



NETWORKING & VIRTUALIZATION

PROOF OF CONCEPT LINUX VIRTUAL NETWORK PROJECT

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Introduction:

My new role is with a consultancy company named 'Consult & Connect Ltd'. The company provides networking consulting services to companies in Ireland. As my first proof of concept project, I am going to create a virtualized Linux network infrastructure based on the network of a new third-level college. This college is Dublin City College (DCC). To get a sense of how their new network and services will perform in a Linux environment, DCC has requested a virtualized environment. Through this assignment, I will be able to assess my understanding of virtualized network services like SSH.

PART 1: Virtual Linux Network and Web server setup

I have been contracted by Dublin City College (DCC) to install a prototype Linux Client/Server Web environment to demonstrate basic connectivity between the Linux Server & Client VMs. Also, I will demonstrate remote connectivity using an SSH terminal and configure basic security in the Linux environment.

IP ADDRESSING TABLE		
Server name	Adapter 1 - enp0s3	Adapter 2 - enp0s8
ubuntuserver	Static IP Address: 192.168.56.50	DHCP
ubuntuclient	Static IP Address: 192.168.56.60	DHCP

1.) Obtaining Linux updates - Update and upgrade the system using the relevant commands.

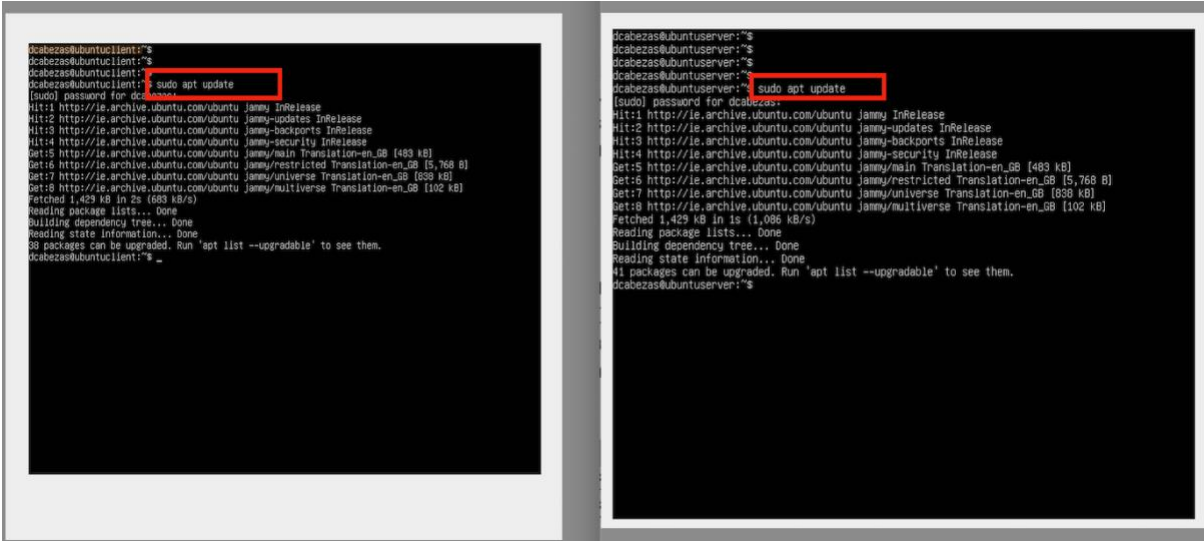


Image #1: updating the system with the command 'sudo apt update'.

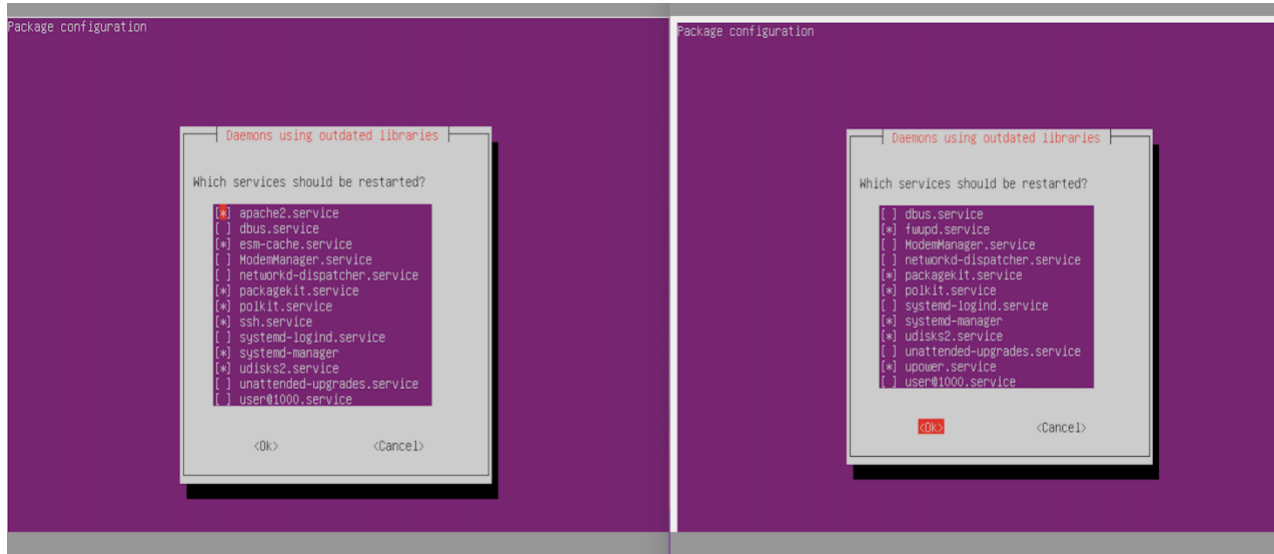


Image #2: system upgraded using the command 'sudo apt upgrade'.

2.) Testing Connectivity between both systems by pinging each internal IP address (192.168.56.x).

