryptsetup-bin
  cryptsetup-initramfs distro-info distro-info-data dmidecode dpkg fwupd fwupd-signed git git-man
  gzip initramfs-tools initramfs-tools-bin initramfs-tools-core iptables isc-dhcp-client
  isc-dhcp-common kbd libapparmor1 libapt-pkg6.0 libcryptsetup12 libdrm-common libdrm2 libfwupd2
  libfwupdplugin5 libgpgme11 libgssapi-krb5-2 libip4tc2 libip6tc2 libk5crypto3 libkrb5-3
  libkrb5support0 libldap-2.5-0 libldap-common libmbim-glib4 libmbim-proxy libmm-glib0 libnetplan0
  libnftables1 libnss-systemd libpam-systemd libqmi-glib5 libqmi-proxy libsasl2-2 libsasl2-modules
  libsasl2-modules-db libsystemd0 libudev1 libunwind8 libxtables12 mdadm modemmanager
  motd-news-config netplan.io nftables python-apt-common python3-apport python3-apt python3-debian
  python3-distro-info python3-distupgrade python3-problem-report python3-software-properties
  python3-tz python3-update-manager software-properties-common sosreport systemd systemd-sysv
  systemd-timesyncd tcpdump tzdata ubuntu-advantage-tools ubuntu-drivers-common ubuntu-minimal
  ubuntu-release-upgrader-core ubuntu-server ubuntu-server-minimal ubuntu-standard udev ufw
  update-manager-core update-notifier-common
90 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 27.9 MB of archives.
After this operation, 607 kB disk space will be freed.
Do you want to continue? [Y/n]
```

Local Machine



```
CPE31S5 Workstation_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 22 22:41
jhnrmendoza@workstation: ~
jhnrmendoza@workstation:~$ sudo nano /etc/hosts
[sudo] password for jhnrmendoza:
jhnrmendoza@workstation:~$ sudo apt update
0% [Connecting to kazoie.canonical.com (91.189.91.39)] [Connecting to securit
```



```
CPE31S5 Workstation_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 22 22:53
jhnrmendoza@workstation: ~
printer-driver-foo2zjs printer-driver-foo2zjs-common printer-driver-splix
pulseaudio pulseaudio-module-bluetooth pulseaudio-utils python-apt-common
python3 python3-appport python3-apt python3-debian python3-distro-info
python3-distupgrade python3-future python3-gdbm python3-jwt python3-ldb
python3-lib2to3 python3-louis python3-macaroonbakery python3-mako
python3-minimal python3-oauthlib python3-pil python3-pkg-resources
python3-problem-report python3-protobuf python3-renderpm python3-reportlab
python3-reportlab-accel python3-requests python3-software-properties
python3-speechd python3-tz python3-uno python3-update-manager python3.10
python3.10-minimal remmina remmina-common remmina-plugin-rdp
remmina-plugin-secret remmina-plugin-vnc rsync samba-lsfs shim-signed snapd
software-properties-common software-properties-gtk speech-dispatcher
speech-dispatcher-audio-plugins speech-dispatcher-espeak-ng sudo systemd
systemd-oemd systemd-sysv systemd-timesyncd tar tcpdump thermald
thunderbird thunderbird-gnome-support thunderbird-locale-en
thunderbird-locale-en-us tzdata ubuntu-advantage-desktop-daemon
ubuntu-advantage-tools ubuntu-desktop ubuntu-desktop-minimal
ubuntu-drivers-common ubuntu-minimal ubuntu-release-upgrader-core
ubuntu-release-upgrader-gtk ubuntu-standard udev ufw uno-libs-private unzip
update-manager update-manager-core update-notifier update-notifier-common
ure vim-common vim-tiny xdg-utils xserver-common xserver-xephyr
xserver-xorg-core xserver-xorg-legacy xserver-xorg-video-amdgpu xwayland
xxd yaru-theme-gnome-shell yaru-theme-gtk yaru-theme-icon yaru-theme-sound
zlib1g
440 upgraded, 11 newly installed, 0 to remove and 2 not upgraded.
226 standard security updates
Need to get 844 MB/890 MB of archives.
After this operation, 1,162 MB of additional disk space will be used.
10% [Connecting to banjo.canonical.com]
```

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

Server 1

```
CPE31S5 Server 1_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrmendoza@server1:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openssh-server is already the newest version (1:8.9p1-3ubuntu0.3).
The following packages were automatically installed and are no longer required:
  libflashrom1 libftdi1-2
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
```

Server 2

