Template Week 5 – Operating Systems

Student number:

587889

Assignment 5.1: Unix-like

a) Find out what the difference is between UNIX and unix-like operating systems?
Unix is het orginele besturingssysteem, en Unix-like systemen zoals Linux en macOS zijn systemen gebouwd van het orginele Unix.

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 ontwikkelaar van Unix in 1969
Dennis Ritchie = bedenker van programmeertaal C
Bill Joy = ontwikkelaar van BSD Unix
Richard Stallman = Startte het GNU Project in 1983 en de Free Software Foundation
Linus Torvalds = ontwikkelde de Linux Kernal in 1991 gebouwd op Unix principes.

c) What is the philosophy of the GNU movement?
De GNU filosofie draait om vrijheid van softwaregebruik. Je bent hierbij vrij om software te gebruiken, bestuderen, wijzigen en delen.

d) Does Ubuntu as a Linux operating system conform to the philosophy of the GNU movement? Please explain your answer.
Ja, Ubuntu is gebaseerd op GNU/Linux en gebruikt veel vrije software, dat komt erg overeen met het GNU movement dat alles zo veel mogelijk toegankelijk moet zijn voor iedereen.

e) Find out what is the Windows Subsystem for Linux?
WSL is een functie in Windows waarmee je een Linux omgeving kunt draaien binnen Windows, zonder VM.

f) Find out, which operating system family belongs to Android, iOS and ChromeOS?
Android = Unix-like, Gebaseerd op Linux kernel
iOS = Unix-like, gebaseerd op Darwin
ChromeOS = Unix-like, gebaseerd op 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

- Weersvoorspellingen
- Code kraken
- Medicijn ontwikkeling
- Wetenschappelijk onderzoek

Ze zijn ontworpen om miljoenen berekeningen per seconde uit te voeren en worden vaak gebruikt door overheden, onderzoeksinstellingen en grote bedrijven.

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 netwerk van PS3-consoles die samenwerken als één supercomputer. De PS3 was populair voor clusters omdat hij goedkoop was en Linux kon draaien via de "OtherOS"-functie.

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's Raspberry Pi supercomputer draait op Oracle Autonomous 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/
Nee, een Raspberry Pi is een super kleine laag energie gebruik computertje, in de top 500 lijst staana de grootste machines ter wereld die ver uit het bereik staan van een Raspberry Pi.

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?

Console	CPU architectuur	OS
PS5	AMD Zen 2	Custom Platstation OS
Xbox Series X	AMD Zen 2	Custom Xbox OS

Beide consoles gebruiken dezelfde CPU-architectuur (AMD Zen 2), maar draaien op totaal verschillende besturingssystemen. Dit laat zien dat hardware gelijk kan zijn, maar software bepaalt de gebruikerservaring en ecosysteem.

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.

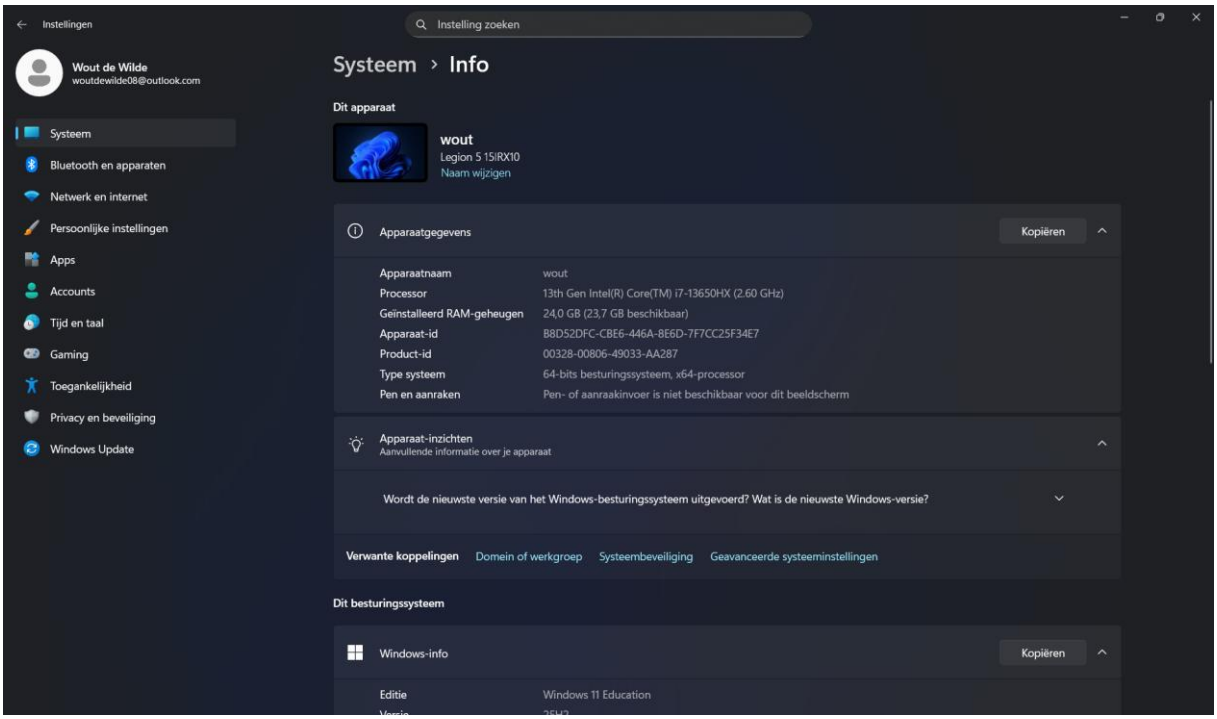
Ik heb 10 minuten geoefend met de windows shortcut combinaties.

