



COLLEGE OF COMPUTING TECHNOLOGY - DUBLIN
BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

SYSTEMS MANAGEMENT AND PROVISION

Assignment 1
Linux Configuration and Automation

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1 Part 1: Configuration of basic Linux Server network

1.1 Task 1a: Changing the names of each of the two VMs

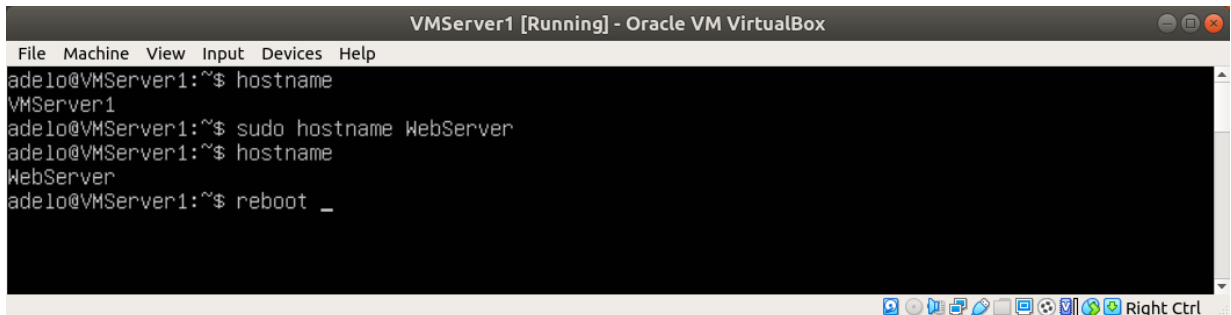
There are 2 ways of configuring the hostname in Ubuntu Systems.

- The first is a temporary configuration by using the hostname command. The changes made with this method will not persist after rebooting the system.
- A permanent configuration can be made by editing the appropriate configuration files.

1.1.1 Temporary configuration using the hostname command

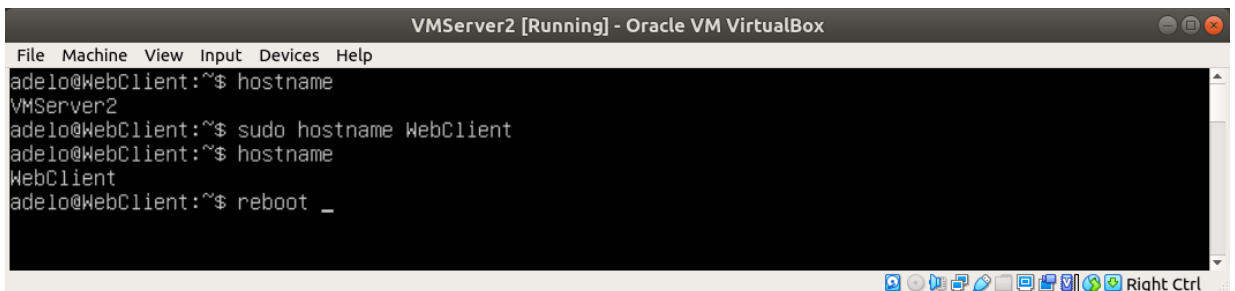
In Figure 1.1 we show the configuration made with the hostname command in both servers (VMServer1 and VM-Server2).

In Figure 1.2 we show that the changes are not persistent after rebooting the system. Notice the results of the «**sudo hostname**» command are still **VMServer1** and **VMServer2**.



```
VMServer1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@VMServer1:~$ hostname
VMServer1
adelo@VMServer1:~$ sudo hostname WebServer
adelo@VMServer1:~$ hostname
WebServer
adelo@VMServer1:~$ reboot _
```

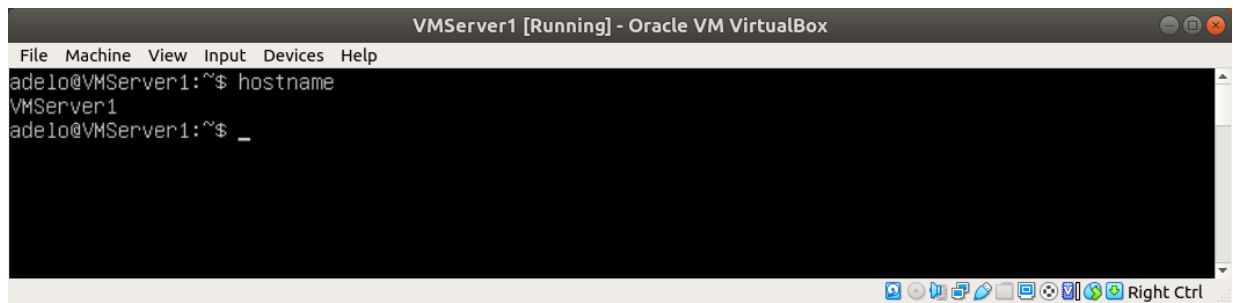
(a) VMServer1



```
VMServer2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebClient:~$ hostname
VMServer2
adelo@WebClient:~$ sudo hostname WebClient
adelo@WebClient:~$ hostname
WebClient
adelo@WebClient:~$ reboot _
```

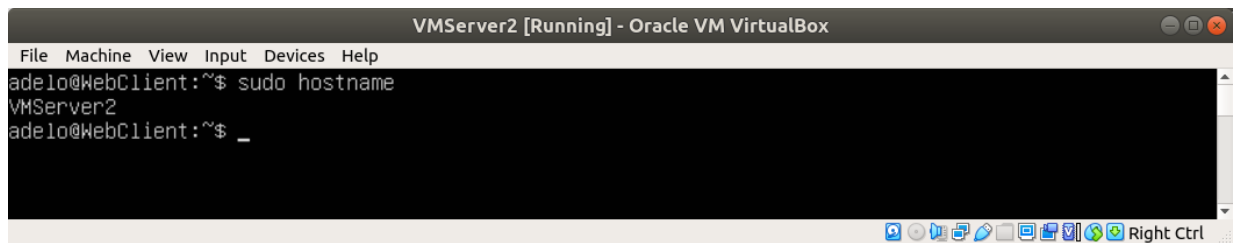
(b) VMServer2

Figure 1.1: Temporary hostname configuration using the hostname command



```
VMServer1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@VMServer1:~$ hostname
VMServer1
adelo@VMServer1:~$ _
```

(a) VMServer1



```
VMServer2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebClient:~$ sudo hostname
VMServer2
adelo@WebClient:~$ _
```

(b) VMServer2

Figure 1.2: Showing that the name changes (using the hostname command) are not persistent after rebooting the system

1.1.2 Permanent configuration using the appropriate configuration file

To change permanently the hostname, we need to configure 2 different configuration files:

- /etc/hostname
- /etc/hosts

In Figure 1.3 we show the content of the /etc/hostname and /etc/hosts files before configuration (VMServer1 and VMServer2). Then, in Figure 1.4 we show the configuration we have made in both files (VMServer1 and VMServer2) using the vi editor.

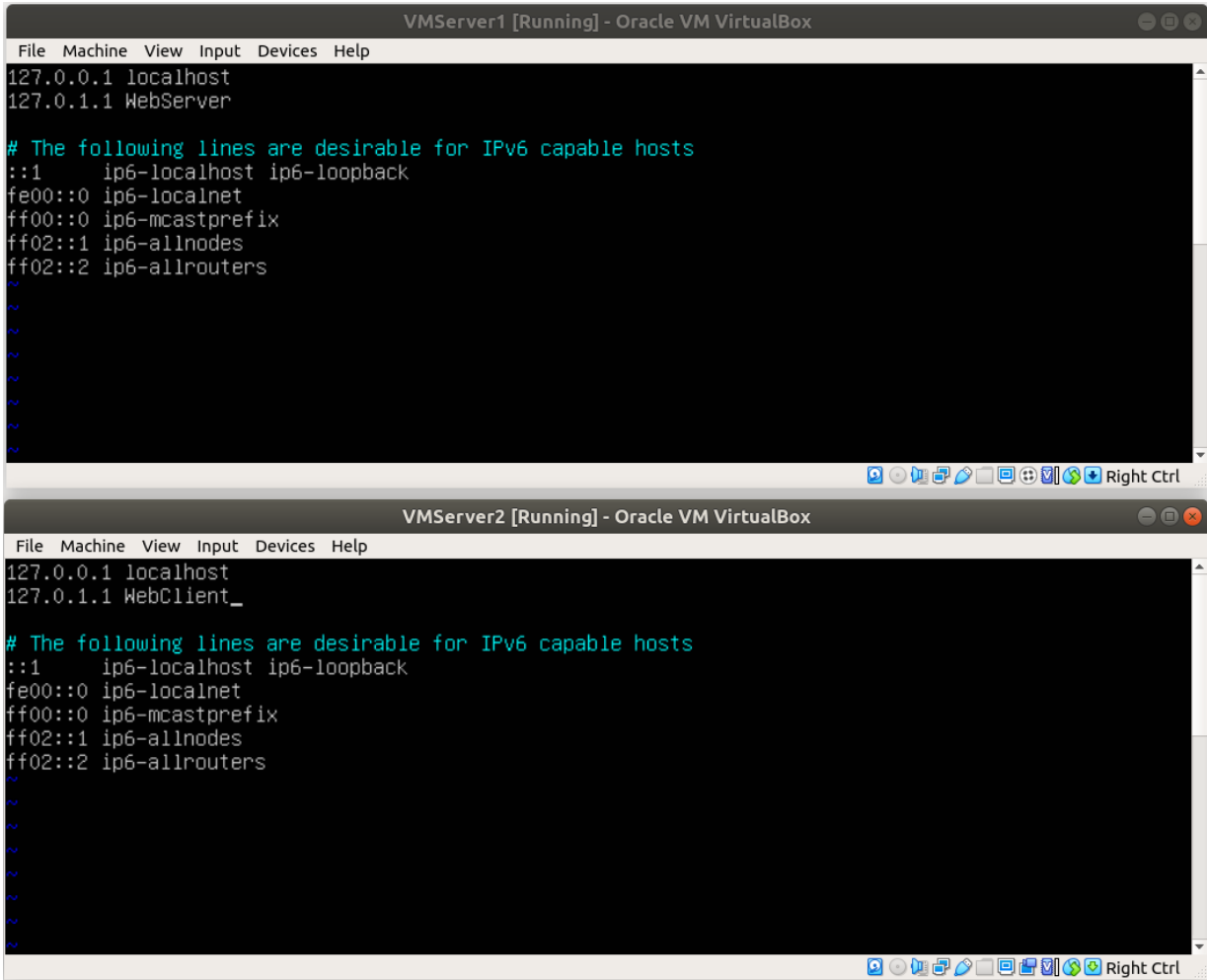
Finally, in Figure 1.5 we show that the name changes are persistent after rebooting the system.

The image shows two terminal windows from Oracle VM VirtualBox. The top window is titled 'VMServer1 [Running] - Oracle VM VirtualBox'. The terminal prompt is 'adelo@VMServer1:~\$'. The user has run 'hostname', which returns 'VMServer1'. Then they ran 'more /etc/hostname', which also returns 'VMServer1'. Next, they ran 'more /etc/hosts', which shows:
127.0.0.1 localhost
127.0.1.1 VMServer1
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 user then typed 'sudo vi /etc/hostname'.
The bottom window is titled 'VMServer2 [Running] - Oracle VM VirtualBox'. The terminal prompt is 'adelo@VMServer2:~\$'. The user has run 'hostname', which returns 'VMServer2'. Then they ran 'more /etc/hostname', which also returns 'VMServer2'. Next, they ran 'more /etc/hosts', which shows:
127.0.0.1 localhost
127.0.1.1 VMServer2
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 user then typed 'sudo vi /etc/hostname'.