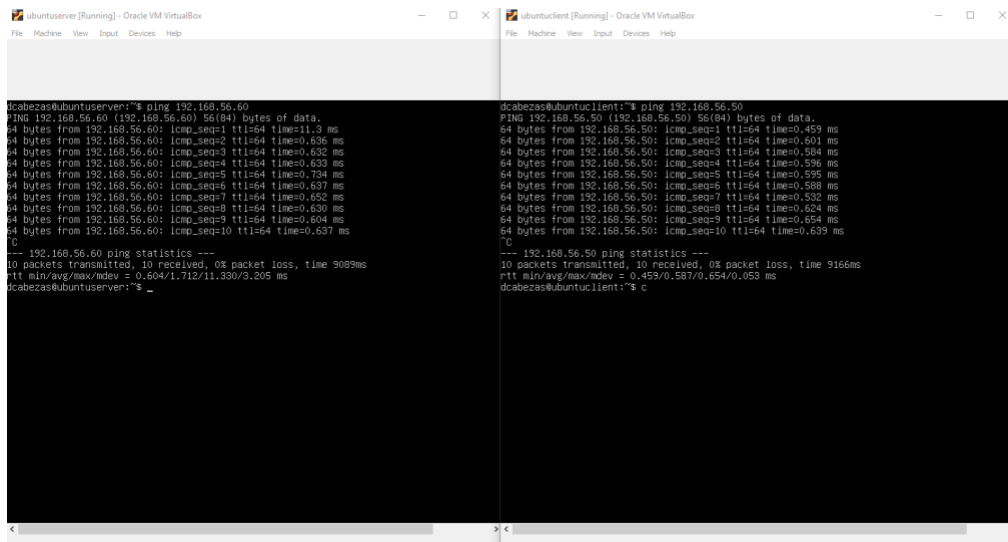


Image #3: pinging the two virtual machines after configuring static IP address for both.

3.) Using the client, test access to the ‘DCC under construction’ web page by opening the Lynx browser on the Linux client and accessing the web page that is hosted on the Ubuntu server.

```

                                                                    Apache2 Ubuntu Default Page: It works (p1 of 3)
Ubuntu Logo
Apache2 Default Page
It works!

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.

The configuration layout for an Apache2 web server installation on Ubuntu systems is as
follows:
/etc/apache2/
|-- apache2.conf
|   |-- ports.conf
|-- mods-enabled
|   |-- *.load
|   |-- *.conf
|-- conf-enabled
|   |-- *.conf
|-- sites-enabled
|   |-- *.conf
-- press space for next page --
Arrow keys: Up and Down to move. Right to follow a link; Left to go back.
H)elp O)ptions P)rint G)o M)ain screen Q)uit /=search [delete]=history list
```

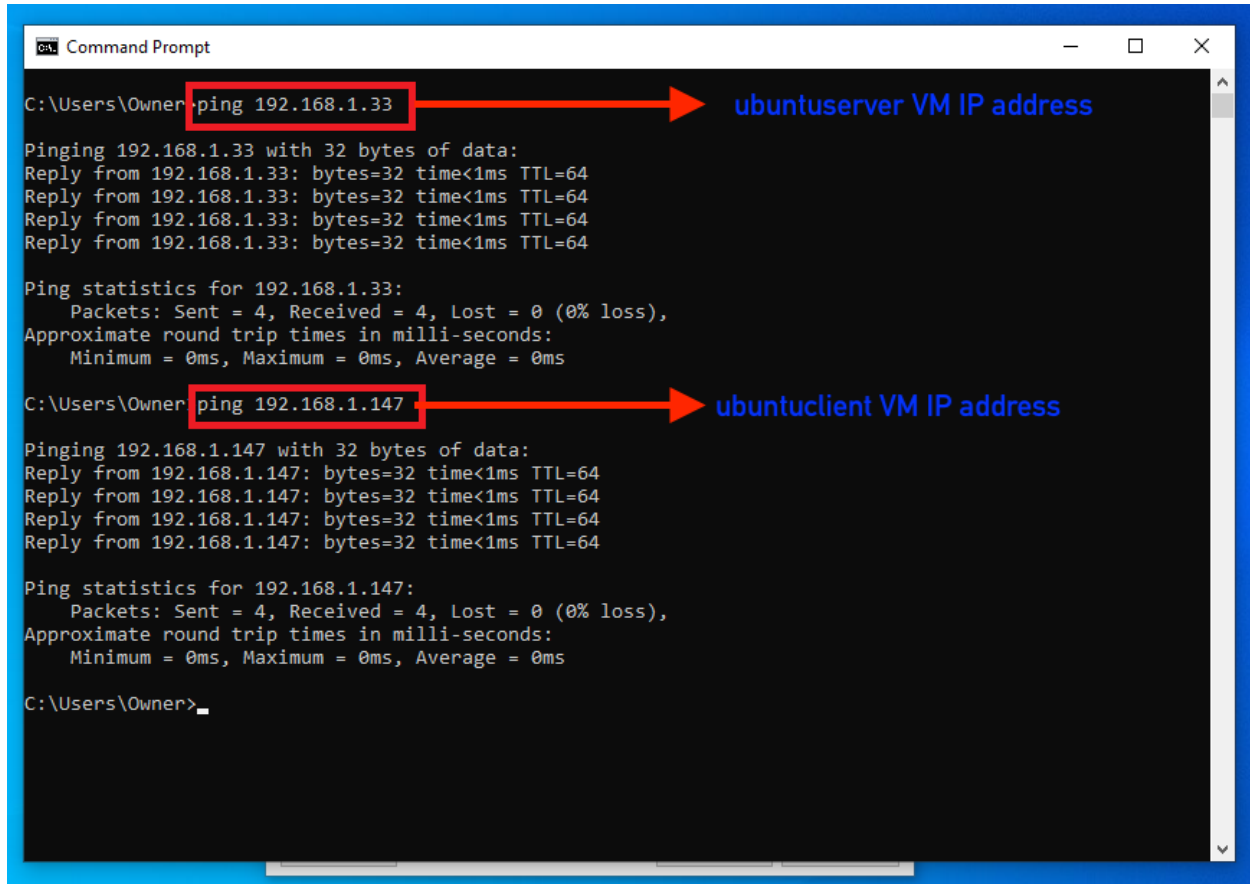
Image #4: Testing access to the DCC under construction from the client VM using Lynx browser.

4.) Using my Windows host operating system, test access to 'DCC under construction' web page by opening a web browser and accessing the 'DCC under construction' web page which is hosted on the Ubuntu server.



Image #5: Testing access to the DCC under construction from the HOST machine using Chrome browser.