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

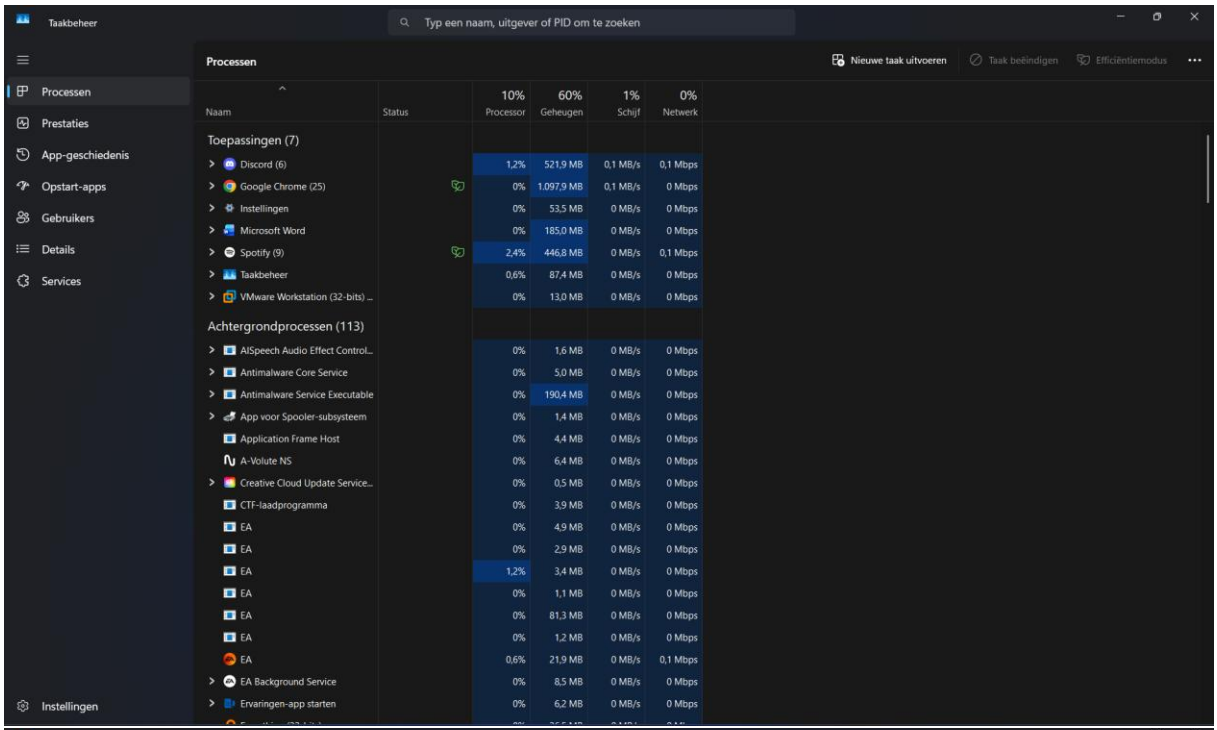
Windows + E

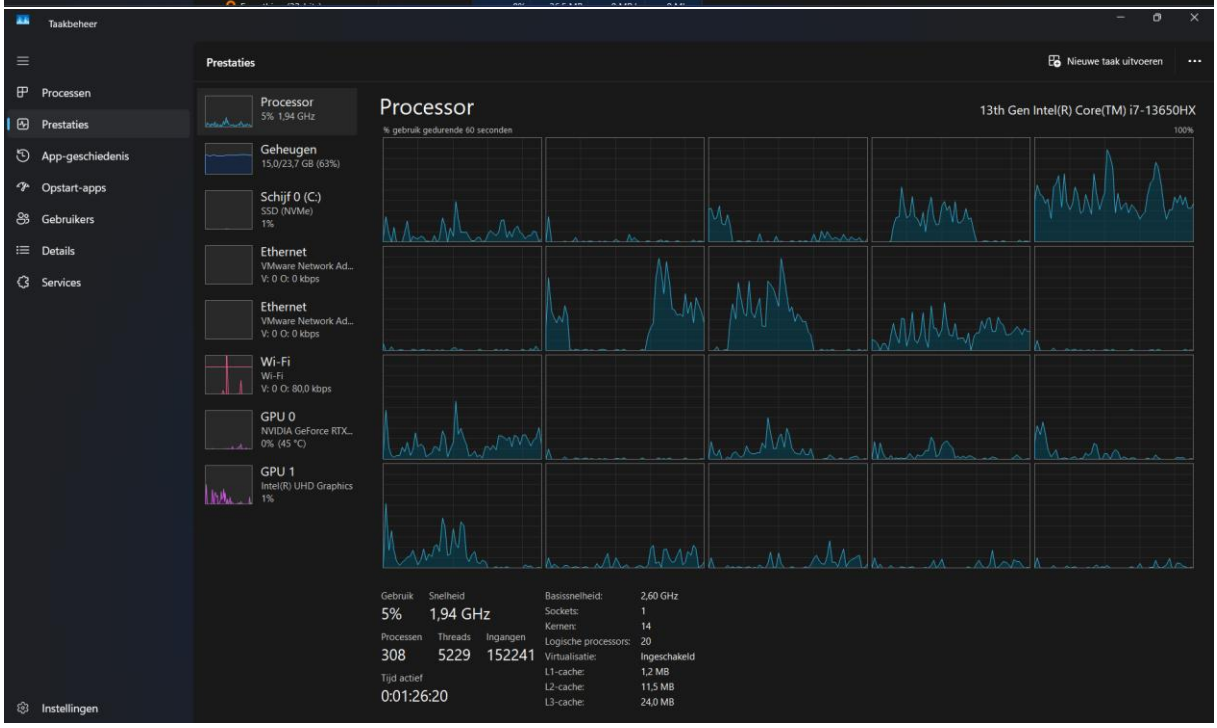
c) Open the system properties with a ⊞ key combination, take a screenshot of the open screen. Paste this screenshot into this template.