Figure 1.3: Content of the /etc/hostname and /etc/hosts files before configuration (VMServer1 and VMServer2)



(a) Changing the names of VMServer1 using the hostname command



(b)

Figure 1.4: Configuring the hostname using in /etc/hostname and /etc/hosts (VMServer1 and VMServer2)

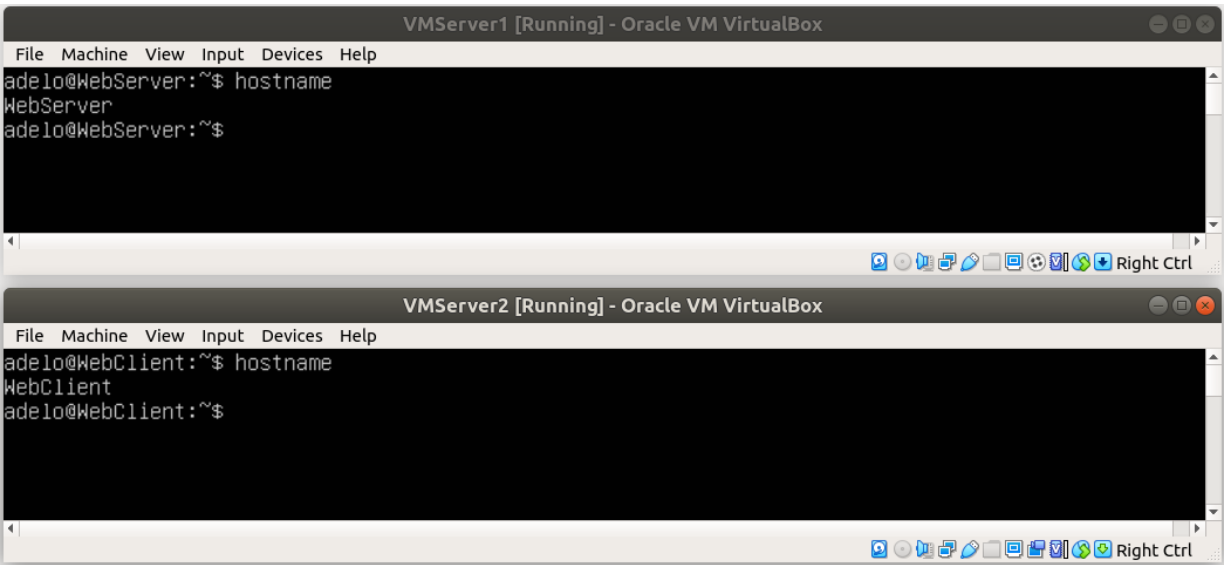
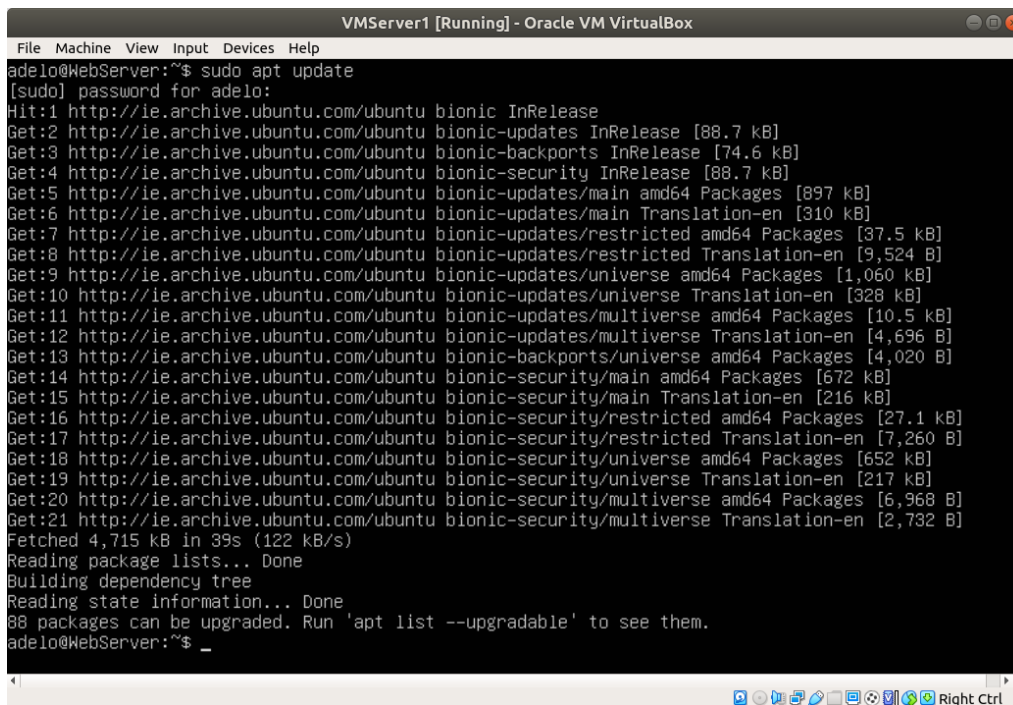


Figure 1.5: Showing that the name changes are persistent after rebooting the system

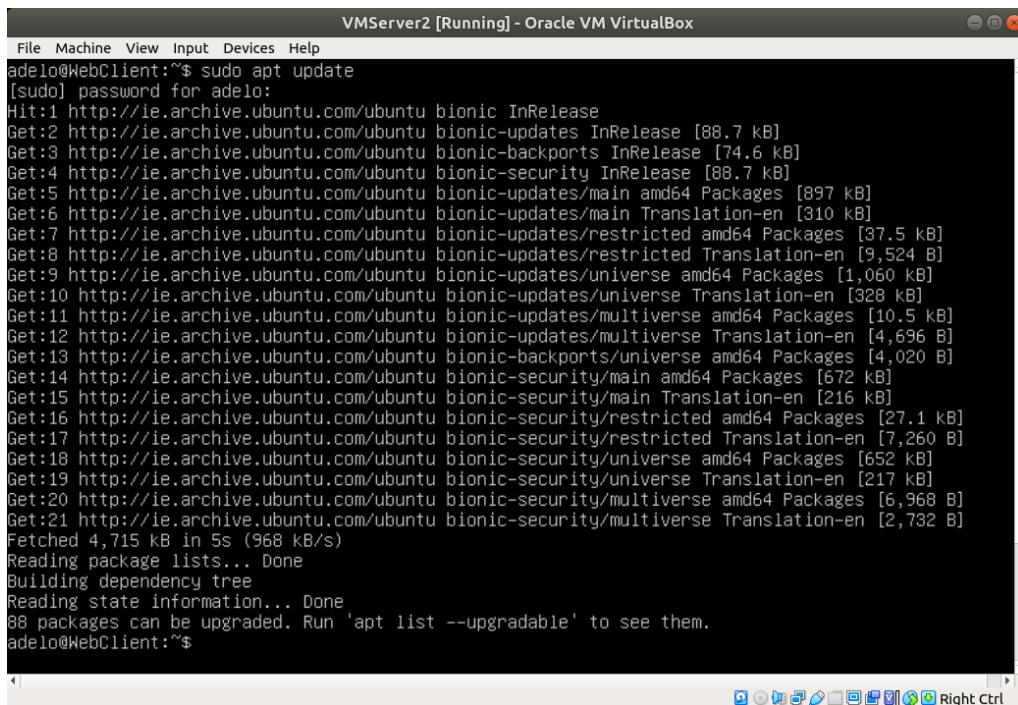
1.2 Task 1b: Network connectivity and configuration

1.2.1 Demonstrating Internet connectivity by getting updates from the Linux repositories



```
VMServer1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ sudo apt update
[sudo] password for adelo:
Hit:1 http://ie.archive.ubuntu.com/ubuntu bionic InRelease
Get:2 http://ie.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Get:3 http://ie.archive.ubuntu.com/ubuntu bionic-backports InRelease [74.6 kB]
Get:4 http://ie.archive.ubuntu.com/ubuntu bionic-security InRelease [88.7 kB]
Get:5 http://ie.archive.ubuntu.com/ubuntu bionic-updates/main amd64 Packages [897 kB]
Get:6 http://ie.archive.ubuntu.com/ubuntu bionic-updates/main Translation-en [310 kB]
Get:7 http://ie.archive.ubuntu.com/ubuntu bionic-updates/restricted amd64 Packages [37.5 kB]
Get:8 http://ie.archive.ubuntu.com/ubuntu bionic-updates/restricted Translation-en [9,524 B]
Get:9 http://ie.archive.ubuntu.com/ubuntu bionic-updates/universe amd64 Packages [1,060 kB]
Get:10 http://ie.archive.ubuntu.com/ubuntu bionic-updates/universe Translation-en [328 kB]
Get:11 http://ie.archive.ubuntu.com/ubuntu bionic-updates/multiverse amd64 Packages [10.5 kB]
Get:12 http://ie.archive.ubuntu.com/ubuntu bionic-updates/multiverse Translation-en [4,696 B]
Get:13 http://ie.archive.ubuntu.com/ubuntu bionic-backports/universe amd64 Packages [4,020 B]
Get:14 http://ie.archive.ubuntu.com/ubuntu bionic-security/main amd64 Packages [672 kB]
Get:15 http://ie.archive.ubuntu.com/ubuntu bionic-security/main Translation-en [216 kB]
Get:16 http://ie.archive.ubuntu.com/ubuntu bionic-security/restricted amd64 Packages [27.1 kB]
Get:17 http://ie.archive.ubuntu.com/ubuntu bionic-security/restricted Translation-en [7,260 B]
Get:18 http://ie.archive.ubuntu.com/ubuntu bionic-security/universe amd64 Packages [652 kB]
Get:19 http://ie.archive.ubuntu.com/ubuntu bionic-security/universe Translation-en [217 kB]
Get:20 http://ie.archive.ubuntu.com/ubuntu bionic-security/multiverse amd64 Packages [6,968 B]
Get:21 http://ie.archive.ubuntu.com/ubuntu bionic-security/multiverse Translation-en [2,732 B]
Fetched 4,715 kB in 39s (122 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
88 packages can be upgraded. Run 'apt list --upgradable' to see them.
adelo@WebServer:~$
```

(a) WebServer



```
VMServer2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebClient:~$ sudo apt update
[sudo] password for adelo:
Hit:1 http://ie.archive.ubuntu.com/ubuntu bionic InRelease
Get:2 http://ie.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Get:3 http://ie.archive.ubuntu.com/ubuntu bionic-backports InRelease [74.6 kB]
Get:4 http://ie.archive.ubuntu.com/ubuntu bionic-security InRelease [88.7 kB]
Get:5 http://ie.archive.ubuntu.com/ubuntu bionic-updates/main amd64 Packages [897 kB]
Get:6 http://ie.archive.ubuntu.com/ubuntu bionic-updates/main Translation-en [310 kB]
Get:7 http://ie.archive.ubuntu.com/ubuntu bionic-updates/restricted amd64 Packages [37.5 kB]
Get:8 http://ie.archive.ubuntu.com/ubuntu bionic-updates/restricted Translation-en [9,524 B]
Get:9 http://ie.archive.ubuntu.com/ubuntu bionic-updates/universe amd64 Packages [1,060 kB]
Get:10 http://ie.archive.ubuntu.com/ubuntu bionic-updates/universe Translation-en [328 kB]
Get:11 http://ie.archive.ubuntu.com/ubuntu bionic-updates/multiverse amd64 Packages [10.5 kB]
Get:12 http://ie.archive.ubuntu.com/ubuntu bionic-updates/multiverse Translation-en [4,696 B]
Get:13 http://ie.archive.ubuntu.com/ubuntu bionic-backports/universe amd64 Packages [4,020 B]
Get:14 http://ie.archive.ubuntu.com/ubuntu bionic-security/main amd64 Packages [672 kB]
Get:15 http://ie.archive.ubuntu.com/ubuntu bionic-security/main Translation-en [216 kB]
Get:16 http://ie.archive.ubuntu.com/ubuntu bionic-security/restricted amd64 Packages [27.1 kB]
Get:17 http://ie.archive.ubuntu.com/ubuntu bionic-security/restricted Translation-en [7,260 B]
Get:18 http://ie.archive.ubuntu.com/ubuntu bionic-security/universe amd64 Packages [652 kB]
Get:19 http://ie.archive.ubuntu.com/ubuntu bionic-security/universe Translation-en [217 kB]
Get:20 http://ie.archive.ubuntu.com/ubuntu bionic-security/multiverse amd64 Packages [6,968 B]
Get:21 http://ie.archive.ubuntu.com/ubuntu bionic-security/multiverse Translation-en [2,732 B]
Fetched 4,715 kB in 5s (968 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
88 packages can be upgraded. Run 'apt list --upgradable' to see them.
adelo@WebClient:~$
```

