Template Week 5 – Operating Systems

Student number: 486707

Assignment 5.1: Unix-like

a) Find out what the difference is between UNIX and unix-like operating systems?

UNIX is proprietary and unix-like is open source.

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 and Dennis Ritchie designed and implemented the original UNIX OS and C programming language. Bill Joy is creator of the vi text editor and developed BSD UNIX. Richard Stallman started the free software movement. He created the GNU project for making a unix-like open source OS. Linus Tovalds created the linux kernel. He also created Git.

c) What is the philosophy of the GNU movement?

Free software means that the software's users have freedom. (The issue is not about price.) We developed the GNU operating system so that users can have freedom in their computing.

Specifically, free software means users have the four essential freedoms: (0) to run the program, (1) to study and change the program in source code form, (2) to redistribute exact copies, and (3) to distribute modified versions.

Source: https://www.gnu.org/philosophy/philosophy.en.html

d) Does Ubuntu as a Linux operating system conform to the philosophy of the GNU movement? Please explain your answer.

Not entirely because it utilises some proprietary hardware drivers.

e) Find out what is the Windows Subsystem for Linux?

It is a feature of Windows to run linux without a virtual machine or dual boot.

f) Find out, which operating system family belongs to Android, iOS and ChromeOS?

Android and ChromeOS are Unix-like, but iOS is UNIX.

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

Supercomputers use thousands of connected processors for parallel calculations with huge datasets.

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?

The US airforce clustered 1760 PS3's to create the Condor supercomputer at 1/10th the cost of comparable supercomputers.

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

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/

No the supercomputers on the list have tens of thousands of nodes and and the Raspberry Pi cluster has 1050.

e) What CPU architecture is used for the PlayStation 5 and Xbox Series X?

A custom AMD Zen 2 CPU architecture.

What operating systems run on these consoles?

PS5 is Orbis OS which is based on FREEBSD and xbox series x is XBOX System Sofware which is a caustom version of windows.

What conclusion can you draw from the answer to the previous question?

That they resemble regular computers.

Assignment 5.3: Working with Windows

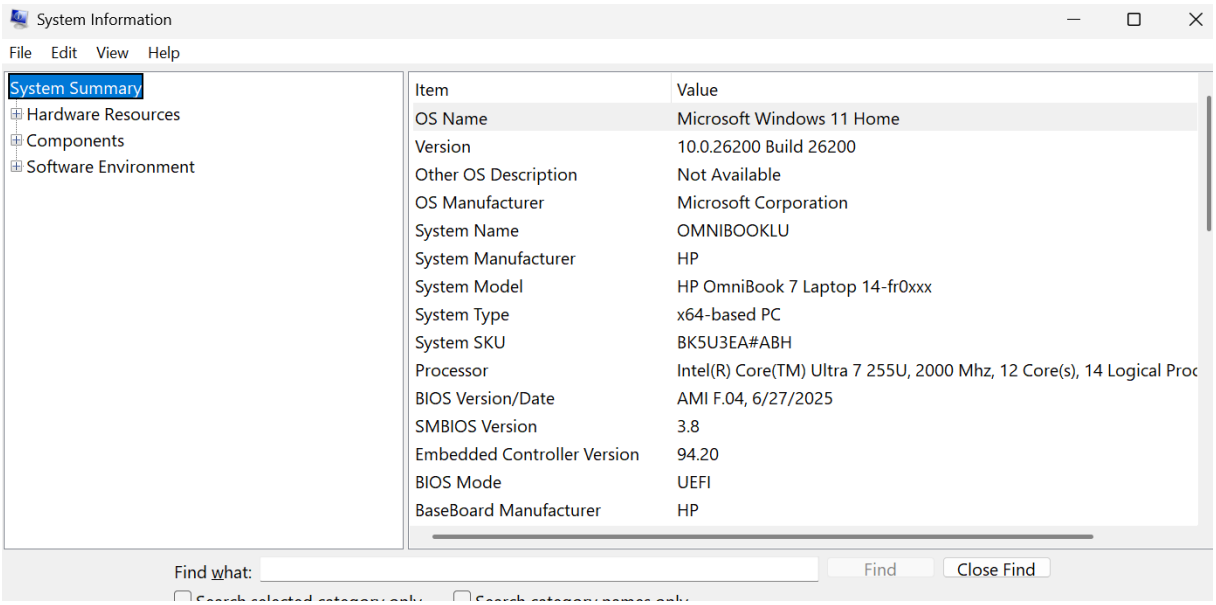
Take relevant screenshots of the assignments below

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.

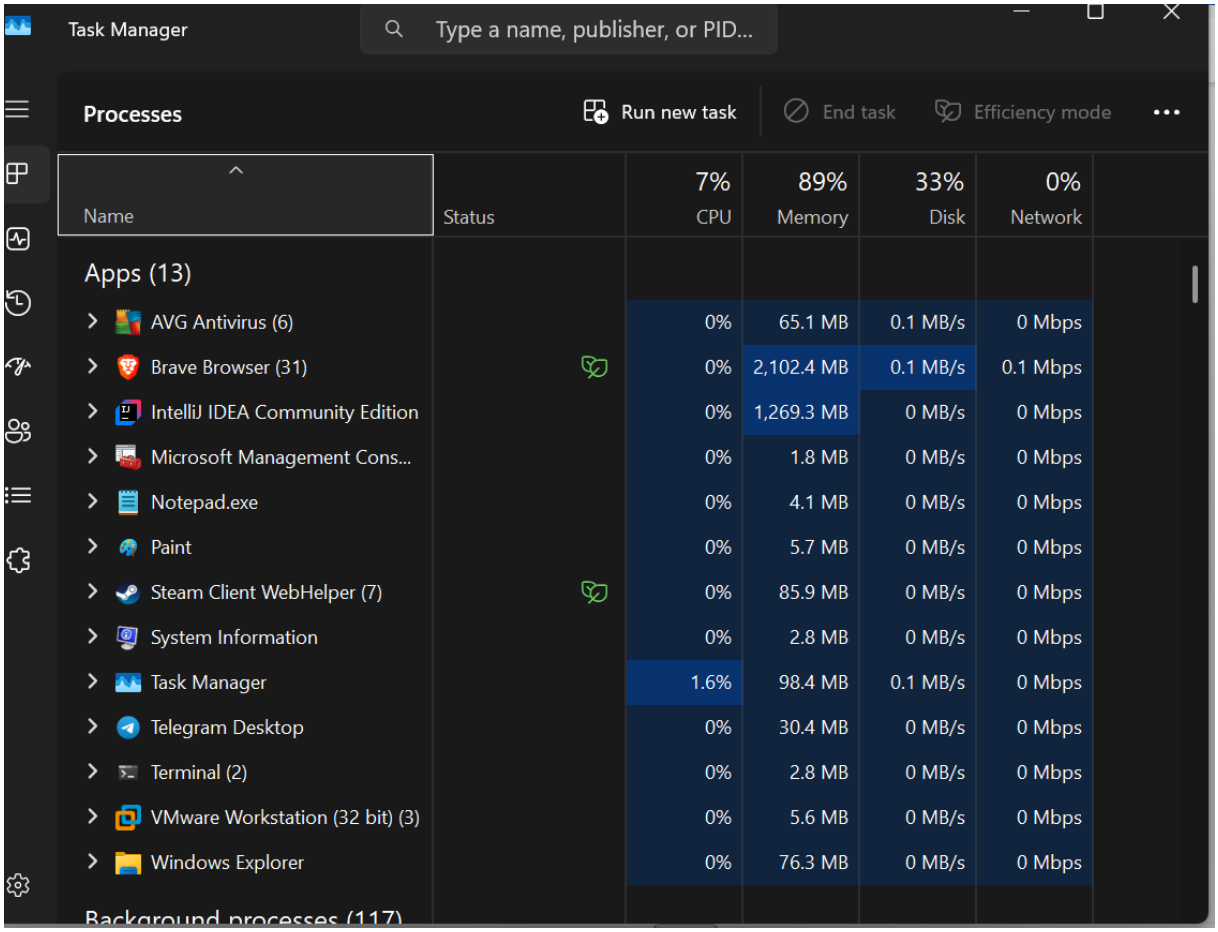
b) The file explorer can be opened with ⊞ + E, Which key combination could you also use?

