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Activity 1: Configure Network using Virtual Machines

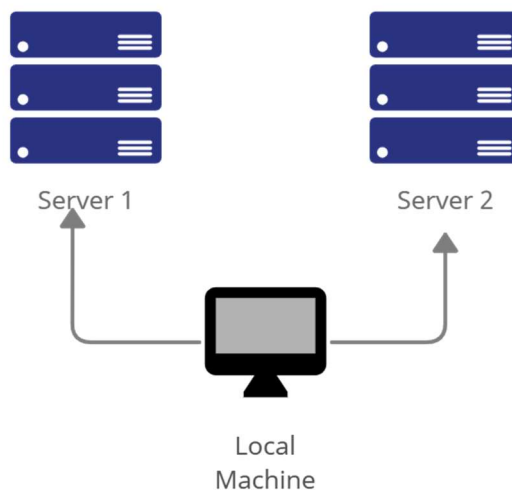
1. Objectives:

- 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).

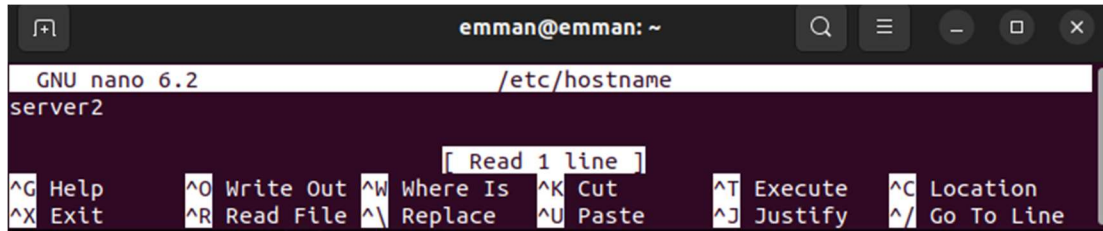


Task 1: Do the following on Server 1, Server 2, and Local Machine. In editing the file using nano command, press control + O to write out (save the file). Press enter when asked for the name of the file. Press control + X to end.

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

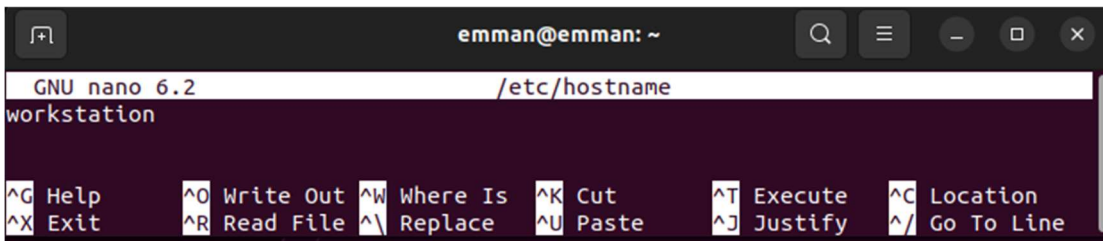
The screenshot shows a terminal window with the prompt 'emman@emman: ~'. The nano text editor is open, editing the file '/etc/hostname *'. The current content of the file is 'server1'. The nano editor's status bar at the bottom displays various keyboard shortcuts: ^G Help, ^O Write Out, ^W Where Is, ^K Cut, ^T Execute, ^C Location, ^X Exit, ^R Read File, ^\ Replace, ^U Paste, ^J Justify, and ^_ Go To Line.

1.2 Use server2 for Server 2



A terminal window titled 'emman@emman: ~' showing the nano 6.2 editor editing the file '/etc/hostname'. The file contains the text 'server2'. The nano status bar at the bottom shows various keyboard shortcuts: ^G Help, ^O Write Out, ^W Where Is, ^K Cut, ^T Execute, ^C Location, ^X Exit, ^R Read File, ^\ Replace, ^U Paste, ^J Justify, and ^_ Go To Line. A 'Read 1 line' indicator is visible above the status bar.

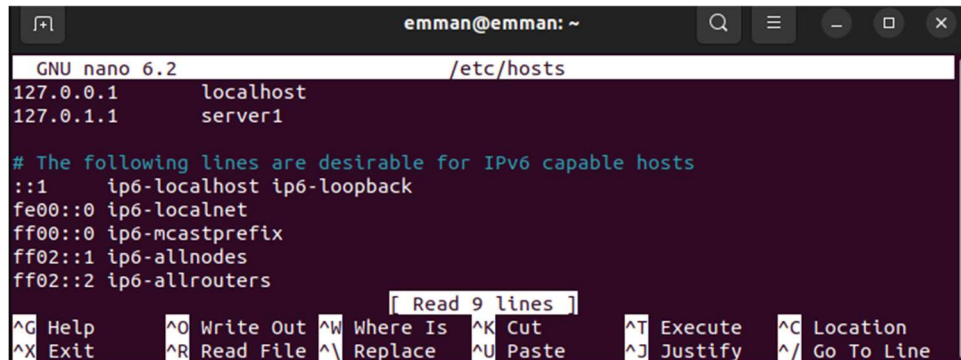
1.3 Use workstation for the Local Machine



A terminal window titled 'emman@emman: ~' showing the nano 6.2 editor editing the file '/etc/hostname'. The file contains the text 'workstation'. The nano status bar at the bottom shows various keyboard shortcuts: ^G Help, ^O Write Out, ^W Where Is, ^K Cut, ^T Execute, ^C Location, ^X Exit, ^R Read File, ^\ Replace, ^U Paste, ^J Justify, and ^_ Go To Line. A 'Read 1 line' indicator is visible above the status bar.