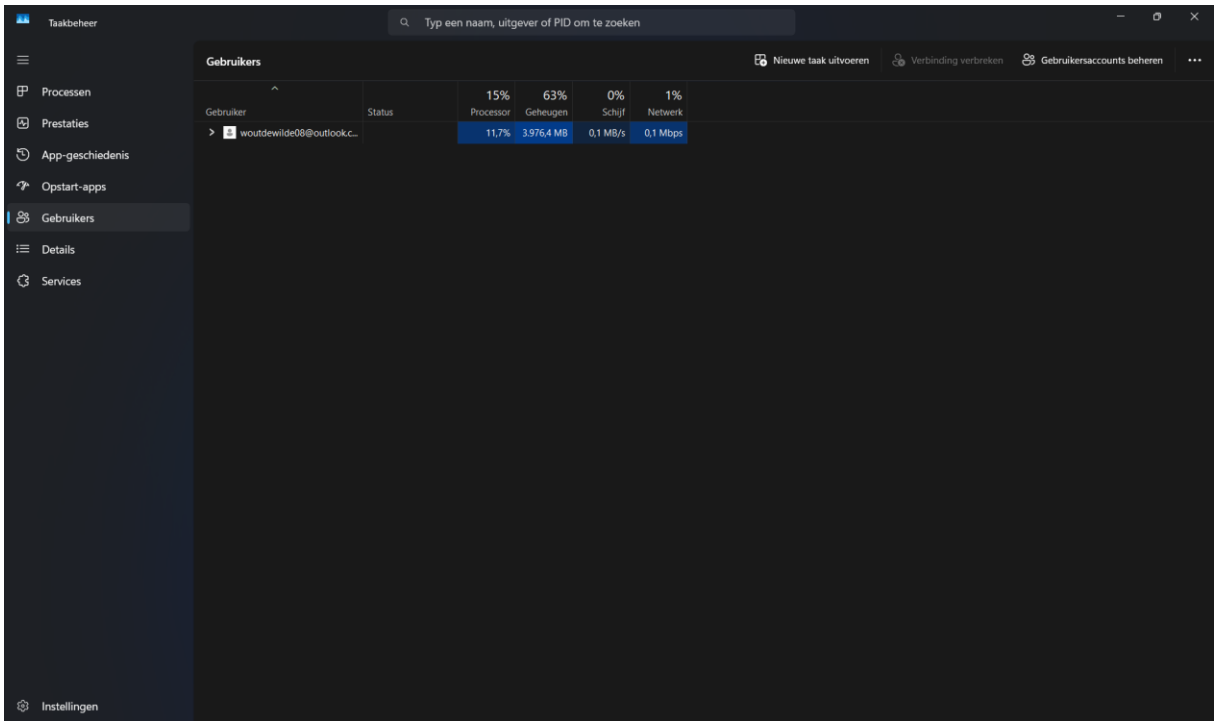
Windows + pause



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.
Control + Shift + Escape


Taakbeheer
Typ een naam, uitgever of PID om te zoeken
Processen
Nieuwe taak uitvoeren
Taak beëindigen
Efficiëntiemodus
Processen
Prestaties
App-geschiedenis
Opstart-apps
Gebruikers
Details
Services
Instellingen
Naam
Status
10% Processor
60% Geheugen
1% Schijf
0% Netwerk
Toepassingen (7)
Discord (6) 1,2% 521,9 MB 0,1 MB/s 0,1 Mbps
Google Chrome (25) 0% 1.097,9 MB 0,1 MB/s 0 Mbps
Instellingen 0% 53,5 MB 0 MB/s 0 Mbps
Microsoft Word 0% 185,0 MB 0 MB/s 0 Mbps
Spotify (9) 2,4% 446,8 MB 0 MB/s 0,1 Mbps
Taakbeheer 0,6% 87,4 MB 0 MB/s 0 Mbps
VMware Workstation (32-bits) ... 0% 13,0 MB 0 MB/s 0 Mbps
Achtergrondprocessen (113)
AISpeech Audio Effect Control... 0% 1,6 MB 0 MB/s 0 Mbps
Antimalware Core Service 0% 5,0 MB 0 MB/s 0 Mbps
Antimalware Service Executable 0% 190,4 MB 0 MB/s 0 Mbps
App voor Spooler-subsysteem 0% 1,4 MB 0 MB/s 0 Mbps
Application Frame Host 0% 4,4 MB 0 MB/s 0 Mbps
A-Volute NS 0% 6,4 MB 0 MB/s 0 Mbps
Creative Cloud Update Service... 0% 0,5 MB 0 MB/s 0 Mbps