5.) *Pinging the IP address of ubuntu server From a Windows host computer. While Wireshark is running on the host operating system, identify the ICMP traffic between your browser on your host operating system and the ubuntu server webserver.*



The screenshot shows a Windows Command Prompt window with the following text:

```
C:\Users\Owner>ping 192.168.1.33

Pinging 192.168.1.33 with 32 bytes of data:
Reply from 192.168.1.33: bytes=32 time<1ms TTL=64
Reply from 192.168.1.33: bytes=32 time<1ms TTL=64
Reply from 192.168.1.33: bytes=32 time<1ms TTL=64
Reply from 192.168.1.33: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.1.33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\Owner>ping 192.168.1.147

Pinging 192.168.1.147 with 32 bytes of data:
Reply from 192.168.1.147: bytes=32 time<1ms TTL=64
Reply from 192.168.1.147: bytes=32 time<1ms TTL=64
Reply from 192.168.1.147: bytes=32 time<1ms TTL=64
Reply from 192.168.1.147: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.1.147:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\Owner>
```

Two red arrows point from the IP addresses in the commands to text labels on the right:

- An arrow points from `192.168.1.33` to the text `ubuntu server VM IP address`.
- An arrow points from `192.168.1.147` to the text `ubuntucient VM IP address`.

Image #6: Pinging from the host machine to the Ubuntu VMs.

6.) From your host computer, put the IP address of ubuntu server into Chrome browser or whatever browser you use.

Utilizing Wireshark on your host operating system, ensure to take a print screen of the packet that shows the TCP/IP 3-way handshake that occurs while the HTTP contents (webpage) are transferred from the ubuntu server server to client (your host operating system).

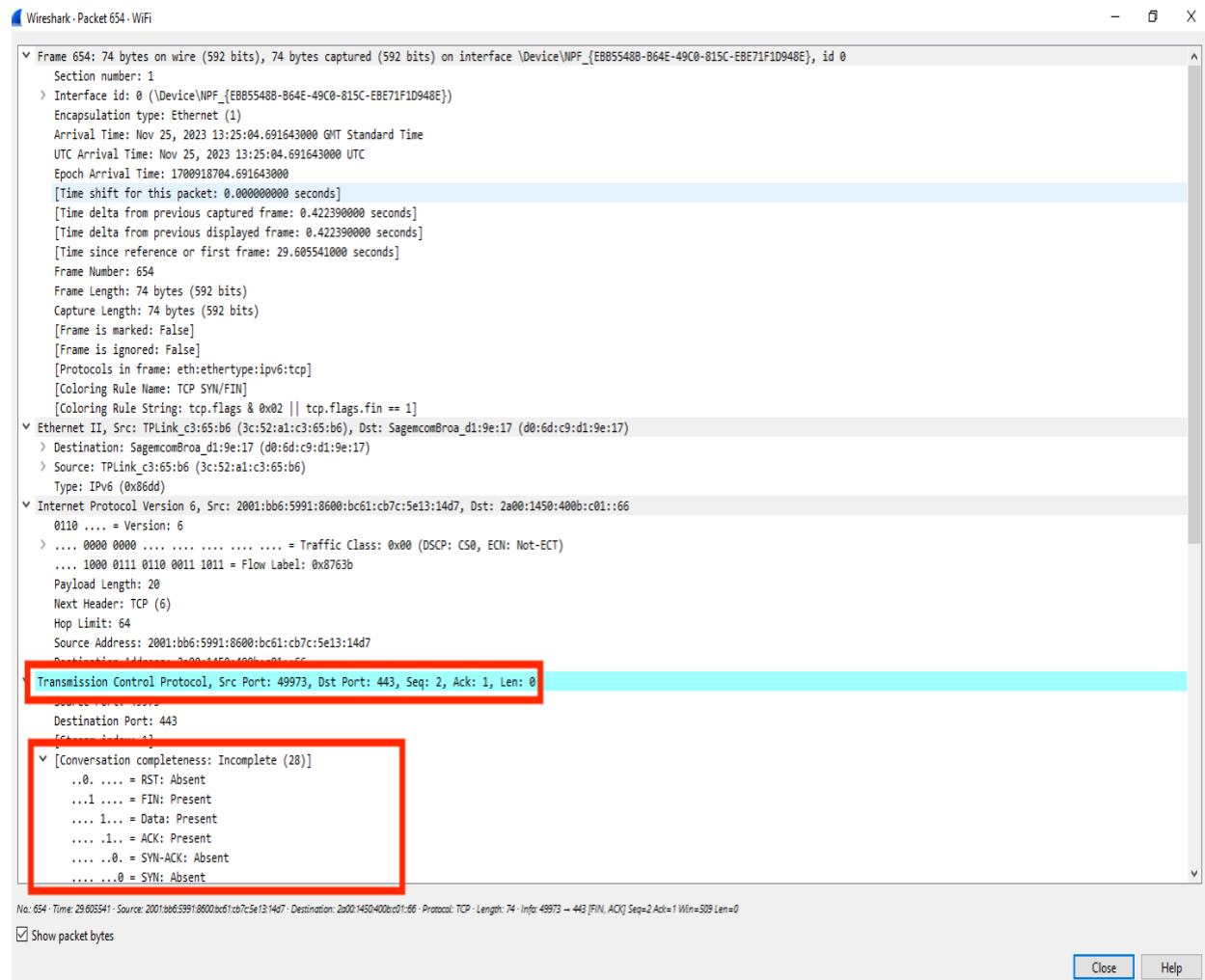


Image #7: The 3-way handshake.

PART 2: SSH

DCC would like you to install OpenSSH on the ubuntu server and install the OpenSSH server on the ubuntu server only.

7.) Show a print screen of your host operating system (using the SSH terminal through Putty logging into the ubuntu server using SSH remotely.