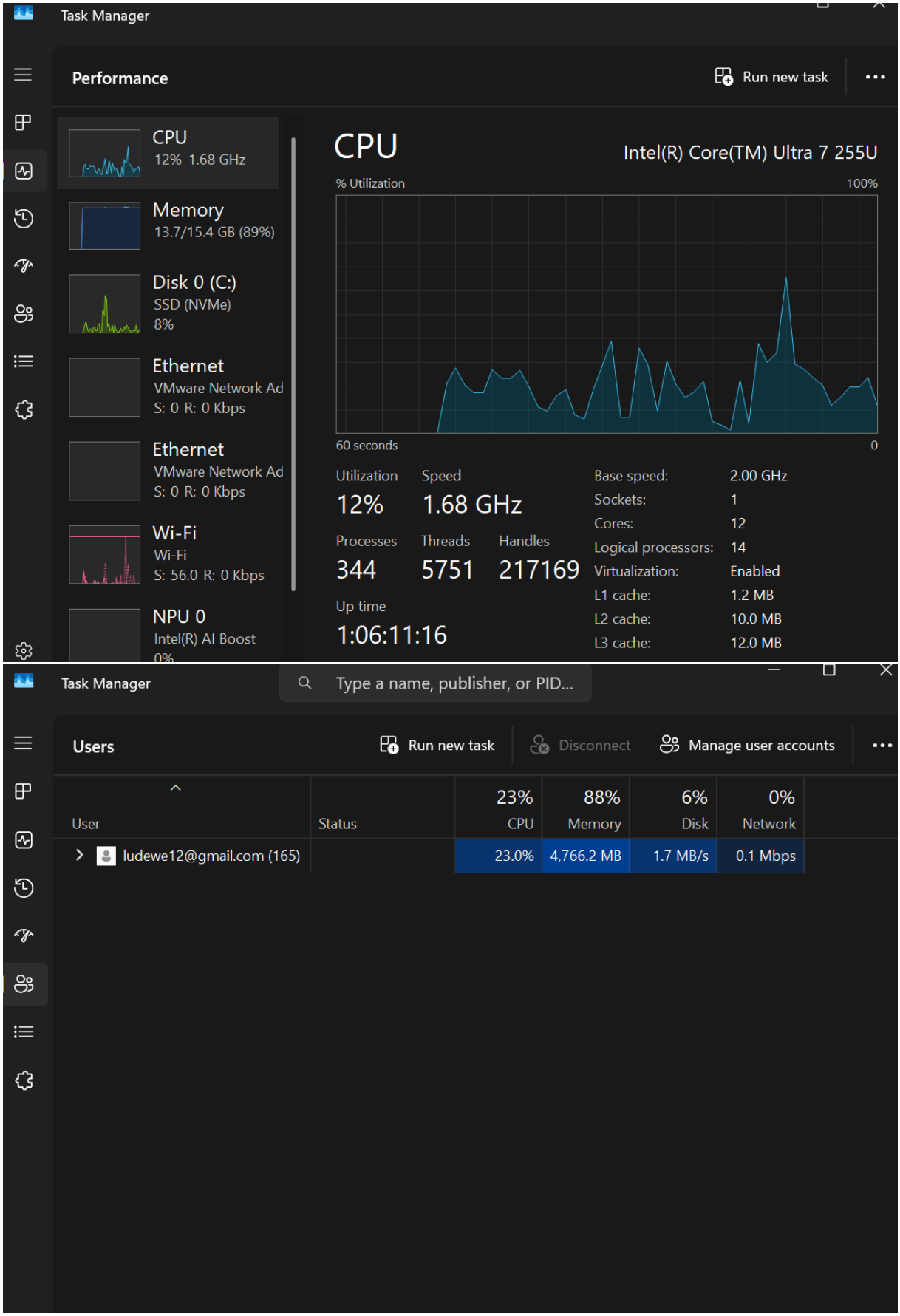
Windows key + X + E

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



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.


Task Manager
Type a name, publisher, or PID...
Processes
Run new task
End task
Efficiency mode
Name
Status
7%
CPU
89%
Memory
33%
Disk
0%
Network
Apps (13)
AVG Antivirus (6) 0% 65.1 MB 0.1 MB/s 0 Mbps
Brave Browser (31) 0% 2,102.4 MB 0.1 MB/s 0.1 Mbps
IntelliJ IDEA Community Edition 0% 1,269.3 MB 0 MB/s 0 Mbps
Microsoft Management Cons... 0% 1.8 MB 0 MB/s 0 Mbps
Notepad.exe 0% 4.1 MB 0 MB/s 0 Mbps
Paint 0% 5.7 MB 0 MB/s 0 Mbps
Steam Client WebHelper (7) 0% 85.9 MB 0 MB/s 0 Mbps
System Information 0% 2.8 MB 0 MB/s 0 Mbps
Task Manager 1.6% 98.4 MB 0.1 MB/s 0 Mbps
Telegram Desktop 0% 30.4 MB 0 MB/s 0 Mbps
Terminal (2) 0% 2.8 MB 0 MB/s 0 Mbps
VMware Workstation (32 bit) (3) 0% 5.6 MB 0 MB/s 0 Mbps
Windows Explorer 0% 76.3 MB 0 MB/s 0 Mbps
Background processes (117)



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

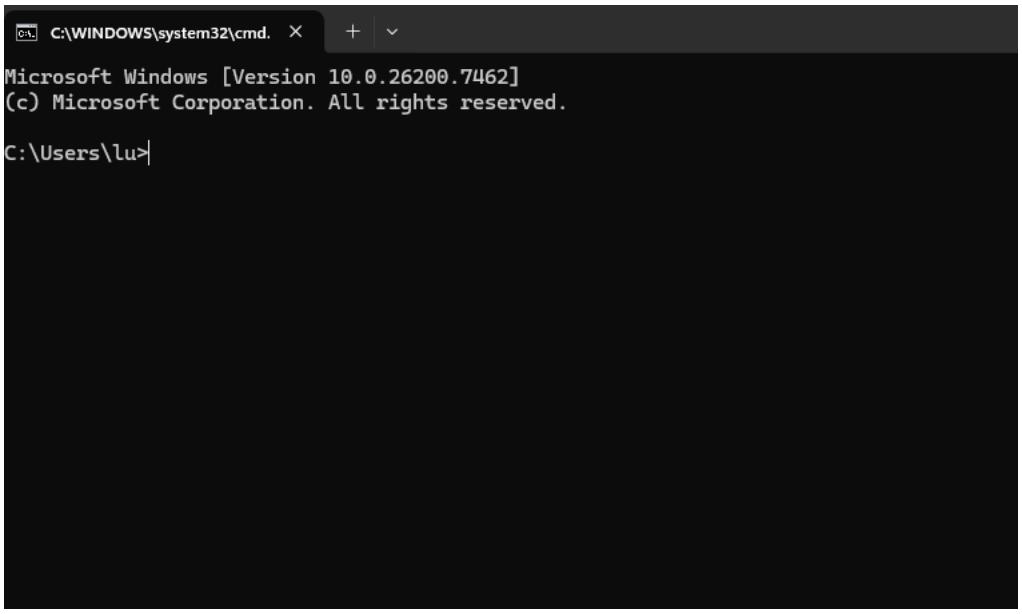
screen that you don't show over the projector, while the PowerPoint presentation is displayed on the projector, or the second screen. Which key combination should you use for this?