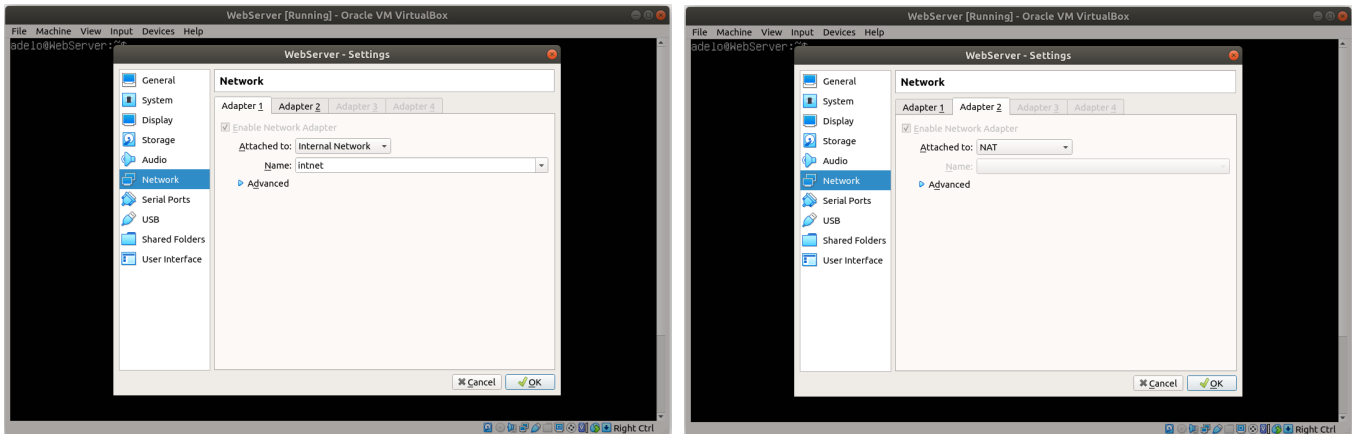
(b) WebClient

Figure 1.6: Demonstrating Internet connectivity by getting updates from the Linux repositories

1.2.2 Using the Settings of the Hypervisor to configure the first network adapter to Internal on both server VMs and leaving the second network adapter set for NAT

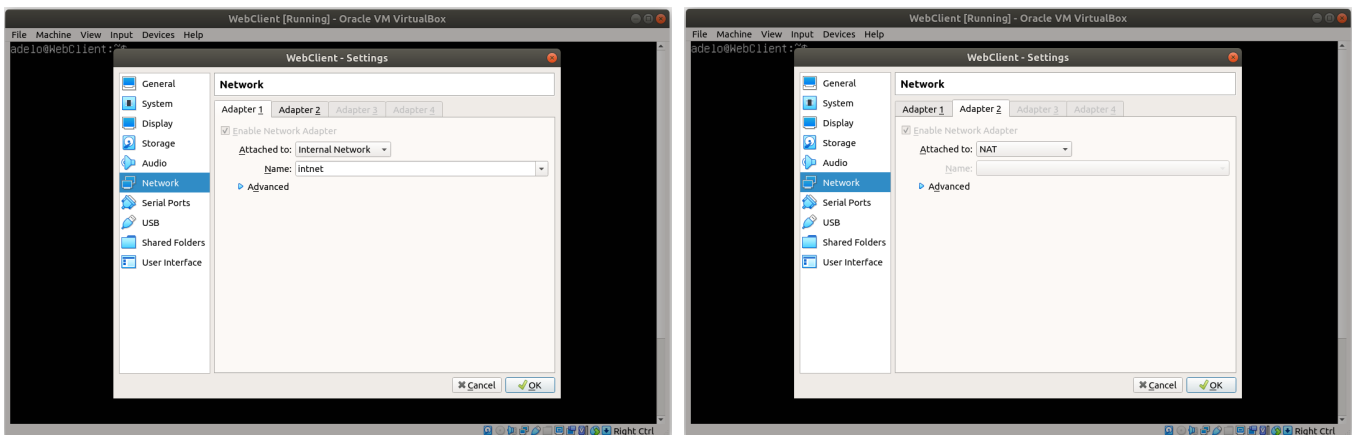
Using our Hypervisor (VirtualBox) we have configured two Network adapters in each VM. The first network adapter will be associated with our Internal Network, which is made up of our 2 VM (WebServer and WebClient). The second Network adapter will be set for NAT and used to connect with the Internet.

In Figure 1.7 we show how we have accomplished this task on VirtualBox.



(a) WebServer - Adaptor 1

(b) WebServer - Adaptor 2



(c) WebClient - Adaptor 1

(d) WebClient - Adaptor 2

Figure 1.7: Configuring the first network adapter to Internal on both server VMs and leaving the second network adapter set for NAT

1.2.3 Running the ifconfig command to show the IP addressing of the Network Interfaces of the servers

In Figure ?? we show the **ifconfig** output in both VMs. Notice that the first network adapter (**enp0se**) of each VM have no IP address. This is because this adapter has been configured as Internal. In the next step, we will configure

a static IP address for this adaptor.

```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet6 fe80::a00:27ff:fea7:9043 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:a7:90:43 txqueuelen 1000 (Ethernet)
    RX packets 18 bytes 2833 (2.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 51 bytes 7018 (7.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.3.15 netmask 255.255.255.0 broadcast 10.0.3.255
    inet6 fe80::a00:27ff:feae:2a8e prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:ae:2a:8e txqueuelen 1000 (Ethernet)
    RX packets 57 bytes 12916 (12.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 68 bytes 7015 (7.0 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 92 bytes 7036 (7.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 92 bytes 7036 (7.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

adelo@WebServer:~$
```

(a) WebServer

```
WebClient [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebClient:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet6 fe80::a00:27ff:fec7:c479 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:c7:c4:79 txqueuelen 1000 (Ethernet)
    RX packets 4 bytes 1356 (1.3 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 12 bytes 936 (936.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.3.15 netmask 255.255.255.0 broadcast 10.0.3.255
    inet6 fe80::a00:27ff:febe:7be5 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:be:7b:e5 txqueuelen 1000 (Ethernet)
    RX packets 3961 bytes 4236245 (4.2 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 1105 bytes 73325 (73.3 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 98 bytes 7702 (7.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 98 bytes 7702 (7.7 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

adelo@WebClient:~$ _
```

(b) WebClient

Figure 1.8

1.2.4 Using `ifconfig` to change the IP address on the first network adapter on each of the servers (ephemeral changes)

We are going to show two methods of configuring a static IP address:

- The first is a temporary configuration by using the **`ifconfig`** command. The changes made with this method will not persist after rebooting the system.
 - See the configuration in Figure 1.9.
 - In Figure 1.10 we can see that both VMs still have Internet connectivity after configuring a static IP address for the adapter 1.
 - In Figure 1.12 we show again the output of the `ifconfig` command after rebooting the systems. Notice the configurations made with the `ifconfig` command were not persistent.
- A permanent configuration can be made by editing the appropriate configuration files. See Section 1.2.8.

```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ sudo ifconfig enp0s3 192.168.0.100 netmask 255.255.255.0 up
[sudo] password for adelo:
adelo@WebServer:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.100 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::a00:27ff:fea7:9043 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:a7:90:43 txqueuelen 1000 (Ethernet)
    RX packets 18 bytes 2833 (2.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 97 bytes 21536 (21.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.3.15 netmask 255.255.255.0 broadcast 10.0.3.255
    inet6 fe80::a00:27ff:feae:2a8e prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:ae:2a:8e txqueuelen 1000 (Ethernet)
    RX packets 160 bytes 20806 (20.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 182 bytes 15835 (15.8 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 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 92 bytes 7036 (7.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 92 bytes 7036 (7.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

adelo@WebServer:~$ _
```

(a)

```
WebClient [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebClient:~$ sudo ifconfig enp0s3 192.168.0.200 netmask 255.255.255.0 up
[sudo] password for adelo:
adelo@WebClient:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.200 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::a00:27ff:fec7:c479 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:c7:c4:79 txqueuelen 1000 (Ethernet)
    RX packets 40 bytes 13560 (13.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 15 bytes 1146 (1.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.3.15 netmask 255.255.255.0 broadcast 10.0.3.255
    inet6 fe80::a00:27ff:febe:7be5 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:be:7b:e5 txqueuelen 1000 (Ethernet)
    RX packets 4030 bytes 4241585 (4.2 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 1181 bytes 79235 (79.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 98 bytes 7702 (7.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 98 bytes 7702 (7.7 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

adelo@WebClient:~$ _
```

(b)

Figure 1.9: Using ifconfig to change the IP address on the first network adapter on each of the servers

1.2.5 Checking that the two VMs still have Internet connectivity

This time, we have verified that both VMs have Internet connectivity by pinging www.google.com.

