Template Week 5 – Operating Systems

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Assignment 5.1: Unix-like

a) **Find out what the difference is between UNIX and unix-like operating systems?**
Ze zijn bijna hetzelfde behalve unix-like voldoen volledig of grotendeels aan de specificaties, maar mogen de Unix-naam wettelijk gezien niet gebruiken.

b) **Study the image above named UNIX timeline. Find out who Ken Thompson, Dennis Ritchie, Bill Joy, Richard Stallman, and Linus Torvalds are and what they have contributed to the development of UNIX or unix-like systems and to IT in general. TIP! English-language sources often contain more detailed information about these individuals.**
Ken Thompson:
1. De ontwikkeling van de original Unix operating system
2. De bedenker van programmeertaal B
3. Een van de ontwikkelaars van Plan 9 besturingssyteem.

Dennis MacAlistair Ritchie:
1. Samen met Ken thompson de ontwikkeling van de original Unix operating system
2. Programmeertaal B
3. Programmeertaal C

Bill Joy:
1. Belangrijke rol in de vroege ontwikkeling van BSD UNIX
2. Auteur van vi text editor
3. medeoprichter van Sun Microsystems

Richard Stallman:
1. Stallman launched the GNU Project, founded the Free Software Foundation (FSF) in October 1985
2. Stallman was responsible for contributing many necessary tools, including a text editor (GNU Emacs), compiler (GCC), debugger (GNU Debugger), and a build automator (GNU make).
3. Stallman pioneered the concept of copyleft, which uses the principles of copyright law to preserve the right to use, modify, and distribute free software. He is the main author of free software licenses which describe those terms, most notably the GNU General Public License (GPL), the most widely used free software license.

Linus Torvalds:
1. de initiële ontwikkeling van de Linuxkernel en daar tegenwoordig nog steeds coördinator van is
2. Om beter te kunnen werken aan de Linuxkernel heeft Linus het programma Git geschreven
3. Linux

c) **What is the philosophy of the GNU movement?**
Vrije software betekent dat de gebruikers van de softwarevrijheid hebben. (Het gaat niet om de prijs.) We hebben het GNU-besturingssysteem ontwikkeld zodat gebruikers vrijheid hebben in hun computergebruik.

Concreet betekent vrije software dat gebruikers de vier essentiële vrijheden hebben:
(0) het programma uitvoeren,
(1) het programma in broncode bestuderen en wijzigen,
(2) exacte kopieën verspreiden en
(3) aangepaste versies verspreiden.

Software verschilt van materiële objecten – zoals stoelen, broodjes en benzine – doordat het veel gemakkelijker kan worden gekopieerd en gewijzigd. Deze mogelijkheden maken software nuttig; wij vinden dat gebruikers van een programma vrij moeten zijn om hiervan gebruik te maken, niet alleen de ontwikkelaar.

d) Does Ubuntu as a Linux operating system conform to the philosophy of the GNU movement? Please explain your answer.
Ja want ubuntu gebruikt de linux kernel met GNU-tools. Meeste software is gratis en open source. En gebruikers kunnen het systeem veranderen en uitdelen aan anderen.

e) Find out what is the Windows Subsystem for Linux?
Windows Subsystem for Linux (WSL) is a feature of Windows that allows you to run a Linux environment on your Windows machine, without the need for a separate virtual machine or dual booting. WSL is designed to provide a seamless and productive experience for developers who want to use both Windows and Linux at the same time.

f) Find out, which operating system family belongs to Android, iOS and ChromeOS?
Android is an open-source, mobile operating system based on a modified version of the Linux kernel

iOS is a proprietary operating system based on Apple's Darwin OS, which itself is based on the XNU kernel that incorporates components from BSD Unix

ChromeOS is a lightweight operating system designed by Google that uses the Linux kernel

Assignment 5.2: Supercomputers and gameconsoles

a) **Research on this site what supercomputers are used for and write a short summary of it:**
    https://www.computerhistory.org/timeline/search/?q=Supercomputer
    Who Needs a Supercomputer?
    Supercomputers are the sports cars of the technology world: fast, glamorous and expensive. But unlike sports cars, they're not luxuries—they're practical tools.
    Who has bought them, and for what? Users include:
    • The National Security Agency to decipher secret codes
    • Mercedes Benz to simulate car crashes
    • The National Weather Service to predict hurricanes
    • Boeing to simulate airplane structures
    • Merck to formulate medicines by analyzing chemical interactions
    • The Atomic Energy Commission to design nuclear bombs
    • The Italian police to examine crime scene videos
    • The Stanford Linear Accelerator Center to analyze data from experiments

b) **IBM is a company that has already built a number of supercomputers. One of them is IBM's Roadrunner. The CPU developed for this supercomputer was further developed at a later stage as the CPU for the PlayStation 3 console. Find out what a PlayStation 3 cluster is and what it was used for?**
    Een netwerk van meerdere ps3 en elke ps3 runs linux. Consoles waren geconnect doormiddel van een netwerk en perform parrallel computing tasks. Samen werkte het gelijk als een supercomputer, maar met een lagere kosten

c) **You can build a supercomputer by putting a few computers together in a cluster. Here's what Oracle did with a collection of Raspberry Pi's, for example:**
    https://blogs.oracle.com/developers/post/building-the-worlds-largest-raspberry-pi-cluster
    What specific operating system is running on this cluster?
    Oracle Linux voor ARM

d) **Does Oracle's Raspberry Pi supercomputer appear in the list of the 500 fastest supercomputers in the world? Make a logical decision for this, without going through the entire list.**
    https://www.top500.org/lists/top500/list/2023/06/
    Nee vanwege dat de top500 rank op supercomputer raw performance in petaflops en oracle's raspberry supercomputer is een cluster waardoor het in gigaflops zit inplaatsvan petaflops waardoor het niet in de top500 voor komt

e) **What CPU architecture is used for the PlayStation 5 and Xbox Series X?**
    AMD Zen 2 processor voor beide consoles
    What operating systems run on these consoles?
   ps5 gebruikt FreeBSD en xbox series x bebruikt Windows
    What conclusion can you draw from the answer to the previous question?
    Dat de CPU architecture hetzelfde is behalve de operating system anders vanwege licenties

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Assignment 5.3: Working with Windows

Take relevant screenshots of the assignments below
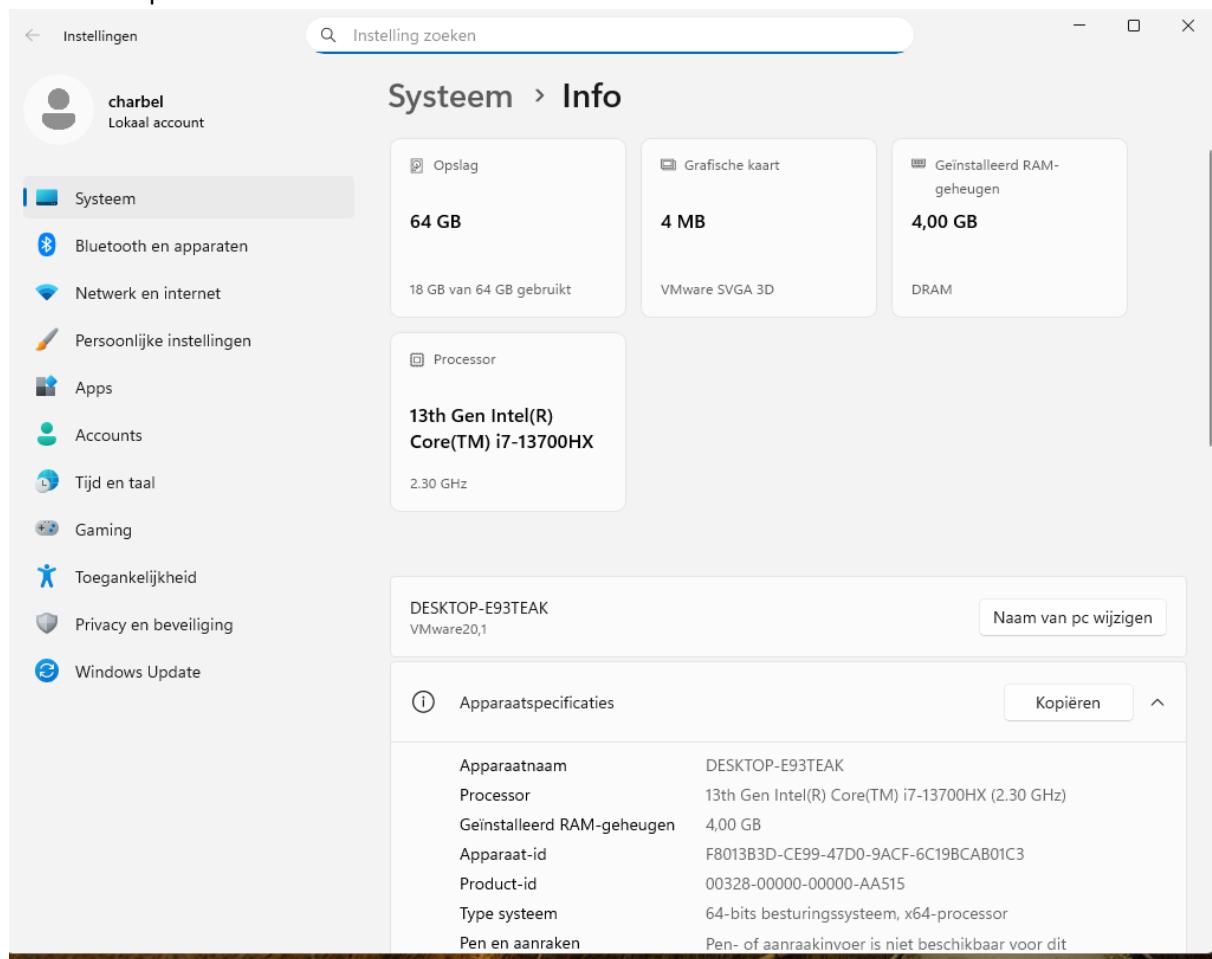
a) **Practice for about 10 minutes with the ⊞ keyboard shortcuts combinations, skip the general shortcuts in this exercise. Take a look at which screens are opened.**

