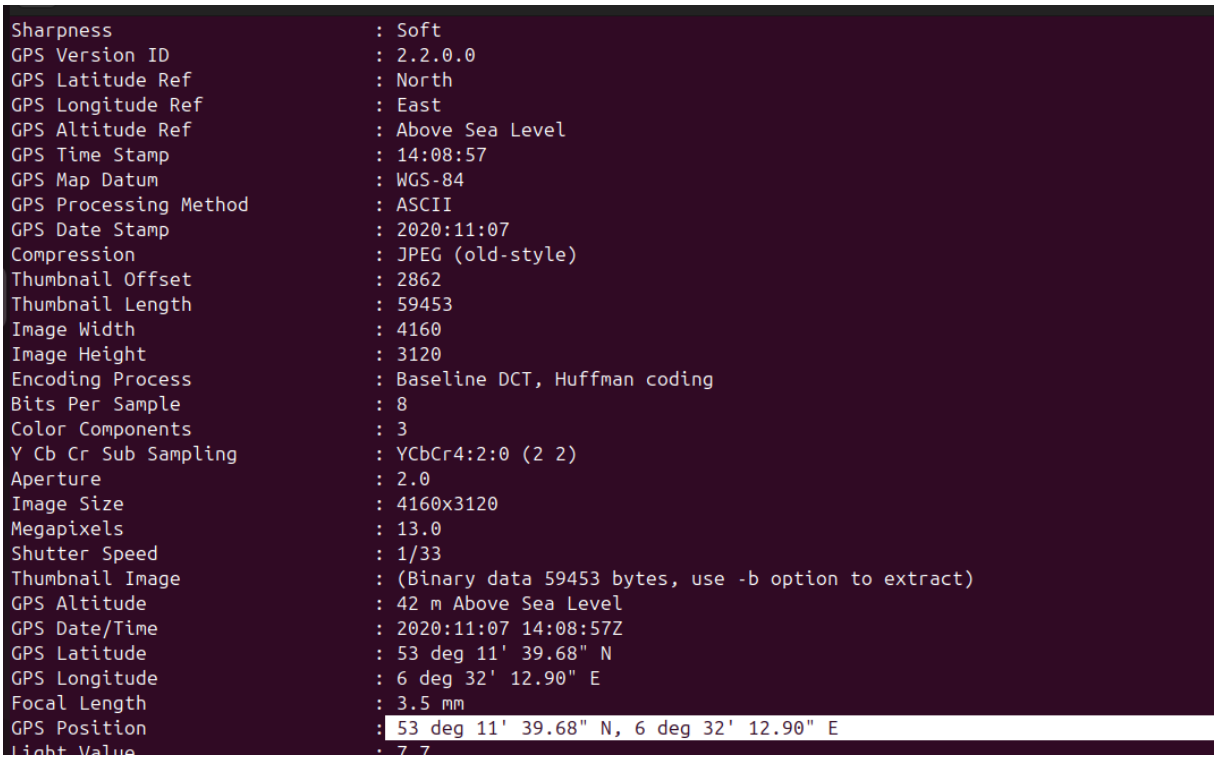


Template Week 5 – Operating Systems

Student number: 589948

Assignment 5.1: Unix-like

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

-UNIX is het originele besturingssysteem dat in de jaren 70 werd ontwikkeld. Het is commercieel, gesloten broncode en alleen systemen met een officiële certificering mogen zichzelf UNIX noemen. Voorbeelden zijn AIX, HP-UX en Solaris. Unix-like systemen lijken functioneel op UNIX, maar zijn niet officieel gecertificeerd. Deze systemen gebruiken dezelfde principes (processen, shells, bestandssysteem, permissies) maar zijn meestal open-source. Voorbeelden zijn Linux, FreeBSD, OpenBSD, NetBSD en macOS. UNIX is het originele, gecertificeerde systeem. Unix-like systemen zijn moderne varianten die werken zoals UNIX maar niet gecertificeerd zijn.

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:

Mede-ontwerper van UNIX bij Bell Labs. Hij schreef de eerste UNIX-kernel en ontwikkelde de B-programmeertaal (voorloper van C).

Dennis Ritchie:

Samen met Thompson ontwikkelde hij UNIX opnieuw in de programmeertaal C, die hij zelf ontwierp. De taal C en UNIX vormen de basis voor vrijwel alle moderne software.

Bill Joy:

Belangrijke ontwikkelaar van BSD UNIX. Hij schreef onder andere de vi-editor en werkte mee aan de TCP/IP-implementatie die later internetstandaard werd. Oprichter van Sun Microsystems.

Richard Stallman:

Oprichter van het GNU-project en de Free Software Foundation. Hij promoot vrije software en creëerde de GPL-licentie. Zijn doel was een volledig vrij UNIX-achtig besturingssysteem.

Linus Torvalds:

Ontwikkelde in 1991 de Linux-kernel. In combinatie met GNU-software ontstond GNU/Linux, dat uitgroeide tot het grootste open-source besturingssysteem ter wereld.

c) What is the philosophy of the GNU movement?
-De GNU-filosofie draait om vrije software. Vrij betekent dat gebruikers het recht hebben om software te gebruiken, te bestuderen, te wijzigen en te verspreiden. Het gaat dus om vrijheid, niet om “gratis”. Het doel is volledige controle en transparantie voor de gebruiker.

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

-Ja, grotendeels. Ubuntu is gebaseerd op GNU/Linux en bevat veel vrije software. De meeste onderdelen (kernel, shell, utilities) volgen de GNU-licentie. Toch is het niet volledig in lijn met de GNU-filosofie, omdat Ubuntu ook gesloten drivers en firmware aanbiedt (bijvoorbeeld voor NVIDIA of bepaalde Wi-Fi-chips). Daarom is Ubuntu niet 100% vrij volgens de strikte GNU-opvatting.

e) Find out what is the Windows Subsystem for Linux?
-WSL is een systeem van Microsoft waarmee Linux binnen Windows kan draaien zonder virtuele machine. Hiermee kun je Linux-commandoregelprogramma’s gebruiken, Linux-distributies installeren (zoals Ubuntu of Debian) en Linux-tools gebruiken terwijl je Windows blijft gebruiken. WSL 2 gebruikt zelfs een echte Linux-kernel.

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

Android: Gebaseerd op de Linux-kernel, dus onderdeel van de Linux-familie (Unix-like).

iOS: Gebaseerd op Darwin, dat voortkomt uit BSD-UNIX. Behoort tot de BSD-familie (Unix-like).

ChromeOS: Gebaseerd op Gentoo Linux. Behoort dus ook tot de Linux-familie (Unix-like).

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 zijn extreem krachtige computers die bestaan uit duizenden tot honderdduizenden CPU's of GPU's die parallel samenwerken. Ze worden gebruikt voor berekeningen die te groot of te complex zijn voor gewone computers. Typische toepassingen zijn:

Weers- en klimaatmodellen, Wetenschappelijk onderzoek (bijv. simulaties van moleculen, sterrenstelsels)Kernfusie- en energieonderzoek Ontwerp van nieuwe medicijnen, Complexe wiskundige berekeningen, Nationale veiligheid, defensie en cryptografie

Kort gezegd: supercomputers worden gebruikt wanneer enorme rekenkracht nodig is om problemen op te lossen die met normale computers niet haalbaar zijn.