CTF-laadprogramma 0% 3,9 MB 0 MB/s 0 Mbps
EA 0% 4,9 MB 0 MB/s 0 Mbps
EA 0% 2,9 MB 0 MB/s 0 Mbps
EA 1,2% 3,4 MB 0 MB/s 0 Mbps
EA 0% 1,1 MB 0 MB/s 0 Mbps
EA 0% 81,3 MB 0 MB/s 0 Mbps
EA 0% 1,2 MB 0 MB/s 0 Mbps
EA 0,6% 21,9 MB 0 MB/s 0,1 Mbps
EA Background Service 0% 8,5 MB 0 MB/s 0 Mbps
Ervaringen-app starten 0% 6,2 MB 0 MB/s 0 Mbps


Taakbeheer
Prestaties
Nieuwe taak uitvoeren
Processen
Prestaties
App-geschiedenis
Opstart-apps
Gebruikers
Details
Services
Instellingen
Processor
5% 1,94 GHz
Geheugen
15,0/23,7 GB (63%)
Schijf 0 (C:)
SSD (NVMe)
1%
Ethernet
VMware Network Ad...
V: 0 O: 0 kbps
Ethernet
VMware Network Ad...
V: 0 O: 0 kbps
Wi-Fi
Wi-Fi
V: 0 O: 80,0 kbps
GPU 0
NVIDIA GeForce RTX...
0% (45 °C)
GPU 1
Intel(R) UHD Graphics
1%
Processor
13th Gen Intel(R) Core(TM) i7-13650HX
% gebruik gedurende 60 seconden
100%
Gebruik
5%
Snelheid
1,94 GHz
Processen
308
Threads
5229
Ingangen
152241
Tijd actief
0:01:26:20
Basissnelheid: 2,60 GHz
Sockets: 1
Kernen: 14
Logische processors: 20
Virtualisatie: Ingeschakeld
L1-cache: 1,2 MB
L2-cache: 11,5 MB
L3-cache: 24,0 MB



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?