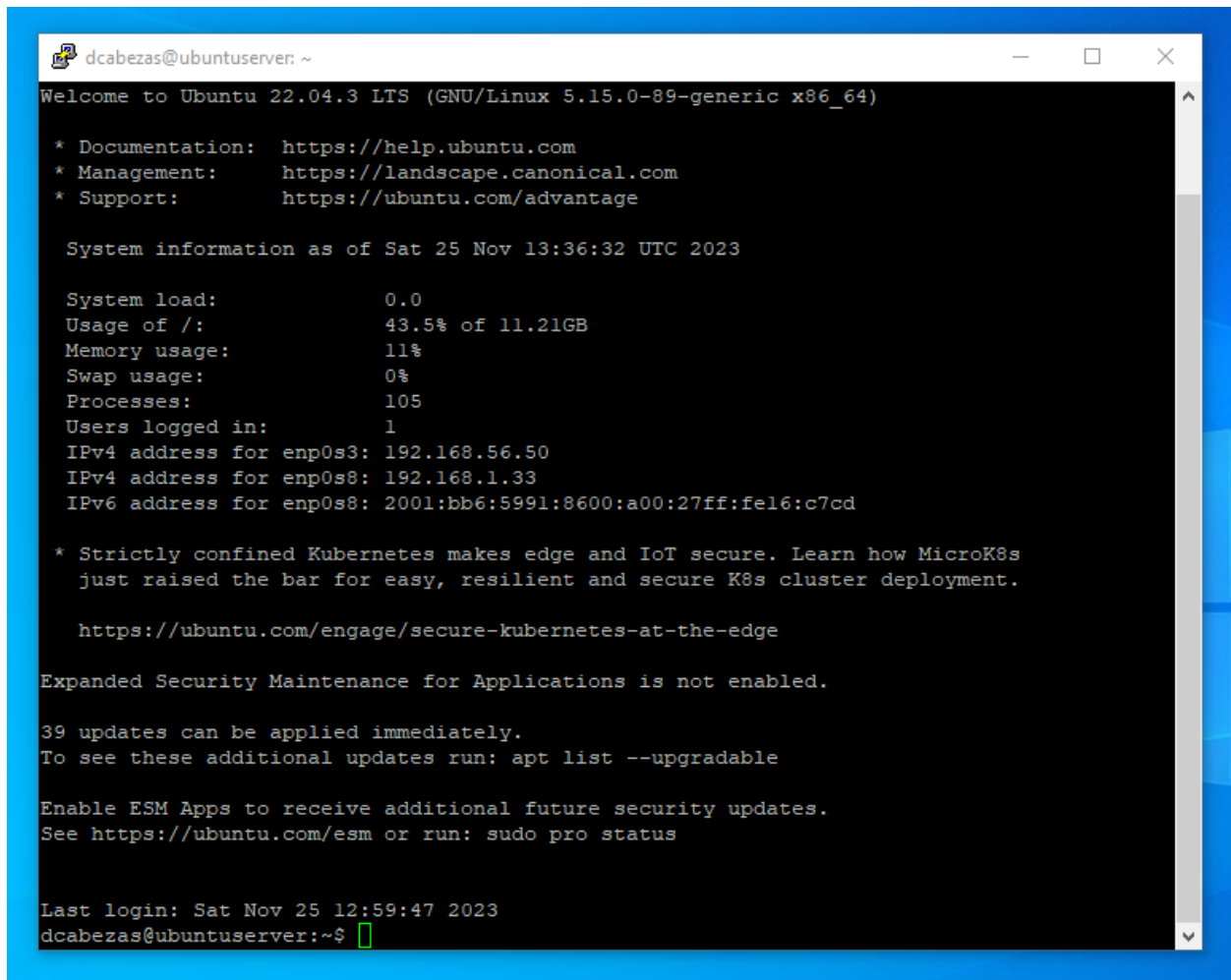
A screenshot of a terminal window titled 'dcabezas@ubuntu server: ~'. The terminal displays the Ubuntu 22.04.3 LTS login banner, which includes links for documentation, management, and support. It then shows system information as of Saturday, November 25, 2023, at 13:36:32 UTC. The information includes system load (0.0), disk usage (43.5% of 11.21GB), memory usage (11%), swap usage (0%), processes (105), and one user logged in. It also lists IPv4 and IPv6 addresses for the network interface enp0s3. A message about MicroK8s is shown, followed by a link to learn more. A notice states that Expanded Security Maintenance for Applications is not enabled, and that 39 updates can be applied immediately. It provides instructions to see these updates with 'apt list --upgradable' and to enable ESM apps for future security updates. The last login time is shown as Saturday, November 25, 2023, at 12:59:47. The prompt 'dcabezas@ubuntu server:~\$' is visible at the bottom with a cursor.

Image #8: Using the SSH terminal through Putty on Windows to remotely access to the ubuntu server VM.

8.) Utilizing Wireshark on your host operating system, show how the communication is encrypted between your client operating system and the ubuntu server.