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 PlayStation 3 cluster is een systeem waarin veel PlayStation 3-consoles samen als één supercomputer worden gebruikt. De Cell-processor in de PS3 was oorspronkelijk ontwikkeld in samenwerking met IBM en heeft eigenschappen die geschikt zijn voor wetenschappelijke berekeningen.
Volgens de informatie over de PS3 cluster:
De Air Force heeft een cluster gebouwd met meer dan 1.700 PS3's.
Het werd gebruikt voor beeldverwerking, patroonherkenning, simulaties en onderzoek.
Het cluster was bijzonder kostenefficiënt omdat PS3's goedkope maar krachtige Cell-processors bevatten.
Het PlayStation 3 cluster werd dus gebruikt voor echte supercomputer-toepassingen zoals simulaties en militaire onderzoeksprojecten.

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?

-Volgens Oracle's eigen blog over hun Raspberry Pi supercomputercluster:
Het cluster gebruikt Oracle Linux als besturingssysteem.
Oracle Linux draait op ARM-processors, wat compatibel is met de Raspberry Pi.
Dus: Het besturingssysteem is 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/

-De TOP500-lijst bevat alleen de snelste supercomputers ter wereld, gebaseerd op zeer krachtige CPU- en GPU-architecturen. Op de TOP500-pagina is Oracle's Raspberry Pi cluster niet te vinden.

Dat is logisch omdat: Raspberry Pi's relatief zwakke ARM-processors hebben. Ze zijn vooral bedoeld voor onderwijs, testen en hobbyprojecten. De prestaties zijn vele duizenden keren lager dan die van echte supercomputers. Conclusie: Oracle's Raspberry Pi cluster staat niet in de TOP500-lijst.

e) What CPU architecture is used for the PlayStation 5 and Xbox Series X?
What operating systems run on these consoles?
What conclusion can you draw from the answer to the previous question?

-PlayStation 5:

- CPU-architectuur: AMD Zen 2, x86-64.
- OS: aangepaste versie van Orbis OS, gebaseerd op FreeBSD

Xbox Series X:

- CPU-architectuur: AMD Zen 2, x86-64.
- OS: aangepaste Windows NT-kernel.

Conclusie:
Hoewel de PlayStation 5 en Xbox Series X verschillende besturingssystemen gebruiken gebruiken ze dezelfde CPU-architectuur, namelijk x86-64. Dit laat zien dat hardware en software onafhankelijk kunnen verschillen: consoles kunnen dezelfde processorarchitectuur delen terwijl ze totaal verschillende besturingssystemen gebruiken. Het maakt ook het ontwikkelen van games gemakkelijker, omdat dezelfde CPU-architectuur voor beide consoles wordt gebruikt.

Assignment 5.3: Working with Windows

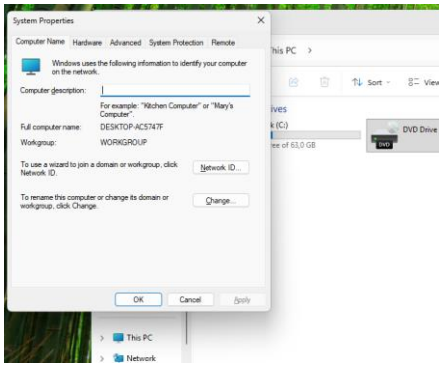
Take relevant screenshots of the assignments below

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.

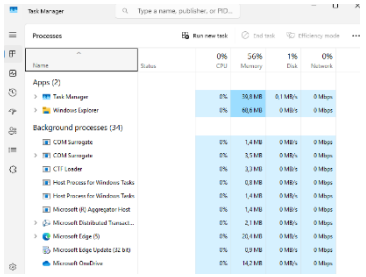
b) The file explorer can be opened with ⊞ + E, Which key combination could you also use?

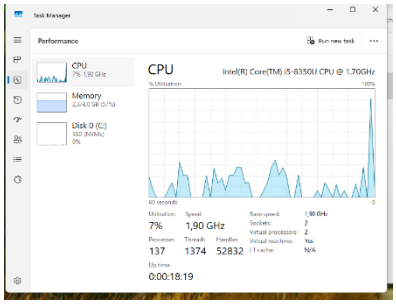
-Win + R typ dan: explorer, en dan Enter

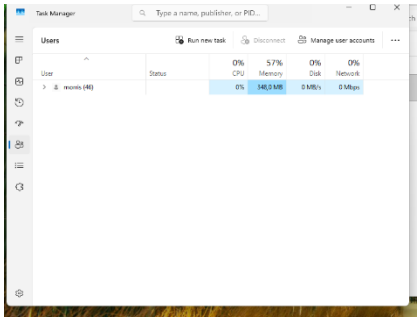
c) Open the system properties with a ⊞ key combination, take a screenshot of the open screen. Paste this screenshot into this template.
-Win + R en typ: sysdm.cpl, en dan Enter. Ik heb geen pause/break op mijn toetsenbord.



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.



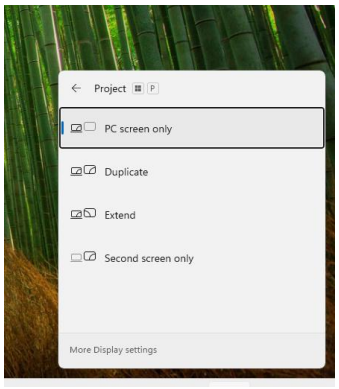




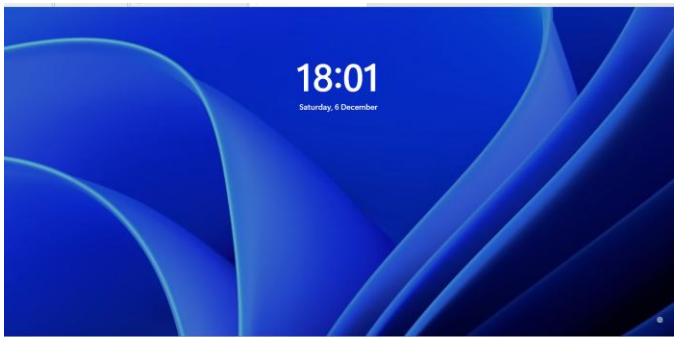
-Ctrl + Shift + Esc

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?

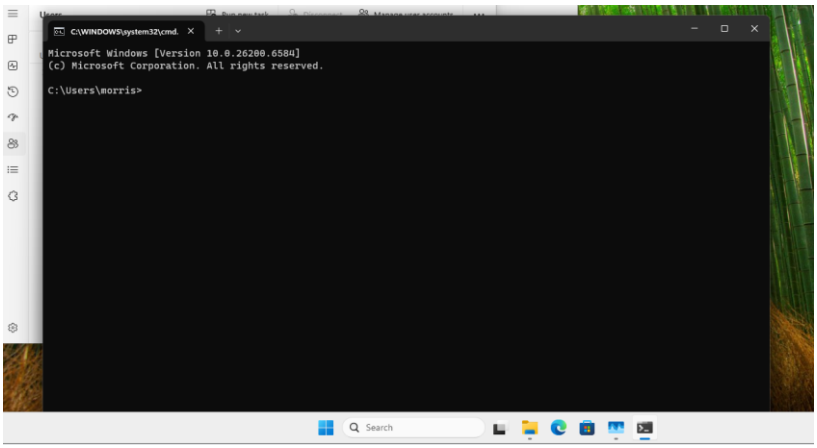
-Win + p



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?
-Win +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.
Win + r en dan CMD typen:



Working in the File Explorer

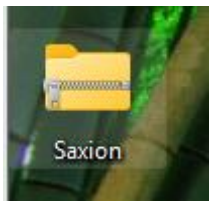
Relevant screenshots **copy** command:

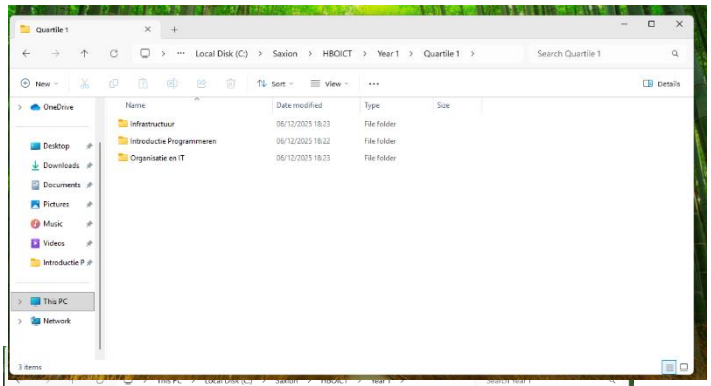
```
C:\Saxion>copy Wave.png "C:\Saxion\HBOICT\Year 1\Quartile 1\Introductie Programmeren"
        1 file(s) copied.

C:\Saxion>copy Plug.png "C:\Saxion\HBOICT\Year 1\Quartile 1\Infrastructuur"
        1 file(s) copied.

C:\Saxion>copy Tumble.png "C:\Saxion\HBOICT\Year 1\Quartile 1\Organisatie en IT"
        1 file(s) copied.
```

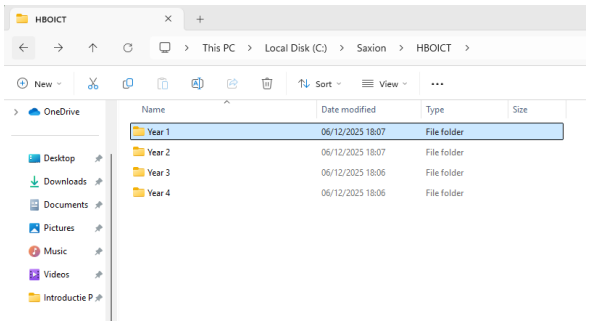
Relevant screenshots **tree** command:

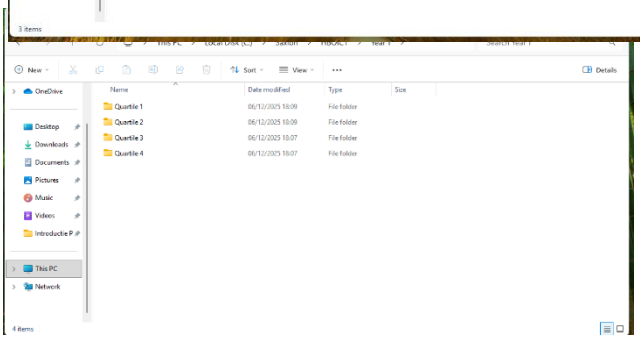
```
C:\Saxion>copy Wave.png "C:\Saxion\HBOICT\Year 1\Quartile 1\Introductie Programmeren"
       1 file(s) copied.

C:\Saxion>copy Plug.png "C:\Saxion\HBOICT\Year 1\Quartile 1\Infrastructuur"
       1 file(s) copied.

C:\Saxion>copy Tumble.png "C:\Saxion\HBOICT\Year 1\Quartile 1\Organisatie en IT"
       1 file(s) copied.

C:\Saxion>tree
Folder PATH listing
Volume serial number is 14EF-CEEA
C:.
└───HBOICT
    ├───Year 1
    │   ├───Quartile 1
    │   │   ├───Infrastructuur
    │   │   ├───Introductie Programmeren
    │   │   └───Organisatie en IT
    │   ├───Quartile 2
    │   │   ├───Databases
    │   │   ├───IT Fundamentals
    │   │   └───Project IT in the game
    │   ├───Quartile 3
    │   └───Quartile 4
    ├───Year 2
    │   ├───Quartile 1
    │   ├───Quartile 2
    │   ├───Quartile 3
    │   └───Quartile 4
    ├───Year 3
    └───Year 4

C:\Saxion>echo %username%
morris

C:\Saxion>
```

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



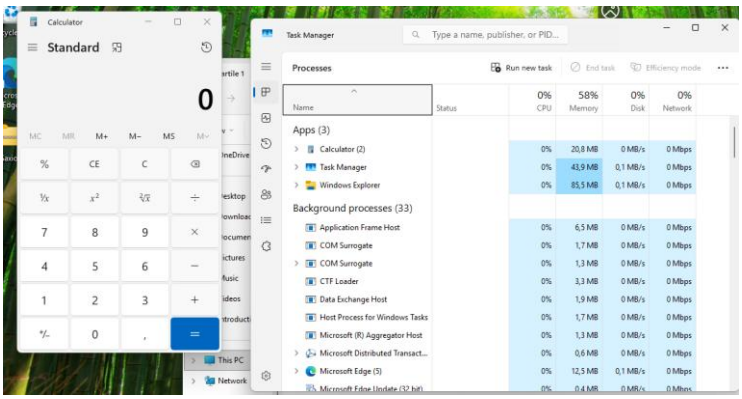


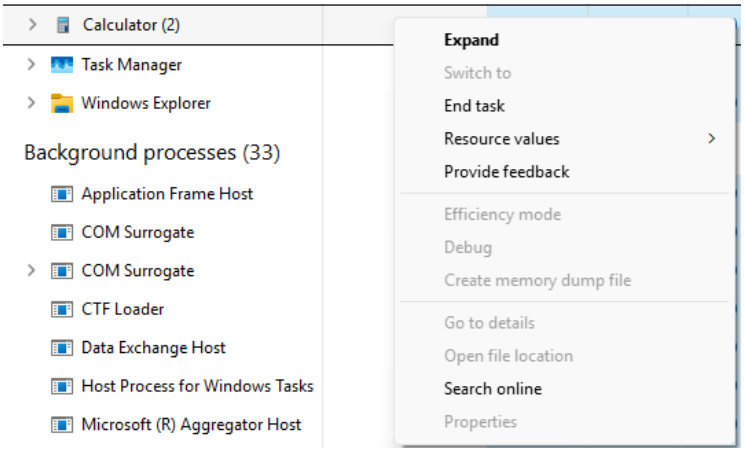




Terminating Processes

Relevant Screenshots Task Manager Window:



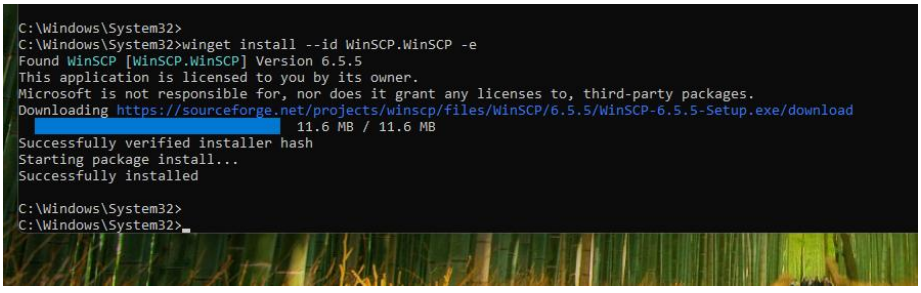


En dan end task klikken.