b) **The file explorer can be opened with ⊞ + E, Which key combination could you also use?**
Windows + R en daarna typ je explorer

c) **Open the system properties with a ⊞ key combination, take a screenshot of the open screen. Paste this screenshot into this template.**
Windows + pause

d) **Open task manager with a key combination. Take screenshots of the tabs: processes (shows active processes), performance, and users. Place these three screenshots in this template.**
Crtl + Shift + esc
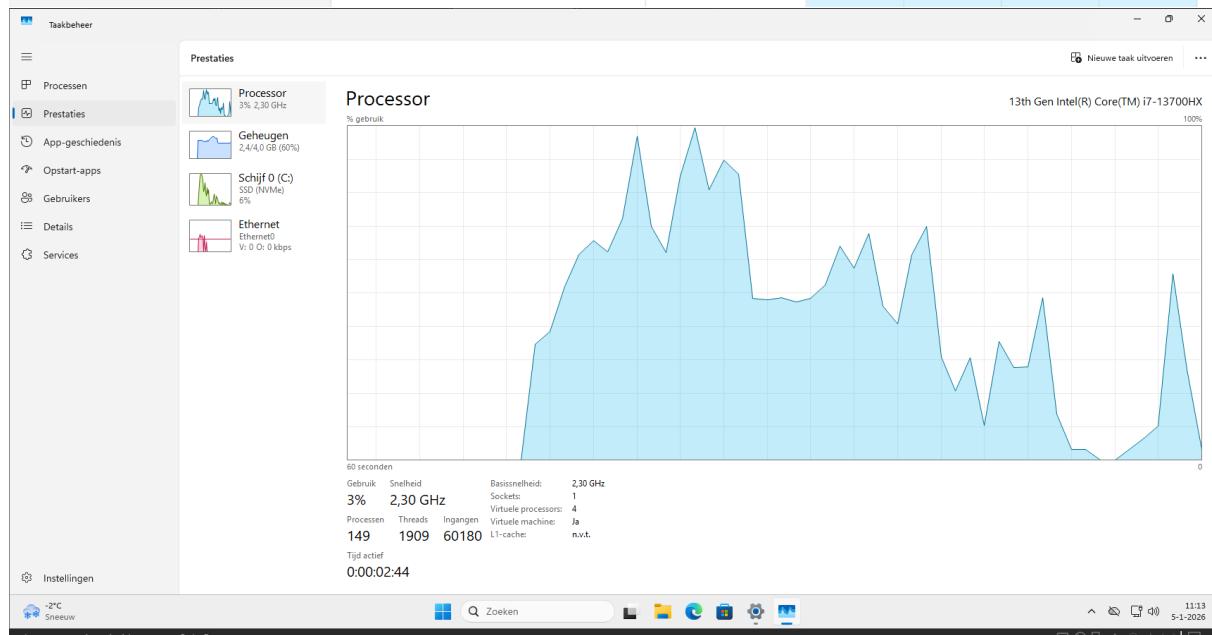
Taakbeheer

Typ een naam, uitgever of PID om te zoeken

Processen

Naam	Status	48% Processor	66% Geheugen	44% Schijf	1% Netwerk
Toepassingen (2)					
> Instellingen		0%	28,1 MB	0 MB/s	0 Mbps
> Taakbeheer		0%	50,6 MB	0,1 MB/s	0 Mbps
Achtergrondprocessen (54)					
> App voor Spooler-subsysteem		0%	3,6 MB	0 MB/s	0 Mbps
Application Frame Host		0%	7,1 MB	0 MB/s	0 Mbps
Background Task Host	Onderbro... ⏸	0%	0 MB	1,4 MB/s	0 Mbps
> COM Surrogate		0%	2,0 MB	0 MB/s	0 Mbps

Taakbeheer

Prestaties — Nieuwe taak uitvoeren ···

Processor 3% 2,30 GHz	
Geheugen 2,4/4,0 GB (60%)	
Schijf 0 (C:) SSD (NVMe) 6%	
Ethernet Ethernet0 V: 0 O: 0 kbps	

Processor
13th Gen Intel(R) Core(TM) i7-13700HX

% gebruik — 100%

60 seconden — 0

Gebruik	Snelheid	Basissnelheid:	2,30 GHz
3%	2,30 GHz	Sockets:	1
		Virtuele processors:	4
Processen	Threads	Ingangen	Virtuele machine:	Ja
149	1909	60180	L1-cache:	n.v.t.

Tijd actief
0:00:02:44

-2°C Sneeuw | Q Zoeken | ∧ 🔇 11:13 5-1-2026

Taakbeheer

Typ een naam, uitgever of PID om te zoeken

Gebruikers

Gebruiker	Status	10% Processor	56% Geheugen	1% Schijf	0% Netwerk
> charbel (43)		3,4%	361,5 MB	0,4 MB/s	0 Mbps

Sidebar (all three screenshots): Processen, Prestaties, App-geschiedenis, Opstart-apps, Gebruikers, Details, Services

e) If you're giving a PowerPoint presentation and you connect your laptop to a projector, Windows can use the projector as a second screen. For example, you may have Outlook open

on your first screen that you don't show over the projector, while the PowerPoint presentation is displayed on the projector, or the second screen. Which key combination should you use for this?

Windows + P

f) **If you leave the classroom for a while and you leave your laptop behind, it is wise to lock the screen. Your Apps will continue to run in the background. So, for example, if you're waiting for a download that takes a while, lock the screen and get a cup of coffee. Which key combination do you use for this?**

Windows + L

g) **Open the Run screen with a key combination. On this screen, type CMD and press <enter>. Take a screenshot of this result and paste it into this template.**

Working in the File Explorer

Relevant screenshots **copy** command:
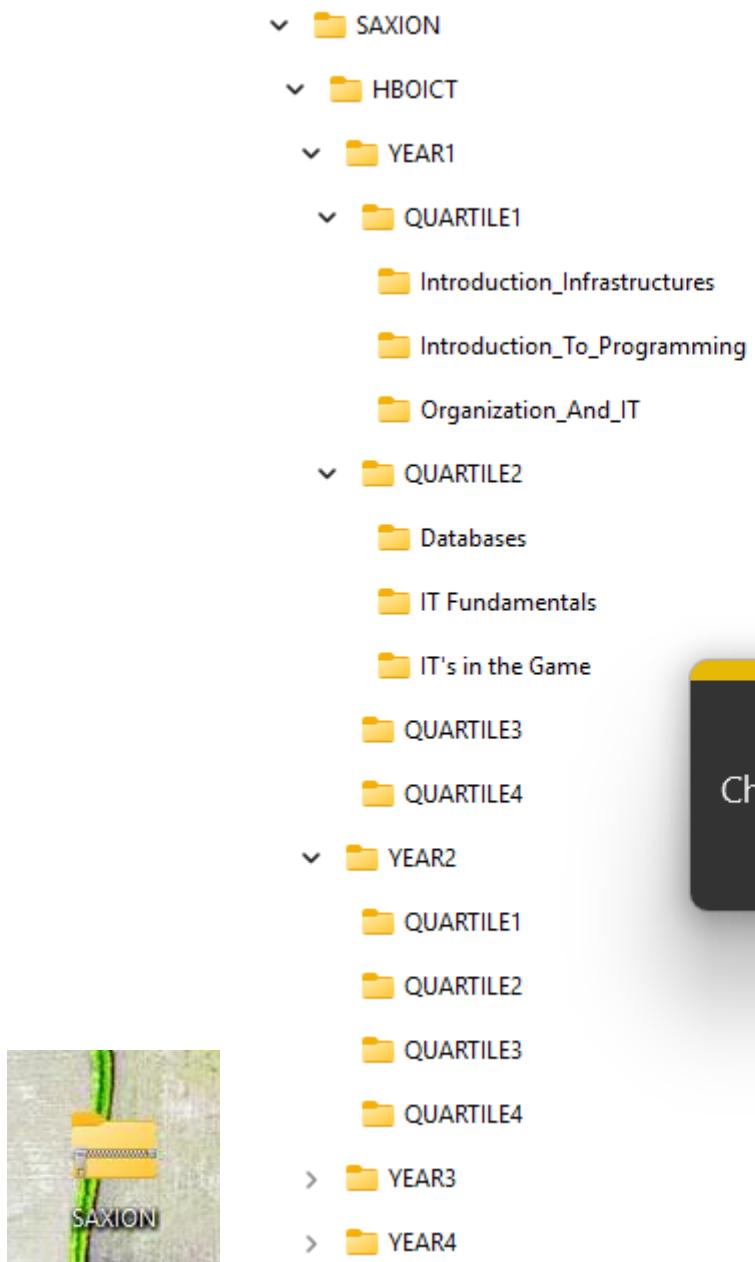
```
c:\SAXION>copy C:\SAXION\Wave.png C:\SAXION\HBOICT\YEAR1\QUARTILE1\Introduction_To_Programming\
        1 file(s) copied.

c:\SAXION>copy C:\SAXION\Plug.png C:\SAXION\HBOICT\YEAR1\QUARTILE1\Introduction_Infrastructures
        1 file(s) copied.

c:\SAXION>copy C:\SAXION\Tumble.png C:\SAXION\HBOICT\YEAR1\QUARTILE1\Organization_And_IT
        1 file(s) copied.

c:\SAXION>
```