2. Edit the hosts using the command `sudo nano /etc/hosts`. Edit the second line.

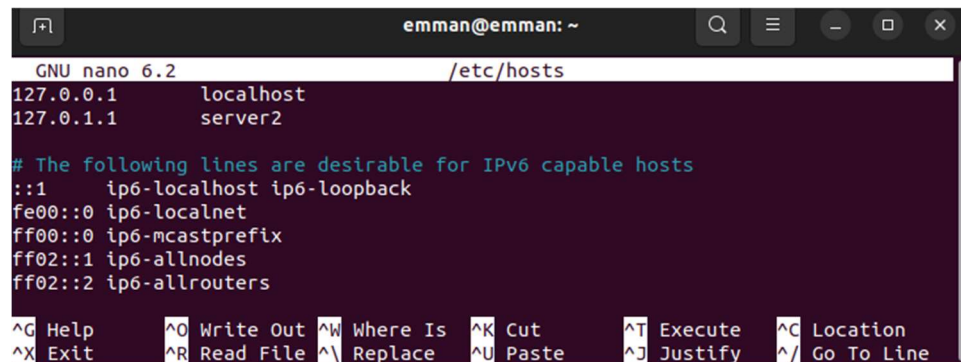
2.1 Type 127.0.0.1 server 1 for Server 1



A terminal window titled 'emman@emman: ~' showing the nano 6.2 editor editing the file '/etc/hosts'. The file contains the following content:
127.0.0.1 localhost
127.0.1.1 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
The nano status bar at the bottom shows various keyboard shortcuts: ^G Help, ^O Write Out, ^W Where Is, ^K Cut, ^T Execute, ^C Location, ^X Exit, ^R Read File, ^\ Replace, ^U Paste, ^J Justify, and ^_ Go To Line. A 'Read 9 lines' indicator is visible above the status bar.

2.2 Type 127.0.0.1 server 2 for Server 2



A terminal window titled 'emman@emman: ~' showing the nano 6.2 editor editing the file '/etc/hosts'. The file contains the following content:
127.0.0.1 localhost
127.0.1.1 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
The nano status bar at the bottom shows various keyboard shortcuts: ^G Help, ^O Write Out, ^W Where Is, ^K Cut, ^T Execute, ^C Location, ^X Exit, ^R Read File, ^\ Replace, ^U Paste, ^J Justify, and ^_ Go To Line.

2.3 Type 127.0.0.1 workstation for the Local Machine

```
emman@emman: ~  
GNU nano 6.2 /etc/hosts  
127.0.0.1    localhost  
127.0.1.1    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  
  
^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location  
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify    ^_ Go To Line
```

After Rebooting:

Server 1:

```
emman@server1: ~  
emman@server1:~$ 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::da0a:68aa:a5d1:c75d prefixlen 64 scopeid 0x20<link>  
    ether 08:00:27:e1:14:72 txqueuelen 1000 (Ethernet)  
    RX packets 68 bytes 16213 (16.2 KB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 131 bytes 14861 (14.8 KB)  
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500  
    inet 192.168.56.101 netmask 255.255.255.0 broadcast 192.168.56.255  
    inet6 fe80::f398:c56e:c23f:cd5f prefixlen 64 scopeid 0x20<link>  
    ether 08:00:27:dc:4e:07 txqueuelen 1000 (Ethernet)  
    RX packets 87 bytes 14134 (14.1 KB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 62 bytes 8172 (8.1 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 176 bytes 16474 (16.4 KB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 176 bytes 16474 (16.4 KB)  
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
emman@server1:~$
```

Server 2:

```
emman@server2: ~  
emman@server2:~$ 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::85d7:44fd:f57a:2001 prefixlen 64 scopeid 0x20<link>  
    ether 08:00:27:ec:a8:60 txqueuelen 1000 (Ethernet)  
    RX packets 68 bytes 16017 (16.0 KB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 141 bytes 15426 (15.4 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::503b:2e41:1159:fd1a prefixlen 64 scopeid 0x20<link>  
    ether 08:00:27:1e:8e:8b txqueuelen 1000 (Ethernet)  
    RX packets 76 bytes 12008 (12.0 KB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 65 bytes 8428 (8.4 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 185 bytes 17453 (17.4 KB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 185 bytes 17453 (17.4 KB)  
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
emman@server2:~$
```