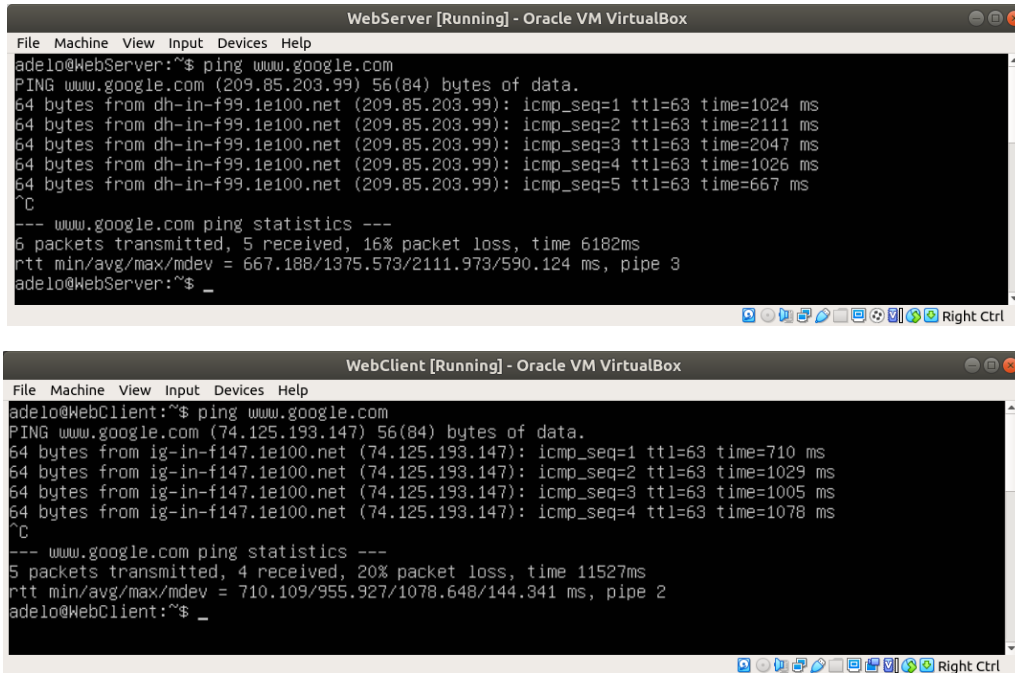


Figure 1.10: Checking that the two VMs still have Internet connectivity

1.2.6 Demonstrating that the two VMs can ping each other

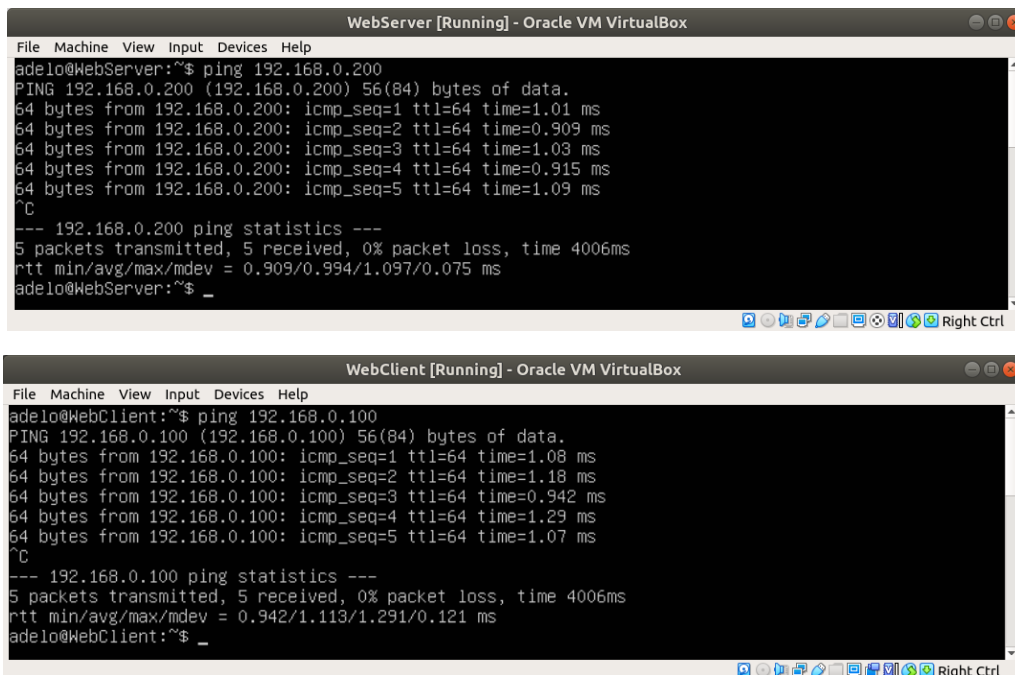
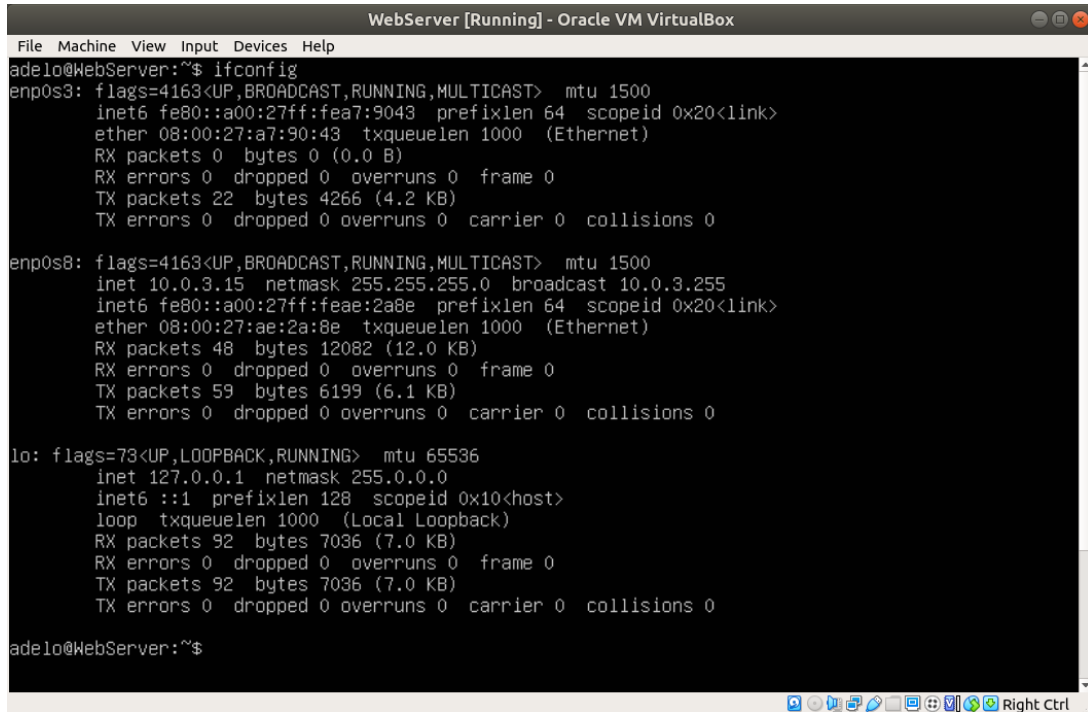


Figure 1.11: Demonstrating that the two VMs can ping each other

1.2.7 Rebooting the two servers and showing that the IP configurations were not persistent



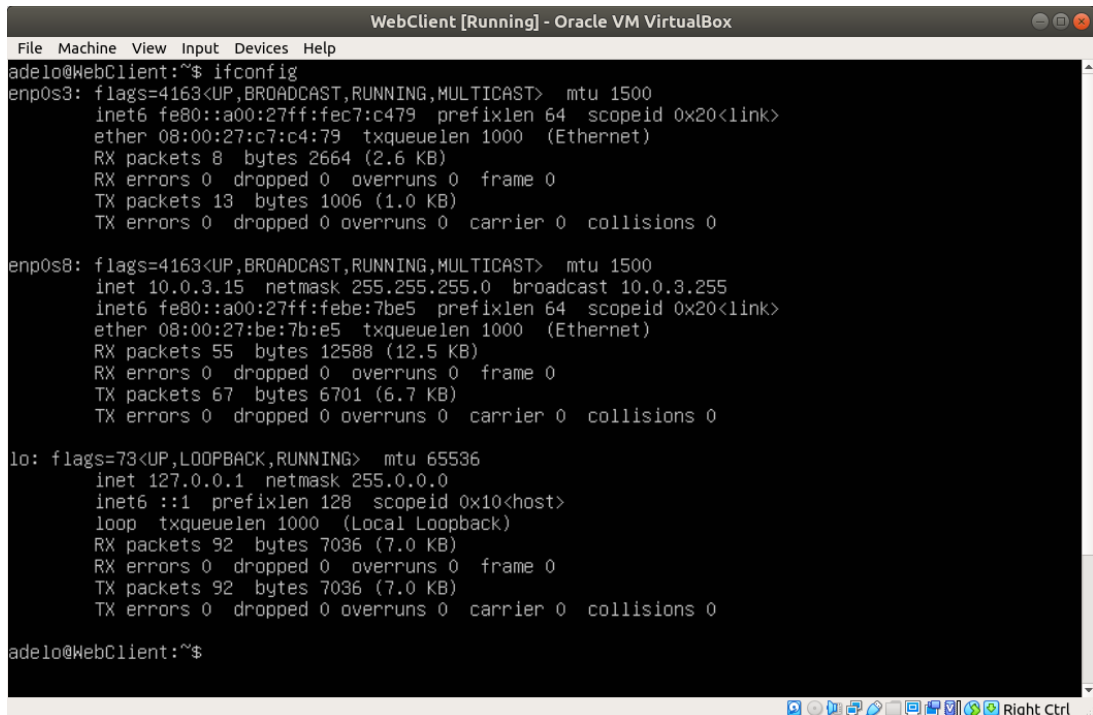
```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet6 fe80::a00:27ff:fea7:9043 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:a7:90:43 txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 22 bytes 4266 (4.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.3.15 netmask 255.255.255.0 broadcast 10.0.3.255
    inet6 fe80::a00:27ff:feae:2a8e prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:ae:2a:8e txqueuelen 1000 (Ethernet)
    RX packets 48 bytes 12082 (12.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 59 bytes 6199 (6.1 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 92 bytes 7036 (7.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 92 bytes 7036 (7.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

adelo@WebServer:~$
```

(a) WebServer



```
WebClient [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebClient:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet6 fe80::a00:27ff:fec7:c479 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:c7:c4:79 txqueuelen 1000 (Ethernet)
    RX packets 8 bytes 2664 (2.6 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 13 bytes 1006 (1.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.3.15 netmask 255.255.255.0 broadcast 10.0.3.255
    inet6 fe80::a00:27ff:febe:7be5 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:be:7b:e5 txqueuelen 1000 (Ethernet)
    RX packets 55 bytes 12588 (12.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 67 bytes 6701 (6.7 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 92 bytes 7036 (7.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 92 bytes 7036 (7.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

adelo@WebClient:~$
```

(b)

Figure 1.12: Showing that the IP configurations (using the ifconfig command) are not persistent after rebooting the system

1.2.8 Using the appropriate configuration file to perform a persistent configuration of the IP addresses

In old Ubuntu versions, to configure a static IP address we need to modify the `/etc/network/interfaces` file. [[ostechnix.com \(2019\)](#)]

From ubuntu 17.10, the configuration needs to be made at a YAML file that is located at the `/etc/netplan/` directory. Usually the `/etc/netplan/50-cloud-init.yaml` file [[ostechnix.com \(2019\)](#)]

In Figure 1.13 we show the default content of the `/etc/netplan/50-cloud-init.yaml` file. Notice that, by default, both adaptors are configure using `dhcp`.

Using the vi text editor we have modified the `/etc/netplan/50-cloud-init.yaml` file to configure the first adaptor of each VM in the following way (See Figure 1.14):

- **WebServer:**

- IP: 192.168.0.100
- Gateway 192.168.0.1
- DNS: 192.168.0.1

- **WebClient:**

- IP: 192.168.0.100
- Gateway 192.168.0.1
- DNS: 192.168.0.1

Finally, in Figure 1.15 we show the output of the `ifconfig` command after rebooting the system. Notice the changes were persistend.


```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ more /etc/netplan/50-cloud-init.yaml
# This file is generated from information provided by
# the datasource. Changes to it will not persist across an instance.
# To disable cloud-init's network configuration capabilities, write a file
# /etc/cloud/cloud.cfg.d/99-disable-network-config.cfg with the following:
# network: {config: disabled}
network:
  ethernets:
    enp0s3:
      dhcp4: true
    enp0s8:
      dhcp4: true
  version: 2
adelo@WebServer:~$

WebClient [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebClient:~$ more /etc/netplan/50-cloud-init.yaml
# This file is generated from information provided by
# the datasource. Changes to it will not persist across an instance.
# To disable cloud-init's network configuration capabilities, write a file
# /etc/cloud/cloud.cfg.d/99-disable-network-config.cfg with the following:
# network: {config: disabled}
network:
  ethernets:
    enp0s3:
      dhcp4: true
    enp0s8:
      dhcp4: true
  version: 2
adelo@WebClient:~$ _
```

Figure 1.13: Default content of the /etc/netplan/50-cloud-init.yaml file

The image displays two screenshots of Oracle VM VirtualBox terminal windows. The top window, titled 'WebServer [Running] - Oracle VM VirtualBox', shows the configuration of the /etc/netplan/50-cloud-init.yaml file. The configuration is as follows:

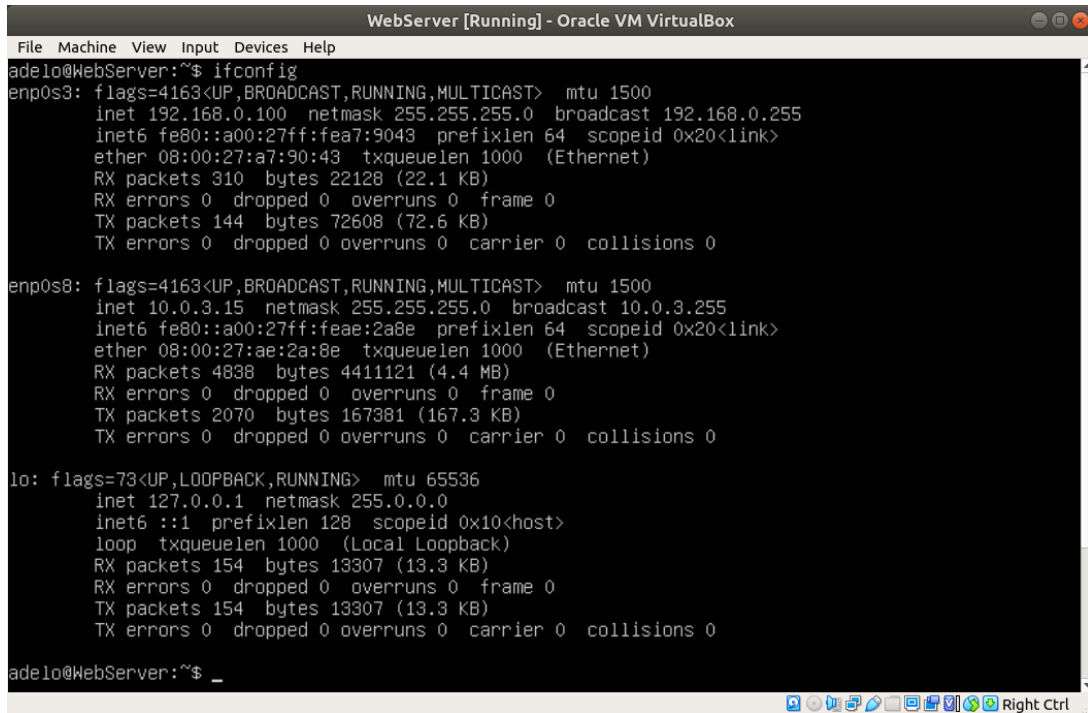
```
# This file is generated from information provided by
# the datasource. Changes to it will not persist across an instance.
# To disable cloud-init's network configuration capabilities, write a file
# /etc/cloud/cloud.cfg.d/99-disable-network-config.cfg with the following:
# network: {config: disabled}
network:
  ethernets:
    enp0s3:
      addresses: [192.168.0.100/24]
      gateway4: 192.168.0.1
      dhcp4: no
      nameservers:
        addresses: [192.168.0.1]
      optional: true
    enp0s8:
      dhcp4: true
  version: 2
```

The bottom window, titled 'WebClient [Running] - Oracle VM VirtualBox', shows the configuration of the /etc/netplan/50-cloud-init.yaml file. The configuration is as follows:

```
# This file is generated from information provided by
# the datasource. Changes to it will not persist across an instance.
# To disable cloud-init's network configuration capabilities, write a file
# /etc/cloud/cloud.cfg.d/99-disable-network-config.cfg with the following:
# network: {config: disabled}
network:
  ethernets:
    enp0s3:
      addresses: [192.168.0.200/24]
      gateway4: 192.168.0.1
      dhcp4: no
      nameservers:
        addresses: [192.168.0.1]
      optional: true
    enp0s8:
      dhcp4: true
  version: 2
```

Figure 1.14: Configuration of the /etc/netplan/50-cloud-init.yaml file using the vi text editor

1.2.9 Rebooting the two servers to demonstrate that the IP address configuration changes of the two VMs are persistent



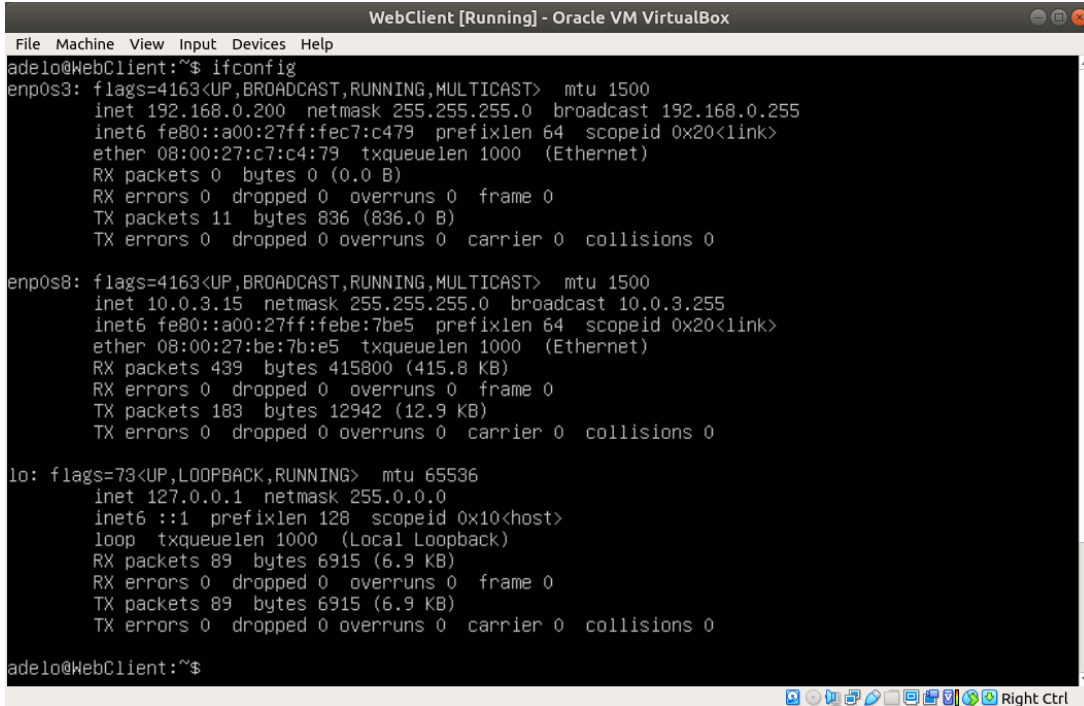
```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.100 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::a00:27ff:fea7:9043 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:a7:90:43 txqueuelen 1000 (Ethernet)
    RX packets 310 bytes 22128 (22.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 144 bytes 72608 (72.6 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.3.15 netmask 255.255.255.0 broadcast 10.0.3.255
    inet6 fe80::a00:27ff:fae:2a8e prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:ae:2a:8e txqueuelen 1000 (Ethernet)
    RX packets 4838 bytes 4411121 (4.4 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 2070 bytes 167381 (167.3 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 154 bytes 13307 (13.3 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 154 bytes 13307 (13.3 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

adelo@WebServer:~$ _
```

(a) WebServer



```
WebClient [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebClient:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.200 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::a00:27ff:fec7:c479 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:c7:c4:79 txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 11 bytes 836 (836.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.3.15 netmask 255.255.255.0 broadcast 10.0.3.255
    inet6 fe80::a00:27ff:febe:7be5 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:be:7b:e5 txqueuelen 1000 (Ethernet)
    RX packets 439 bytes 415800 (415.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 183 bytes 12942 (12.9 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 89 bytes 6915 (6.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 89 bytes 6915 (6.9 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

adelo@WebClient:~$
```

(b) WebClient

Figure 1.15: Showing that the IP configurations (using the ifconfig command) are persistent after rebooting the system

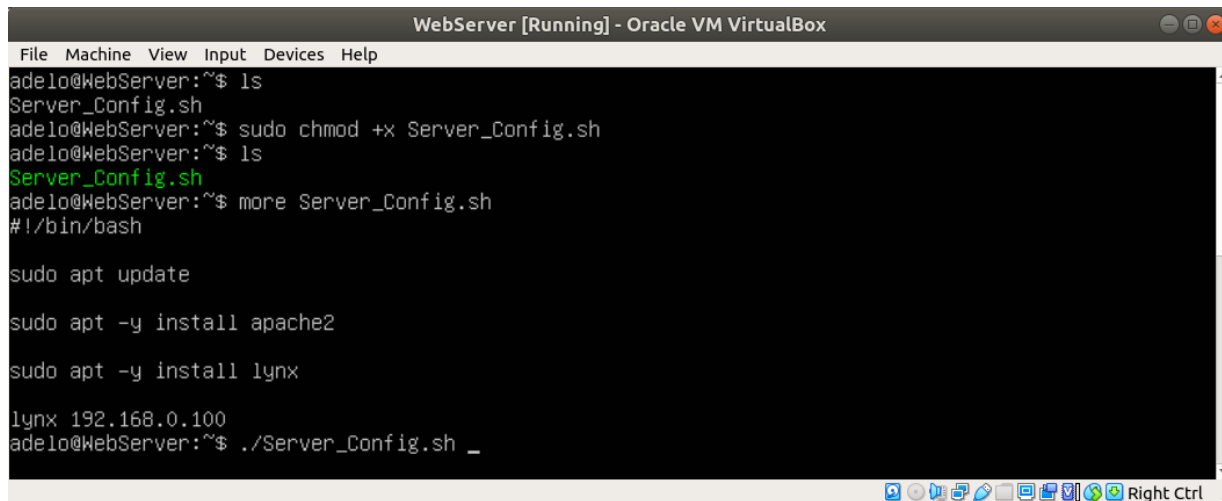
2 Part 2: Automating Basic Linux Tasks

2.1 Task 2a: Automating tasks with shell scripting

Using the vi editor, we have created a shell script that perform the following tasks (See the Shell Script in Figure ??):

- Pulls updates from the Linux repositories. This make sure that we install the las version of the package available in the Ubuntu repositories.
- Installs the Apache web server. Notice that using the option **-y** the installation is performed without being prompted for permission to use extra storage when installing the service.
- Installs the Lynx web browser service.
- Displays the default Apache web page of the web server by using the Lynx browser.

Before running the shell script, we have use the **chmod** command to give it execute permission (x) so it can be directly executed (./) without the need of using the command bash (Figure ??). The result of the execution of the **Server_Config.sh** is shown in Figure 2.1. Notice that the default Apache web page is correctly displayed by the Lynx browser.



```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ ls
Server_Config.sh
adelo@WebServer:~$ sudo chmod +x Server_Config.sh
adelo@WebServer:~$ ls
Server_Config.sh
adelo@WebServer:~$ more Server_Config.sh
#!/bin/bash

sudo apt update

sudo apt -y install apache2

sudo apt -y install lynx

lynx 192.168.0.100
adelo@WebServer:~$ ./Server_Config.sh _
```