Charbel Elkhoury 553809

Relevant screenshots **tree** command:
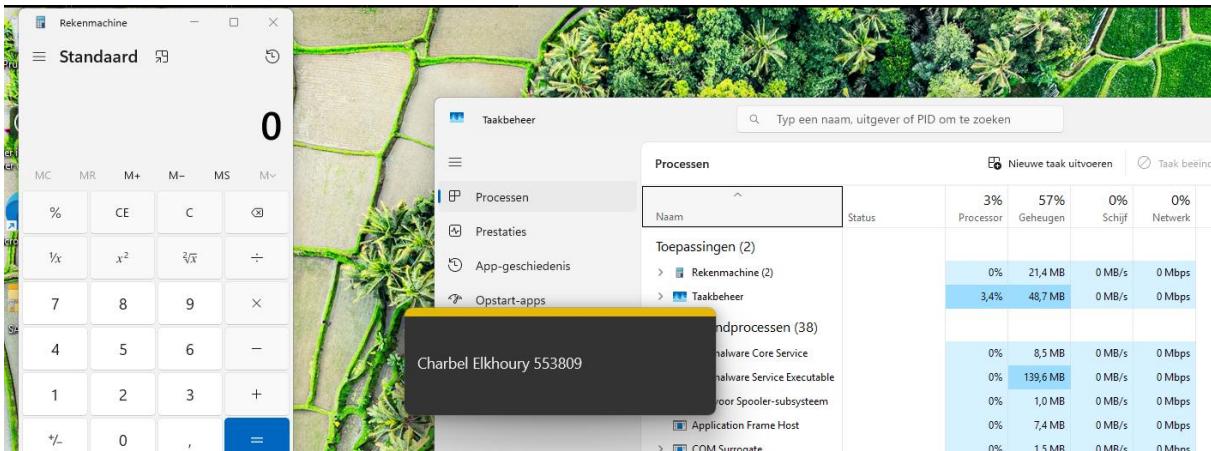
```
c:\SAXION>tree
Folder PATH listing
Volume serial number is 5E1D-7E75
C:.
└───HBOICT
    ├───YEAR1
    │   ├───QUARTILE1
    │   │   ├───Introduction_Infrastructures
    │   │   ├───Introduction_To_Programming
    │   │   └───Organization_And_IT
    │   ├───QUARTILE2
    │   │   ├───Databases
    │   │   ├───IT Fundamentals
    │   │   └───IT's in the Game
    │   ├───QUARTILE3
    │   └───QUARTILE4
    ├───YEAR2
    │   ├───QUARTILE1
    │   ├───QUARTILE2
    │   ├───QUARTILE3
    │   └───QUARTILE4
    ├───YEAR3
    │   ├───QUARTILE1
    │   ├───QUARTILE2
    │   ├───QUARTILE3
    │   └───QUARTILE4
    └───YEAR4
        ├───QUARTILE1
        ├───QUARTILE2
        ├───QUARTILE3
        └───QUARTILE4

c:\SAXION>echo %Charbel%
%Charbel%
```

Relevant screenshots in the file explorer of the folder c:\Saxion + created zip file.

Terminating Processes

Relevant Screenshots Task Manager Window:

Install Software

Relevant screenshots that the following software is installed with winget:

- WinSCP

- Notepad++

- 7zip

- Firefox

Assignment:

a) Show that you have installed Firefox via winget in the command prompt.

```
C:\Users\charbel>winget install Firefox
The `msstore` source requires that you view the following agreements before using.
Terms of Transaction: https://aka.ms/microsoft-store-terms-of-transaction
The source requires the current machine's 2-letter geographic region to be sent to the backend service to function properly (ex. "US").

Do you agree to all the source agreements terms?
[Y] Yes  [N] No: y
Multiple packages found matching input criteria. Please refine the input.
Name                     Id                     Source
-----------------------------------------------------------------
Mozilla Firefox          9NZVDKPMR9RD           msstore
Mozilla Firefox (en-US)  Mozilla.Firefox        winget
Mozilla Firefox (MSIX)   Mozilla.Firefox.MSIX   winget
```
Charbel Elkhoury 553809

```
C:\Users\charbel>winget install Mozilla.Firefox
Found Mozilla Firefox (en-US) [Mozilla.Firefox] Version 146.0.1
This application is licensed to you by its owner.
Microsoft is not responsible for, nor does it grant any licenses to, third-party packages.
Downloading https://download-installer.cdn.mozilla.net/pub/firefox/releases/146.0.1/win64/en-US/Firefox%20Setup%20146.0.1.exe
                        82.3 MB / 82.3 MB
Successfully verified installer hash
Starting package install...
Successfully installed

C:\Users\charbel>
```
Charbel Elkhoury 553809

b) Explain in your own words what exactly the above command does, explain the -e and

--id options used as well. Use this site:

https://learn.microsoft.com/en-us/windows/package-manager/winget/install

-e wordt gebruikt om exact match(Uses the exact string in the query, including checking for case-sensitivity. It will not use the default behavior of a substring.) en –id wordt gebruikt om Beperkt de installatie tot de ID van de applicatie. (Limits the install to the ID of the application.)

Assignment 5.4: Working with Linux

Relevant screenshots + motivation

Copying files
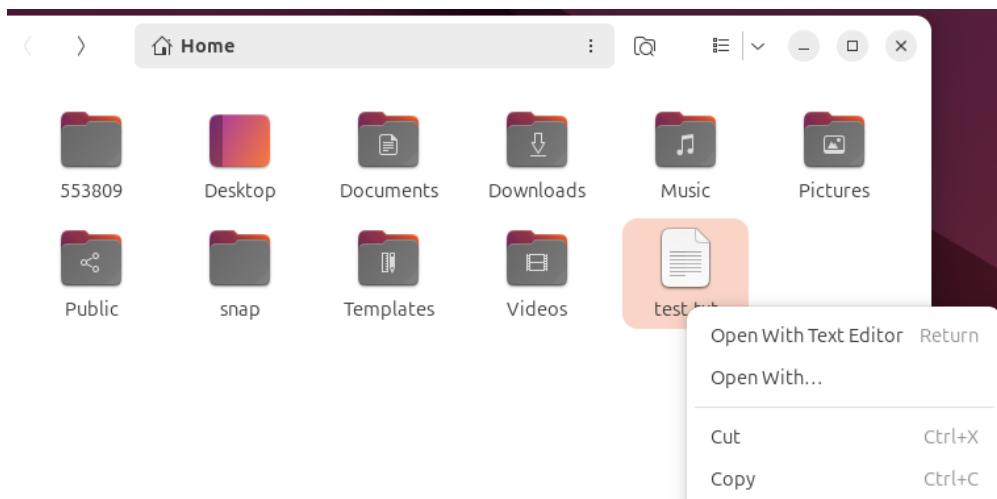

```
charbel@helpdesk:~$ cd ~
charbel@helpdesk:~$ echo "test" > test.txt
charbel@helpdesk:~$
```
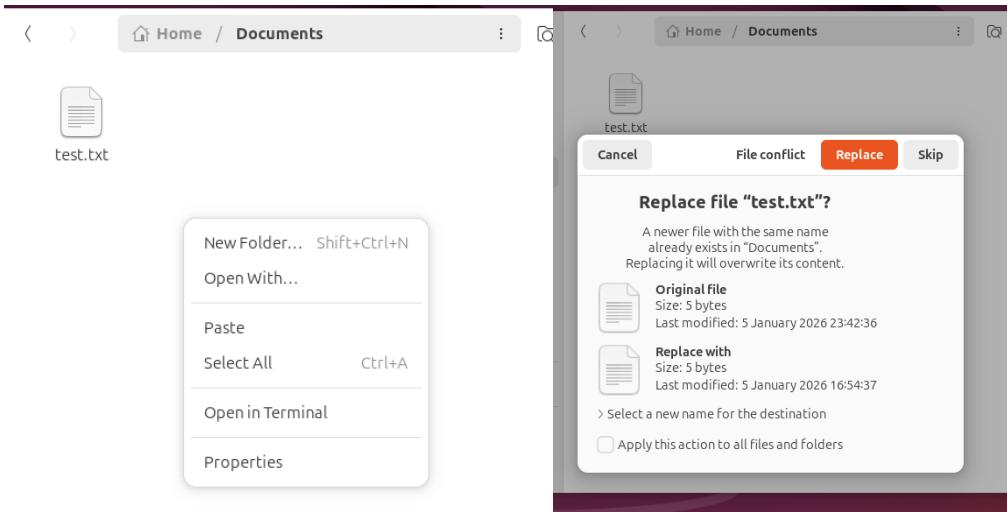


```
charbel@helpdesk:~$ cp test/.txt Documents/
cp: cannot stat 'test/.txt': No such file or directory
charbel@helpdesk:~$ cp test.txt Documents/
charbel@helpdesk:~$
```