```
CPE31S5 Server 2_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrmendoza@server2:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openssh-server is already the newest version (1:8.9p1-3ubuntu0.3).
The following packages were automatically installed and are no longer required:
  libflashrom1 libftdi1-2
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
```

Local Machine

```
jhnrmendoza@workstation:~$ sudo apt install openssh-server
[sudo] password for jhnrmendoza:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libflashrom1 libftdi1-2 libllvm13
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  ncurses-term openssh-sftp-server ssh-import-id
Suggested packages:
  molly-guard monkeysphere ssh-askpass
The following NEW packages will be installed:
  ncurses-term openssh-server openssh-sftp-server ssh-import-id
0 upgraded, 4 newly installed, 0 to remove and 2 not upgraded.
Need to get 751 kB of archives.
After this operation, 6,046 kB of additional disk space will be used.
```

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*

Server 1

```
jhnrmendoza@server1:~$ sudo service ssh start
jhnrmendoza@server1:~$ sudo systemctl status ssh
• ssh.service - OpenBSD Secure Shell server
   Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset: enabled)
   Active: active (running) since Tue 2023-08-22 15:27:49 UTC; 3min 28s ago
     Docs: man:sshd(8)
           man:sshd_config(5)
   Process: 16170 ExecStartPre=/usr/sbin/sshd -t (code=exited, status=0/SUCCESS)
  Main PID: 16174 (sshd)
    Tasks: 1 (limit: 4557)
   Memory: 1.7M
      CPU: 20ms
   CGroup: /system.slice/ssh.service
           └─16174 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Aug 22 15:27:48 server1 systemd[1]: ssh.service: Deactivated successfully.
Aug 22 15:27:48 server1 systemd[1]: Stopped OpenBSD Secure Shell server.
Aug 22 15:27:48 server1 systemd[1]: Starting OpenBSD Secure Shell server...
Aug 22 15:27:49 server1 sshd[16174]: Server listening on 0.0.0.0 port 22.
Aug 22 15:27:49 server1 systemd[1]: Started OpenBSD Secure Shell server.
Aug 22 15:27:49 server1 sshd[16174]: Server listening on :: port 22.
```

Server 2

```
jhnrmendoza@server2:~$ sudo service ssh start
jhnrmendoza@server2:~$ sudo systemctl status ssh
• ssh.service - OpenBSD Secure Shell server
   Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset: enabled)
   Active: active (running) since Tue 2023-08-22 15:28:06 UTC; 2min 14s ago
     Docs: man:sshd(8)
           man:sshd_config(5)
   Process: 16168 ExecStartPre=/usr/sbin/sshd -t (code=exited, status=0/SUCCESS)
  Main PID: 16172 (sshd)
    Tasks: 1 (limit: 4557)
   Memory: 1.7M
      CPU: 19ms
   CGroup: /system.slice/ssh.service
           └─16172 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Aug 22 15:28:06 server2 systemd[1]: Starting OpenBSD Secure Shell server...
Aug 22 15:28:06 server2 sshd[16172]: Server listening on 0.0.0.0 port 22.
Aug 22 15:28:06 server2 sshd[16172]: Server listening on :: port 22.
Aug 22 15:28:06 server2 systemd[1]: Started OpenBSD Secure Shell server.
```

Local Machine

```
jhnrnmendoza@workstation:~$ sudo service ssh start
jhnrnmendoza@workstation:~$ 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 2023-08-22 23:32:48 +08; 30s ago
     Docs: man:sshd(8)
           man:sshd_config(5)
   Main PID: 41649 (sshd)
     Tasks: 1 (limit: 4629)
    Memory: 1.7M
       CPU: 18ms
    CGroup: /system.slice/ssh.service
            └─41649 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Aug 22 23:32:48 workstation systemd[1]: Starting OpenBSD Secure Shell server...
Aug 22 23:32:48 workstation sshd[41649]: Server listening on 0.0.0.0 port 22.
Aug 22 23:32:48 workstation sshd[41649]: Server listening on :: port 22.
Aug 22 23:32:48 workstation systemd[1]: Started OpenBSD Secure Shell server.
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*