Workstation:

```
emman@workstation: ~  
emman@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::25db:989c:b266:b422 prefixlen 64 scopeid 0x20<link>  
    ether 08:00:27:0b:0d:e4 txqueuelen 1000 (Ethernet)  
    RX packets 70 bytes 16071 (16.0 KB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 143 bytes 15850 (15.8 KB)  
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500  
    inet 192.168.56.103 netmask 255.255.255.0 broadcast 192.168.56.255  
    inet6 fe80::df74:533a:d29a:1d78 prefixlen 64 scopeid 0x20<link>  
    ether 08:00:27:98:06:92 txqueuelen 1000 (Ethernet)  
    RX packets 52 bytes 8556 (8.5 KB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 71 bytes 9002 (9.0 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 180 bytes 16798 (16.7 KB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 180 bytes 16798 (16.7 KB)  
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
emman@workstation:~$
```

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:

```
emman@server1:~$ sudo apt update  
[sudo] password for emman:  
Hit:1 http://ph.archive.ubuntu.com/ubuntu jammy InRelease  
Get:2 http://ph.archive.ubuntu.com/ubuntu jammy-updates InRelease [114 kB]  
Get:3 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]  
Get:4 http://ph.archive.ubuntu.com/ubuntu jammy-backports InRelease [99.8 kB]  
Get:5 http://ph.archive.ubuntu.com/ubuntu jammy-updates/main i386 Packages [274 kB]  
Get:6 http://ph.archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [509 kB]  
Get:7 http://ph.archive.ubuntu.com/ubuntu jammy-updates/main amd64 DEP-11 Metadata [91.7 kB]  
Get:8 http://ph.archive.ubuntu.com/ubuntu jammy-updates/universe i386 Packages [115 kB]  
Get:9 http://ph.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages [213 kB]  
Get:10 http://ph.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 DEP-11 Metadata [141 kB]  
Get:11 http://ph.archive.ubuntu.com/ubuntu jammy-updates/multiverse amd64 DEP-11 Metadata [940 B]  
Get:12 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 DEP-11 Metadata [12.5 kB]  
Get:13 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 c-n-f Metadata [252 B]  
Get:14 http://security.ubuntu.com/ubuntu jammy-security/main amd64 DEP-11 Metadata [11.4 kB]  
Get:15 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 DEP-11 Metadata [10.1 kB]  
Fetched 1,702 kB in 3s (639 kB/s)  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
All packages are up to date.  
emman@server1:~$ sudo apt upgrade  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
Calculating upgrade... Done  
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.  
emman@server1:~$
```


Server 2:

```
emman@server2: ~  
emman@server2:~$ sudo apt update  
[sudo] password for emman:  
Get:1 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]  
Hit:2 http://ph.archive.ubuntu.com/ubuntu jammy InRelease  
Get:3 http://ph.archive.ubuntu.com/ubuntu jammy-updates InRelease [114 kB]  
Get:4 http://security.ubuntu.com/ubuntu jammy-security/main amd64 DEP-11 Metadata [11.4 kB]  
Get:5 http://ph.archive.ubuntu.com/ubuntu jammy-backports InRelease [99.8 kB]  
Get:6 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 DEP-11 Metadata [10.1 kB]  
Get:7 http://ph.archive.ubuntu.com/ubuntu jammy-updates/main i386 Packages [274 kB]  
Get:8 http://ph.archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [509 kB]  
Get:9 http://ph.archive.ubuntu.com/ubuntu jammy-updates/main amd64 DEP-11 Metadata [91.7 kB]  
Get:10 http://ph.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages [213 kB]  
Get:11 http://ph.archive.ubuntu.com/ubuntu jammy-updates/universe i386 Packages [115 kB]  
Get:12 http://ph.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 DEP-11 Metadata [141 kB]  
Get:13 http://ph.archive.ubuntu.com/ubuntu jammy-updates/multiverse amd64 DEP-11 Metadata [940 B]  
Get:14 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 DEP-11 Metadata [12.5 kB]  
Get:15 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 c-n-f Metadata [252 B]  
Fetched 1,702 kB in 3s (680 kB/s)  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
All packages are up to date.  
emman@server2:~$ sudo apt upgrade  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
Calculating upgrade... Done  
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.  
emman@server2:~$
```