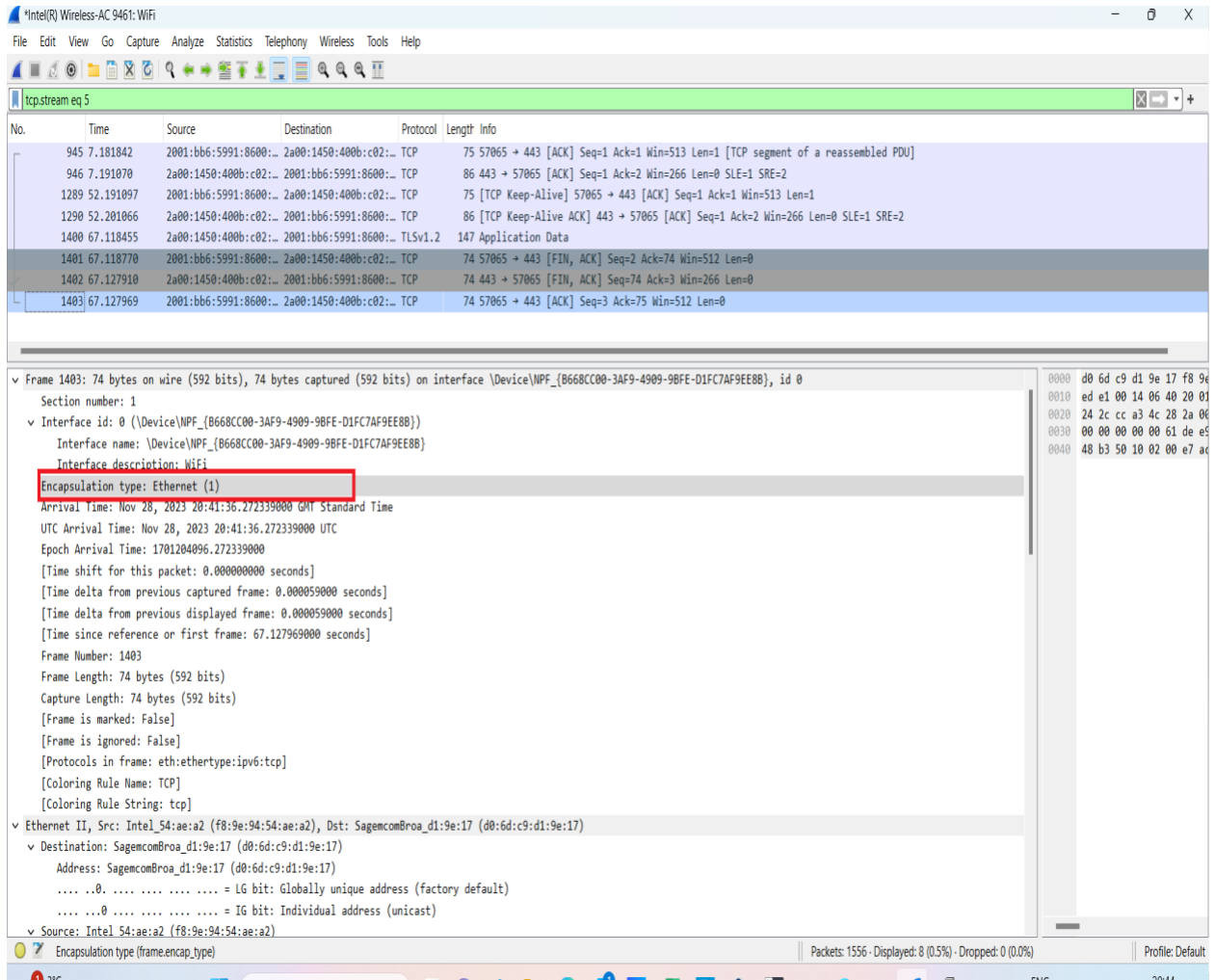
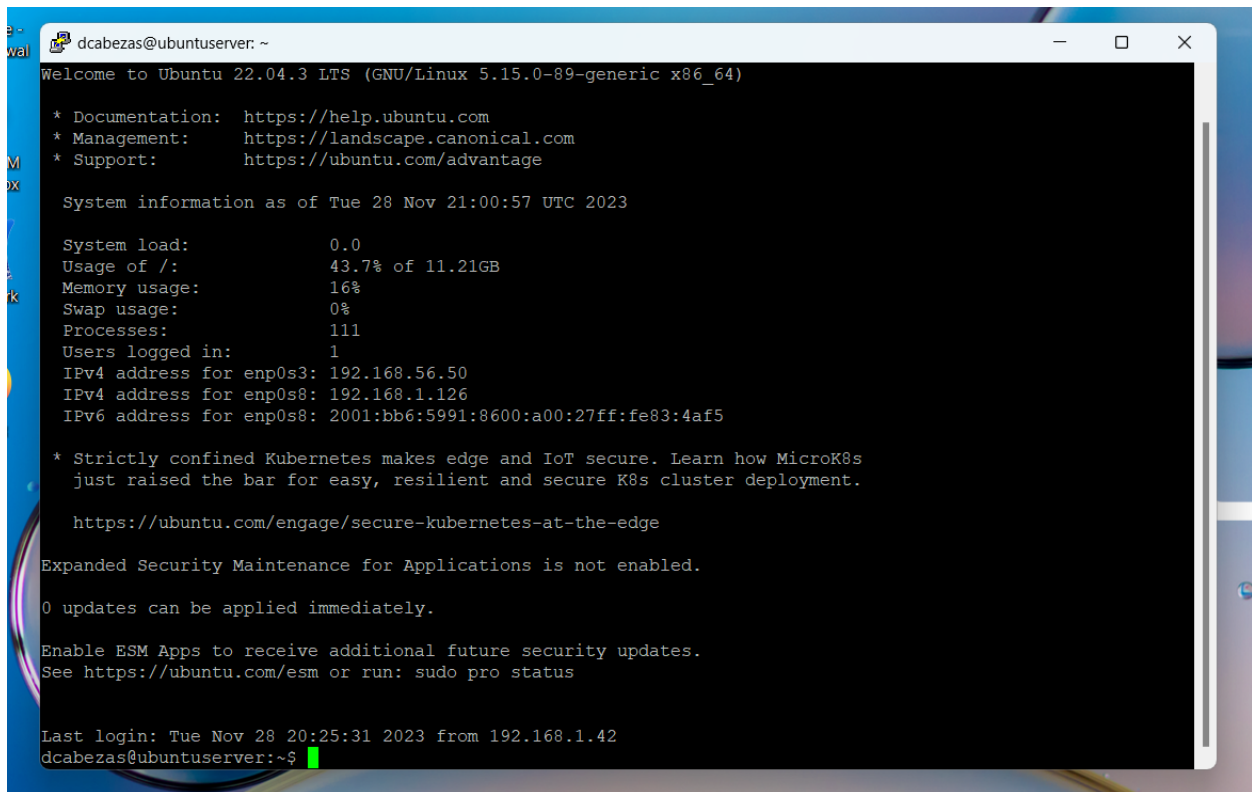


Image #9: Encrypted SSH communication between the client operating system and the ubuntu server.

PART 3: FIREWALL

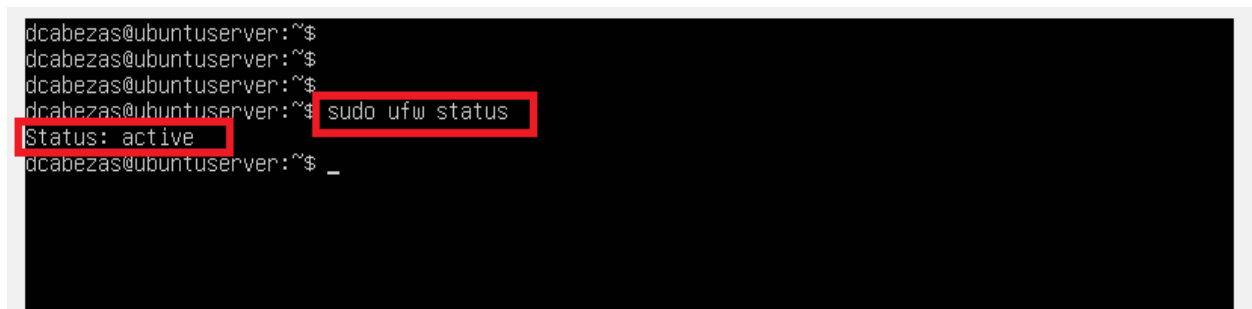
The default firewall configuration tool for Ubuntu is Uncomplicated Firewall (ufw) which is a utility that provides a user-friendly way to create an IPv4 host-based firewall. ufw by default is initially disabled.