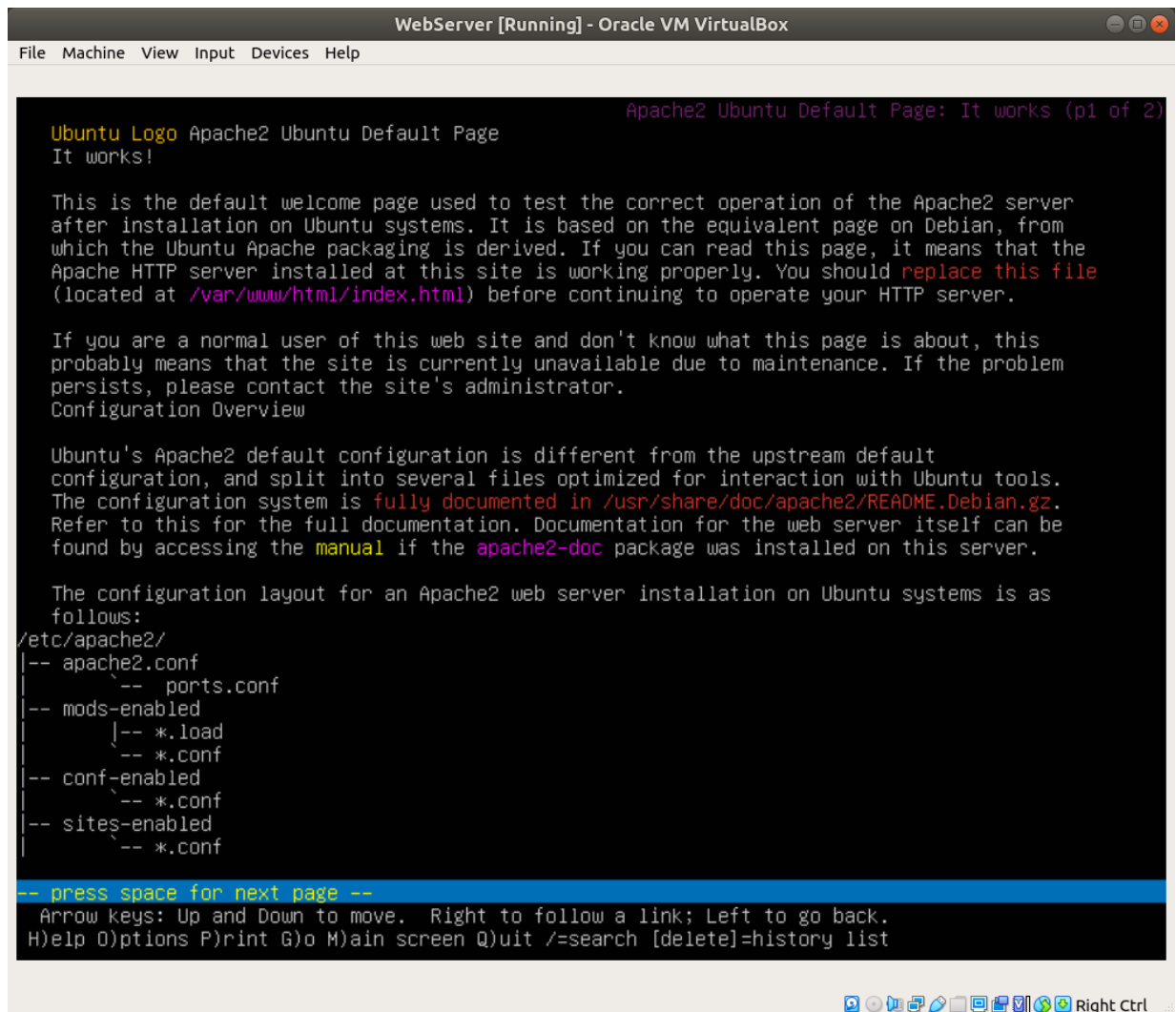


Figure 2.1

2.2 Task 2b: Creating simple DigiTech Web Page

To create a DigiTech Web Page we have just modified the default Apache web page (using **vi**) so that it says **DigiTech Web Server** (Figure 2.2(a)).

Then we have used again the Lynx browser to display the page:

lynx 192.168.0.100 (See the result in Figure 2.2(b))

```
File Machine View Input Devices Help
184 background-color: #000000;
185
186 color: #DCDFE6;
187 }
188
189 div.validator {
190 }
191 </style>
192 </head>
193 <body>
194 <div class="main_page">
195 <div class="page_header floating_element">
196 <span class="floating_element">
197
198 <br />
199 <div style="text-align: center">DigiTech Web Server</div>
200 <br />
201
202 </span>
203 </div>
204
```

(a)

```
File Machine View Input Devices Help Apache2 Ubuntu Default Page: It works (p1 of 2)
DigiTech Web Server
This is the default welcome page used to test the correct operation of the Apache2 server
after installation on Ubuntu systems. It is based on the equivalent page on Debian, from
which the Ubuntu Apache packaging is derived. If you can read this page, it means that the
Apache HTTP server installed at this site is working properly. You should replace this file
(located at /var/www/html/index.html) before continuing to operate your HTTP server.
If you are a normal user of this web site and don't know what this page is about, this
probably means that the site is currently unavailable due to maintenance. If the problem
persists, please contact the site's administrator.
Configuration Overview
```

(b)

Figure 2.2: modifying the default Apache web page (using «vi») so that it says «DigiTech Web Site»

2.3 Task 2c: Automating server data backup

In Figure 2.3 we show the Shell script we have created to perform a backup of the `/home` directory (WebServeBackup.sh). Note that we are making sure of backing up all the user home directories inside `/home`.

We think it is important not to replace the previous backup every time we perform a backup. That is why we have decided to do a small change in the backup file name that was specified in the brief of this assignment. Instead of name the file as «WebServBackup.tar.gz», our script will name it as «WebServBackup-date_Y_M_D.tar.gz». This way, every time a backup is performed, it will be created with a different name by using the current date.

In Figure 2.3 we show the script we have created. The output of the execution of this script is shown in Figure 2.4.

We have made sure the script works as specified by displaying the content of the «WebServBackup-date_Y_M_D.-tar.gz» file that has been created and checking that the files in this inside this tar file match the files in the `/home`

directory (Figure 2.5).



Figure 2.3: Creation of a Shell script that back up the entire contents of the home folder on WebServer

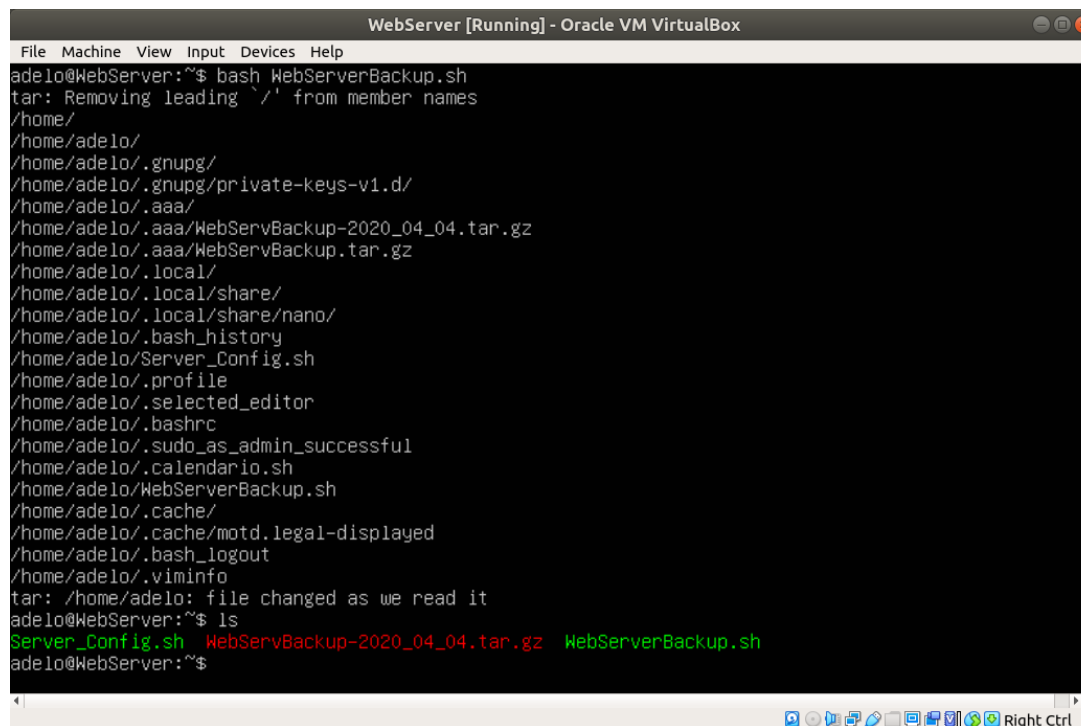
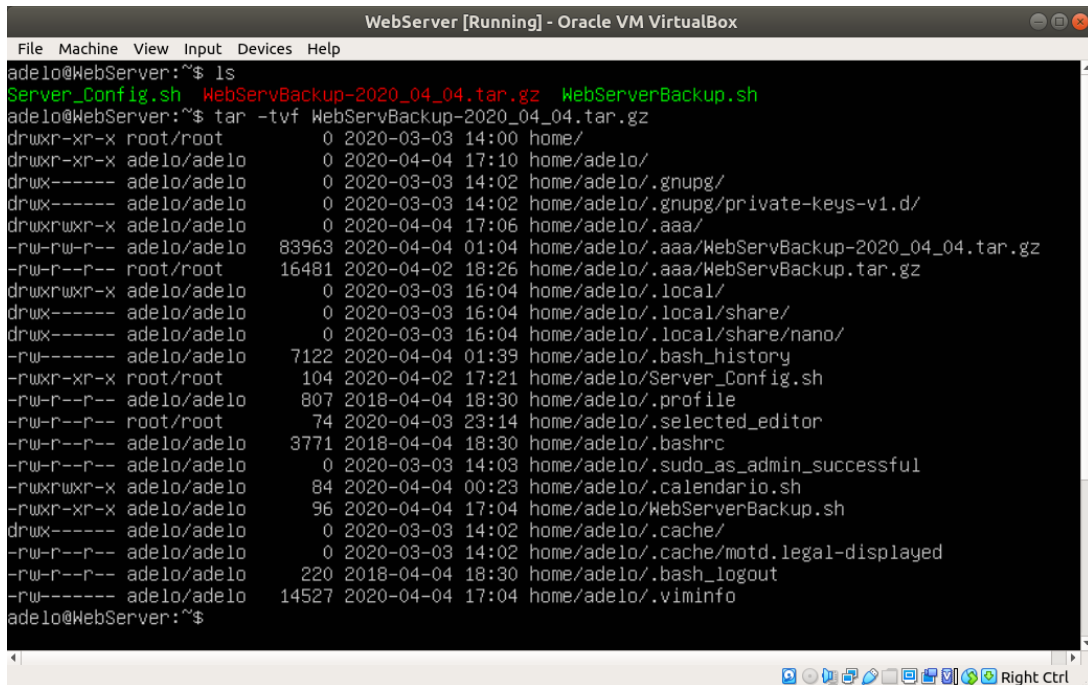


Figure 2.4: Running WebServeBackup.sh




```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ ls
Server_Config.sh  WebServBackup-2020_04_04.tar.gz  WebServerBackup.sh
adelo@WebServer:~$ tar -tvf WebServBackup-2020_04_04.tar.gz
drwxr-xr-x root/root          0 2020-03-03 14:00 home/
drwxr-xr-x adelo/adelo        0 2020-04-04 17:10 home/adelo/
drwx----- adelo/adelo        0 2020-03-03 14:02 home/adelo/.gnupg/
drwx----- adelo/adelo        0 2020-03-03 14:02 home/adelo/.gnupg/private-keys-v1.d/
drwxrwxr-x adelo/adelo        0 2020-04-04 17:06 home/adelo/.aaa/
-rw-rw-r-- adelo/adelo     83963 2020-04-04 01:04 home/adelo/.aaa/WebServBackup-2020_04_04.tar.gz
-rw-r--r-- root/root     16481 2020-04-02 18:26 home/adelo/.aaa/WebServBackup.tar.gz
drwxrwxr-x adelo/adelo        0 2020-03-03 16:04 home/adelo/.local/
drwx----- adelo/adelo        0 2020-03-03 16:04 home/adelo/.local/share/
drwx----- adelo/adelo        0 2020-03-03 16:04 home/adelo/.local/share/nano/
-rw----- adelo/adelo        7122 2020-04-04 01:39 home/adelo/.bash_history
-rwxr-xr-x root/root         104 2020-04-02 17:21 home/adelo/Server_Config.sh
-rw-r--r-- adelo/adelo        807 2018-04-04 18:30 home/adelo/.profile
-rw-r--r-- root/root         74 2020-04-03 23:14 home/adelo/.selected_editor
-rw-r--r-- adelo/adelo     3771 2018-04-04 18:30 home/adelo/.bashrc
-rw-r--r-- adelo/adelo        0 2020-03-03 14:03 home/adelo/.sudo_as_admin_successful
-rwxrwxr-x adelo/adelo        84 2020-04-04 00:23 home/adelo/.calendario.sh
-rwxr-xr-x adelo/adelo        96 2020-04-04 17:04 home/adelo/WebServerBackup.sh
drwx----- adelo/adelo        0 2020-03-03 14:02 home/adelo/.cache/
-rw-r--r-- adelo/adelo        0 2020-03-03 14:02 home/adelo/.cache/motd.legal-displayed
-rw-r--r-- adelo/adelo        220 2018-04-04 18:30 home/adelo/.bash_logout
-rw----- adelo/adelo     14527 2020-04-04 17:04 home/adelo/.viminfo
adelo@WebServer:~$
```

Figure 2.5: Listing all the files inside the backup file (WebServBackup-2020_04_04.tar.gz). This way we are making sure the content of the backup match the files in the /home directory

2.4 Task 2d: Automating scheduling of server backups with cronusing crontab

Using **crontab** we automated scheduling of server backups. In Figure 2.6 we show the way we have configured crontab so it will perform a backup at the end of every workweek at one minute to midnight. Notice that we didn't need to use the command «**bash**» in the command field of crontab because we have use the **chmod** command to give to **WebServerBackup.sh** execute permission (x) so it can be directly executed.