Workstation:

```
emman@workstation: ~  
emman@workstation:~$ sudo apt update  
[sudo] password for emman:  
Hit:1 http://ph.archive.ubuntu.com/ubuntu jammy InRelease  
Get:2 http://ph.archive.ubuntu.com/ubuntu jammy-updates InRelease [114 kB]  
Get:3 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]  
Get:4 http://ph.archive.ubuntu.com/ubuntu jammy-backports InRelease [99.8 kB]  
Get:5 http://ph.archive.ubuntu.com/ubuntu jammy-updates/main i386 Packages [274 kB]  
Get:6 http://ph.archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [509 kB]  
Get:7 http://ph.archive.ubuntu.com/ubuntu jammy-updates/main amd64 DEP-11 Metadata [91.7 kB]  
Get:8 http://ph.archive.ubuntu.com/ubuntu jammy-updates/universe i386 Packages [115 kB]  
Get:9 http://ph.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages [213 kB]  
Get:10 http://ph.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 DEP-11 Metadata [141 kB]  
Get:11 http://ph.archive.ubuntu.com/ubuntu jammy-updates/multiverse amd64 DEP-11 Metadata [940 B]  
Get:12 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 DEP-11 Metadata [12.5 kB]  
Get:13 http://ph.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 c-n-f Metadata [252 B]  
Get:14 http://security.ubuntu.com/ubuntu jammy-security/main amd64 DEP-11 Metadata [11.4 kB]  
Get:15 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 DEP-11 Metadata [10.1 kB]  
Fetched 1,702 kB in 2s (746 kB/s)  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
All packages are up to date.  
emman@workstation:~$ sudo apt upgrade  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
Calculating upgrade... Done  
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.  
emman@workstation:~$
```

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

Server 1:

```
emman@server1: ~  
emman@server1:~$ sudo apt install openssh-server  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
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 0 not upgraded.  
Need to get 751 kB of archives.  
After this operation, 6,046 kB of additional disk space will be used.  
Do you want to continue? [Y/n] y  
Get:1 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 openssh-sftp-server amd64 1:8.9p1-3 [38.8 kB]  
Get:2 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 openssh-server amd64 1:8.9p1-3 [434 kB]  
Get:3 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 ncurses-term all 6.3-2 [267 kB]  
Get:4 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 ssh-import-id all 5.11-0ubuntu1 [10.1 kB]  
Fetched 751 kB in 1s (866 kB/s)  
Preconfiguring packages ...  
Selecting previously unselected package openssh-sftp-server.  
(Reading database ... 195625 files and directories currently installed.)  
Preparing to unpack .../openssh-sftp-server_1%3a8.9p1-3_amd64.deb ...  
Unpacking openssh-sftp-server (1:8.9p1-3) ...  
Selecting previously unselected package openssh-server.  
Preparing to unpack .../openssh-server_1%3a8.9p1-3_amd64.deb ...  
Unpacking openssh-server (1:8.9p1-3) ...  
Selecting previously unselected package ncurses-term.  
Preparing to unpack .../ncurses-term_6.3-2_all.deb ...  
Unpacking ncurses-term (6.3-2) ...  
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) ...
```

Server 2:

```
emman@server2: ~  
emman@server2:~$ sudo apt install openssh-server  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
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 0 not upgraded.  
Need to get 751 kB of archives.  
After this operation, 6,046 kB of additional disk space will be used.  
Do you want to continue? [Y/n] y  
Get:1 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 openssh-sftp-server amd64 1:8.9p1-3 [38.8 kB]  
Get:2 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 openssh-server amd64 1:8.9p1-3 [434 kB]  
Get:3 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 ncurses-term all 6.3-2 [267 kB]  
Get:4 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 ssh-import-id all 5.11-0ubuntu1 [10.1 kB]  
Fetched 751 kB in 1s (893 kB/s)  
Preconfiguring packages ...  
Selecting previously unselected package openssh-sftp-server.  
(Reading database ... 195625 files and directories currently installed.)  
Preparing to unpack .../openssh-sftp-server_1%3a8.9p1-3_amd64.deb ...  
Unpacking openssh-sftp-server (1:8.9p1-3) ...  
Selecting previously unselected package openssh-server.  
Preparing to unpack .../openssh-server_1%3a8.9p1-3_amd64.deb ...  
Unpacking openssh-server (1:8.9p1-3) ...  
Selecting previously unselected package ncurses-term.  
Preparing to unpack .../ncurses-term_6.3-2_all.deb ...  
Unpacking ncurses-term (6.3-2) ...  
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) ...
```

Workstation:

```
emman@workstation: ~  
emman@workstation:~$ sudo apt install openssh-server  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
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 0 not upgraded.  
Need to get 751 kB of archives.  
After this operation, 6,046 kB of additional disk space will be used.  
Do you want to continue? [Y/n] y  
Get:1 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 openssh-sftp-server amd64 1:8.9p1-3 [38.8 kB]  
Get:2 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 openssh-server amd64 1:8.9p1-3 [434 kB]  
Get:3 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 ncurses-term all 6.3-2 [267 kB]  
Get:4 http://ph.archive.ubuntu.com/ubuntu jammy/main amd64 ssh-import-id all 5.11-0ubuntu1 [10.1 kB]  
Fetched 751 kB in 1s (826 kB/s)  
Preconfiguring packages ...  
Selecting previously unselected package openssh-sftp-server.  
(Reading database ... 195625 files and directories currently installed.)  
Preparing to unpack .../openssh-sftp-server_1%3a8.9p1-3_amd64.deb ...  
Unpacking openssh-sftp-server (1:8.9p1-3) ...  
Selecting previously unselected package openssh-server.  
Preparing to unpack .../openssh-server_1%3a8.9p1-3_amd64.deb ...  
Unpacking openssh-server (1:8.9p1-3) ...  
Selecting previously unselected package ncurses-term.  
Preparing to unpack .../ncurses-term_6.3-2_all.deb ...  
Unpacking ncurses-term (6.3-2) ...  
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) ...
```