Windows + P and then extend

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

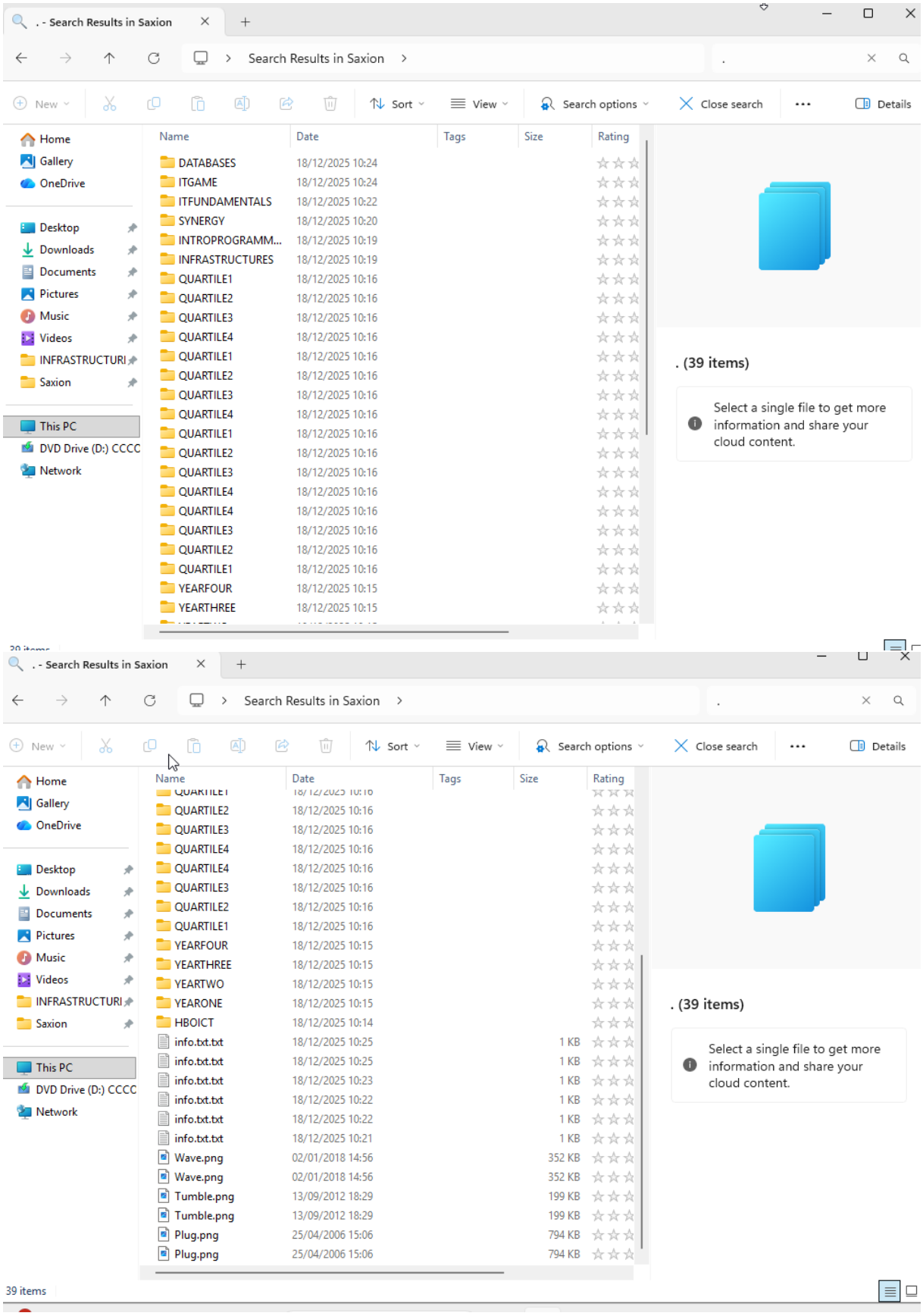
Relevant screenshots **copy** command:

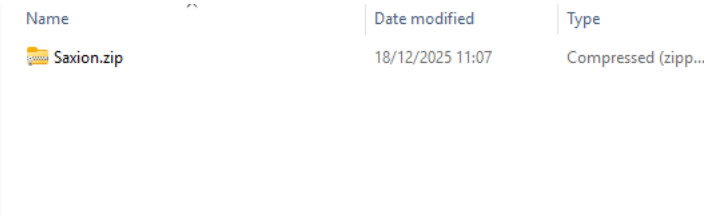
```
C:\Saxion>COPY plug.png HBOICT\YEARONE\QUARTILE1\INFRASTRUCTURES
        1 file(s) copied.

C:\Saxion>COPY wave.png HBOICT\YEARONE\QUARTILE1\INTROPROGRAMMING
        1 file(s) copied.

C:\Saxion>COPY tumble.png HBOICT\YEARONE\QUARTILE1\SYNERGY
        1 file(s) copied.

C:\Saxion>dir HBOICT\YEARONE\QUARTILE1\SYNERGY
 Volume in drive C has no label.
 Volume Serial Number is 0220-4EE5

 Directory of C:\Saxion\HBOICT\YEARONE\QUARTILE1\SYNERGY

18/12/2025  11:02    <DIR>          .
18/12/2025  10:20    <DIR>          ..
18/12/2025  10:22                30 info.txt.txt
18/12/2025  10:27           203.548 Tumble.png
               2 File(s)        203.578 bytes
               2 Dir(s)  40.524.812.288 bytes free

C:\Saxion>
```

Relevant screenshots **tree** command:

```
C:.
└───HBOICT
    ├───YEARFOUR
    │   ├───QUARTILE1
    │   ├───QUARTILE2
    │   ├───QUARTILE3
    │   └───QUARTILE4
    ├───YEARONE
    │   ├───QUARTILE1
    │   │   ├───INFRASTRUCTURES
    │   │   ├───INTROPROGRAMMING
    │   │   └───SYNERGY
    │   ├───QUARTILE2
    │   │   ├───DATABASES
    │   │   ├───ITFUNDAMENTALS
    │   │   └───ITGAME
    │   ├───QUARTILE3
    │   └───QUARTILE4
    ├───YEARTHREE
    │   ├───QUARTILE1
    │   ├───QUARTILE2
    │   ├───QUARTILE3
    │   └───QUARTILE4
    └───YEARTWO
        ├───QUARTILE1
        ├───QUARTILE2
        ├───QUARTILE3
        └───QUARTILE4

C:\Saxion>echo %username%
lu
```

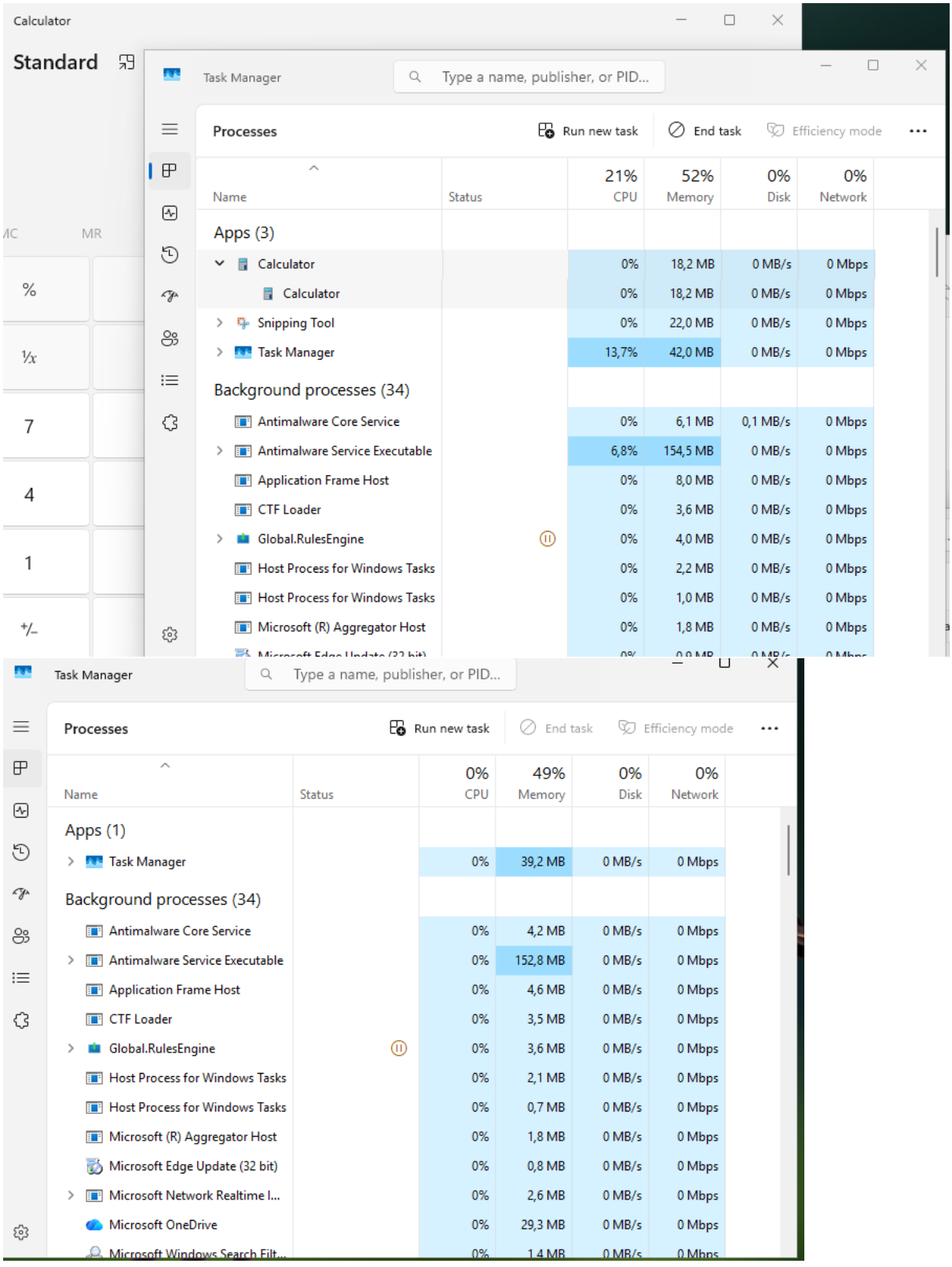
Relevant screenshots in the file explorer of the folder c:\Saxion + created zip file.