⟨ ⟩   🏠 Home / **Documents**
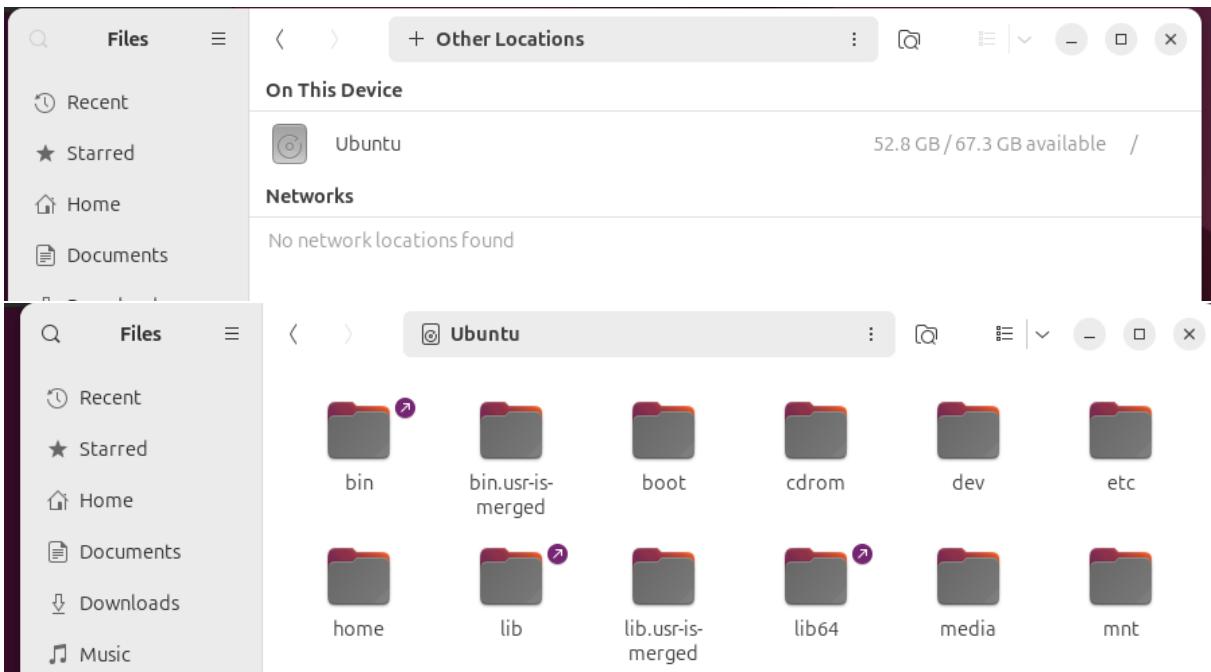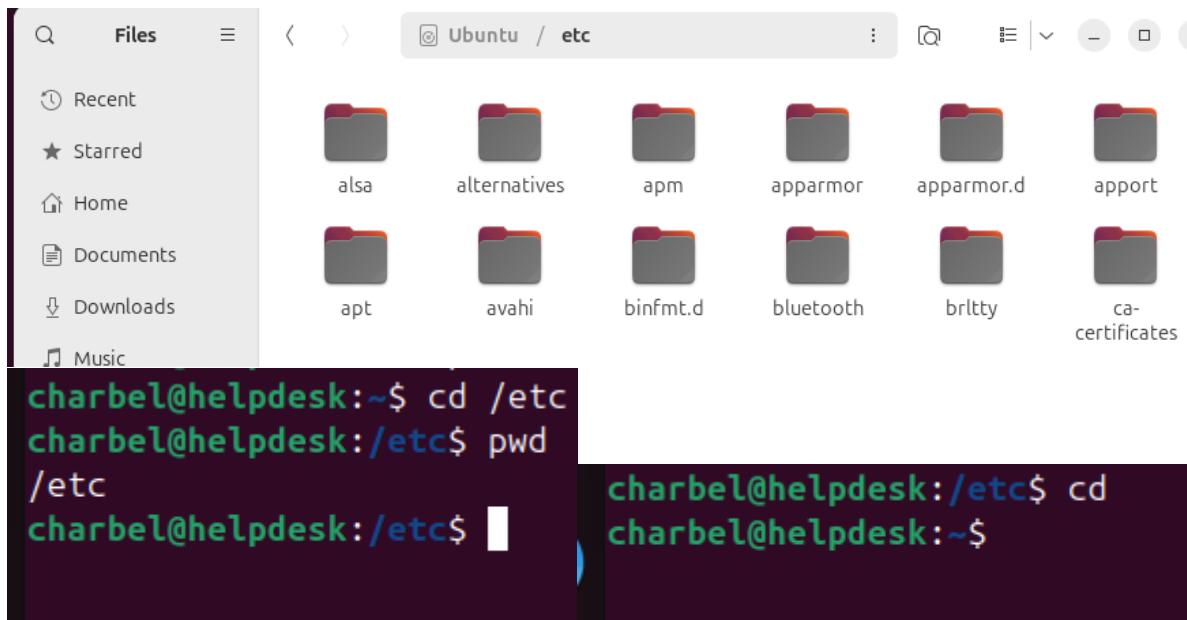
test.txt

Navigating the file structure
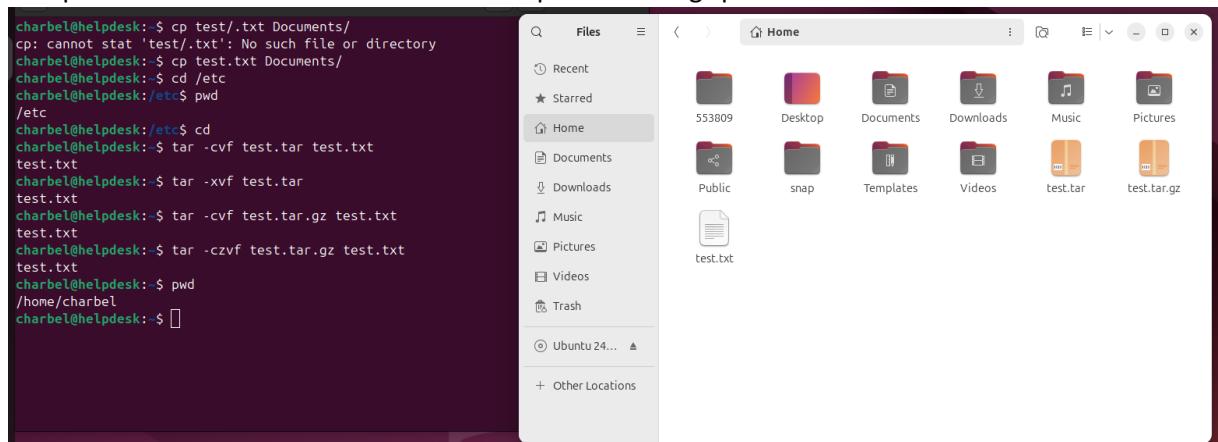
- **Name one significant difference in Linux's file structure when comparing it to Windows.**
  er is maar een schijf in linux en er kan een of meer schijven in windows C:/ D:/ E:/

- **What is the /etc directory usually used for?**
  settings voor services, users en startup behaviors

Compress files

- **Which command in the terminal would you use to compress a text file into a tar archive?**
  tar -cvf test.tar test.txt
- **With which command in the terminal would you be able to extract a tar file?**
  tar -xvf tast.tar
- Compress a text file in a tar archive and compress it with gzip.
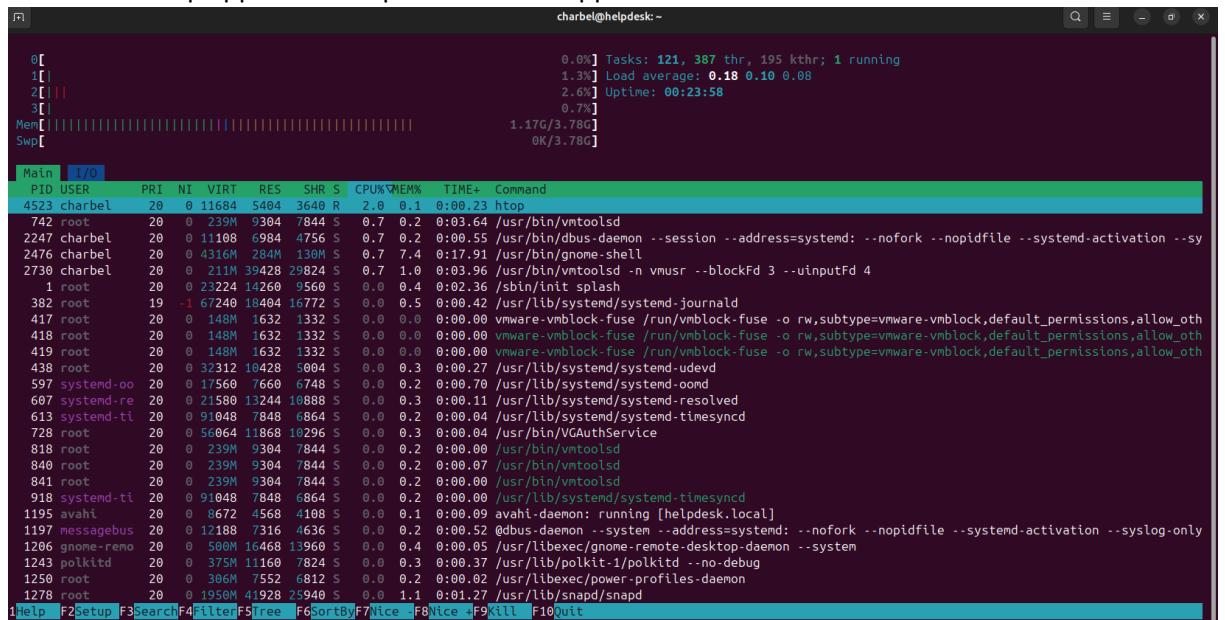
- View processes
  Install the application htop via a terminal command

```
charbel@helpdesk:~$ sudo apt install htop
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following package was automatically installed and is no longer required:
  libllvm19
Use 'sudo apt autoremove' to remove it.
Suggested packages:
  lm-sensors
The following NEW packages will be installed:
  htop
0 upgraded, 1 newly installed, 0 to remove and 159 not upgraded.
Need to get 171 kB of archives.
After this operation, 434 kB of additional disk space will be used.
Get:1 http://nl.archive.ubuntu.com/ubuntu noble/main amd64 htop amd64 3.3.0-4build1 [171 kB]
Fetched 171 kB in 4s (41.5 kB/s)
Selecting previously unselected package htop.
(Reading database ... 153081 files and directories currently installed.)
Preparing to unpack .../htop_3.3.0-4build1_amd64.deb ...
Unpacking htop (3.3.0-4build1) ...
Setting up htop (3.3.0-4build1) ...
Processing triggers for desktop-file-utils (0.27-2build1) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for gnome-menus (3.36.0-1.1ubuntu3) ...
Processing triggers for man-db (2.12.0-4build2) ...
charbel@helpdesk:~$
```

Launch the htop application. Explain what this application shows.