Server 1

```
CPE31S5 Server 1_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrnmendoza@server1:~$ sudo ufw allow ssh
Rules updated
Rules updated (v6)
jhnrnmendoza@server1:~$ sudo ufw enable
Firewall is active and enabled on system startup
jhnrnmendoza@server1:~$ sudo ufw status
Status: active

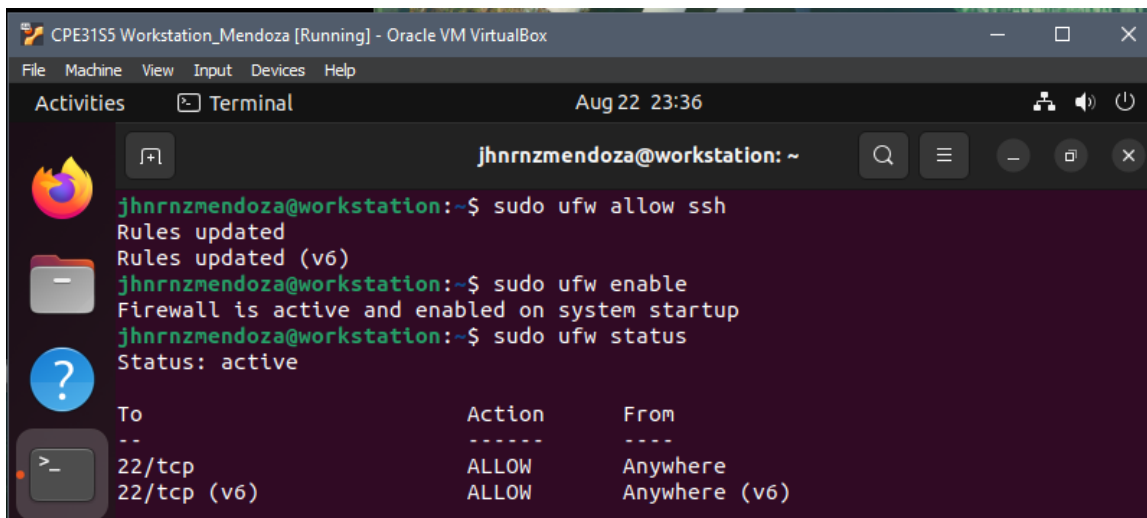
To Action From
--
22/tcp ALLOW Anywhere
22/tcp (v6) ALLOW Anywhere (v6)
```

Server 2

```
CPE31S5 Server 2_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrnmendoza@server2:~$ sudo ufw allow ssh
Rules updated
Rules updated (v6)
jhnrnmendoza@server2:~$ sudo ufw enable
Firewall is active and enabled on system startup
jhnrnmendoza@server2:~$ sudo ufw status
Status: active

To Action From
--
22/tcp ALLOW Anywhere
22/tcp (v6) ALLOW Anywhere (v6)
```

Local Machine



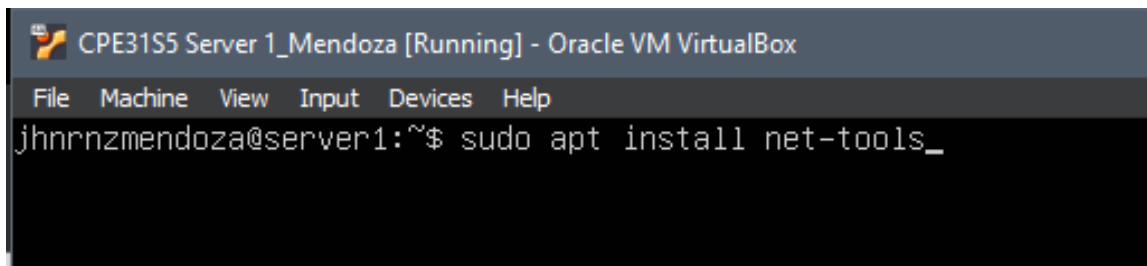
```
CPE31S5 Workstation_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Aug 22 23:36
jhnrmendoza@workstation: ~
jhnrmendoza@workstation:~$ sudo ufw allow ssh
Rules updated
Rules updated (v6)
jhnrmendoza@workstation:~$ sudo ufw enable
Firewall is active and enabled on system startup
jhnrmendoza@workstation:~$ sudo ufw status
Status: active

To Action From
--
22/tcp ALLOW Anywhere
22/tcp (v6) ALLOW Anywhere (v6)
```