. - Search Results in Saxion
Search Results in Saxion
New
Sort
View
Search options
Close search
Details
Home
Gallery
OneDrive
Desktop
Downloads
Documents
Pictures
Music
Videos
INFRASTRUCTURI
Saxion
This PC
DVD Drive (D:) CCCC
Network
Name
Date
Tags
Size
Rating
DATABASES 18/12/2025 10:24
ITGAME 18/12/2025 10:24
ITFUNDAMENTALS 18/12/2025 10:22
SYNERGY 18/12/2025 10:20
INTROPROGRAMM... 18/12/2025 10:19
INFRASTRUCTURES 18/12/2025 10:19
QUARTILE1 18/12/2025 10:16
QUARTILE2 18/12/2025 10:16
QUARTILE3 18/12/2025 10:16
QUARTILE4 18/12/2025 10:16
QUARTILE1 18/12/2025 10:16
QUARTILE2 18/12/2025 10:16
QUARTILE3 18/12/2025 10:16
QUARTILE4 18/12/2025 10:16
QUARTILE1 18/12/2025 10:16
QUARTILE2 18/12/2025 10:16
QUARTILE3 18/12/2025 10:16
QUARTILE4 18/12/2025 10:16
QUARTILE4 18/12/2025 10:16
QUARTILE3 18/12/2025 10:16
QUARTILE2 18/12/2025 10:16
QUARTILE1 18/12/2025 10:16
YEARFOUR 18/12/2025 10:15
YEARTHREE 18/12/2025 10:15
. (39 items)
Select a single file to get more information and share your cloud content.
. - Search Results in Saxion
Search Results in Saxion
New
Sort
View
Search options
Close search
Details
Home
Gallery
OneDrive
Desktop
Downloads
Documents
Pictures
Music
Videos
INFRASTRUCTURI
Saxion
This PC
DVD Drive (D:) CCCC
Network
Name
Date
Tags
Size
Rating
QUARTILE2 18/12/2025 10:16
QUARTILE3 18/12/2025 10:16
QUARTILE4 18/12/2025 10:16
QUARTILE4 18/12/2025 10:16
QUARTILE3 18/12/2025 10:16
QUARTILE2 18/12/2025 10:16
QUARTILE1 18/12/2025 10:16
YEARFOUR 18/12/2025 10:15
YEARTHREE 18/12/2025 10:15
YEARTWO 18/12/2025 10:15
YEARONE 18/12/2025 10:15
HBOICT 18/12/2025 10:14
info.txt.txt 18/12/2025 10:25 1 KB
info.txt.txt 18/12/2025 10:25 1 KB
info.txt.txt 18/12/2025 10:23 1 KB
info.txt.txt 18/12/2025 10:22 1 KB
info.txt.txt 18/12/2025 10:22 1 KB
info.txt.txt 18/12/2025 10:21 1 KB
Wave.png 02/01/2018 14:56 352 KB
Wave.png 02/01/2018 14:56 352 KB
Tumble.png 13/09/2012 18:29 199 KB
Tumble.png 13/09/2012 18:29 199 KB
Plug.png 25/04/2006 15:06 794 KB
Plug.png 25/04/2006 15:06 794 KB
. (39 items)
Select a single file to get more information and share your cloud content.
39 items



Terminating Processes

Relevant Screenshots Task Manager Window:

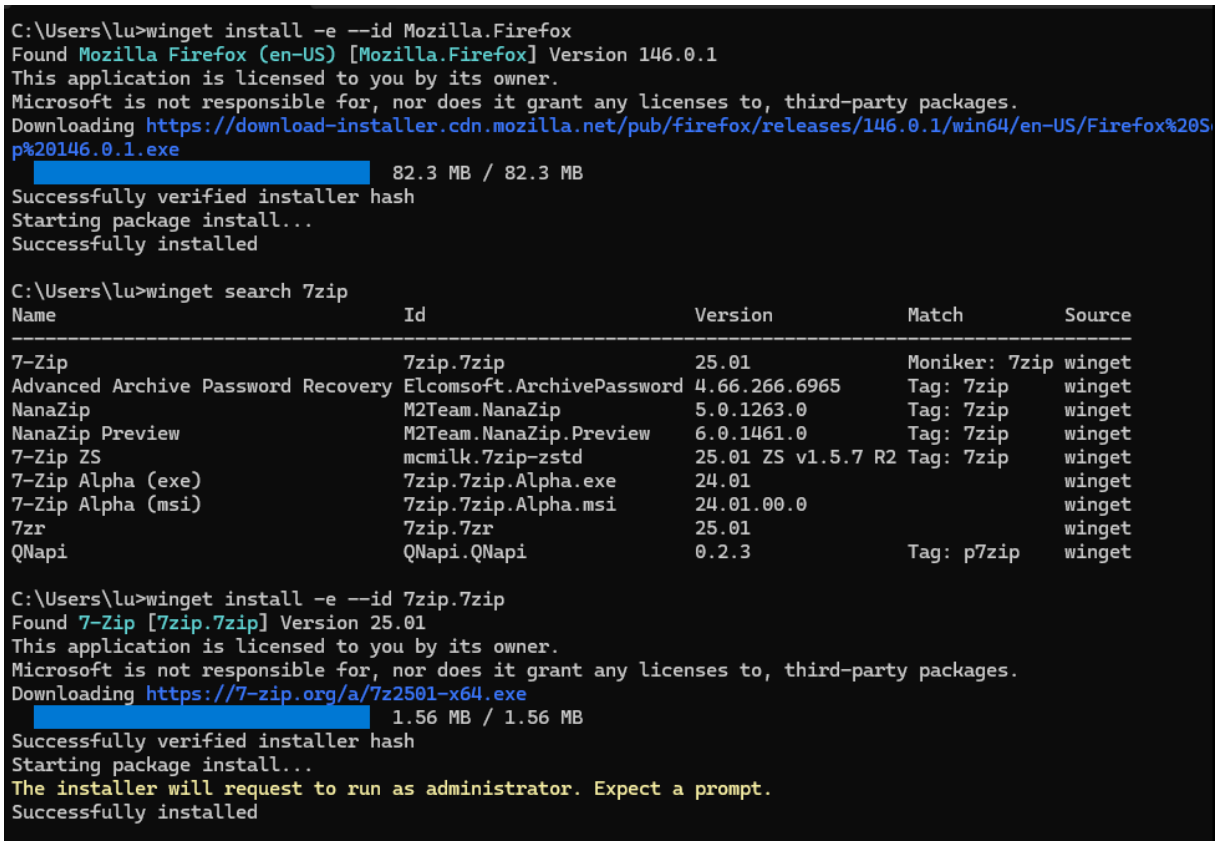


Install Software

Relevant screenshots that the following software is installed with winget:

- WinSCP
- Notepad++
- 7zip

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



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 means exact, it will look at the exact string you typed.