9.) In this part you will configure the uncomplicated firewall to control the network traffic and demonstrate the uncomplicated firewall doing its job.



```
dcabezas@ubuntu: ~  
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-89-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:       https://ubuntu.com/advantage  
  
System information as of Tue 28 Nov 21:00:57 UTC 2023  
  
System load:          0.0  
Usage of /:           43.7% of 11.21GB  
Memory usage:        16%  
Swap usage:          0%  
Processes:           111  
Users logged in:      1  
IPv4 address for enp0s3: 192.168.56.50  
IPv4 address for enp0s8: 192.168.1.126  
IPv6 address for enp0s8: 2001:bb6:5991:8600:a00:27ff:fe83:4af5  
  
* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s  
  just raised the bar for easy, resilient and secure K8s cluster deployment.  
  
https://ubuntu.com/engage/secure-kubernetes-at-the-edge  
  
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  
  
Last login: Tue Nov 28 20:25:31 2023 from 192.168.1.42  
dcabezas@ubuntu:~$
```

Image #10: SSH connection to ubuntu server machine using PUTTY before enabling ufw.



```
dcabezas@ubuntu:~$  
dcabezas@ubuntu:~$  
dcabezas@ubuntu:~$  
dcabezas@ubuntu:~$ sudo ufw status  
Status: active  
dcabezas@ubuntu:~$
```

Image #11: enabling the uncomplicated firewall on ubuntu server.

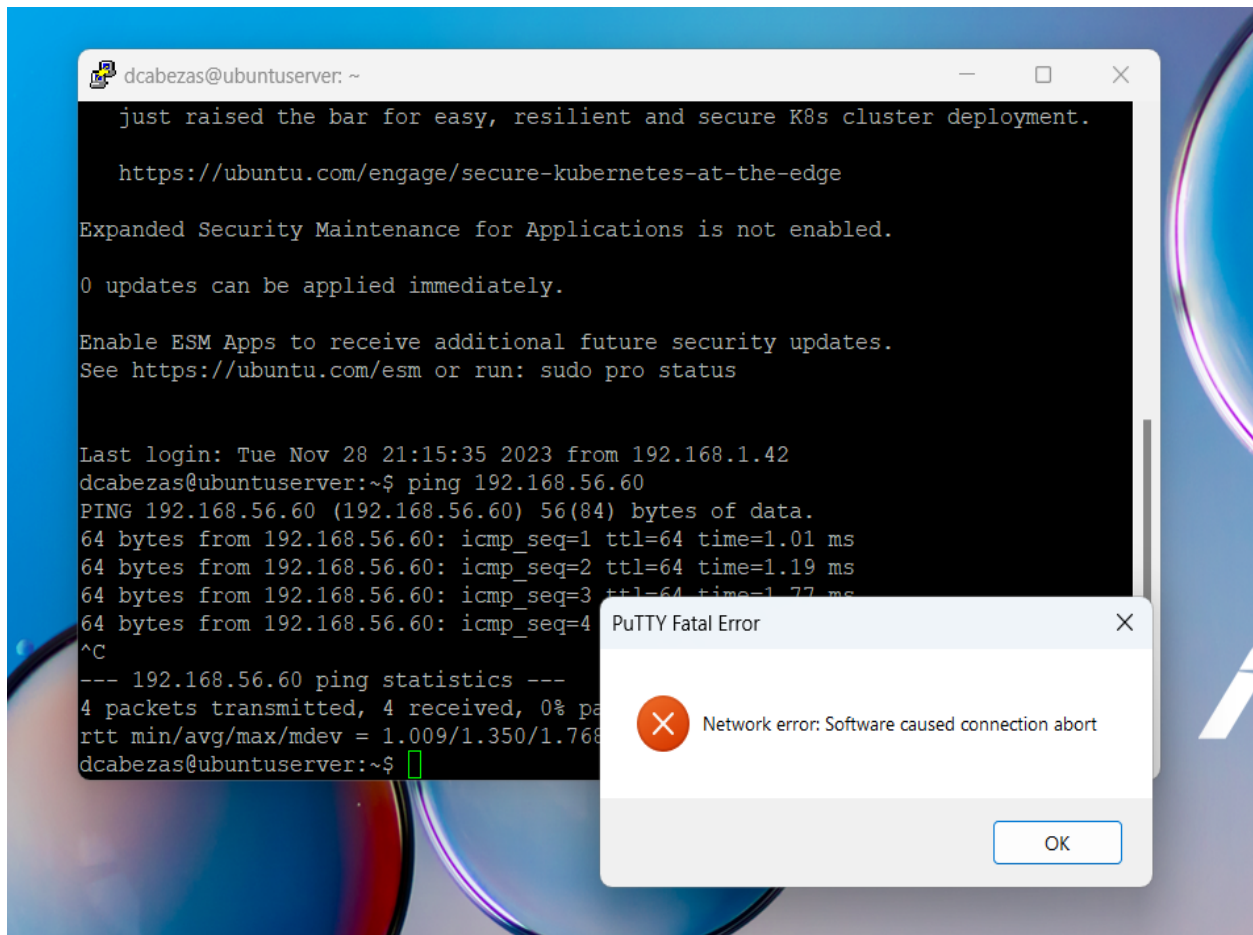


Image #12: SSH connection ended by enabling the uncomplicated firewall on ubuntu:server.

PART 4: IP ADDRESS & HOSTNAME MANAGEMENT

10.) *IP address configuration – use nano to edit the Netplan file.*

Configure both computers as shown here:

IP ADDRESSING TABLE		
Server name	Adapter 1 - enp0s3	Adapter 2 - enp0s8
ubuntuserver	Static IP Address: 192.168.56.100	DHCP
ubuntucient	Static IP Address: 192.168.56.125	DHCP

Edit the necessary configuration file (or files) to make these changes permanent. Use PING to demonstrate that these are the correct addresses and show that you have connectivity between these two Linux VMs.