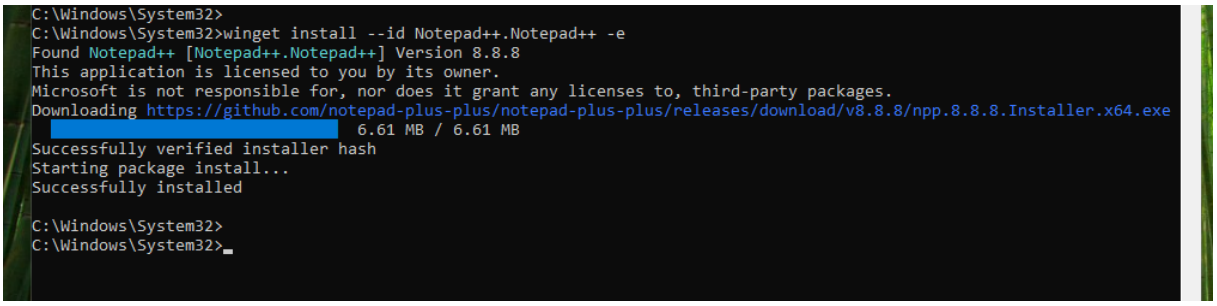
Install Software

Relevant screenshots that the following software is installed with winget:

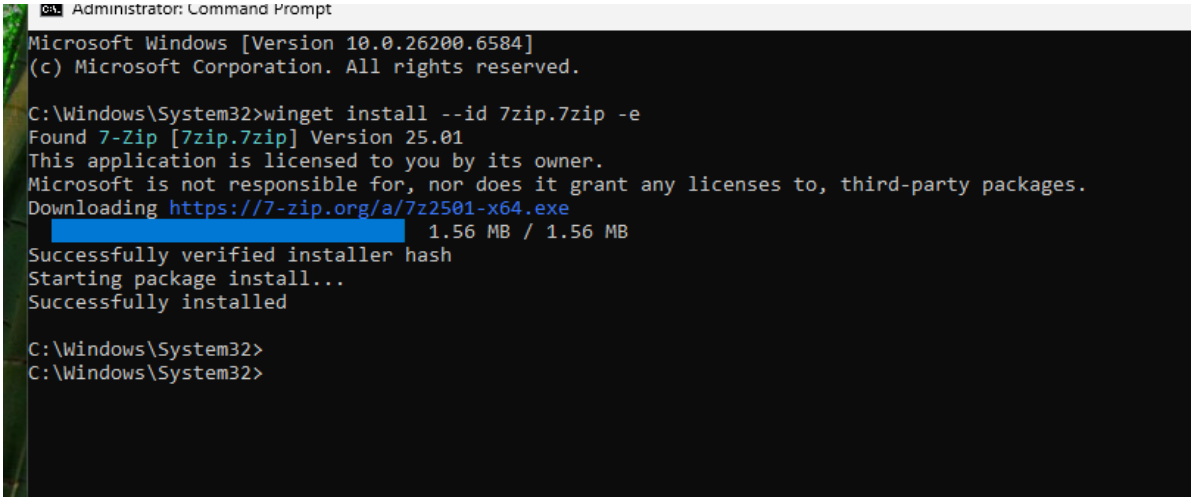
- WinSCP



- Notepad++

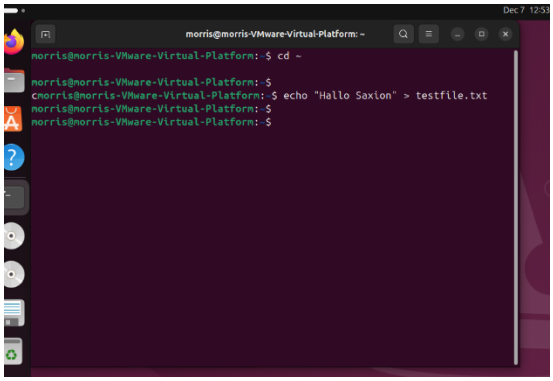


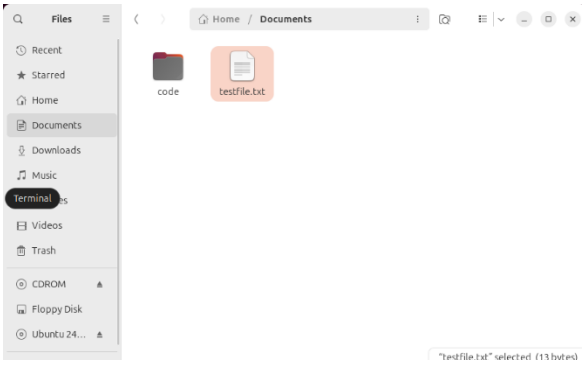
- 7zip

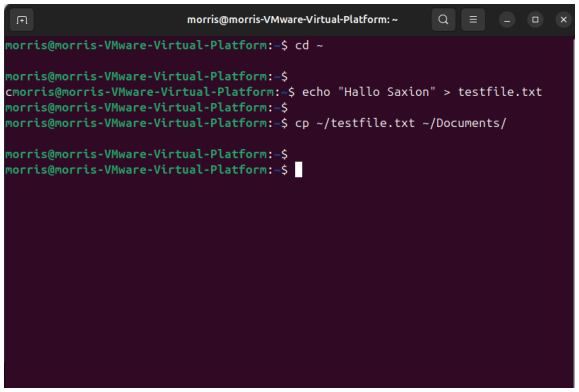


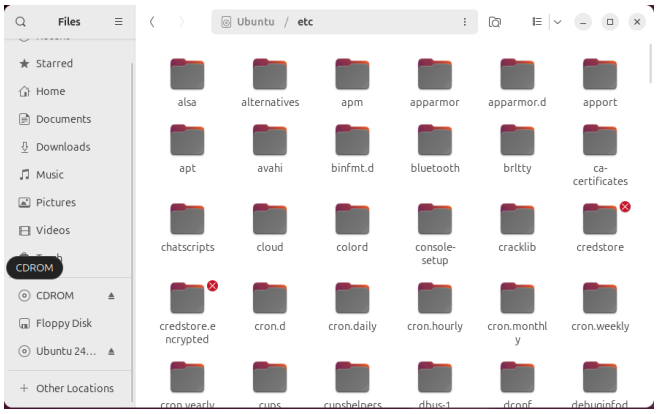
Assignment 5.4: Working with Linux

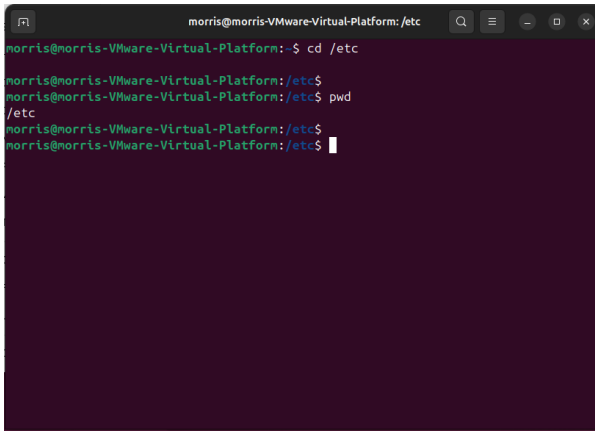
Relevant screenshots + motivation

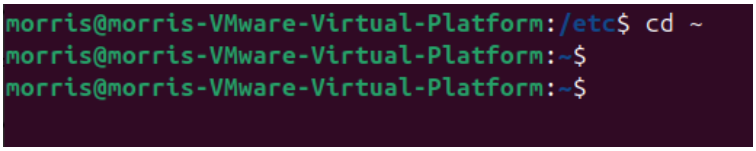












Name one significant difference in Linux's file structure when comparing it to Windows: Linux heeft geen drive letters (C:, D:). Alles begint bij een root directory /. Windows heeft meerdere schijven zoals C:\, terwijl Linux een boomstructuur gebruikt met / als basis.