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

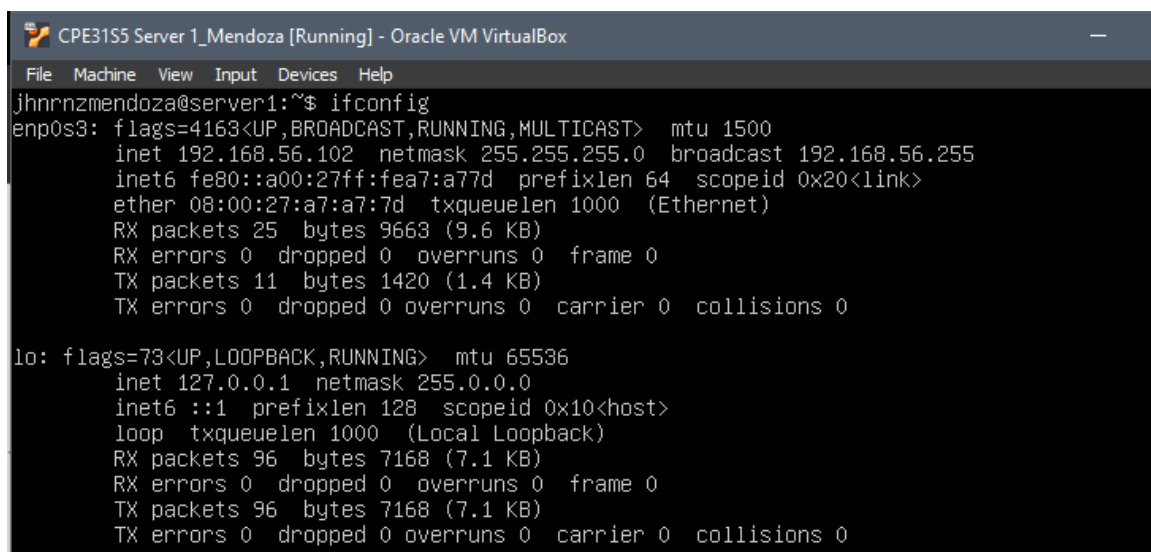
1. Record the ip address of Server 1, Server 2, and Local Machine. Issue the command *ifconfig* and check network settings. Note that the ip addresses of all the machines are in this network 192.168.56.XX.

In order to use the *ifconfig* command, the following query is installed on each device for it to be used.



```
CPE31S5 Server 1_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrmendoza@server1:~$ sudo apt install net-tools_
```

1.1 Server 1 IP address: 192.168.56.102



```
CPE31S5 Server 1_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrmendoza@server1:~$ ifconfig
enp0s3: 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::a00:27ff:fea7:a77d prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:a7:a7:7d txqueuelen 1000 (Ethernet)
    RX packets 25 bytes 9663 (9.6 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 11 bytes 1420 (1.4 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 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 96 bytes 7168 (7.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 96 bytes 7168 (7.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```


1.2 Server 2 IP address: 192.168.56.103

```
CPE31S5 Server 2_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrmendoza@server2:~$ ifconfig
enp0s3: 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::a00:27ff:fea7:a77d prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:a7:a7:7d txqueuelen 1000 (Ethernet)
    RX packets 28 bytes 9843 (9.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 5 bytes 944 (944.0 B)
    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 896 bytes 63968 (63.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 896 bytes 63968 (63.9 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

1.3 Server 3 IP address: 192.168.56.104

```
jhnrmendoza@workstation:~$ 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::7d2d:664f:a9fc:65a2 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:23:bf:be txqueuelen 1000 (Ethernet)
    RX packets 21 bytes 3721 (3.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 73 bytes 8801 (8.8 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.56.104 netmask 255.255.255.0 broadcast 192.168.56.255
    inet6 fe80::deb0:bf2f:e184:ce4b prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:2a:e9:4d txqueuelen 1000 (Ethernet)
    RX packets 28 bytes 14879 (14.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 55 bytes 7598 (7.5 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 133 bytes 13087 (13.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 133 bytes 13087 (13.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

2. Make sure that they can ping each other.

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