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:

```
emman@server1: ~  
emman@server1:~$ sudo service ssh start  
emman@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 Fri 2022-08-19 18:53:40 PST; 6min ago  
     Docs: man:sshd(8)  
           man:sshd_config(5)  
   Main PID: 2813 (sshd)  
     Tasks: 1 (limit: 2288)  
    Memory: 1.7M  
       CPU: 25ms  
    CGroup: /system.slice/ssh.service  
            └─2813 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"  
  
Aug 19 18:53:40 server1 systemd[1]: Starting OpenBSD Secure Shell server...  
Aug 19 18:53:40 server1 sshd[2813]: Server listening on 0.0.0.0 port 22.  
Aug 19 18:53:40 server1 sshd[2813]: Server listening on :: port 22.  
Aug 19 18:53:40 server1 systemd[1]: Started OpenBSD Secure Shell server.  
emman@server1:~$
```


Server 2:

```
emman@server2: ~  
emman@server2:~$ sudo service ssh start  
emman@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 Fri 2022-08-19 18:55:35 PST; 8min ago  
     Docs: man:sshd(8)  
           man:sshd_config(5)  
    Main PID: 2816 (sshd)  
      Tasks: 1 (limit: 2288)  
    Memory: 1.7M  
       CPU: 25ms  
    CGroup: /system.slice/ssh.service  
            └─2816 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"  
  
Aug 19 18:55:35 server2 systemd[1]: Starting OpenBSD Secure Shell server...  
Aug 19 18:55:35 server2 sshd[2816]: Server listening on 0.0.0.0 port 22.  
Aug 19 18:55:35 server2 sshd[2816]: Server listening on :: port 22.  
Aug 19 18:55:35 server2 systemd[1]: Started OpenBSD Secure Shell server.  
emman@server2:~$
```

Workstation:

```
emman@workstation: ~  
emman@workstation:~$ sudo service ssh start  
emman@workstation:~$ 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 Fri 2022-08-19 18:57:20 PST; 7min ago  
     Docs: man:sshd(8)  
           man:sshd_config(5)  
    Main PID: 3145 (sshd)  
      Tasks: 1 (limit: 2288)  
    Memory: 1.7M  
       CPU: 27ms  
    CGroup: /system.slice/ssh.service  
            └─3145 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"  
  
Aug 19 18:57:20 workstation systemd[1]: Starting OpenBSD Secure Shell server...  
Aug 19 18:57:20 workstation sshd[3145]: Server listening on 0.0.0.0 port 22.  
Aug 19 18:57:20 workstation sshd[3145]: Server listening on :: port 22.  
Aug 19 18:57:20 workstation systemd[1]: Started OpenBSD Secure Shell server.  
emman@workstation:~$
```

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:

```
emman@server1: ~  
emman@server1:~$ sudo ufw allow ssh  
Rules updated  
Rules updated (v6)  
emman@server1:~$ sudo ufw enable  
Firewall is active and enabled on system startup  
emman@server1:~$ sudo ufw status  
Status: active  
  
To Action From  
--  
22/tcp ALLOW Anywhere  
22/tcp (v6) ALLOW Anywhere (v6)  
  
emman@server1:~$
```


Server 2:

```
emman@server2: ~  
emman@server2:~$ sudo ufw allow ssh  
Skipping adding existing rule  
Skipping adding existing rule (v6)  
emman@server2:~$ sudo ufw enable  
Firewall is active and enabled on system startup  
emman@server2:~$ sudo ufw status  
Status: active  
  
To Action From  
--  
22/tcp ALLOW Anywhere  
  
22/tcp (v6) ALLOW Anywhere (v6)  
  
emman@server2:~$
```

Workstation:

```
emman@workstation: ~  
emman@workstation:~$ sudo ufw allow ssh  
Rules updated  
Rules updated (v6)  
emman@workstation:~$ sudo ufw enable  
Firewall is active and enabled on system startup  
emman@workstation:~$ sudo ufw status  
Status: active  
  
To Action From  
--  
22/tcp ALLOW Anywhere  
  
22/tcp (v6) ALLOW Anywhere (v6)  
  
emman@workstation:~$
```

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.____
 - 1.2 Server 2 IP address: 192.168.56.____
 - 1.3 Server 3 IP address: 192.168.56.____