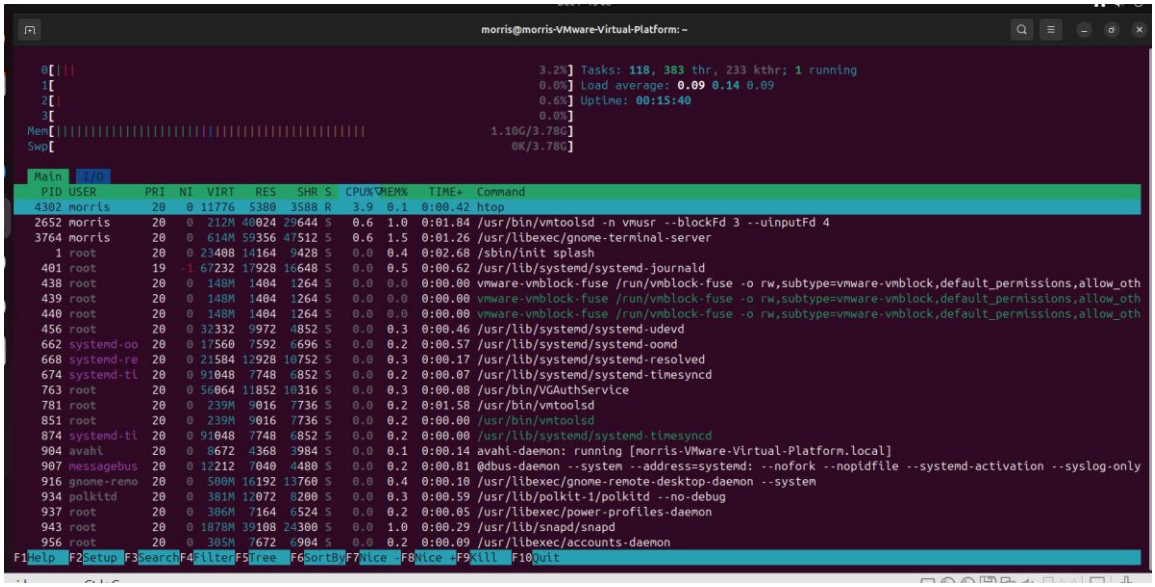
What is the /etc directory usually used for: /etc bevat systeemconfiguratiebestanden voor Linux services, netwerk, wachtwoorden, instellingen van programma's

Which command in the terminal would you use to compress a text file into a tar archive: tar -cvf archive.tar testfile.txt

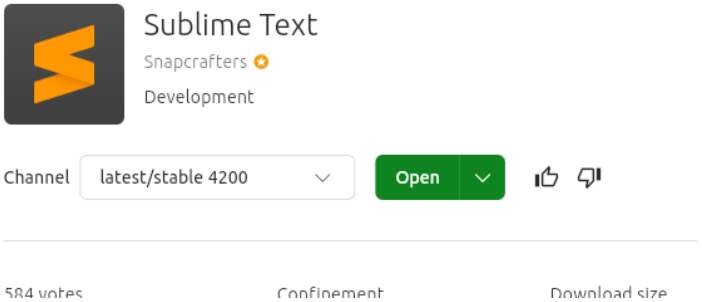
With which command in the terminal would you be able to extract a tar file: tar -xvf archive.tar

Compress a text file in a tar archive and compress it with gzip: tar -cvzf archive.tar.gz testfile.txt

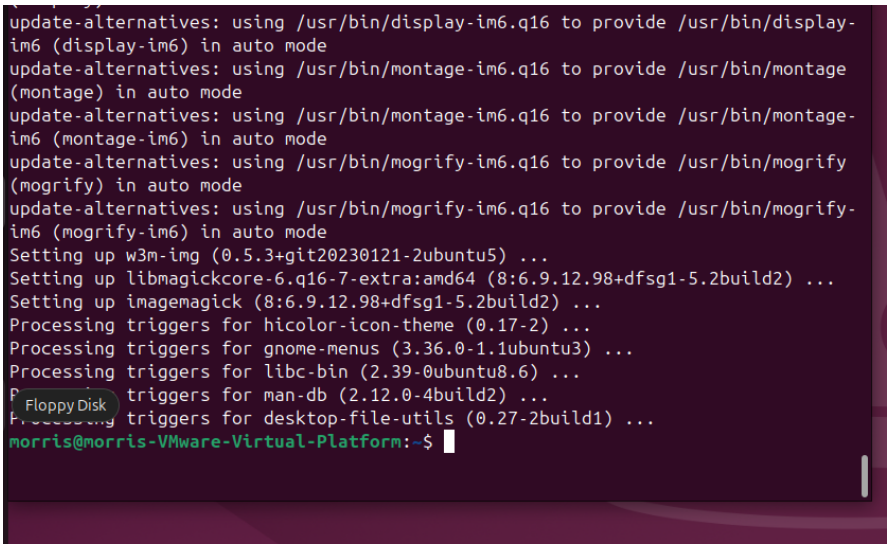
```
morris@morris-VMware-Virtual-Platform:~$ sudo apt install htop

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 116 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 0s (1,427 kB/s)
Selecting previously unselected package htop.
(Reading database ... 159841 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) ...
morris@morris-VMware-Virtual-Platform:~$
```



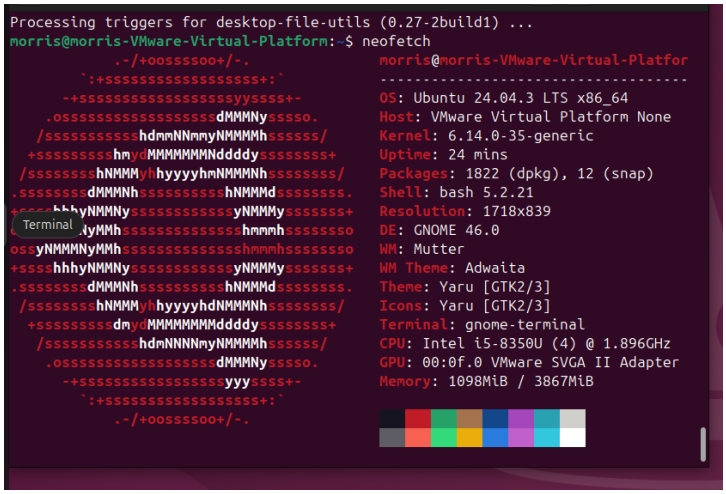
Explain what htop application shows: Een real-time overzicht van CPU-gebruik, geheugen, processen, load, threads, PID, gebruikers, etc.