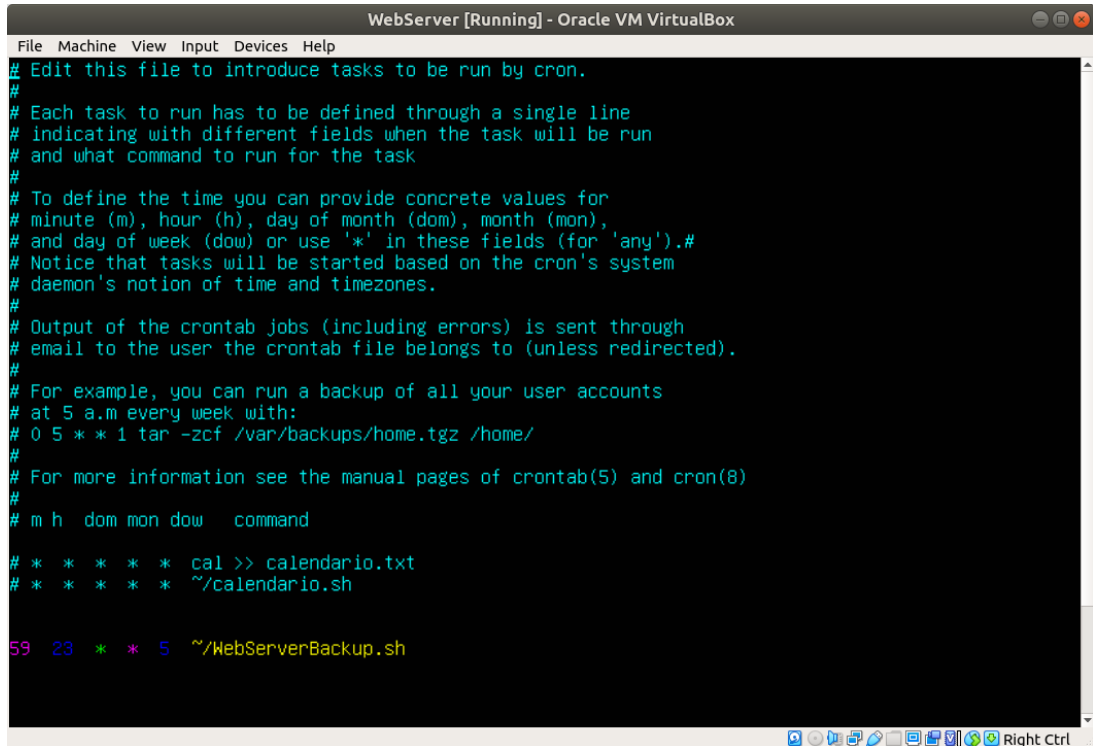


```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ crontab -e
no crontab for adelo - using an empty one

Select an editor. To change later, run 'select-editor'.
 1. /bin/nano      <---- easiest
 2. /usr/bin/vim.basic
 3. /usr/bin/vim.tiny
 4. /bin/ed

Choose 1-4 [1]: 3
```

(a)



```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
# Edit this file to introduce tasks to be run by cron.
#
# Each task to run has to be defined through a single line
# indicating with different fields when the task will be run
# and what command to run for the task
#
# To define the time you can provide concrete values for
# minute (m), hour (h), day of month (dom), month (mon),
# and day of week (dow) or use '*' in these fields (for 'any').#
# Notice that tasks will be started based on the cron's system
# daemon's notion of time and timezones.
#
# Output of the crontab jobs (including errors) is sent through
# email to the user the crontab file belongs to (unless redirected).
#
# For example, you can run a backup of all your user accounts
# at 5 a.m every week with:
# 0 5 * * 1 tar -zcf /var/backups/home.tgz /home/
#
# For more information see the manual pages of crontab(5) and cron(8)
#
# m h dom mon dow   command
# * * * * * cal >> calendario.txt
# * * * * * ~/calendario.sh
59 23 * * 5 ~/WebServerBackup.sh
```

(b)

Figure 2.6: Using crontab to automate scheduling of server backups. This way it will perform a backup at the end of every workweek at one minute to midnight

3 Part 3: Configuration of basic Linux Server firewall

We have accomplished this task using the Uncomplicated Firewall tool (UFW).

We have used official Ubuntu documentation to discover and implement some basic configuration in our Servers:

[wiki.ubuntu.com (2020)] [help.ubuntu.com (2017)] [askubuntu.com (2017)]

3.1 Task 3a: Configuring the Firewall

The first thing we did was to enable the Uncomplicated Firewall tool (UFW) on WebServer. In Figure 3.1 we show the status of UFW before and after enable it. It is important to notice that, after enable UFW, a default firewall configuration is activated.

Default UFW configuration:

- Allow all outgoing traffic from the Web server but block all incoming traffic.

After enable UFW, we have installed the Lynx browser on WebClient and tried to access the DigiTech web page from WebClient. As you can see in Figure 3.2, the request fails because of the default UFW firewall configuration, which is blocking all incoming traffic.