Server 1:

```
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::f398:c56e:c23f:cd5f prefixlen 64 scopeid 0x20<link>  
ether 08:00:27:dc:4e:07 txqueuelen 1000 (Ethernet)  
RX packets 145 bytes 24310 (24.3 KB)  
RX errors 0 dropped 0 overruns 0 frame 0  
TX packets 113 bytes 14915 (14.9 KB)  
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Server 2:

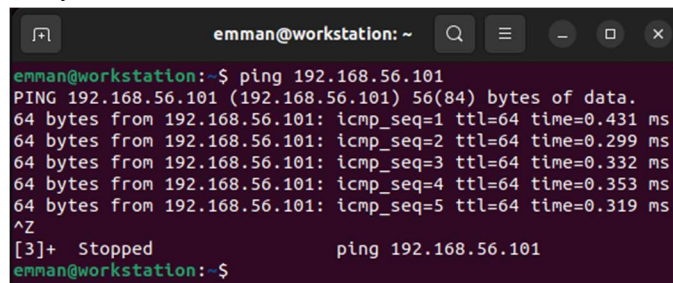
```
enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet 192.168.56.102 netmask 255.255.255.0 broadcast 192.168.56.255
inet6 fe80::503b:2e41:1159:fd1a prefixlen 64 scopeid 0x20<link>
ether 08:00:27:1e:8e:8b txqueuelen 1000 (Ethernet)
RX packets 132 bytes 22458 (22.4 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 117 bytes 15522 (15.5 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Workstation:

```
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::df74:533a:d29a:1d78 prefixlen 64 scopeid 0x20<link>
ether 08:00:27:98:06:92 txqueuelen 1000 (Ethernet)
RX packets 94 bytes 17720 (17.7 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 129 bytes 16694 (16.6 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

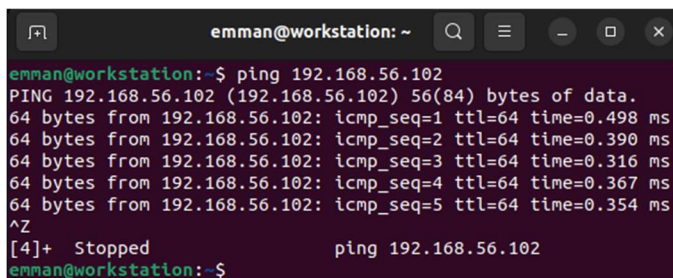
2. Make sure that they can ping each other.

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



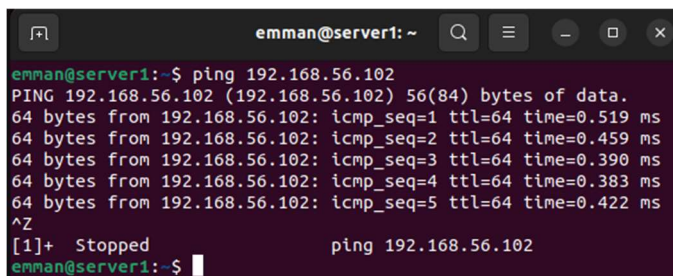
```
emman@workstation: ~
emman@workstation:~$ ping 192.168.56.101
PING 192.168.56.101 (192.168.56.101) 56(84) bytes of data:
64 bytes from 192.168.56.101: icmp_seq=1 ttl=64 time=0.431 ms
64 bytes from 192.168.56.101: icmp_seq=2 ttl=64 time=0.299 ms
64 bytes from 192.168.56.101: icmp_seq=3 ttl=64 time=0.332 ms
64 bytes from 192.168.56.101: icmp_seq=4 ttl=64 time=0.353 ms
64 bytes from 192.168.56.101: icmp_seq=5 ttl=64 time=0.319 ms
^Z
[3]+  Stopped                  ping 192.168.56.101
emman@workstation:~$
```

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



```
emman@workstation: ~
emman@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=0.498 ms
64 bytes from 192.168.56.102: icmp_seq=2 ttl=64 time=0.390 ms
64 bytes from 192.168.56.102: icmp_seq=3 ttl=64 time=0.316 ms
64 bytes from 192.168.56.102: icmp_seq=4 ttl=64 time=0.367 ms
64 bytes from 192.168.56.102: icmp_seq=5 ttl=64 time=0.354 ms
^Z
[4]+  Stopped                  ping 192.168.56.102
emman@workstation:~$
```

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