Running processes irl, CPU gebruik, memory gebruik

- Install Software
  Software can be installed via the terminal in Ubuntu as we just did in the previous assignment, but it can also be installed in Ubuntu via the Software center. Find and install the Sublime Text application on your Ubuntu VM

Sublime Text

Snapcrafters ✿

Development

Channel latest/stable 4200 ⌄   ◯ Installing   Cancel

602 votes	Confinement	Download size	License
Very good	Classic	67.83 MB	Proprietary

Version	Published	Links
4200	Sep 20, 2025	Developer website
		Contact Snapcrafters

Sublime Text

Snapcrafters ✿

Development

Channel latest/stable 4200 ⌄   Open ⌄   👍 👎

Using a terminal command, install the neofetch application. What does this application show when you launch it?

operating system en kernel system, CPU en GPU, RAM gebruik, hostname en uptime en output samen met ASCII logo

```
charbel@helpdesk:~$ sudo apt install neofetch
Reading package lists... Done
Building dependency tree... Done
```

```
charbel@helpdesk:~$ neofetch
                 .-/+oosssssoo+/-.               charbel@helpdesk
            `:+ssssssssssssssssss+:`             ---------------
         -+sssssssssssssssssssyyssss+-           OS: Ubuntu 24.04.3 LTS x86_64
       .ossssssssssssssssssdMMMNysssso.          Host: VMware Virtual Platform None
      /sssssssssshdmmNNmmyNMMMMhssssss/          Kernel: 6.14.0-37-generic
     +sssssssssshmydMMMMMMMNddddysssssss+        Uptime: 33 mins
    /sssssssshNMMMyhhyyyyhmNMMMNhssssssss/       Packages: 1663 (dpkg), 12 (snap)
   .ssssssssdMMMNhsssssssssshNMMMdssssssss.      Shell: bash 5.2.21
   +sssshhhyNMMNyssssssssssssyNMMMysssssss+      Resolution: 1718x878
   ossyNMMMNyMMhsssssssssssssshmmmhssssssso      DE: GNOME 46.0
   ossyNMMMNyMMhsssssssssssssshmmmhssssssso      WM: Mutter
   +sssshhhyNMMNyssssssssssssyNMMMysssssss+      WM Theme: Adwaita
   .ssssssssdMMMNhsssssssssshNMMMdssssssss.      Theme: Yaru [GTK2/3]
    /sssssssshNMMMyhhyyyyhdNMMMNhssssssss/       Icons: Yaru [GTK2/3]
     +sssssssssdmydMMMMMMMMddddysssssss+         Terminal: gnome-terminal
      /sssssssssshdmNNNNmyNMMMMhssssss/          CPU: 13th Gen Intel i7-13700HX (4) @ 2.304GHz
       .ossssssssssssssssssdMMMNysssso.          GPU: 00:0f.0 VMware SVGA II Adapter
         -+sssssssssssssssssyyyssss+-            Memory: 1120MiB / 3867MiB
          `:+ssssssssssssssssss+:`
             .-/+oosssssoo+/-.


charbel@helpdesk:~$
```

Assignment 5.5: Users and permissions on Linux

Relevant screenshots + motivation

```
charbel@helpdesk:~$ mkdir ~/hello
charbel@helpdesk:~$ cd /hello
bash: cd: /hello: No such file or directory
charbel@helpdesk:~$ cd ~/hello
charbel@helpdesk:~/hello$
```

```
  GNU nano 7.2
#!/bin/bash
echo Hello <Charbel, 553809>!
```

```
charbel@helpdesk:~/hello$ nano hello.sh
charbel@helpdesk:~/hello$
```

```
charbel@helpdesk:~/hello$ ls -l hello.sh
-rwxrwxr-x 1 charbel charbel 42 Jan  6 00:22 hello.sh
charbel@helpdesk:~/hello$
```

```
charbel@helpdesk:~/hello$ ./hello.sh
./hello.sh: line 2: Charbel,: No such file or directory
charbel@helpdesk:~/hello$
```

```
charbel@helpdesk:~/hello$ chmod 744 hello.sh
charbel@helpdesk:~/hello$ █
```

```
charbel@helpdesk:~/hello$ ls -l hello.sh
-rwxr--r-- 1 charbel charbel 55 Jan  6 00:28 hello.sh
charbel@helpdesk:~/hello$ █
```

Assignment 5.6: View the contents of files

Relevant screenshots + motivation

For this assignment, you can use the following commands: cat, wc, less, tail, head & grep.

• **What does each of these commands do? Write it out for yourself.**

Cat: geeft de volledige inhoud van een bestand in de terminal zien

Wc: telt regels, woorden en tekens met de common options -l = lines, -w = words of -c = characters

Less: toont een bestand pagina per pagina

Tail: toont de laatste 10 regels van een bestand

Head: toont de eerste 10 regels van een bestand

Grep: zoekt naar tekstpatronen in een bestand

• Download the file SherlockHolmes.txt from Brightspace and place it in a directory on your VM.

Or download the file directly from https://www.gutenberg.org/files/1661/1661-0.txt.

```
                              charbel@helpdesk: ~                    Q  ≡  _  □  ×
charbel@helpdesk:~$ wget  https://www.gutenberg.org/files/1661/1661-0.txt. -O Sh
erlockHolmes.txt
--2026-01-06 10:03:24--  https://www.gutenberg.org/files/1661/1661-0.txt.
Resolving www.gutenberg.org (www.gutenberg.org)... 152.19.134.47, 2610:28:3090:3
000:0:bad:cafe:47
Connecting to www.gutenberg.org (www.gutenberg.org)|152.19.134.47|:443... connec
ted.
HTTP request sent, awaiting response... 404 Not Found
2026-01-06 10:03:25 ERROR 404: Not Found.

charbel@helpdesk:~$ ls
553809     Downloads  Pictures              snap        test.tar.gz
Desktop    hello      Public                Templates   test.txt
Documents  Music      SherlockHolmes.txt    test.tar    Videos
```

Use the commands cat, wc, less, tail, head & grep for the following assignments:

• How many lines does the file have? How many words? And how many characters?

```
charbel@helpdesk:~$ wc SherlockHolmes.txt
 12306 107562 607504 SherlockHolmes.txt
charbel@helpdesk:~$
```

12306 lines, 107562 words en 607504 characters

```
charbel@helpdesk:~$ wc -l SherlockHolmes.txt
12306 SherlockHolmes.txt
charbel@helpdesk:~$ wc -w SherlockHolmes.txt
107562 SherlockHolmes.txt
charbel@helpdesk:~$ wc -c SherlockHolmes.txt
607504 SherlockHolmes.txt
charbel@helpdesk:~$
```

• On which lines is the word "kingdom" in the file? TIP! grep -n

```
charbel@helpdesk:~$ grep -n kingdom SherlockHolmes.txt
490:"I tell you that I would give one of the provinces of my kingdom to
1124:And that was how a great scandal threatened to affect the kingdom of
charbel@helpdesk:~$
```

• Use the head and/or tail commands to see the 10 lines above and below the word "kingdom" on

the screen.

```
charbel@helpdesk:~$ grep -n kingdom SherlockHolmes.txt
490:"I tell you that I would give one of the provinces of my kingdom to
1124:And that was how a great scandal threatened to affect the kingdom of
charbel@helpdesk:~$ head -n 1134 SherlockHolmes.txt | tail -n 21

The King stared at him in amazement.

"Irene's photograph!" he cried. "Certainly, if you wish it."

"I thank your Majesty. Then there is no more to be done in the matter.
I have the honour to wish you a very good morning." He bowed, and,
turning away without observing the hand which the King had stretched
out to him, he set off in my company for his chambers.

And that was how a great scandal threatened to affect the kingdom of
Bohemia, and how the best plans of Mr. Sherlock Holmes were beaten by a
woman's wit. He used to make merry over the cleverness of women, but I
have not heard him do it of late. And when he speaks of Irene Adler, or
when he refers to her photograph, it is always under the honourable
title of _the_ woman.




II. THE RED-HEADED LEAGUE
charbel@helpdesk:~$
```

Assignment 5.7: Digital forensics

Relevant screenshots + motivation

```
charbel@helpdesk:~$ exiftool oldcar.jpg
ExifTool Version Number         : 12.76
File Name                       : oldcar.jpg
Directory                       : .
File Size                       : 2.4 MB
File Modification Date/Time     : 2026:01:06 10:42:58+01:00
File Access Date/Time           : 2026:01:06 11:00:10+01:00
File Inode Change Date/Time     : 2026:01:06 11:00:10+01:00
File Permissions                : -rwxrw-rw-
File Type                       : JPEG
File Type Extension             : jpg
MIME Type                       : image/jpeg
JFIF Version                    : 1.01
Exif Byte Order                 : Big-endian (Motorola, MM)
Make                            : motorola
Camera Model Name               : moto g(6) play
X Resolution                    : 72
Y Resolution                    : 72
Resolution Unit                 : inches
Software                        : aljeter-user 9 PPPS29.55-35-18-7 6a0d0 release-keys
Modify Date                     : 2020:11:07 15:08:57
Y Cb Cr Positioning             : Centered
Exposure Time                   : 1/33
F Number                        : 2.0
Exposure Program                : Program AE
ISO                             : 64
Exif Version                    : 0220
Date/Time Original              : 2020:11:07 15:08:57
Create Date                     : 2020:11:07 15:08:57
Components Configuration        : Y, Cb, Cr, -
Shutter Speed Value             : 1/33
Aperture Value                  : 2.0
Brightness Value                : -1
Exposure Compensation           : 0
Max Aperture Value              : 2.0
```

```
                                                    charbel@helpdesk: ~

Metering Mode                    : Center-weighted average
Flash                            : Auto, Did not fire
Focal Length                     : 3.5 mm
Build Number                     : PPPS29.55-35-18-7
Sensor                           : BACK,mot_s5k3l8
Manufacture Date                 : 14Oct2018
Flashpix Version                 : 0100
Color Space                      : sRGB
Exif Image Width                 : 4160
Exif Image Height                : 3120
Interoperability Index           : R98 - DCF basic file (sRGB)
Interoperability Version         : 0100
Scene Type                       : Directly photographed
Custom Rendered                  : Normal
Exposure Mode                    : Auto
White Balance                    : Auto
Digital Zoom Ratio               : 1
Scene Capture Type               : Standard
Contrast                         : Normal
Saturation                       : Low
Sharpness                        : Soft
GPS Version ID                   : 2.2.0.0
GPS Latitude Ref                 : North
GPS Longitude Ref                : East
GPS Altitude Ref                 : Above Sea Level
GPS Time Stamp                   : 14:08:57
GPS Map Datum                    : WGS-84
GPS Processing Method            : ASCII
GPS Date Stamp                   : 2020:11:07
Compression                      : JPEG (old-style)
Thumbnail Offset                 : 2862
Thumbnail Length                 : 59453
Image Width                      : 4160
Image Height                     : 3120
Encoding Process                 : Baseline DCT, Huffman coding
Bits Per Sample                  : 8
```

```
Bits Per Sample                   : 8
Color Components                  : 3
Y Cb Cr Sub Sampling              : YCbCr4:2:0 (2 2)
Aperture                          : 2.0
Image Size                        : 4160x3120
Megapixels                        : 13.0
Shutter Speed                     : 1/33
Thumbnail Image                   : (Binary data 59453 bytes, use -b option to extract)
GPS Altitude                      : 42 m Above Sea Level
GPS Date/Time                     : 2020:11:07 14:08:57Z
GPS Latitude                      : 53 deg 11' 39.68" N
GPS Longitude                     : 6 deg 32' 12.90" E
Focal Length                      : 3.5 mm
GPS Position                      : 53 deg 11' 39.68" N, 6 deg 32' 12.90" E
Light Value                       : 7.7
charbel@helpdesk:~$
```