Neofetch install:

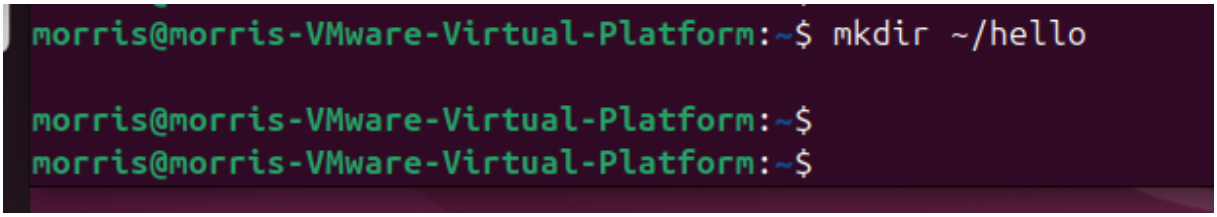


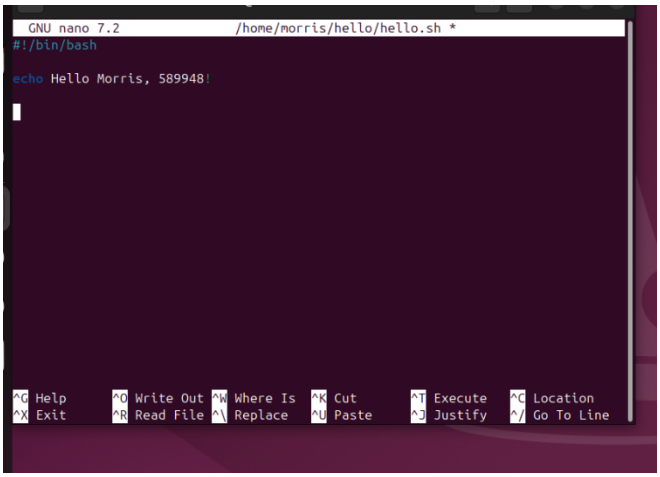
What does neofetch application show when you launch it:
Systeeminfo zoals OS, kernel, CPU, RAM, GPU, uptime, resolutie, thema, etc.

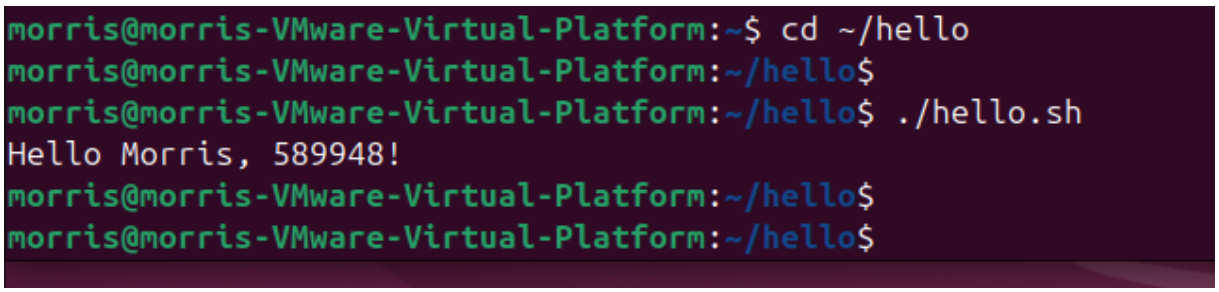


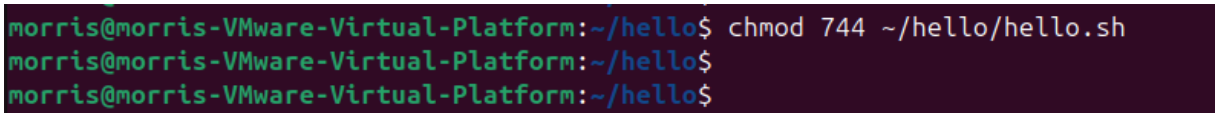
Assignment 5.5: Users and permissions on Linux

Relevant screenshots + motivation









Assignment 5.6: View the contents of files

Relevant screenshots + motivation

What does each of these commands do? Write it out for yourself:

cat
Toont de volledige inhoud van een bestand in de terminal.

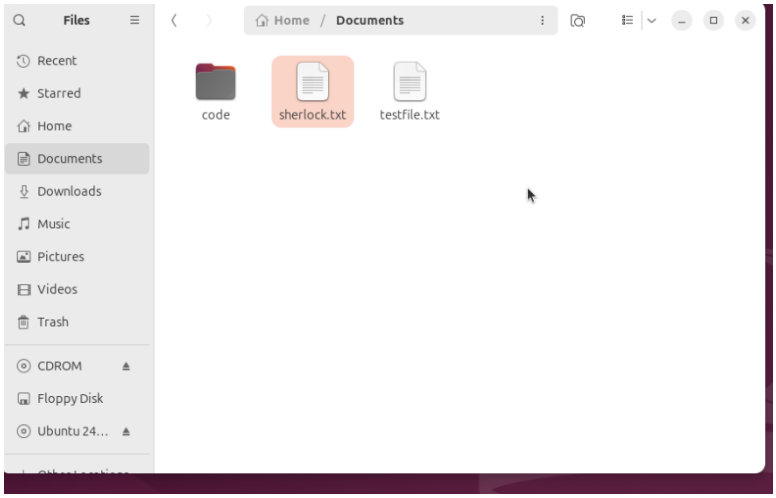
wc
Telt regels, woorden en karakters in een bestand.

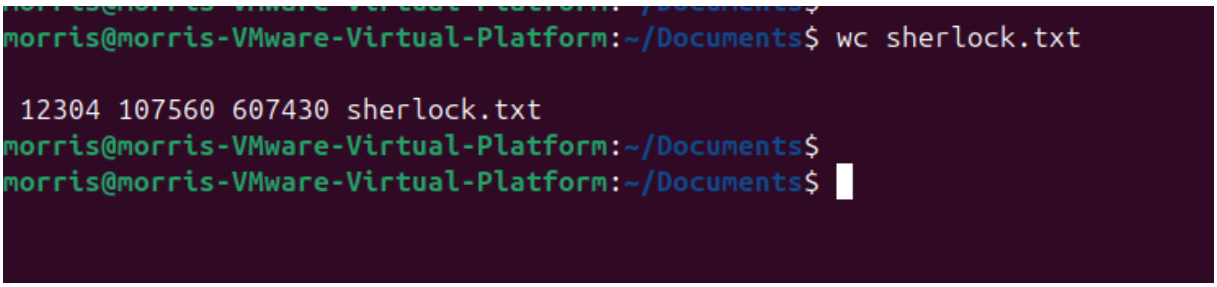
less
Opent een bestand in een scrollbaar scherm. Je kunt omhoog/omlaag bladeren.

tail
Toont de laatste regels van een bestand.

head
Toont de eerste regels van een bestand.

grep
Zoekt tekst in een bestand.
Met -n laat het ook de regelnummers zien.