```
emman@server1: ~
emman@server1:~$ 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=0.519 ms
64 bytes from 192.168.56.102: icmp_seq=2 ttl=64 time=0.459 ms
64 bytes from 192.168.56.102: icmp_seq=3 ttl=64 time=0.390 ms
64 bytes from 192.168.56.102: icmp_seq=4 ttl=64 time=0.383 ms
64 bytes from 192.168.56.102: icmp_seq=5 ttl=64 time=0.422 ms
^Z
[1]+  Stopped                  ping 192.168.56.102
emman@server1:~$
```

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

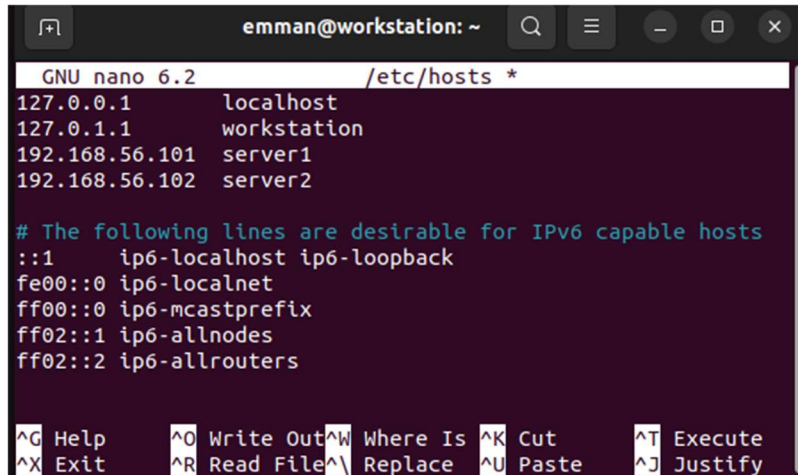
1. On the Local Machine, issue the following commands:
 - 1.1 `ssh username@ip_address_server1` for example, `ssh jvtaylor@192.168.56.120`
 - 1.2 Enter the password for server 1 when prompted
 - 1.3 Verify that you are in server 1. The user should be in this format `user@server1`. For example, `jvtaylor@server1`
2. Logout of Server 1 by issuing the command `control + D`.

```
emman@workstation: ~  
emman@workstation:~$ ssh emman@192.168.56.101  
The authenticity of host '192.168.56.101 (192.168.56.101)' can't be established.  
ED25519 key fingerprint is SHA256:53iKCUIhNGa2l/RtdNGcUIzaF/NWjyTGJwcirSLx1g.  
This key is not known by any other names  
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes  
Warning: Permanently added '192.168.56.101' (ED25519) to the list of known hosts.  
emman@192.168.56.101'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.  
  
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.  
  
emman@server1:~$  
logout  
Connection to 192.168.56.101 closed.  
emman@workstation:~$
```

3. Do the same for Server 2.

```
emman@workstation: ~  
emman@workstation:~$ ssh emman@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:s8mwFDBdl0UXZbVkpYiY2h10LLRHQYe0GrteJHx9/es.  
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.  
emman@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.  
  
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.  
  
emman@server2:~$  
logout  
Connection to 192.168.56.102 closed.  
emman@workstation:~$
```

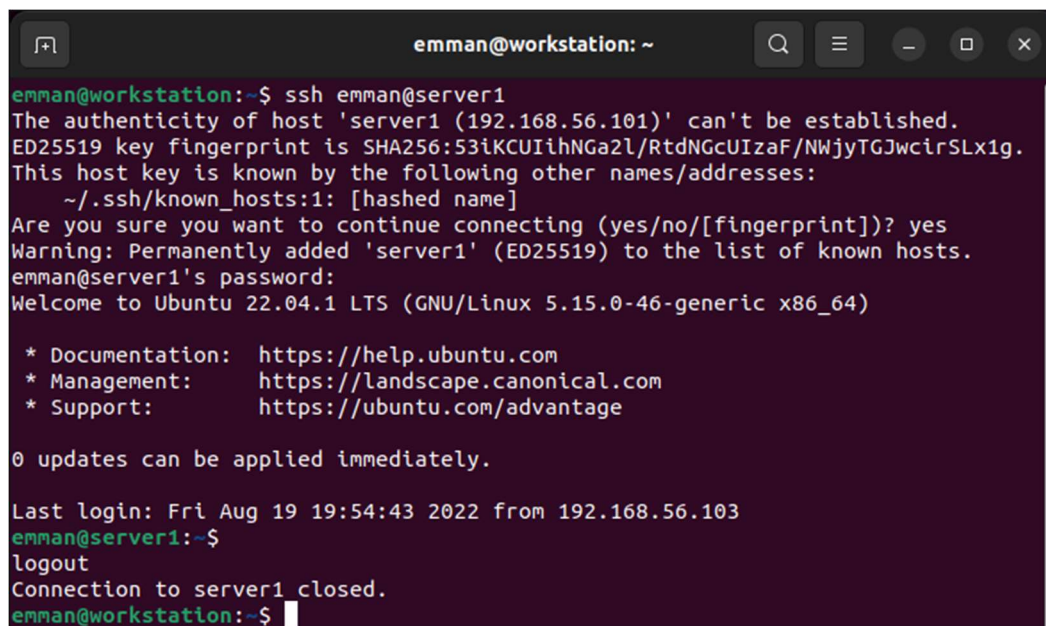

4. Edit the hosts of the Local Machine by issuing the command `sudo nano /etc/hosts`. Below all texts type the following:
 - 4.1 `IP_address server 1` (provide the ip address of server 1 followed by the hostname)
 - 4.2 `IP_address server 2` (provide the ip address of server 2 followed by the hostname)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