In which city was this photo taken? 5GVP+PQV Groningen

```
charbel@helpdesk:~$ mv oldcar.jpg oldcar
charbel@helpdesk:~$ file oldcar
oldcar: JPEG image data, JFIF standard 1.01, aspect ratio, density 1x1, segment length 16, Exif Standard: [TIFF image data, big-endian, direntries=10, manufacturer
=motorola, model=moto g(6) play, xresolution=160, yresolution=168, resolutionunit=2, software=aljeter-user 9 PPPS29.55-35-18-7 6a0d0 release-keys, datetime=2020:11
:07 15:08:57, GPS-Data], baseline, precision 8, 4160x3120, components 3
charbel@helpdesk:~$
```

Does Ubuntu still consider it to be a jpg file? Ja

IT FUNDAMENTALS   20

```
charbel@helpdesk:~$ base64 -d email-base64.txt > email-base64.gif
charbel@helpdesk:~$ ls
553809      Desktop     Downloads           email-base64.txt  Music     Pictures  SherlockHolmes.txt  Templates  test.tar.gz  Videos
apple2.jpg  Documents   email-base64.gif    hello               oldcar    Public    snap                test.tar   test.txt
charbel@helpdesk:~$
charbel@helpdesk:~$ ls
553809       Desktop     Downloads          email-base64.txt
apple2.jpg   Documents   email-base64.gif   hello
charbel@helpdesk:~$ file email-base64.gif
email-base64.gif: GIF image data, version 89a, 108 x 52
charbel@helpdesk:~$ xdg-open email-base64.gif
charbel@helpdesk:~$
```

Assignment 5.8: Steganography

Relevant screenshots + motivation

• Select the blank line above.
• Copy the selected line.
• Paste the line into a text editor (notepad/texteditor/nano etc.)

SECRETS, HIDING DATA IN PLAIN VIEW !!!

```
charbel@helpdesk:~$ steghide --help
steghide version 0.5.1

the first argument must be one of the following:
 embed, --embed          embed data
 extract, --extract      extract data
 info, --info            display information about a cover- or stego-file
   info <filename>       display information about <filename>
 encinfo, --encinfo      display a list of supported encryption algorithms
 version, --version      display version information
 license, --license      display steghide's license
 help, --help            display this usage information

embedding options:
 -ef, --embedfile        select file to be embedded
   -ef <filename>        embed the file <filename>
 -cf, --coverfile        select cover-file
   -cf <filename>        embed into the file <filename>
 -p, --passphrase        specify passphrase
   -p <passphrase>       use <passphrase> to embed data
 -sf, --stegofile        select stego file
   -sf <filename>        write result to <filename> instead of cover-file
 -e, --encryption        select encryption parameters
   -e <a>[<m>]|<m>[<a>]  specify an encryption algorithm and/or mode
   -e none               do not encrypt data before embedding
 -z, --compress          compress data before embedding (default)
   -z <l>                 using level <l> (1 best speed...9 best compression)
 -Z, --dontcompress      do not compress data before embedding
 -K, --nochecksum        do not embed crc32 checksum of embedded data
 -N, --dontembedname     do not embed the name of the original file
 -f, --force             overwrite existing files
 -q, --quiet             suppress information messages
 -v, --verbose           display detailed information
```

```
extracting options:
 -sf, --stegofile        select stego file
   -sf <filename>        extract data from <filename>
 -p, --passphrase        specify passphrase
   -p <passphrase>       use <passphrase> to extract data
 -xf, --extractfile      select file name for extracted data
   -xf <filename>        write the extracted data to <filename>
 -f, --force             overwrite existing files
 -q, --quiet             suppress information messages
 -v, --verbose           display detailed information

options for the info command:
 -p, --passphrase        specify passphrase
   -p <passphrase>       use <passphrase> to get info about embedded data

To embed emb.txt in cvr.jpg: steghide embed -cf cvr.jpg -ef emb.txt
To extract embedded data from stg.jpg: steghide extract -sf stg.jpg
charbel@helpdesk:~$
```

```
charbel@helpdesk:~$ steghide extract -sf apple2.jpg
Enter passphrase:
wrote extracted data to "message.txt".
charbel@helpdesk:~$ ls
553809      Desktop      Downloads           email-base64.txt  message.txt  oldcar   Public              snap       test.tar    test.txt
apple2.jpg  Documents  email-base64.gif  hello               Music        Pictures  SherlockHolmes.txt  Templates  test.tar.gz  Videos
charbel@helpdesk:~$ cat message.txt
Hello class.
You have almost completed Week 5.

charbel@helpdesk:~$
```

Assignment 5.9: Capture disk images

Make relevant screenshots + motivation:

- Proof that the Debian 13 server stored a back-up image of the Ubuntu 24.04 Desktop VM.
- Proof that you can restore the back-up image into an empty VM.
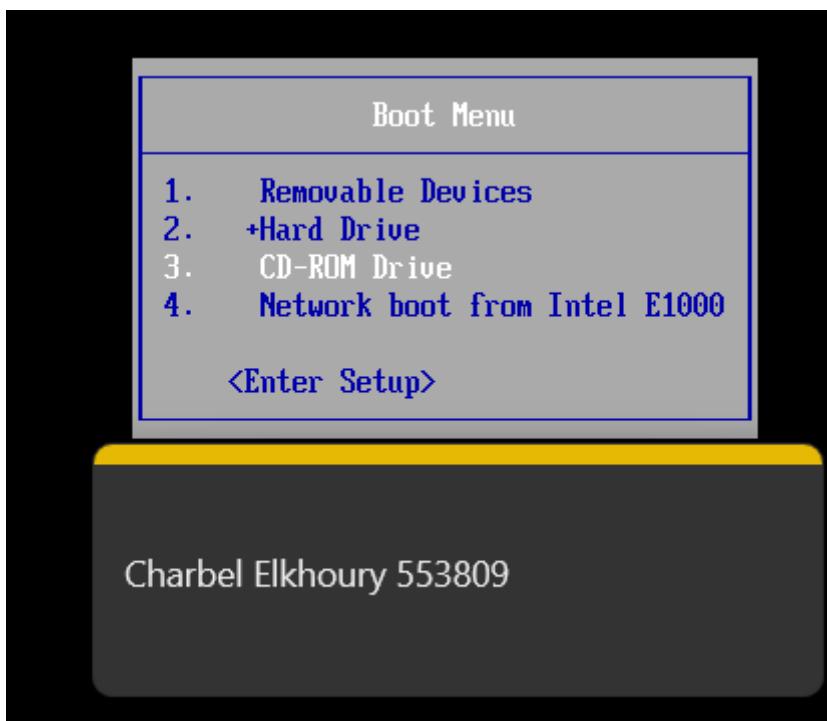
```
charbel@omv553809:~$ sudo apt update
[sudo] password for charbel:
Hit:1 http://deb.debian.org/debian trixie InRelease
Get:2 http://deb.debian.org/debian trixie-updates InRelease [47.3 kB]
Get:3 http://security.debian.org/debian-security trixie-security InRelease [43.4 kB]
Get:4 http://security.debian.org/debian-security trixie-security/main Sources [117 kB]
Get:5 http://security.debian.org/debian-security trixie-security/main amd64 Packages [94.2 kB]
Get:6 http://security.debian.org/debian-security trixie-security/main Translation-en [59.3 kB]
Fetched 361 kB in 0s (1,415 kB/s)
All packages are up to date.
charbel@omv553809:~$ sudo apt install openssh-server -y
openssh-server is already the newest version (1:10.0p1-7).
openssh-server set to manually installed.
Summary:
  Upgrading: 0, Installing: 0, Removing: 0, Not Upgrading: 0
charbel@omv553809:~$ sudo systemctl enable --now ssh
Synchronizing state of ssh.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable ssh
charbel@omv553809:~$ sudo mkdir -p /srv/images
charbel@omv553809:~$ sudo chow $USER:$USER /srv/images
sudo: chow: command not found
charbel@omv553809:~$ sudo chown $USER:$USER /srv/images
charbel@omv553809:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
       valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:7f:5b:b5 brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    altname enx000c297f5bb5
    inet 192.168.139.134/24 brd 192.168.139.255 scope global dynamic noprefixroute ens33
       valid_lft 955sec preferred_lft 730sec
    inet6 fe80::5fb6:cb22:9e2e:85db/64 scope link
       valid_lft forever preferred_lft forever
charbel@omv553809:~$
```
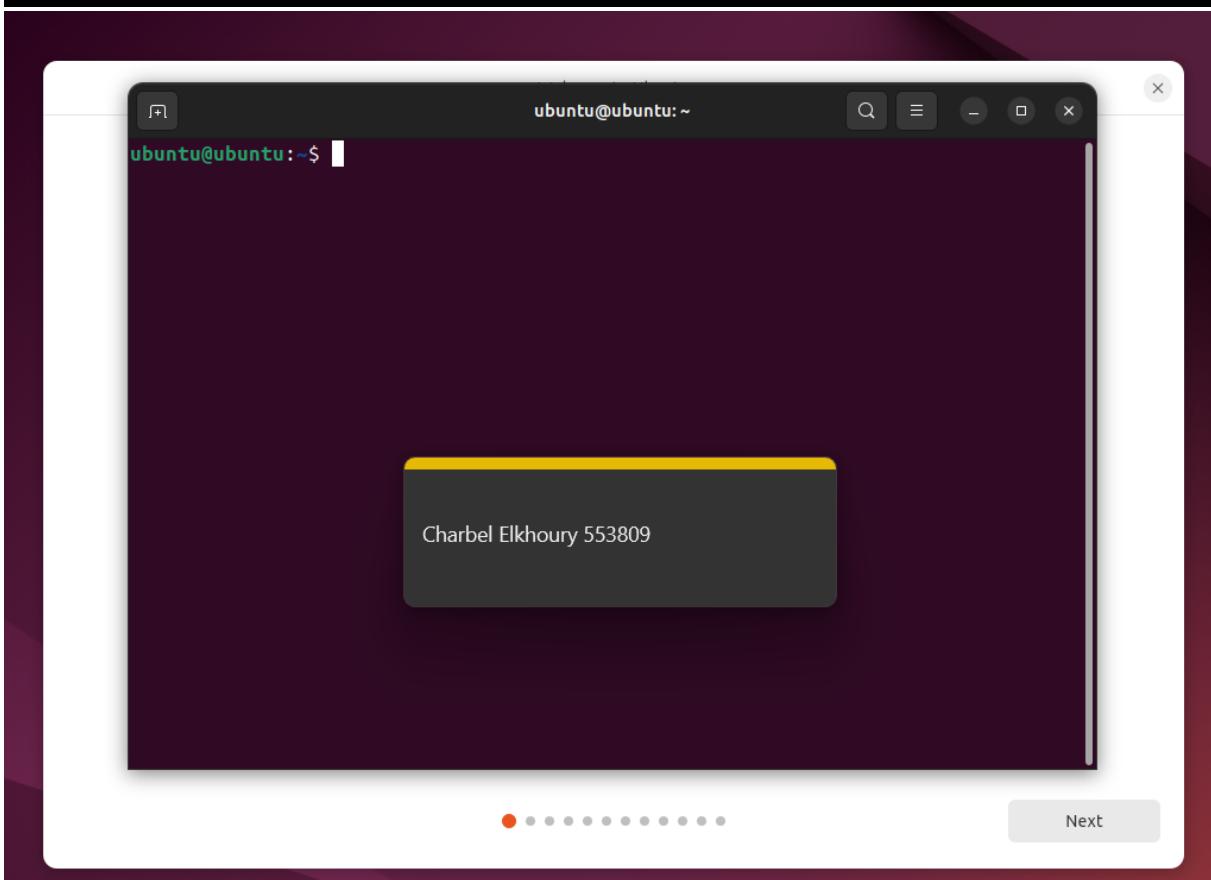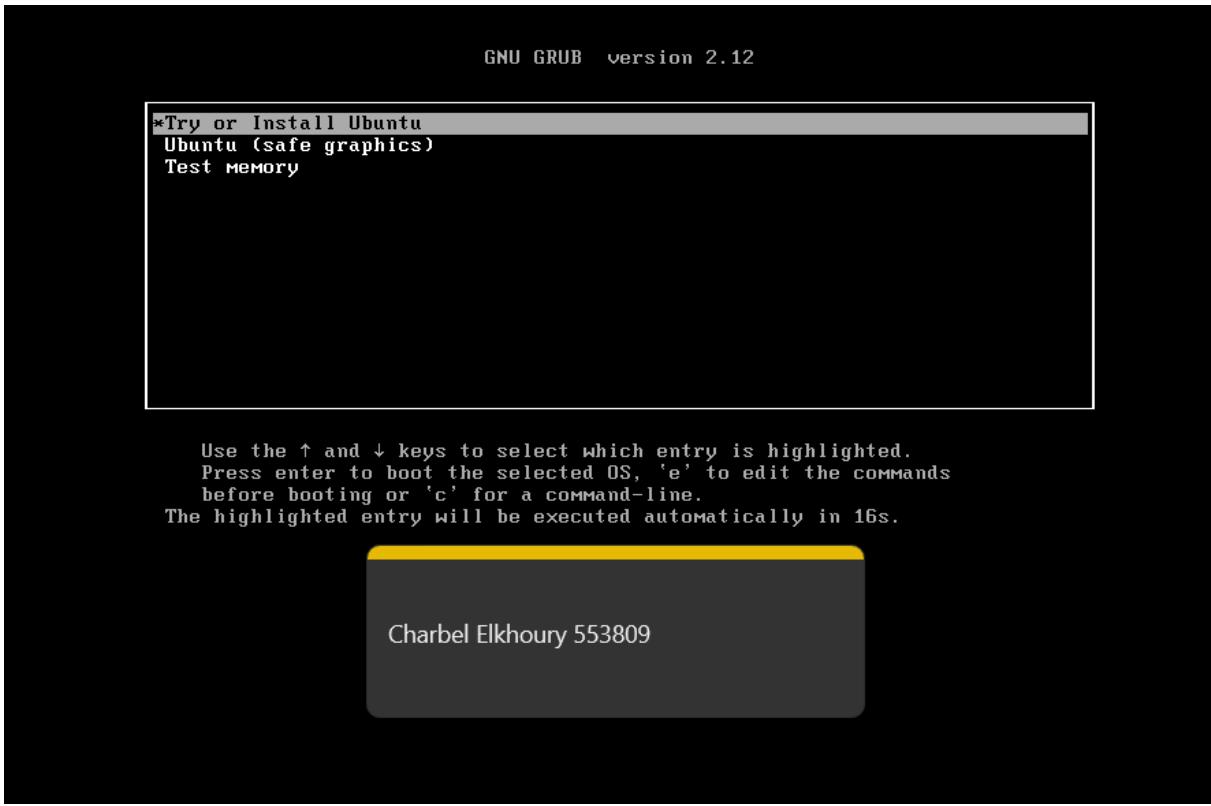
```
charbel@helpdesk:~$ ssh charbel@192.168.139.134
The authenticity of host '192.168.139.134 (192.168.139.134)' can't be establishe
d.
ED25519 key fingerprint is SHA256:8e+MAjNzpf2ZKqMtD0UqnQNEMBkkeIA7xMNew3d+7YA.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.139.134' (ED25519) to the list of known host
s.
charbel@192.168.139.134's password:
Linux omv553809 6.12.57+deb13-amd64 #1 SMP PREEMPT_DYNAMIC Debian 6.12.57-1 (202
5-11-05) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
charbel@omv553809:~$
```

```
                    Boot Menu

     1.     Removable Devices
     2.    +Hard Drive
     3.     CD-ROM Drive
     4.     Network boot from Intel E1000

           <Enter Setup>
```

Charbel Elkhoury 553809

```
ubuntu@ubuntu:~$ ls blk
ls: cannot access 'blk': No such file or directory
ubuntu@ubuntu:~$ lsblk
NAME          MAJ:MIN RM    SIZE RO TYPE MOUNTPOINTS
loop0           7:0    0    1.7G  1 loop /rofs
loop1           7:1    0  523.3M  1 loop
loop2           7:2    0  925.9M  1 loop
loop3           7:3    0      4K  1 loop /snap/bare/5
loop4           7:4    0   11.1M  1 loop /snap/firmware-updater/167
loop5           7:5    0  245.1M  1 loop /snap/firefox/6565
loop6           7:6    0    516M  1 loop /snap/gnome-42-2204/202
loop7           7:7    0   73.9M  1 loop /snap/core22/2045
loop8           7:8    0   91.7M  1 loop /snap/gtk-common-themes/1535
loop9           7:9    0   10.8M  1 loop /snap/snap-store/1270
loop10          7:10   0   49.3M  1 loop /snap/snapd/24792
loop11          7:11   0    210M  1 loop /snap/thunderbird/769
loop12          7:12   0  112.6M  1 loop /snap/ubuntu-desktop-bootstrap/413
loop13          7:13   0    576K  1 loop /snap/snapd-desktop-integration/315
sr0            11:0    1    5.9G  0 rom  /cdrom
nvme0n1       259:0    0     64G  0 disk
├─nvme0n1p1   259:1    0      1M  0 part
└─nvme0n1p2   259:2    0     64G  0 part
ubuntu@ubuntu:~$
```