--id means searching by the ID of the app.

c) Also install the following applications via winget and take screenshots of t he successful installations: • 7Zip • notepad++ • winscp

```
C:\Users\lu>winget install -e --id 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%20S
p%20146.0.1.exe
  ████████████████████████████████ 82.3 MB / 82.3 MB
Successfully verified installer hash
Starting package install...
Successfully installed

C:\Users\lu>winget search 7zip
Name                                Id                        Version            Match         Source
-------------------------------------------------------------------------------------------------------
7-Zip                               7zip.7zip                 25.01              Moniker: 7zip winget
Advanced Archive Password Recovery Elcomsoft.ArchivePassword 4.66.266.6965      Tag: 7zip     winget
NanaZip                             M2Team.NanaZip            5.0.1263.0         Tag: 7zip     winget
NanaZip Preview                     M2Team.NanaZip.Preview    6.0.1461.0         Tag: 7zip     winget
7-Zip ZS                            mcmilk.7zip-zstd          25.01 ZS v1.5.7 R2 Tag: 7zip     winget
7-Zip Alpha (exe)                   7zip.7zip.Alpha.exe       24.01                            winget
7-Zip Alpha (msi)                   7zip.7zip.Alpha.msi       24.01.00.0                       winget
7zr                                 7zip.7zr                  25.01                            winget
QNapi                               QNapi.QNapi               0.2.3              Tag: p7zip    winget

C:\Users\lu>winget install -e --id 7zip.7zip
Found 7-Zip [7zip.7zip] Version 25.01
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://7-zip.org/a/7z2501-x64.exe
  ████████████████████████████████ 1.56 MB / 1.56 MB
Successfully verified installer hash
Starting package install...
The installer will request to run as administrator. Expect a prompt.
Successfully installed
```

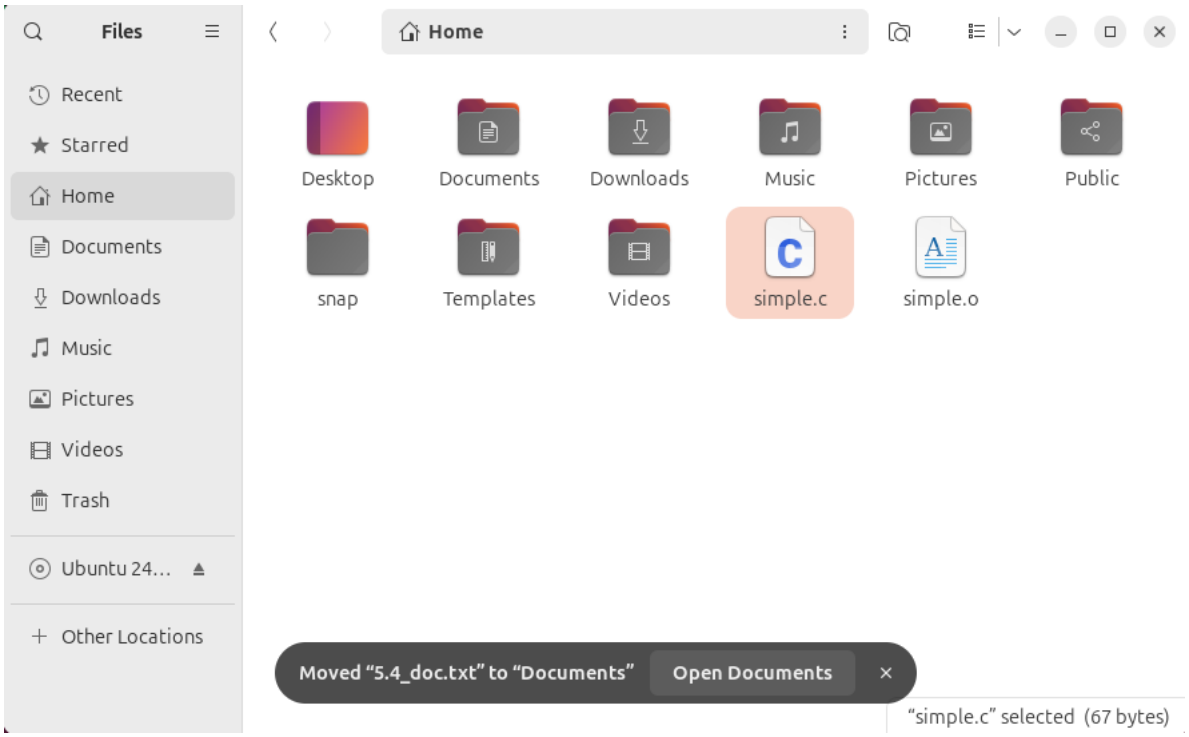
```
C:\Users\lu>winget install -e --id Notepad++.Notepad++
Found Notepad++ [Notepad++.Notepad++] Version 8.9
This application is licensed to you by its owner.
Microsoft is not responsible for, nor does it grant any licenses to, third-party packages.
Downloading https://github.com/notepad-plus-plus/notepad-plus-plus/releases/download/v8.9/npp.8.9.Installer
4.exe
  ████████████████████████████████ 6.54 MB / 6.54 MB
Successfully verified installer hash
Starting package install...
The installer will request to run as administrator. Expect a prompt.
Successfully installed

C:\Users\lu>winget install -e --id WinSCP.WinSCP
Found WinSCP [WinSCP.WinSCP] Version 6.5.5
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://sourceforge.net/projects/winscp/files/WinSCP/6.5.5/WinSCP-6.5.5-Setup.exe/download
  ████████████████████████████████ 11.6 MB / 11.6 MB
Successfully verified installer hash
Starting package install...
The installer will request to run as administrator. Expect a prompt.
Successfully installed

C:\Users\lu>
```