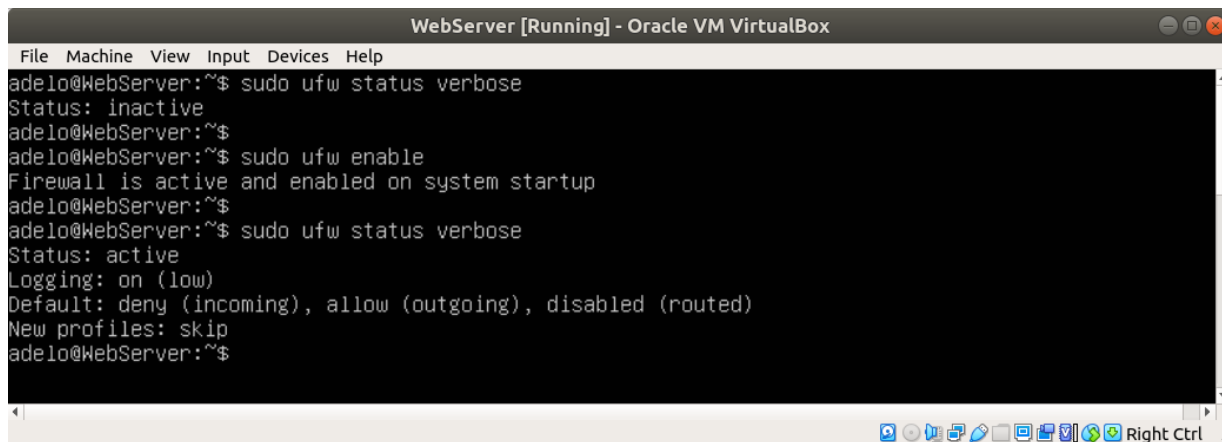


Figure 3.1: Status of UFW before and after enable it

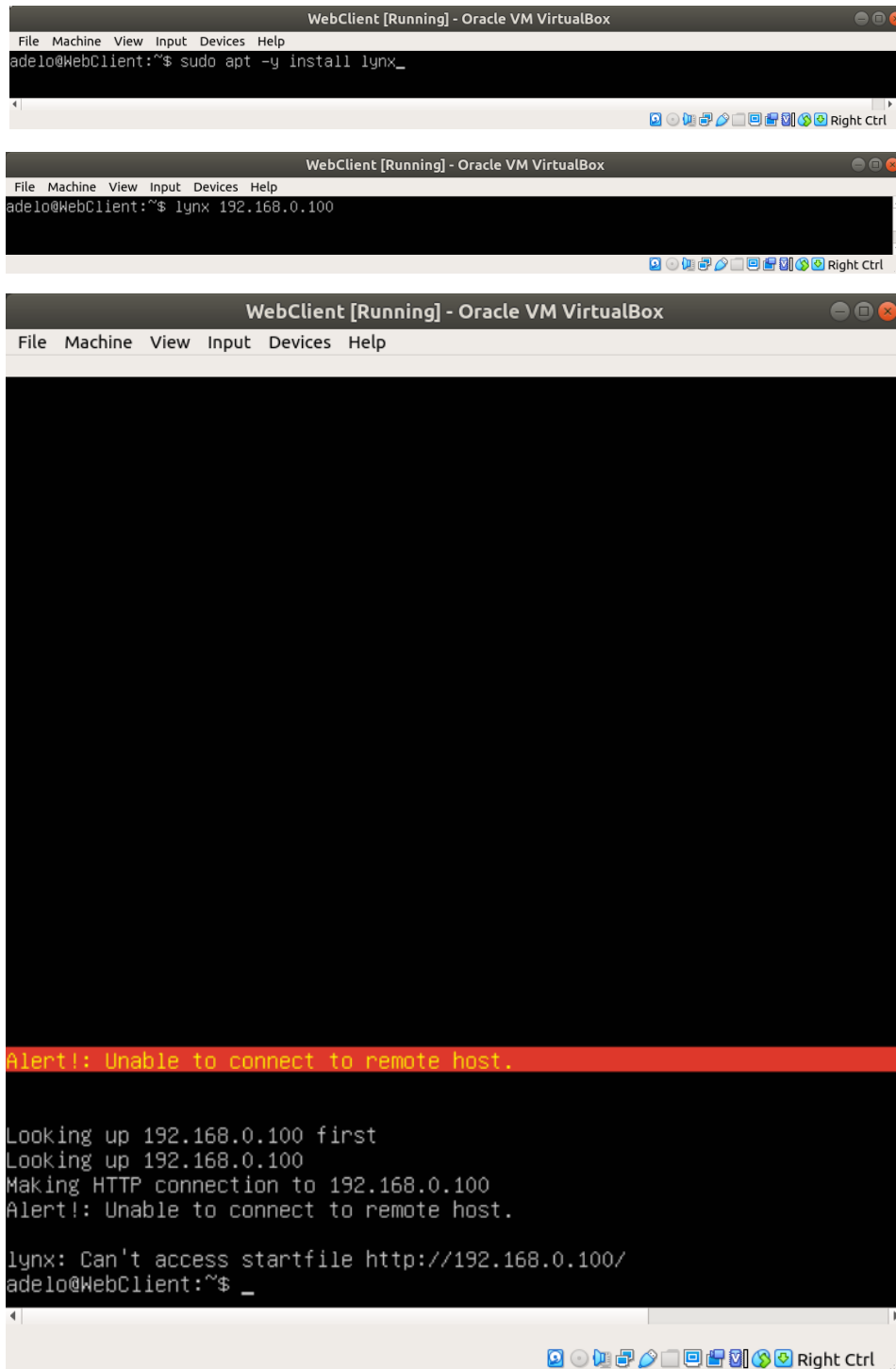


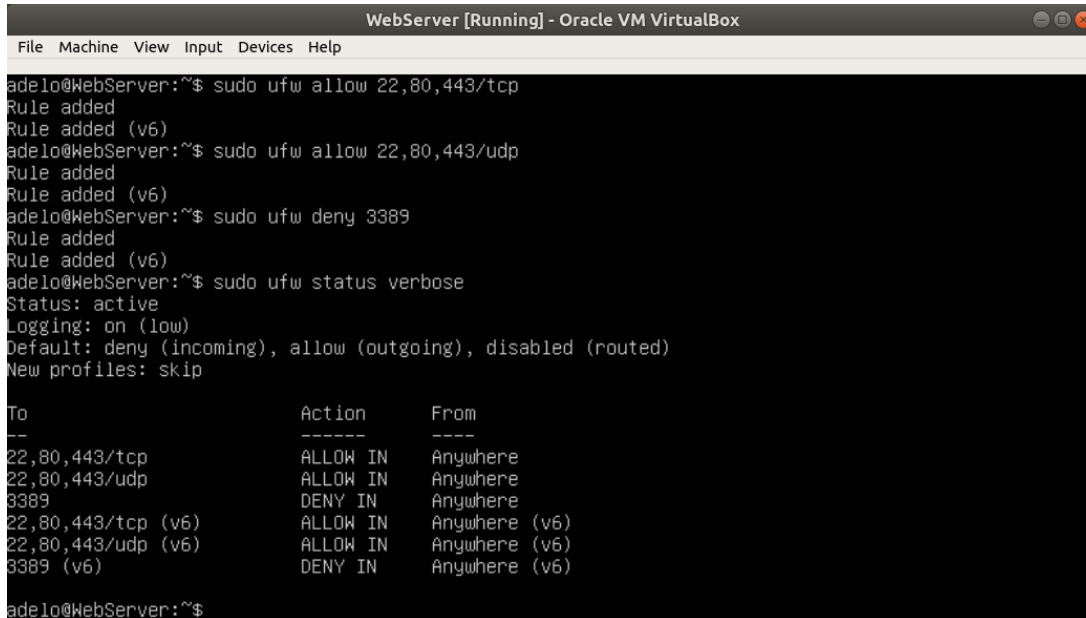
Figure 3.2: Installing the Lynx web browser on WebClient and trying to access the DigiTech Web page. Notice the Firewall is blocking the request (Default UFW firewall configuration)

Our first customized firewall configuration: We have then customized UFW in the following way:

- Allow traffic on ports 22, 80 and 443
- Deny traffic on port 3389

The above configuration would allow us to access the DigiTech Web page from WebClient.

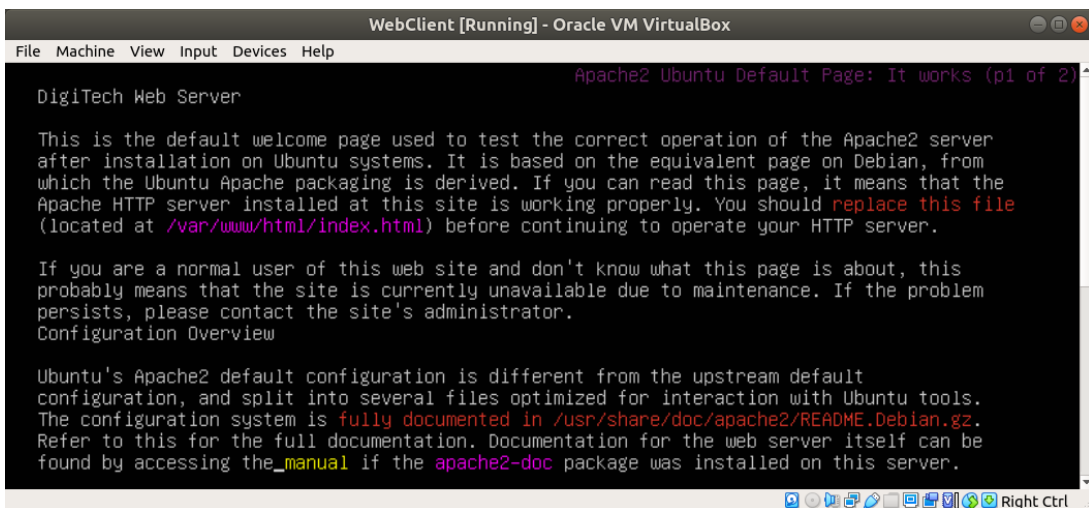
In Figure 3.3(a) we show the way we had configured the firewall using UFW and the status after configuration. In Figure 3.3(a) you can see that this configuration is allowing us to access the DigiTech web page.



```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ sudo ufw allow 22,80,443/tcp
Rule added
Rule added (v6)
adelo@WebServer:~$ sudo ufw allow 22,80,443/udp
Rule added
Rule added (v6)
adelo@WebServer:~$ sudo ufw deny 3389
Rule added
Rule added (v6)
adelo@WebServer:~$ sudo ufw status verbose
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), disabled (routed)
New profiles: skip

To Action From
--
22,80,443/tcp ALLOW IN Anywhere
22,80,443/udp ALLOW IN Anywhere
3389 DENY IN Anywhere
22,80,443/tcp (v6) ALLOW IN Anywhere (v6)
22,80,443/udp (v6) ALLOW IN Anywhere (v6)
3389 (v6) DENY IN Anywhere (v6)
adelo@WebServer:~$
```

(a) Customized configuration of UFW



```
WebClient [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Apache2 Ubuntu Default Page: It works (p1 of 2)
DigiTech Web Server

This is the default welcome page used to test the correct operation of the Apache2 server
after installation on Ubuntu systems. It is based on the equivalent page on Debian, from
which the Ubuntu Apache packaging is derived. If you can read this page, it means that the
Apache HTTP server installed at this site is working properly. You should replace this file
(located at /var/www/html/index.html) before continuing to operate your HTTP server.

If you are a normal user of this web site and don't know what this page is about, this
probably means that the site is currently unavailable due to maintenance. If the problem
persists, please contact the site's administrator.
Configuration Overview

Ubuntu's Apache2 default configuration is different from the upstream default
configuration, and split into several files optimized for interaction with Ubuntu tools.
The configuration system is fully documented in /usr/share/doc/apache2/README.Debian.gz.
Refer to this for the full documentation. Documentation for the web server itself can be
found by accessing the _manual if the apache2-doc package was installed on this server.
```

(b) Accessing the DigiTech web page from WebClient

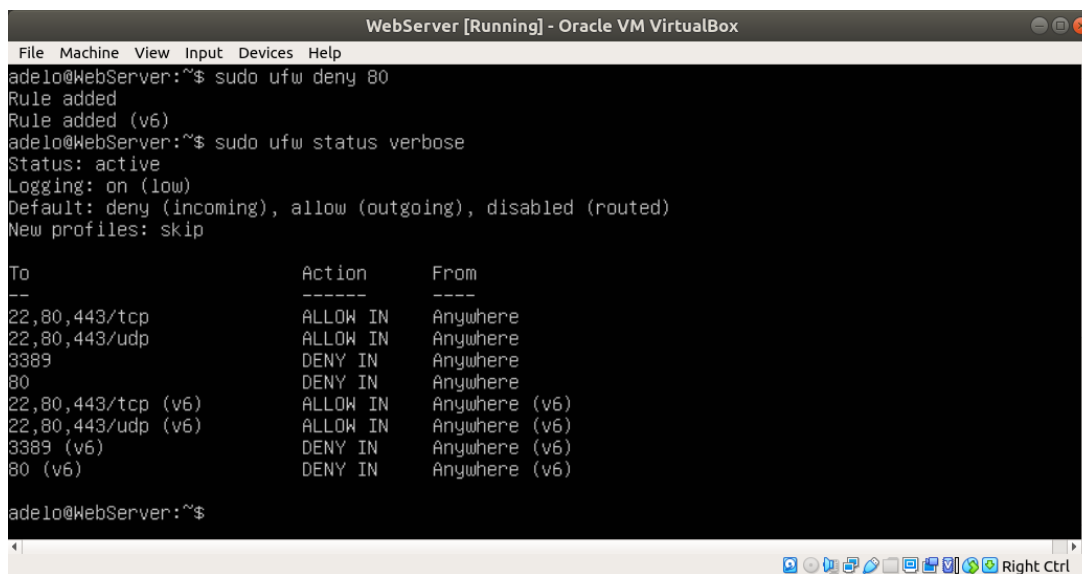
Figure 3.3: Customized configuration of the Firewall on WebServe using UFW. Notice that this configuration is allowing us to access the DigiTech web page

3.2 Task 3b: Testing firewall by closing one of the ports

To test the firewall, we have then closed port 80 (Figure 3.4). We thought this configuration would be enough to avoid request through port 80. However, after this configuration, we tried to access the DigiTech web page from WebClient

and the request was successful.

We realized that one of the rules of our UFW configuration was allowing incoming traffic from port 80 and the other was denying it. Therefore, what we did was to delete the rule that was allowing traffic from port 80 (Figure 3.5). After that, we tried again to access the DigiTech web page from WebClient. This time the firewall was working as expected. The request from WebClient was denied by the Firewall on WebServer, where we have added a rule that denies incoming traffic using port 80 (Figure 3.6). [help.ubuntu.com (2017)]



```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
adelo@WebServer:~$ sudo ufw deny 80
Rule added
Rule added (v6)
adelo@WebServer:~$ sudo ufw status verbose
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), disabled (routed)
New profiles: skip

To Action From
--
22,80,443/tcp ALLOW IN Anywhere
22,80,443/udp ALLOW IN Anywhere
3389 DENY IN Anywhere
80 DENY IN Anywhere
22,80,443/tcp (v6) ALLOW IN Anywhere (v6)
22,80,443/udp (v6) ALLOW IN Anywhere (v6)
3389 (v6) DENY IN Anywhere (v6)
80 (v6) DENY IN Anywhere (v6)

adelo@WebServer:~$
```

Figure 3.4: Closing port 80 using UFW

```
WebServer [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
New profiles: skip

To           Action      From
--           -
22,80,443/udp ALLOW IN    Anywhere
3389         DENY IN    Anywhere
22,80,443/tcp ALLOW IN    Anywhere
80          DENY IN    Anywhere
22,80,443/udp (v6) ALLOW IN    Anywhere (v6)
3389 (v6)   DENY IN    Anywhere (v6)
22,80,443/tcp (v6) ALLOW IN    Anywhere (v6)
80 (v6)     DENY IN    Anywhere (v6)

adelo@WebServer:~$ sudo ufw delete allow 22,80,443/tcp
Rule deleted
Rule deleted (v6)
adelo@WebServer:~$ sudo ufw allow 22,443/tcp
Rule added
Rule added (v6)
adelo@WebServer:~$ sudo ufw status verbose
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), disabled (routed)
New profiles: skip

To           Action      From
--           -
22,80,443/udp ALLOW IN    Anywhere
3389         DENY IN    Anywhere
80          DENY IN    Anywhere
22,443/tcp   ALLOW IN    Anywhere
22,80,443/udp (v6) ALLOW IN    Anywhere (v6)
3389 (v6)   DENY IN    Anywhere (v6)
80 (v6)     DENY IN    Anywhere (v6)
22,443/tcp (v6) ALLOW IN    Anywhere (v6)

adelo@WebServer:~$
```

Figure 3.5: Deleting the rule that allows incoming traffic from port 80

```
WebClient [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

Alert!: Unable to connect to remote host.

Looking up 192.168.0.100 first
Looking up 192.168.0.100
Making HTTP connection to 192.168.0.100
Alert!: Unable to connect to remote host.

lynx: Can't access startfile http://192.168.0.100/
adelo@WebClient:~$ _
```

Figure 3.6: Accessing the DigiTech web page from WebClient. Notice the request is denied by the Firewall on WebServer

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