Charbel Elkhoury 553809

Next

```
ubuntu@ubuntu:~$ sudo fdisk -l /dev/nvme0n1
Disk /dev/nvme0n1: 64 GiB, 68719476736 bytes, 134217728 sectors
Disk model: VMware Virtual NVMe Disk
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: gpt
Disk identifier: 5E6058E7-1754-4BF4-9A3D-48608FF1B7D2

Device           Start       End   Sectors Size Type
/dev/nvme0n1p1    2048      4095      2048   1M BIOS boot
/dev/nvme0n1p2    4096 134215679 134211584  64G Linux filesystem
ubuntu@ubuntu:~$
```
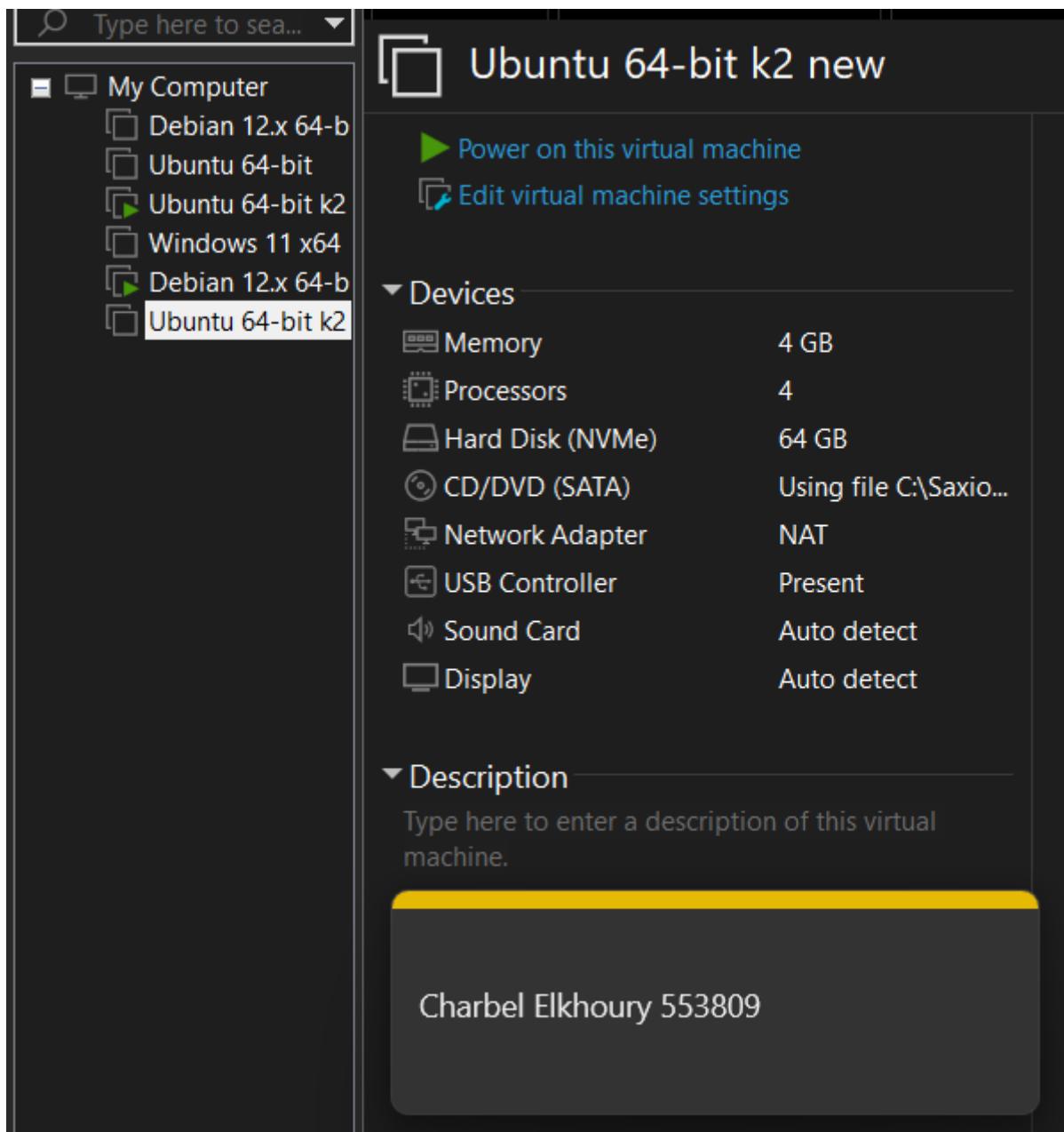
```
ubuntu@ubuntu:~$ sudo fdisk -l /dev/nvme0n1
Disk /dev/nvme0n1: 64 GiB, 68719476736 bytes, 134217728 sectors
Disk model: VMware Virtual NVMe Disk
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: gpt
Disk identifier: 5E6058E7-1754-4BF4-9A3D-48608FF1B7D2

Device         Start      End   Sectors Size Type
/dev/nvme0n1p1  2048     4095      2048   1M BIOS boot
ubuntu@ubuntu:~$ sudo dd if=/dev/nvme0n1 bs=4m status=progress | gzip | ssh charbel@192.168.139.134 "cat > /srv/images/ubuntu2
404_vm.img.gz"
dd: invalid number: '4m'
The authenticity of host '192.168.139.134 (192.168.139.134)' can't be established.
ED25519 key fingerprint is SHA256:8e+MAjNzpf2ZKqMtD0UqnQNEMBkkeIA7xMNew3d+7YA.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? y
Please type 'yes', 'no' or the fingerprint: yes
Warning: Permanently added '192.168.139.134' (ED25519) to the list of known hosts.
charbel@192.168.139.134's password:
Permission denied, please try again.
charbel@192.168.139.134's password:
Permission denied, please try again.
charbel@192.168.139.134's password:
ubuntu@ubuntu:~$ █
```

```
ubuntu@ubuntu:~$ sudo dd if=/dev/nvme0n1 bs=4M status=progress | gzip | ssh charbel@192.168.139.134 "cat > /srv/images/ubuntu2
404_vm.img.gz"
charbel@192.168.139.134's password:
574619648 bytes (575 MB, 548 MiB) copied, 11 s, 52.2 MB/s█
```

```
ubuntu@ubuntu:~$ sudo dd if=/dev/nvme0n1 bs=4M status=progress | gzip | ssh charbel@192.168.139.134 "cat > /srv/images/ubuntu2
404_vm.img.gz"
charbel@192.168.139.134's password:
68719476736 bytes (69 GB, 64 GiB) copied, 865 s, 79.4 MB/s
16384+0 records in
16384+0 records out
68719476736 bytes (69 GB, 64 GiB) copied, 865.317 s, 79.4 MB/s
ubuntu@ubuntu:~$
```

Ubuntu 64-bit k2 new

▶ Power on this virtual machine
📝 Edit virtual machine settings

▼ Devices

Memory	4 GB
Processors	4
Hard Disk (NVMe)	64 GB
CD/DVD (SATA)	Using file C:\Saxio...
Network Adapter	NAT
USB Controller	Present
Sound Card	Auto detect
Display	Auto detect

▼ Description

Type here to enter a description of this virtual machine.

Charbel Elkhoury 553809
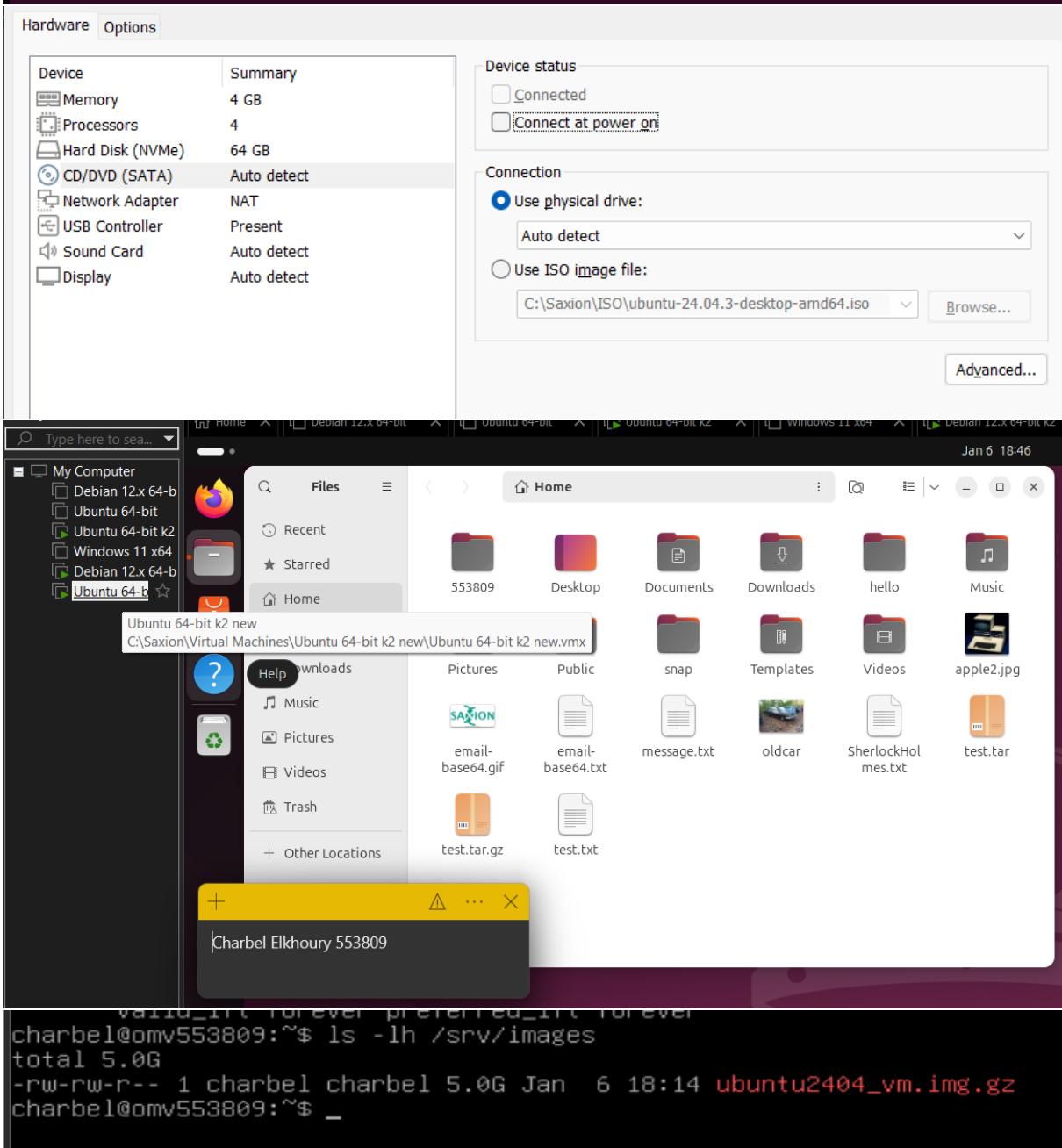
Ubuntu 24.04

```
ubuntu@ubuntu:~$ ssh charbel@192.168.139.134 "cat /srv/images/ubuntu2404_vm.img.gz" | gzip -d | sudo dd of=/dev/nvme0n1 bs=4M
status=progress
The authenticity of host '192.168.139.134 (192.168.139.134)' can't be established.
ED25519 key fingerprint is SHA256:8e+MAjNzpf2ZKqMtD0UqnQNEMBkkeIA7xMNew3d+7YA.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.139.134' (ED25519) to the list of known hosts.
charbel@192.168.139.134's password:
904527872 bytes (905 MB, 863 MiB) copied, 19 s, 47.6 MB/s
```

```
ubuntu@ubuntu:~$ ssh charbel@192.168.139.134 "cat /srv/images/ubuntu2404_vm.img.gz" | gzip -d | sudo dd of=/dev/nvme0n1 bs=4M
status=progress
The authenticity of host '192.168.139.134 (192.168.139.134)' can't be established.
ED25519 key fingerprint is SHA256:8e+MAjNzpf2ZKqMtD0UqnQNEMBkkeIA7xMNew3d+7YA.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.139.134' (ED25519) to the list of known hosts.
charbel@192.168.139.134's password:
68579033088 bytes (69 GB, 64 GiB) copied, 278 s, 247 MB/s
0+2049542 records in
0+2049542 records out
68719476736 bytes (69 GB, 64 GiB) copied, 278.735 s, 247 MB/s
ubuntu@ubuntu:~$
```

```
charbel@omv553809:~$ ls -lh /srv/images
total 5.0G
-rw-rw-r-- 1 charbel charbel 5.0G Jan  6 18:14 ubuntu2404_vm.img.gz
charbel@omv553809:~$ _
```

Ready? Save this file and export it as a pdf file with the name: **week5.pdf**