Assignment 5.4: Working with Linux

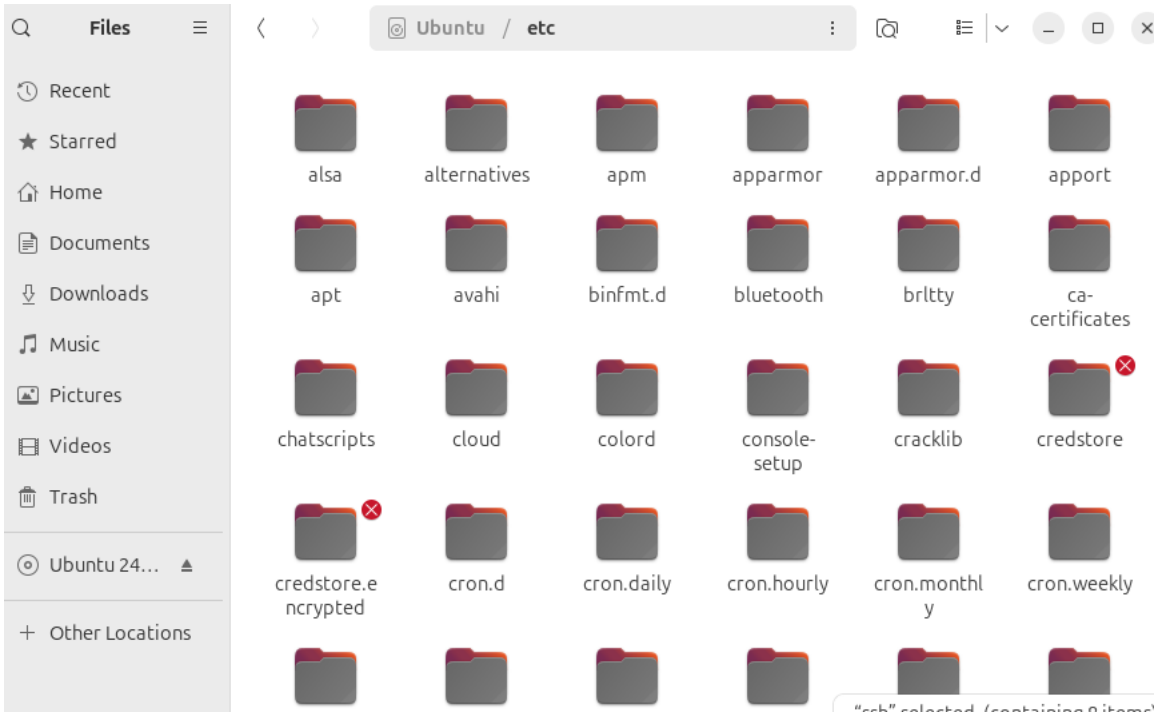
Relevant screenshots + motivation

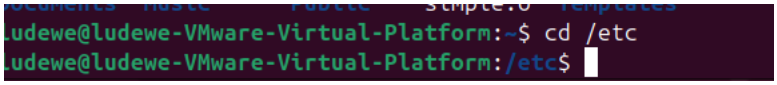
• Copying files

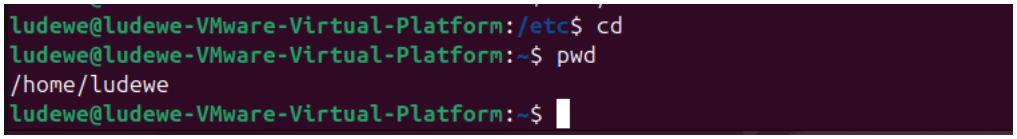
```
ludewe@ludewe-VMware-Virtual-Platform:~$ pwd
/home/ludewe
ludewe@ludewe-VMware-Virtual-Platform:~$ ls
5.4_doc.txt  Documents  Music     Public    simple.o  Templates
Desktop      Downloads  Pictures  simple.c  snap      Videos
ludewe@ludewe-VMware-Virtual-Platform:~$ mv -i 5.4_doc.txt /home/ludewe/Document
s
ludewe@ludewe-VMware-Virtual-Platform:~$ ls Documents
5.4_doc.txt  code
ludewe@ludewe-VMware-Virtual-Platform:~$
```



• Navigating the file structure







Windows has seperate drive directories while linux has a single root directory.

The /etc folder is used for configuration files.

• Compress files

o Which command in the terminal would you use to compress a text file into a tar archive?

tar -zcvf 5.4_doc.tar.gz 5.4_doc.txt

o With which command in the terminal would you be able to extract a tar file?

tar -zxvf 5.4_doc.tar.gz

o Compress a text file in a tar archive and compress it with gzip.

tar -zxvf 5.4_doc.tar.gz

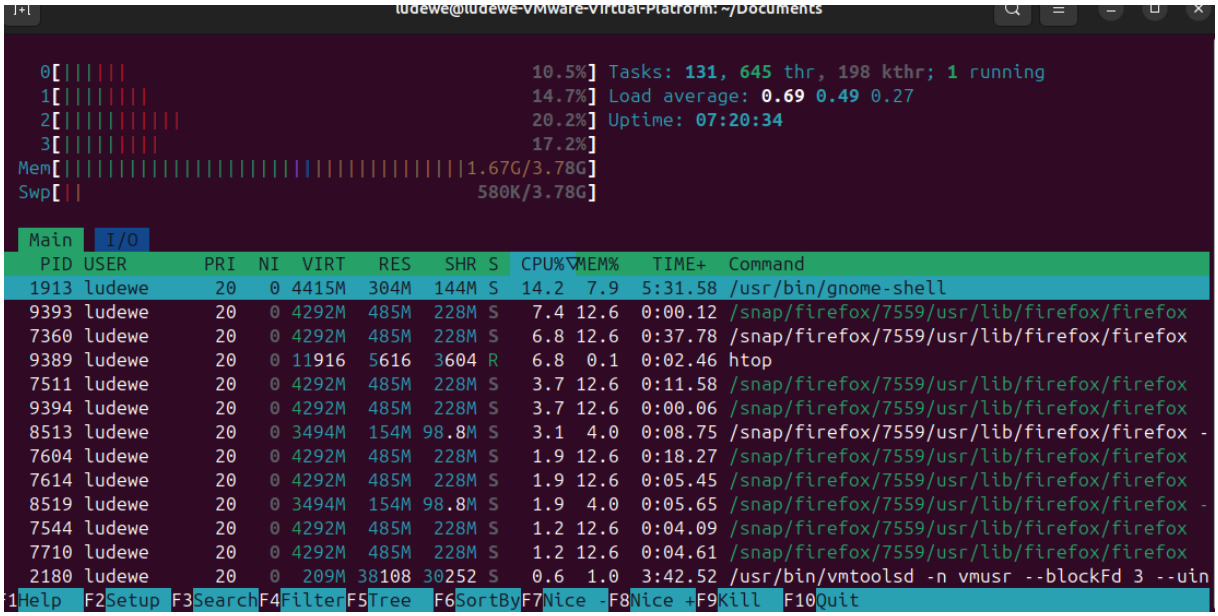
```
ludewe@ludewe-VMware-Virtual-Platform:~/Documents$ tar -zcvf 5.4_doc.tar.gz 5.4_doc.txt
5.4_doc.txt
ludewe@ludewe-VMware-Virtual-Platform:~/Documents$ rm 5.4_doc.txt
ludewe@ludewe-VMware-Virtual-Platform:~/Documents$ tar -zxvf 5.4_doc.tar.gz
5.4_doc.txt
ludewe@ludewe-VMware-Virtual-Platform:~/Documents$
```

```
ludewe@ludewe-VMware-Virtual-Platform:~/Documents$ gzip 5.4_doc.txt
ludewe@ludewe-VMware-Virtual-Platform:~/Documents$ gzip -d 5.4_doc.txt.gz
ludewe@ludewe-VMware-Virtual-Platform:~/Documents$
```

• View processes

o Install the application htop via a terminal command

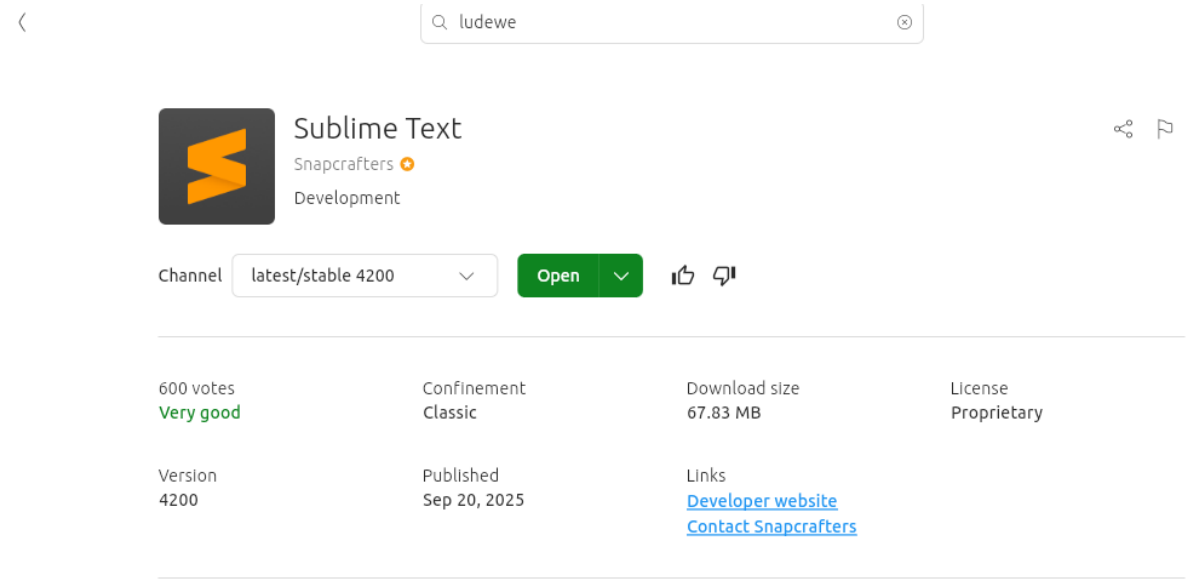
o Launch the htop application. Explain what this application shows.



Htop lists all running processes.