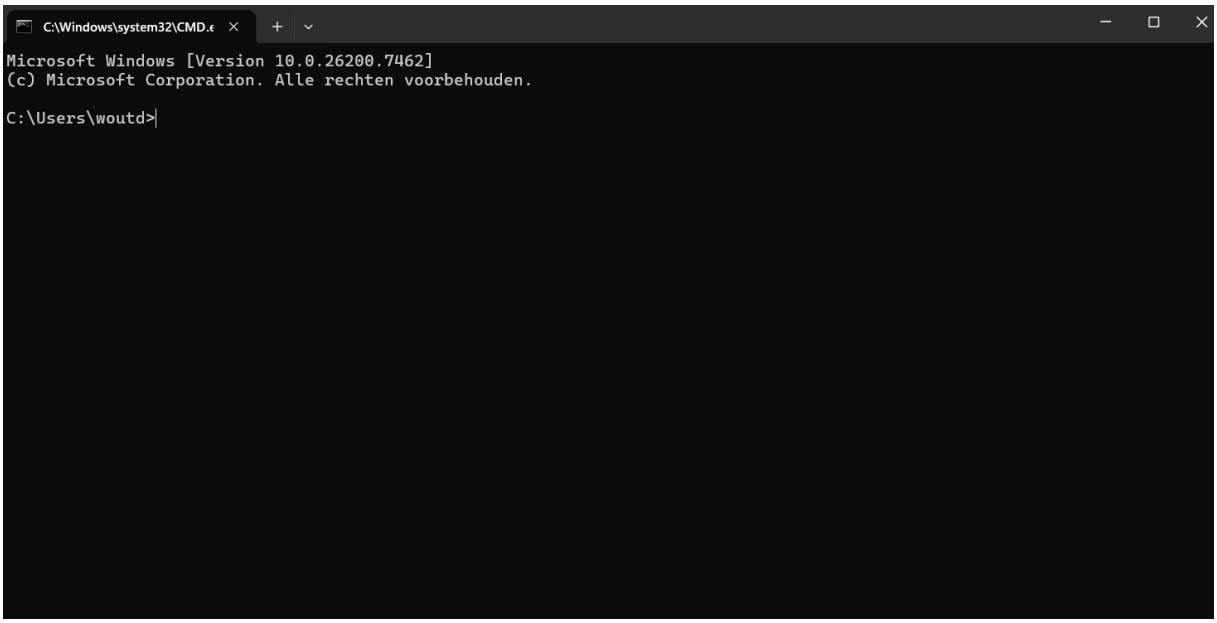
Windows + P

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

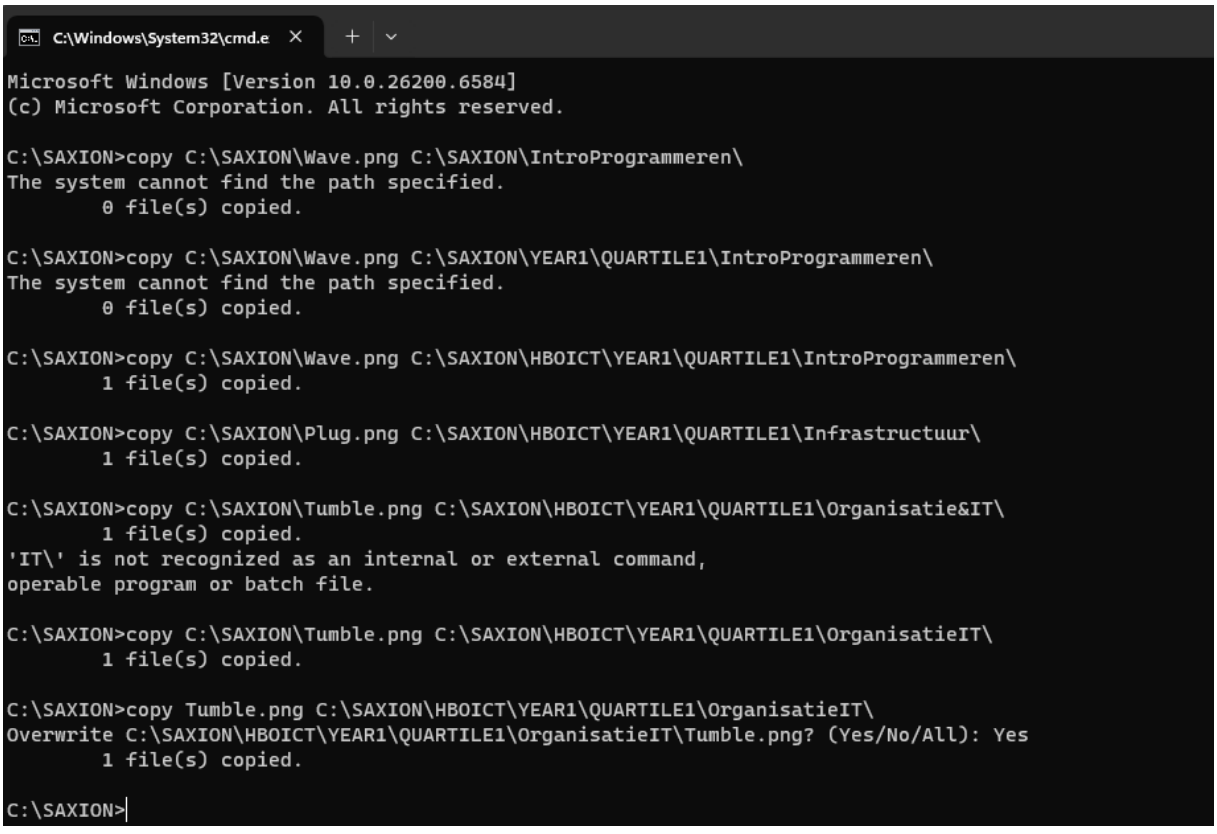
g) Open the Run screen with a key combination. On this screen, type CMD and press <enter>. Take a