```
jhnrmendoza@workstation:~$ 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=0.530 ms
64 bytes from 192.168.56.102: icmp_seq=2 ttl=64 time=0.513 ms
64 bytes from 192.168.56.102: icmp_seq=3 ttl=64 time=0.399 ms
64 bytes from 192.168.56.102: icmp_seq=4 ttl=64 time=0.420 ms
64 bytes from 192.168.56.102: icmp_seq=5 ttl=64 time=0.393 ms
64 bytes from 192.168.56.102: icmp_seq=6 ttl=64 time=0.350 ms
64 bytes from 192.168.56.102: icmp_seq=7 ttl=64 time=0.534 ms
64 bytes from 192.168.56.102: icmp_seq=8 ttl=64 time=0.321 ms
64 bytes from 192.168.56.102: icmp_seq=9 ttl=64 time=0.482 ms
64 bytes from 192.168.56.102: icmp_seq=10 ttl=64 time=0.521 ms
```

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

```
jhnrmendoza@workstation: ~
jhnrmendoza@workstation:~$ 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=0.699 ms
64 bytes from 192.168.56.103: icmp_seq=2 ttl=64 time=0.392 ms
64 bytes from 192.168.56.103: icmp_seq=3 ttl=64 time=0.576 ms
64 bytes from 192.168.56.103: icmp_seq=4 ttl=64 time=0.394 ms
64 bytes from 192.168.56.103: icmp_seq=5 ttl=64 time=0.387 ms
64 bytes from 192.168.56.103: icmp_seq=6 ttl=64 time=0.457 ms
64 bytes from 192.168.56.103: icmp_seq=7 ttl=64 time=0.353 ms
64 bytes from 192.168.56.103: icmp_seq=8 ttl=64 time=0.289 ms
64 bytes from 192.168.56.103: icmp_seq=9 ttl=64 time=0.355 ms
64 bytes from 192.168.56.103: icmp_seq=10 ttl=64 time=0.307 ms
64 bytes from 192.168.56.103: icmp_seq=11 ttl=64 time=0.508 ms
```

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

```
jhnrmendoza@server1:~$ 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=0.714 ms
64 bytes from 192.168.56.103: icmp_seq=2 ttl=64 time=0.541 ms
64 bytes from 192.168.56.103: icmp_seq=3 ttl=64 time=0.428 ms
64 bytes from 192.168.56.103: icmp_seq=4 ttl=64 time=0.427 ms
64 bytes from 192.168.56.103: icmp_seq=5 ttl=64 time=0.312 ms
```

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*

```
jhnrmendoza@workstation:~$ ssh jhnrmendoza@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:K7JLZjn/KLSgnUfLYhFuaSTT/L+Fndou9GdkLKhYspE.
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 hosts.
jhnrmendoza@192.168.56.102's password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-79-generic x86_64)
```

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

```
System information as of Tue Aug 22 04:05:22 PM UTC 2023
```

```
System load:  0.201171875      Processes:            115
Usage of /:    44.3% of 11.21GB Users logged in:       1
Memory usage:  5%              IPv4 address for enp0s3: 192.168.56.102
Swap usage:    0%
```

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*

```
Last login: Tue Aug 22 15:59:14 2023
jhnrmendoza@server1:~$
```

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

```
Last login: Tue Aug 22 15:59:14 2023
jhnrmendoza@server1:~$
logout
Connection to 192.168.56.102 closed.
jhnrmendoza@workstation:~$
```

3. Do the same for Server 2.

```
jhnrmendoza@workstation:~$ ssh jhnrmendoza@192.168.56.103
The authenticity of host '192.168.56.103 (192.168.56.103)' can't be established.
ED25519 key fingerprint is SHA256:47V08jD6iQqaqPUAy4gnwBdrKaevsNDZruD/M+Yrjwo.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.56.103' (ED25519) to the list of known hosts.
jhnrmendoza@192.168.56.103's password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-79-generic x86_64)