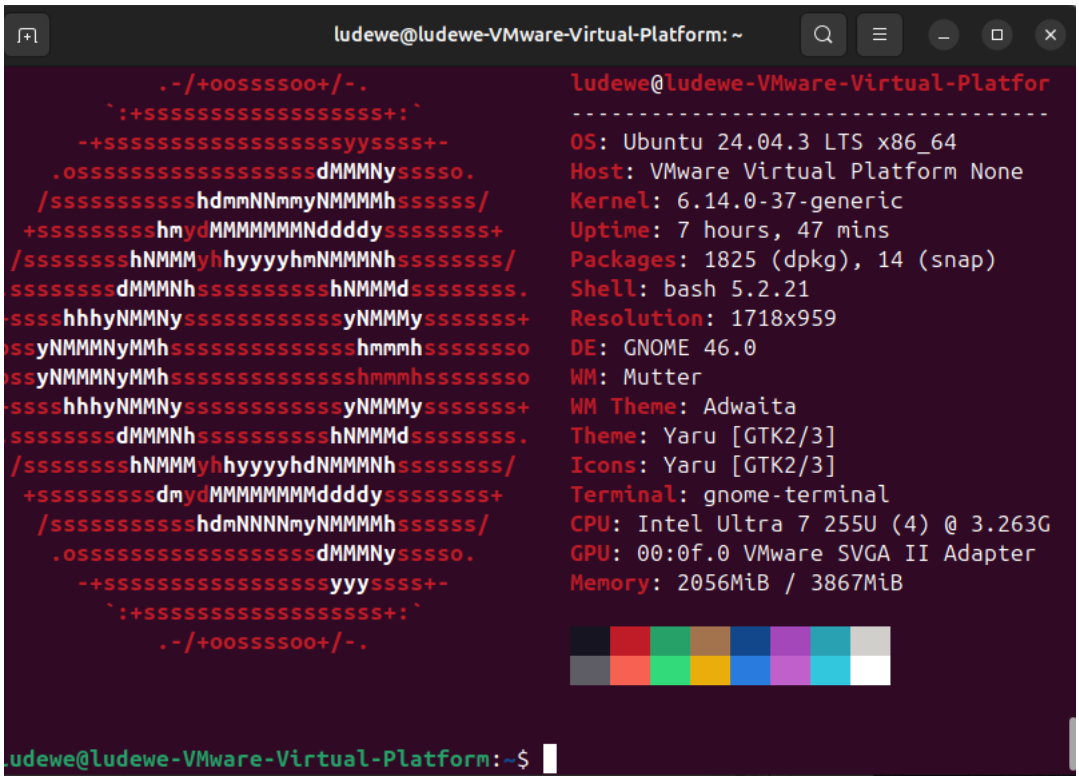
• Install Software

o 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



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

It shows my system information.



Assignment 5.5: Users and permissions on Linux

```
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads/hello$ chmod +x hello.sh
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads/hello$ ./hello.sh
Hello Ludewe, 486707!
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads/hello$ chmod 744 hello.sh
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads/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 concatenates the whole file together as output. Wc does a word count, it shows lines, words and bytes. The less command shows the file by page so you can read it more easily. Tail shows the last 10 lines of the file. Head shows the first 10 lines of the file.

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

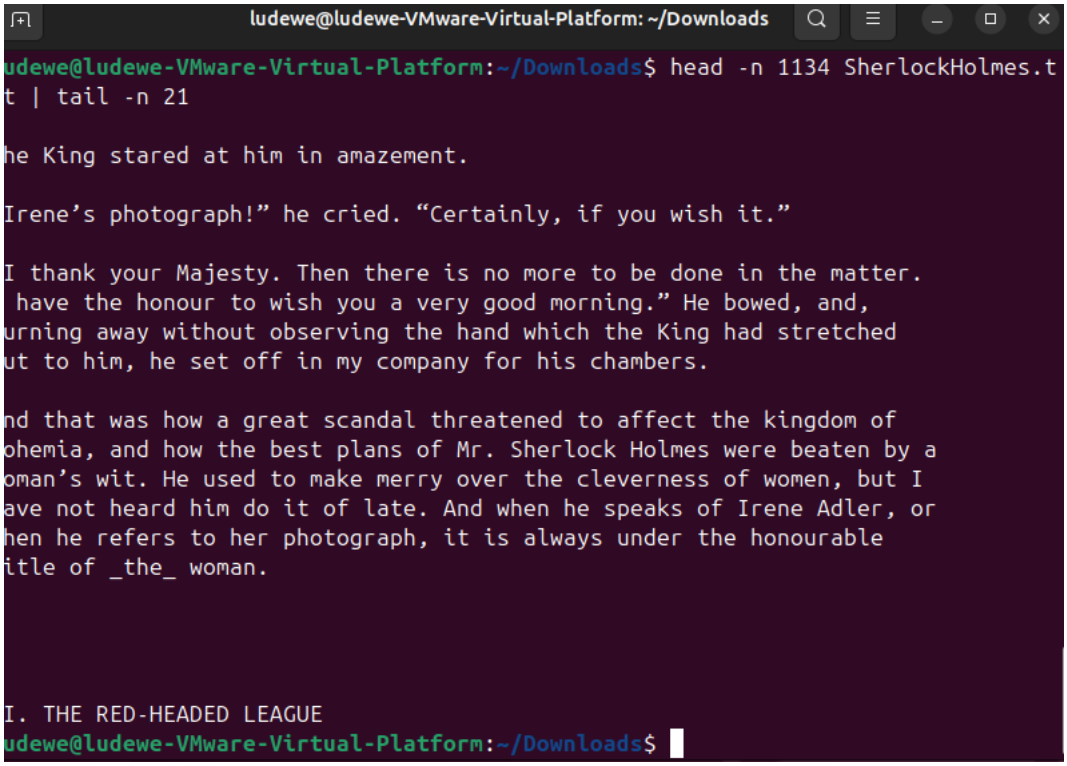
• How many lines does the file have? How many words? And how many characters?

```
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads$ wc -l SherlockHolmes.txt
12306 SherlockHolmes.txt
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads$ wc -w SherlockHolmes.txt
107562 SherlockHolmes.txt
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads$ wc -m SherlockHolmes.txt
593731 SherlockHolmes.txt
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads$
```

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