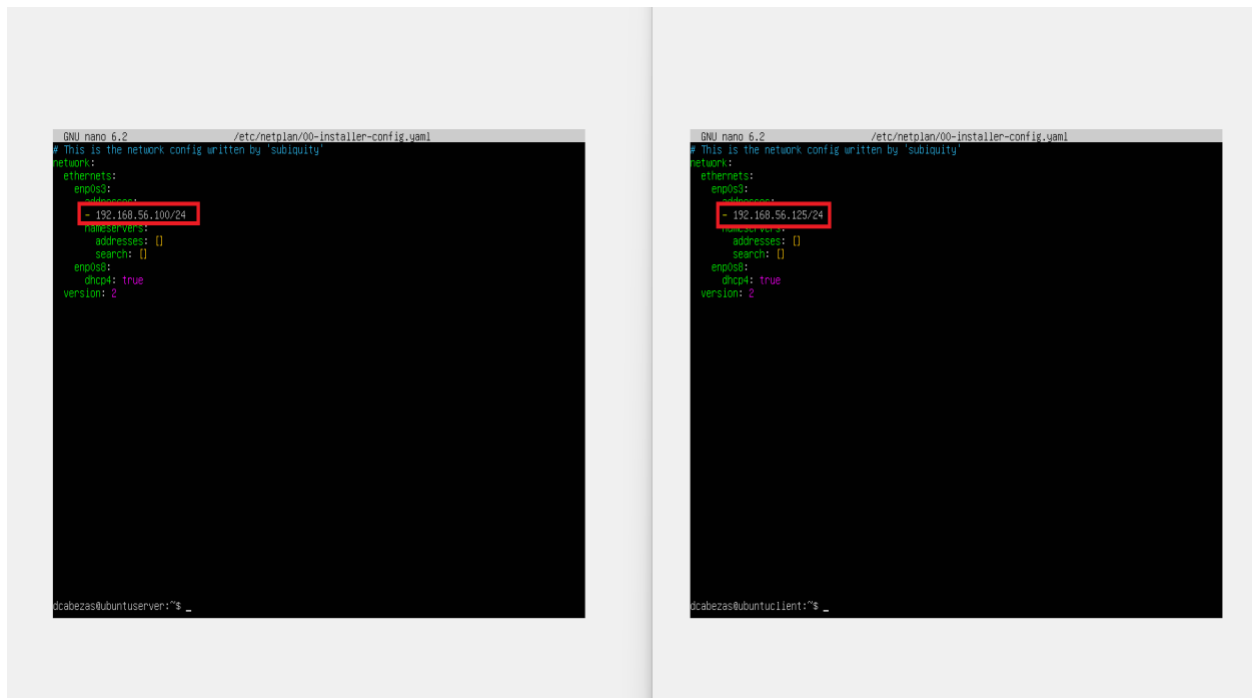


Image #13: Using nano to edit the netplan file to configure static IP address for the VMs. (Mike, 2023)

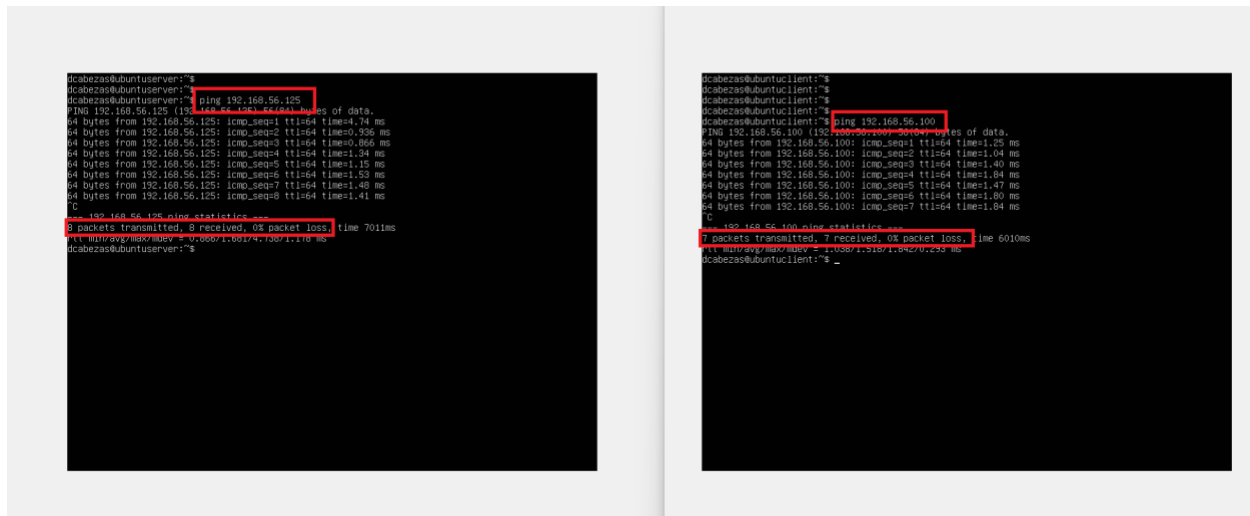


Image #14: New static IP address for the VMs. (Mike, 2023)

11.) *Rename hostname(s) DCC needs you to rename ubuntuserver.*

Give it the new name web-server-your last three digits of your student number. For example. You also need to rename ubuntuclient. Give it the new name web-client-123 Note: the 123 is last 3 digits again of your student number.

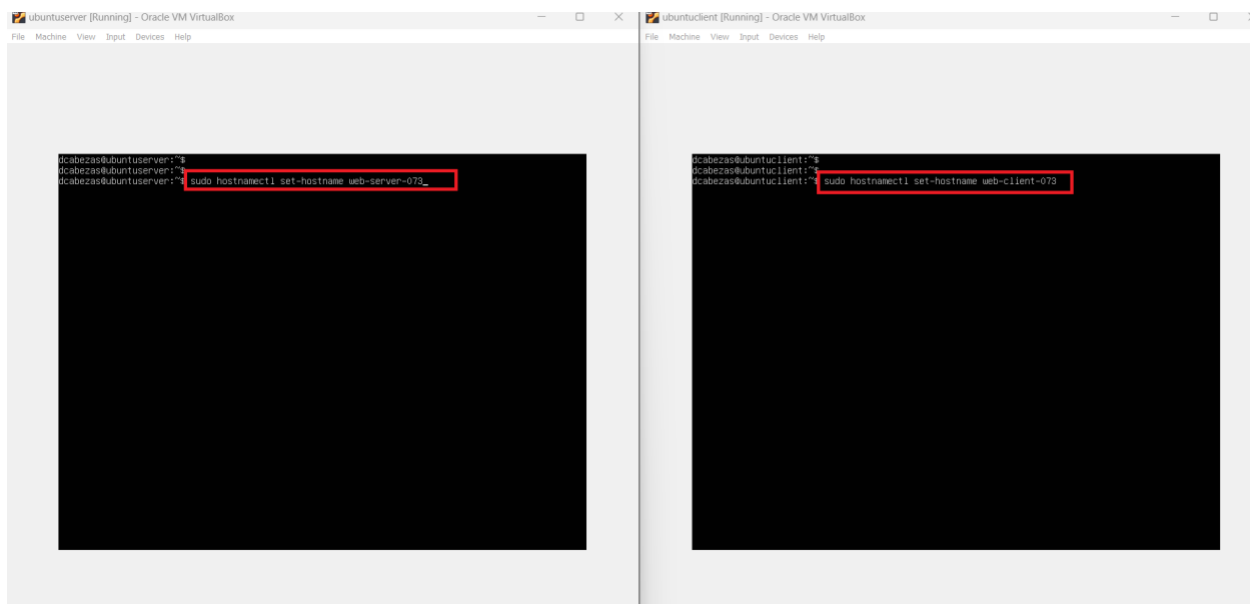


Image #15: Changing hostnames of the VMs. (R2Schools, 2021)