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

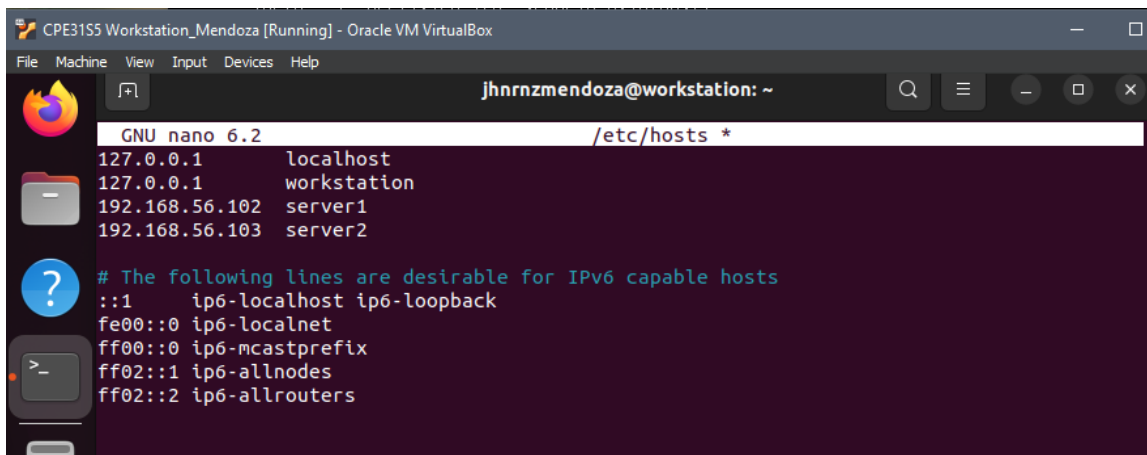
System information as of Tue Aug 22 04:06:44 PM UTC 2023

System load:  0.11181640625      Processes:           115
Usage of /:   44.3% of 11.21GB   Users logged in:    1
Memory usage: 6%                IPv4 address for enp0s3: 192.168.56.103
Swap usage:   0%

Last login: Tue Aug 22 16:01:41 2023
jhnrmendoza@server2:~$
logout
Connection to 192.168.56.103 closed.
jhnrmendoza@workstation:~$
```

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)



```
CPE31S5 Workstation_Mendoza [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
jhnrmendoza@workstation: ~
GNU nano 6.2 /etc/hosts *
127.0.0.1 localhost
127.0.0.1 workstation
192.168.56.102 server1
192.168.56.103 server2

# 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
```

4.3 Save the file and exit.

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.

Server 1

```
jhnrmendoza@workstation:~$ ssh jhnrmendoza@server1
The authenticity of host 'server1 (192.168.56.102)' can't be established.
ED25519 key fingerprint is SHA256:K7JLZjn/KLSgnUfLYhFuaSTT/L+Fndou9GdkLKhYspE.
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.
jhnrmendoza@server1's password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-79-generic x86_64)

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

System information as of Tue Aug 22 04:10:10 PM UTC 2023

System load:	0.20361328125	Processes:	114
Usage of /:	44.3% of 11.21GB	Users logged in:	1
Memory usage:	6%	IPv4 address for enp0s3:	192.168.56.102
Swap usage:	0%		

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: Tue Aug 22 16:05:22 2023 from 192.168.56.104

```
jhnrmendoza@server1:~$
```

Server 2

```
jhnrmendoza@workstation:~$ ssh jhnrmendoza@server2
The authenticity of host 'server2 (192.168.56.103)' can't be established.
ED25519 key fingerprint is SHA256:47V08jD6iQqaqPUAy4gnwBdrKaevsNDZruD/M+Yrjwo.
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.
jhnrmendoza@server2's password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-79-generic x86_64)

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

System information as of Tue Aug 22 04:11:39 PM UTC 2023

System load:  0.0048828125      Processes:           114
Usage of /:   44.3% of 11.21GB   Users logged in:     1
Memory usage: 6%               IPv4 address for enp0s3: 192.168.56.103
Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.
```

```
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: Tue Aug 22 16:06:44 2023 from 192.168.56.104
jhnrmendoza@server2:~$
```

Reflections:

Answer the following:

1. How are we able to use the hostname instead of IP address in SSH commands?

After physically connecting the desktop to the servers by following the given network topology, we are able to have an ip address generated for each of the servers as well as the local machine (desktop). Using these ip addresses, we input it to the `/etc/hostname` file in which you may append an ip address with its paired hostname. Then, the user would be able to use the hostname instead of the ip address in order to remotely access the server. Furthermore, by accessing the servers using the local machine, the user is still prompted with an authentication in which it asks the password of the respective server, in this way, only privileged or authorized users can access the remote servers.

2. How secure is SSH?

Based on this activity, we are able to remotely access the 2 servers using a local machine which is the desktop workstation. Initially, we have given the 2 servers and 1 workstation their own hostname, user, and password. After connecting them using the given network topology, we are able to access each server remotely. We may say that this is secure as the user who is trying to access the remote servers is prompted with an authentication which does not permit random or alien access to the servers. To what extent does secured shell's security? the connection established in ssh connection is encrypted in a way that only the devices connected in an ssh network can access the data, meaning, no other devices outside the network has permissions to the data.