```
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads$ grep -n "kingdom" SherlockHol
mes.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
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads$
```

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

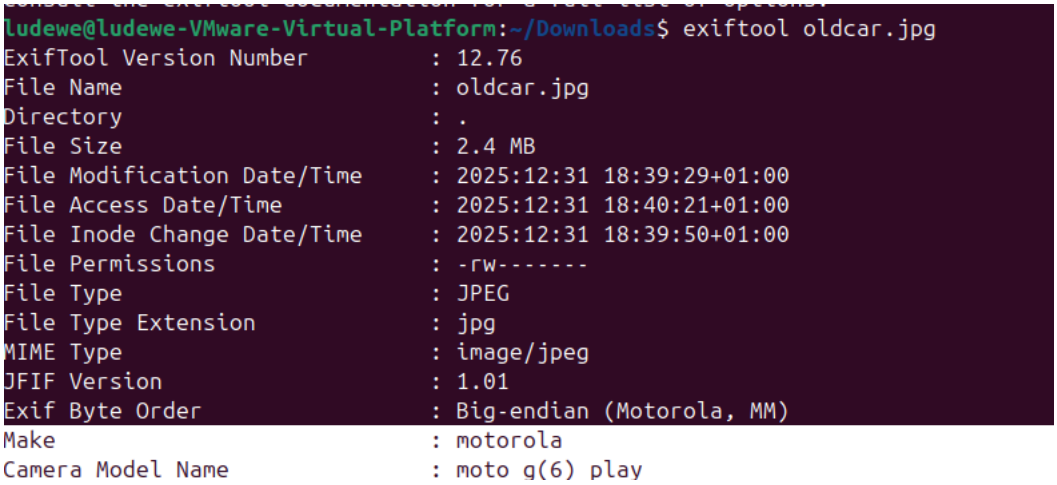


Assignment 5.7: Digital forensics

Relevant screenshots + motivation

During a raid, several smartphones were confiscated with some interesting photos on them. Analyze the jpeg file with the EXIF tool and document the following metadata for this file. Download the file: oldcar.jpg from Brightspace, copy it to your Ubuntu VM.

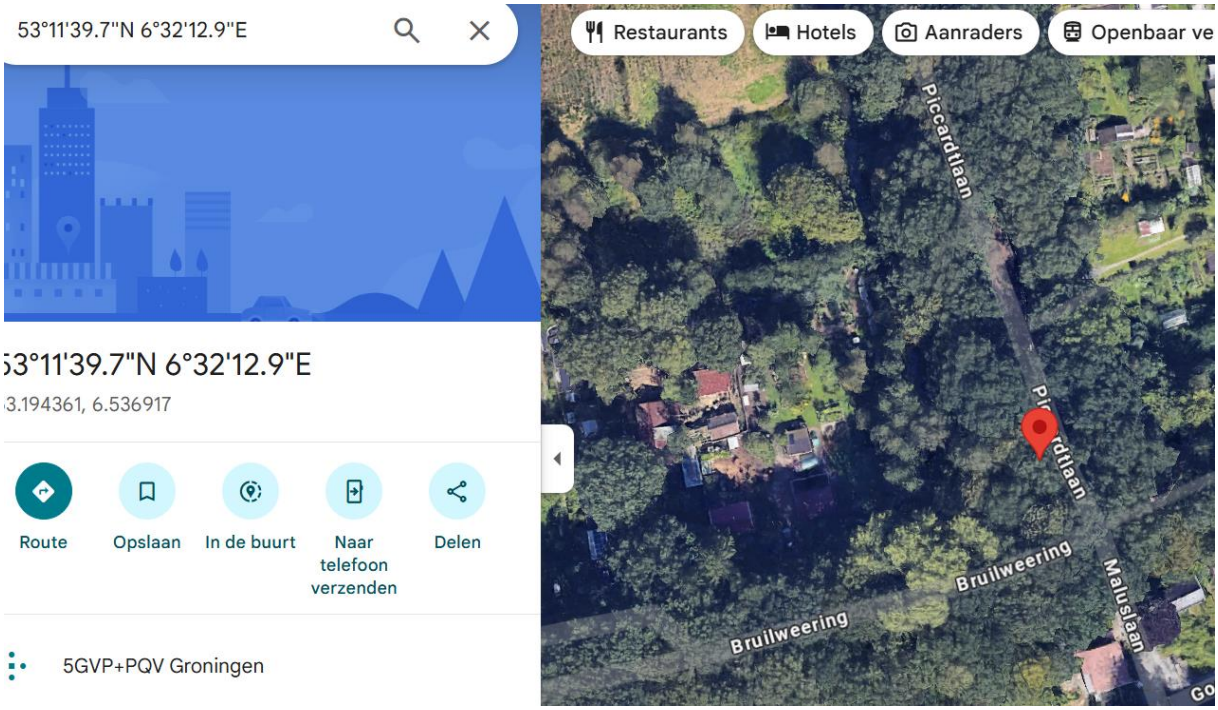
• Identify phone brand/type



• Are there GPS coordinates known?

o If yes: look up the location in Google maps and Streetview

o In which city was this photo taken?



Groningen!

• Rename the file to oldcar. (So you've removed the file extension)

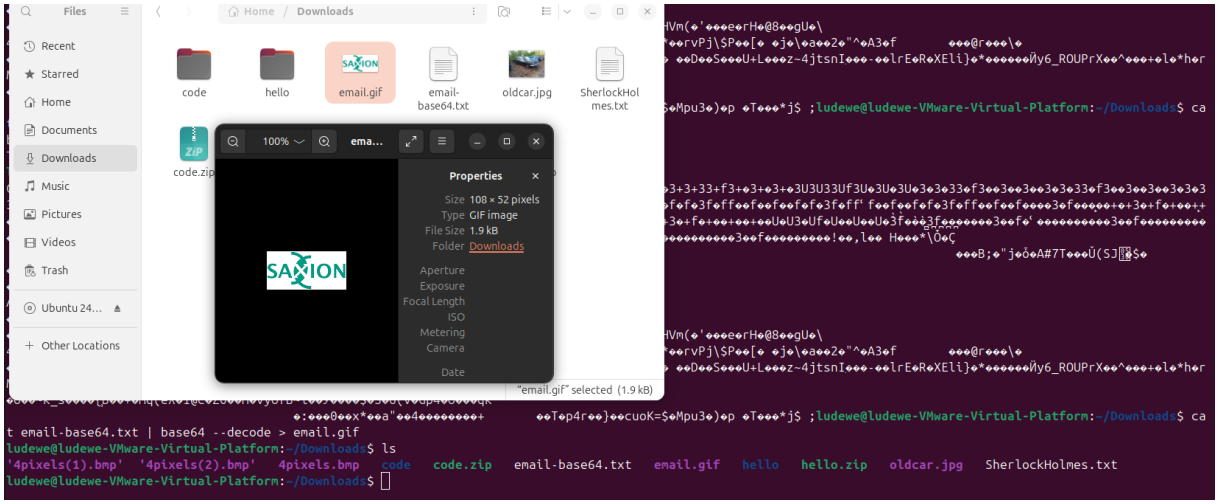
• In the terminal, type the command file oldcar.

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

```
'4pixels(1).bmp'  '4pixels(2).bmp'   4pixels.bmp   code   code.zip   hello   hello.zip   oldcar.jpg   SherlockHolmes.txt
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads$ ls
'4pixels(1).bmp'  '4pixels(2).bmp'   4pixels.bmp   code   code.zip   hello   hello.zip   oldcar   SherlockHolmes.txt
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads$ 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
ludewe@ludewe-VMware-Virtual-Platform:~/Downloads$
```

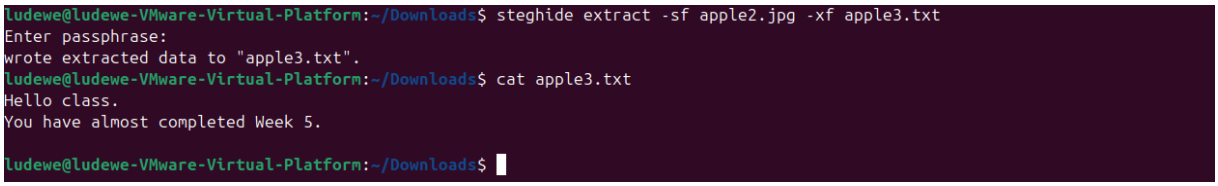
Yes it still considers it a jpg file.

Decode this BASE64 String, and save the output as a binary gif file. To do this, use the base64 command on the Ubuntu VM. Read the man pages of the base64 command on your Ubuntu VM and find out how to do this. TIP! Figure out how to send output to a file instead of the screen on Linux:



Assignment 5.8: Steganography

Relevant screenshots + motivation



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.

```
PS C:\Users\ludew> ssh ludewe@192.168.139.135
The authenticity of host '192.168.139.135 (192.168.139.135)' can't be established.
ED25519 key fingerprint is SHA256:cVD0G1tXjA3j9j6nBB0JcHlh802WNo+JoGb1DypBs+o.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.139.135' (ED25519) to the list of known hosts.
ludewe@192.168.139.135's password:
Linux debian 6.1.0-41-amd64 #1 SMP PREEMPT_DYNAMIC Debian 6.1.158-1 (2025-11-09) 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.
ludewe@debian:~$
```

--

```
ubuntu@ubuntu:~$ sudo dd if=/dev/sda bs=4M status=progress | gzip | ssh ludewe@1
92.168.139.135 "cat > /srv/images/ubuntu2404_vm.img.gz"
260046848 bytes (260 MB, 248 MiB) copied, 1 s, 258 MB/s
68522344448 bytes (69 GB, 64 GiB) copied, 278 s, 246 MB/s
16384+0 records in
16384+0 records out
68719476736 bytes (69 GB, 64 GiB) copied, 278.965 s, 246 MB/s
ubuntu@ubuntu:~$
```

```
ubuntu@ubuntu: ~
ubuntu@ubuntu:~$ ssh ludewe@192.168.139.135 "cat /srv/images/ubuntu2404_vm.img.g
z" | gzip -d | sudo dd of=/dev/sda bs=4M status=progress
The authenticity of host '192.168.139.135 (192.168.139.135)' can't be establishe
d.
ED25519 key fingerprint is SHA256:CmWbHUJb0VP5BQ48jeE1MULwIsafBg9m5l5+A755UEU.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.139.135' (ED25519) to the list of known host
s.
ludewe@192.168.139.135's password:
68591419392 bytes (69 GB, 64 GiB) copied, 268 s, 256 MB/s
0+2045547 records in
0+2045547 records out
68719476736 bytes (69 GB, 64 GiB) copied, 268.807 s, 256 MB/s
ubuntu@ubuntu:~$ S
```

(it would not transfer correctly so it didn't boot from the hard disk)

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