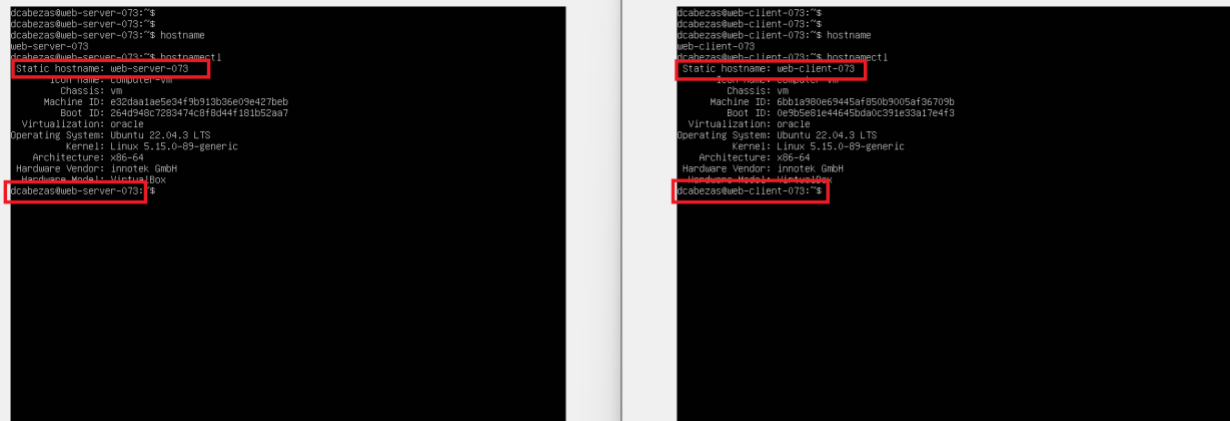


Image #16: Hostnames of the VMs changed. (R2Schools, 2021)

PART 5: RESEARCH AND CHALLENGE ACTIVITIES

12.) *Linux shell scripting Backup.sh.*

DCC would like advice and help with automating backing up of their Apache webserver files. Create a folder called Server-Data on your Ubuntu server VM. Create three simple text files called DATA1, DATA2, and DATA3 and add them to the folder. Write your name into each of these files. Use a text editor to create a Linux BASH shell script that backs up these three files every day a noon.

```

RX errors 0 dropped 0 overruns 0 frame 0
TX packets 15209 bytes 1496560 (1.4 MB)
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 1873 bytes 173909 (173.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 1873 bytes 173909 (173.9 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

dcabezas@ubuntu-server:~$ mkdir Server-Data
dcabezas@ubuntu-server:~$ ls
Server-Data
dcabezas@ubuntu-server:~$ cd /Server-Data
-bash: cd: /Server-Data: No such file or directory
dcabezas@ubuntu-server:~$ cd Server-Data
dcabezas@ubuntu-server:~/Server-Data$ touch DATA1
dcabezas@ubuntu-server:~/Server-Data$ touch DATA2
dcabezas@ubuntu-server:~/Server-Data$ LAS
LAS: command not found
dcabezas@ubuntu-server:~/Server-Data$ ls
DATA1 DATA2
dcabezas@ubuntu-server:~/Server-Data$ touch DATA3
dcabezas@ubuntu-server:~/Server-Data$ touch DATA3
dcabezas@ubuntu-server:~/Server-Data$ ls
DATA1 DATA2 DATA3
dcabezas@ubuntu-server:~/Server-Data$ delete
delete: command not found
dcabezas@ubuntu-server:~/Server-Data$ rm DATA~
dcabezas@ubuntu-server:~/Server-Data$ ls
DATA1 DATA2 DATA3
dcabezas@ubuntu-server:~/Server-Data$ source
source: command not found
dcabezas@ubuntu-server:~/Server-Data$ _

```

Image #17: creating folder and files to be backup. (Gite, 2023) (Core, 2023)


```
GNU nano 6.2                                backup.sh
#!/bin/bash
#etting the ource and the detnation directories
SOURCE_DIR="/home/dcabezas/Server-Data"
DEST_DIR="/home/dcabezas/backup"

#specifying the files that are going to be backup
FILE1="DATA1"
FILE2="DATA2"
FILE3="DATA3"

#cREATING A TIMESTAMP FOR THE BACKUP
TIMESTAMP=$(date +"%y%m%d_%H%M%S")

#CREATING THE BACKUP ARCHVE FILENAME
BACKUP_FLE="backup_${TIMESTAMP}.tar.gz"

#NAVIGATING TO THE SOURCE DIRECTORY
cd "$SOURCE_DIR" || exit

#CREATING A TAR ARCHVE OF THE SPECIFIED FILES
tar -czf "$DEST_DIR/$BACKUP_FILE" "$FILE1" "$FILE2" "$FILE3"

#PRINTING MESSAGE NDCATING THE BACKUP HAS BEEN COMPLETED
echo "Backup completed successfully: $DEST_DIR/$BACKUP_FLE"

#SHOWING THE SIZE OF THE BACKUP FOLDER
du -sh "$DEST_DIR"
```

[Read 28 lines]















 Help	 Write Out	 Where Is	 Cut	 Execute	 Location	 Undo
 Exit	 Read File	 Replace	 Paste	 Justify	 Go To Line	 Redo

Image #18: Script to backup the folder along with its files. (Ubuntu, 2023)

```
GNU nano 6.2 /tmp/crontab.DDFdWt/crontab *
# 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
# Scheduling th script to run everyday at noon_
0 12 * * * /home/dcabezas/backup.sh

^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location  M-U Undo
^X Exit      ^R Read File ^_ Replace   ^U Paste     ^J Justify   ^_ Go To Line M-E Redo
```

Image #19: Crating a crontab for the script to run every day at noon.

Bibliography

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- Gite, V. (2023, April 27). *Ubuntu Linux Create a Text File Using cat Command*. Retrieved from nixCraft: <https://www.cyberciti.biz/faq/ubuntu-create-file-using-cat-command/>
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- Ubuntu. (2023, June 29). *Basic backup shell script*. Retrieved from Ubuntu: <https://ubuntu.com/server/docs/basic-backup-shell-script>