Dus: 12304 regels, 107560 woorden en 607430 karakters

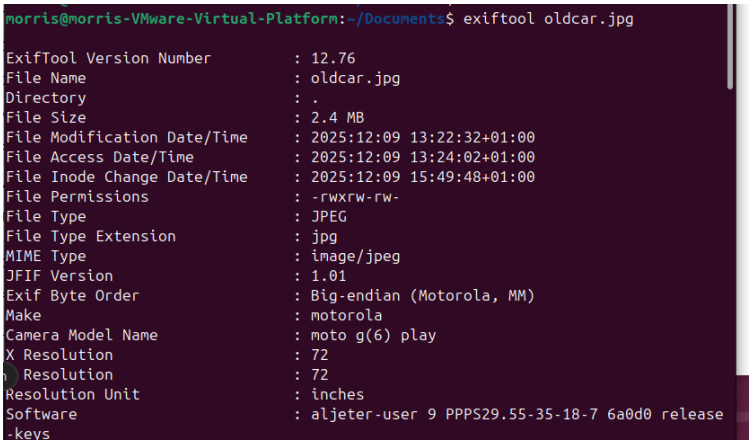
```
morris@morris-VMware-Virtual-Platform:~/Documents$ grep -n "kingdom" sherlock.t
t

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
morris@morris-VMware-Virtual-Platform:~/Documents$
morris@morris-VMware-Virtual-Platform:~/Documents$
```

Dus regels: 490 en 1124

```
morris@morris-VMware-Virtual-Platform:~/Documents$ sed -n '470,510p' sherlock.txt

betrothal was publicly proclaimed. That will be next Monday.”

“Oh, then we have three days yet,” said Holmes with a yawn. “That is
very fortunate, as I have one or two matters of importance to look into
just at present. Your Majesty will, of course, stay in London for the
present?”

“Certainly. You will find me at the Langham under the name of the Count
Von Kramm.”

“Then I shall drop you a line to let you know how we progress.”

“Pray do so. I shall be all anxiety.”

“Then, as to money?”

“You have _carte blanche_.”

“Absolutely?”

“I tell you that I would give one of the provinces of my kingdom to
have that photograph.”

“And for present expenses?”

The King took a heavy chamois leather bag from under his cloak and laid
it on the table.

“There are three hundred pounds in gold and seven hundred in notes,” he
said.

Holmes scribbled a receipt upon a sheet of his note-book and handed it
```