```
emman@workstation: ~  
GNU nano 6.2 /etc/hosts *  
127.0.0.1 localhost  
127.0.1.1 workstation  
192.168.56.101 server1  
192.168.56.102 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  
  
^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute  
^X Exit      ^R Read File ^_ Replace   ^U Paste     ^J Justify
```

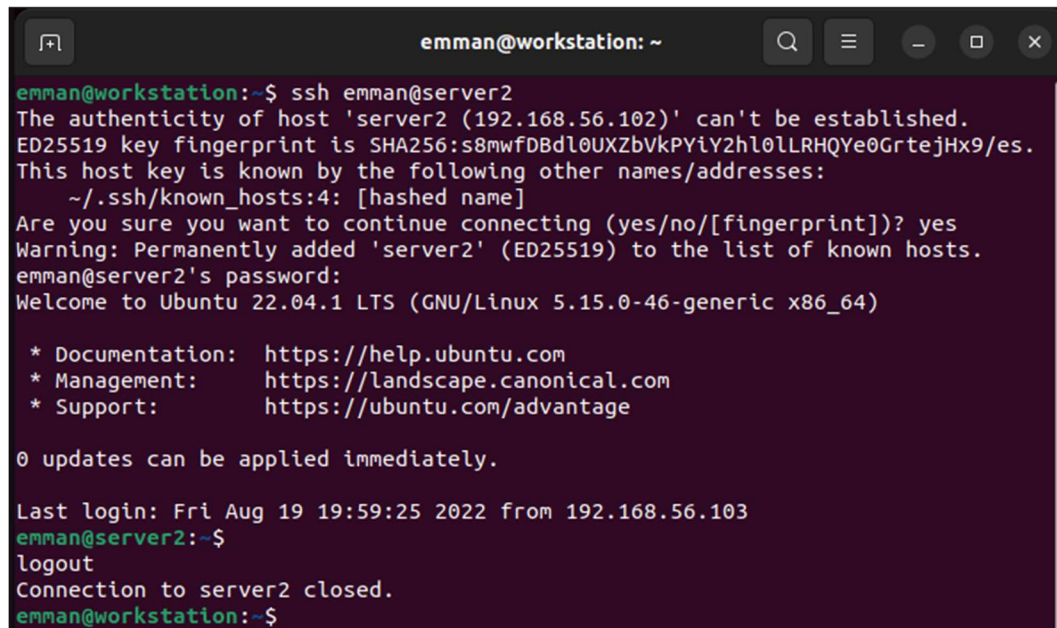
5. On the local machine, verify that you can do the SSH command but this time, use the hostname instead of typing the IP address of the servers. For example, try to do `ssh jvtaylor@server1`. Enter the password when prompted. Verify that you have entered Server 1. Do the same for Server 2.

Server 1:



```
emman@workstation: ~  
emman@workstation:~$ ssh emman@server1  
The authenticity of host 'server1 (192.168.56.101)' can't be established.  
ED25519 key fingerprint is SHA256:53iKCUIihNGa2l/RtdNGcUIzaF/NWjyTGJwcirSLx1g.  
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.  
emman@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: Fri Aug 19 19:54:43 2022 from 192.168.56.103  
emman@server1:~$  
logout  
Connection to server1 closed.  
emman@workstation:~$
```

Server 2:

A terminal window titled 'emman@workstation: ~' showing an SSH session. The user runs 'ssh emman@server2'. The terminal displays a warning about the host's authenticity, showing the ED25519 key fingerprint. The user confirms the connection. The terminal then shows the user's login on server2, the Ubuntu version (22.04.1 LTS), and system updates. The user logs out, and the connection closes.

```
emman@workstation:~$ ssh emman@server2
The authenticity of host 'server2 (192.168.56.102)' can't be established.
ED25519 key fingerprint is SHA256:s8mwFDBdL0UXZbVkpYiY2hl0LlRHQYe0GrtejHx9/es.
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.
emman@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: Fri Aug 19 19:59:25 2022 from 192.168.56.103
emman@server2:~$
logout
Connection to server2 closed.
emman@workstation:~$
```

Reflections:

Answer the following:

1. How are we able to use the hostname instead of IP address in SSH commands?
 - By completing step 4, in which we update the /etc/hosts file and add the IP addresses of servers 1 and 2, matching their names, we are allowed to use IP addresses in SSH commands. By doing this, we are creating an alias for an IP address that can be used to access SSH servers using just the server's login.
2. How secured is SSH?
 - By default, SSH connects to the remote machine via the TCP protocol on port 22, but by default, this connection is not secure. To send encrypted packets to a recipient system, SSH first encrypts the packets before receiving them, and vice versa. The use of a multiplex multiple connected by SSH, which builds a tunnel over the TCP connection, is the other factor keeping it linked. When connecting to a machine that offers a high level of security, it also employs authentication, but this can occasionally be brute forced.

Honor Pledge:

"I affirm that I shall not give or receive any unauthorized help on this hands-on activity and that all work shall be my own. "