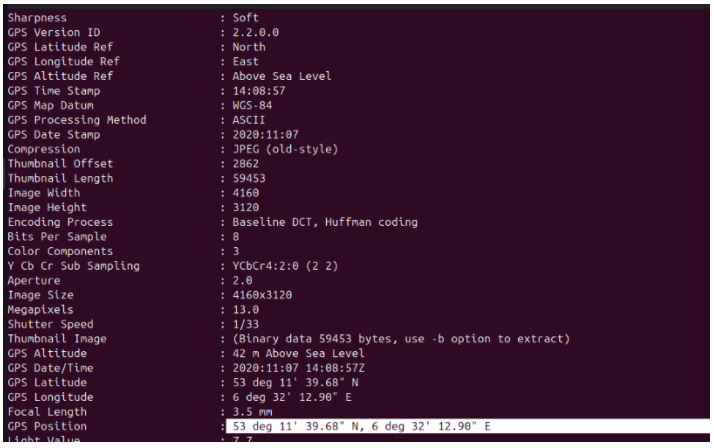
Assignment 5.7: Digital forensics

Relevant screenshots + motivation

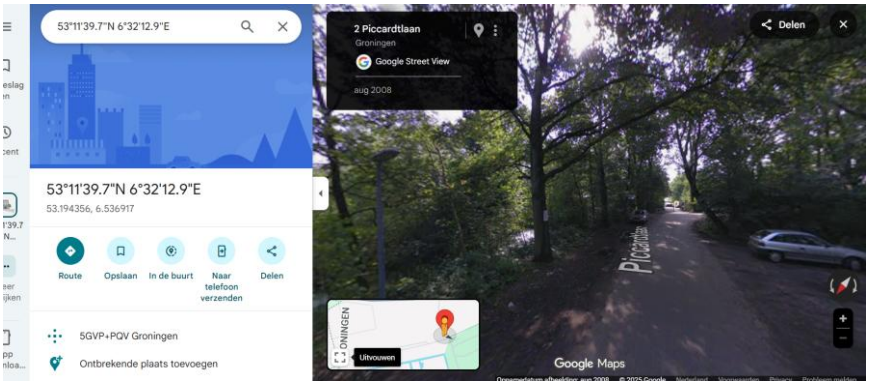


Camera model name: moto g(6) play

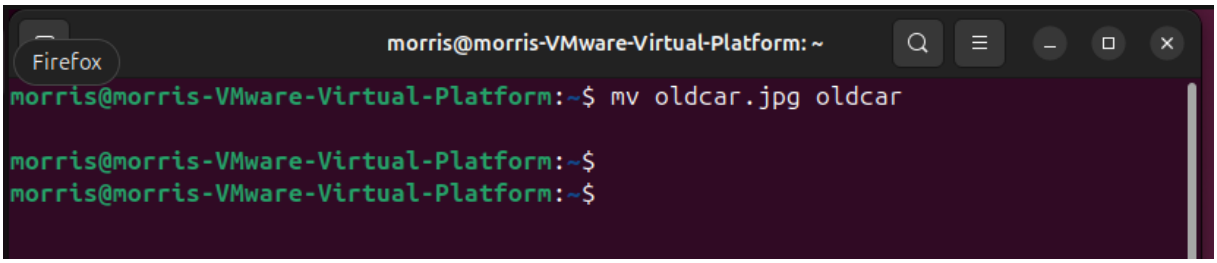
Make: motorola

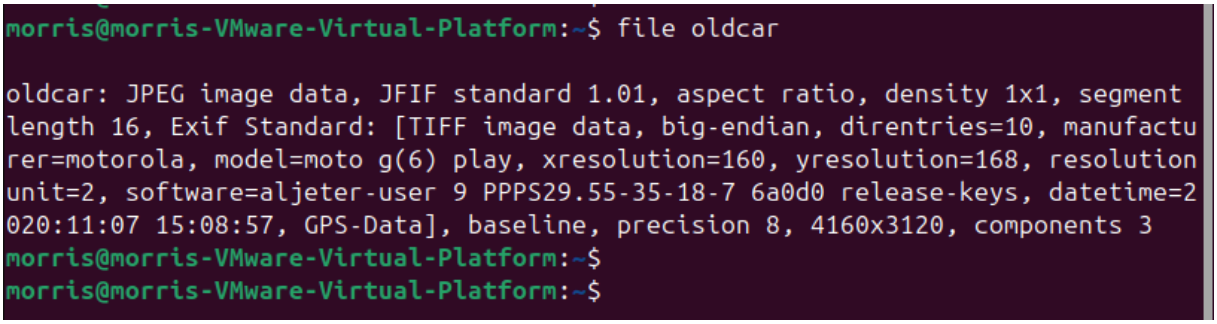


Gps position: 53 deg 11’ 39.68* N, 6 deg 32’ 12.90* E

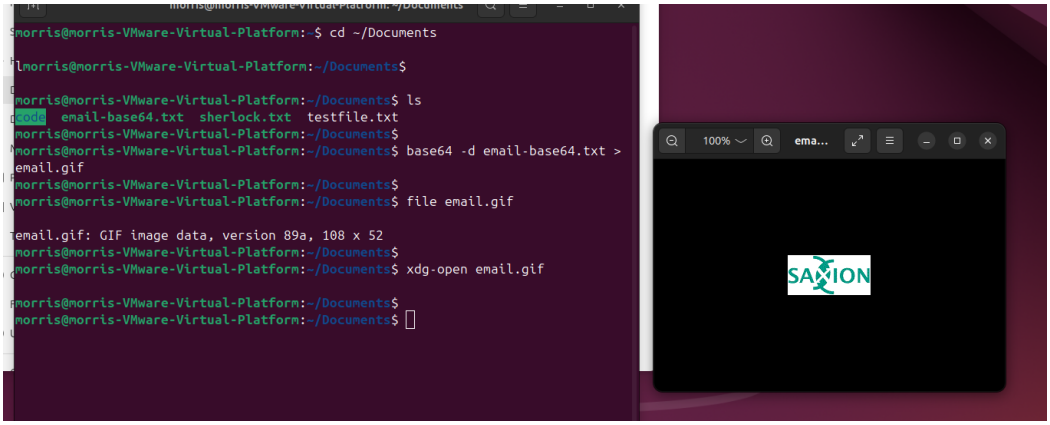


In Groningen





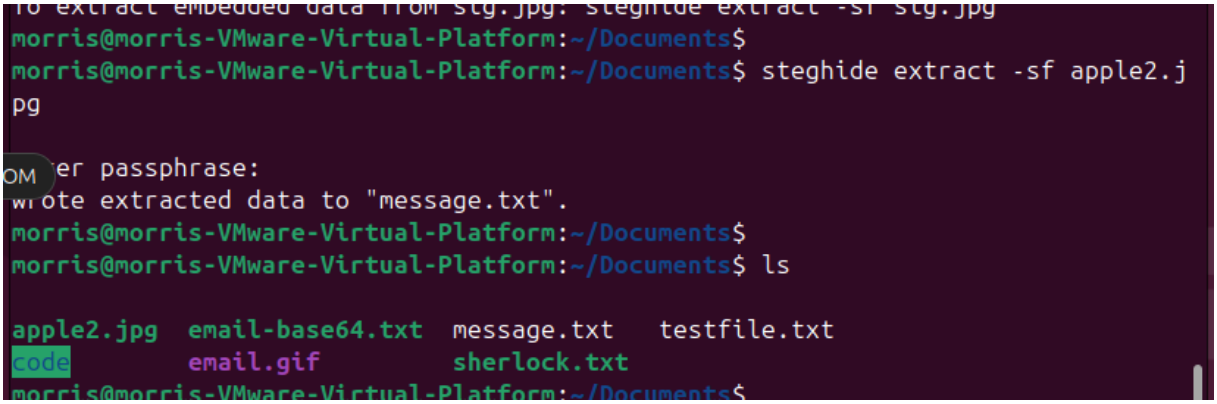
Ubuntu ziet het dus nog steeds als een jpg file.



dit is de volledige base64 opdracht.

Assignment 5.8: Steganography

Relevant screenshots + motivation



```
morris@morris-VMware-Virtual-Platform:~/Documents$ cat message.txt

Hello class.
You have almost completed Week 5.

morris@morris-VMware-Virtual-Platform:~/Documents$
morris@morris-VMware-Virtual-Platform:~/Documents$
```

Tool gebruikt: steghide

Command:

steghide extract -sf apple2.jpg

Password: apple2

Resultaat:

Ik heb de tekst als het goed is succesvol geextract.

Assignment 5.9: Capture disk images

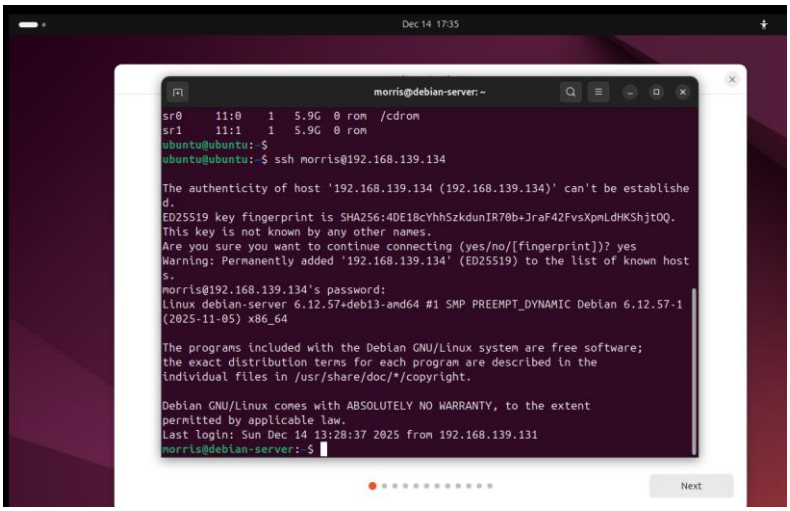
Make relevant screenshots + motivation:

- 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.

```
● ssh.service - OpenBSD Secure Shell server
     Loaded: loaded (/usr/lib/systemd/system/ssh.service; enabled; preset: enabled)
     Active: active (running) since Sun 2025-12-14 12:30:32 CET; 4min 8s ago
 Invocation: 179f445ddb884c8e8a10e67f4ff53d74
       Docs: man:sshd(8)
             man:sshd_config(5)
    Process: 842 ExecStartPre=/usr/sbin/sshd -t (code=exited, status=0/SUCCESS)
   Main PID: 873 (sshd)
      Tasks: 1 (limit: 2257)
     Memory: 2.6M (peak: 3.6M)
        CPU: 96ms
     CGroup: /system.slice/ssh.service
             └─873 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Warning: some journal files were not opened due to insufficient permissions.
morris@debian-server:~$ _
```

```
morris@debian-server:~$ ls /
bin   dev  home        initrd.img.old  lib64       media  opt   root  sbin  sys  usr  vmlinuz
boot  etc  initrd.img  lib             lost+found  mnt    proc  run   srv   tmp  var  vmlinuz.old
morris@debian-server:~$ sudo mkdir -p /srv/images
morris@debian-server:~$ ls -ld /srv/images
drwxr-xr-x 2 root root 4096 Dec 14 12:48 /srv/images
morris@debian-server:~$ sudo chown morris:morris /srv/images
morris@debian-server:~$ ls -ld /srv/images
drwxr-xr-x 2 morris morris 4096 Dec 14 12:48 /srv/images
morris@debian-server:~$
```

```
NAME   MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
fd0      2:0    1     4K  0 disk
loop0    7:0    0     4K  1 loop /snap/bare/5
loop1    7:1    0  63.8M  1 loop /snap/core20/2682
loop2    7:2    0  73.9M  1 loop /snap/core22/2045
loop3    7:3    0 245.1M  1 loop /snap/firefox/6565
loop4    7:4    0  11.1M  1 loop /snap/firmware-updater/167
loop5    7:5    0  10.8M  1 loop /snap/snap-store/1270
loop6    7:6    0    74M  1 loop /snap/core22/2163
loop7    7:7    0  49.3M  1 loop /snap/snapd/24792
loop8    7:8    0  50.9M  1 loop /snap/snapd/25577
loop9    7:9    0  18.5M  1 loop /snap/firmware-updater/210
loop10   7:10   0  64.7M  1 loop /snap/sublime-text/217
loop11   7:11   0  91.7M  1 loop /snap/gtk-common-themes/1535
loop12   7:12   0   516M  1 loop /snap/gnome-42-2204/202
loop13   7:13   0   576K  1 loop /snap/snapd-desktop-integration/315
sda      8:0    0    64G  0 disk
├─sda1   8:1    0     1M  0 part
└─sda2   8:2    0    64G  0 part /
sr0     11:0    1  1024M  0 rom
sr1     11:1    1   5.9G  0 rom  /media/morris/Ubuntu 24.04.3 LTS amd64
morris@morris-VMware-Virtual-Platform:~$
```



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