screenshot of this result and paste it into this template.

Windows + R voor het Run scherm



Working in the File Explorer

Relevant screenshots **copy** command:



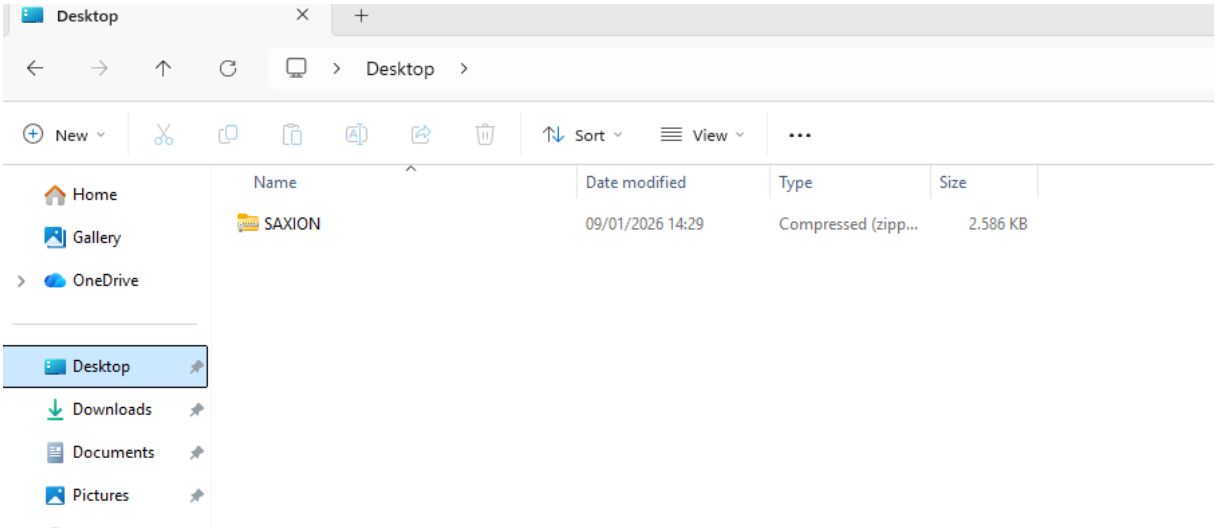
Relevant screenshots **tree** command:

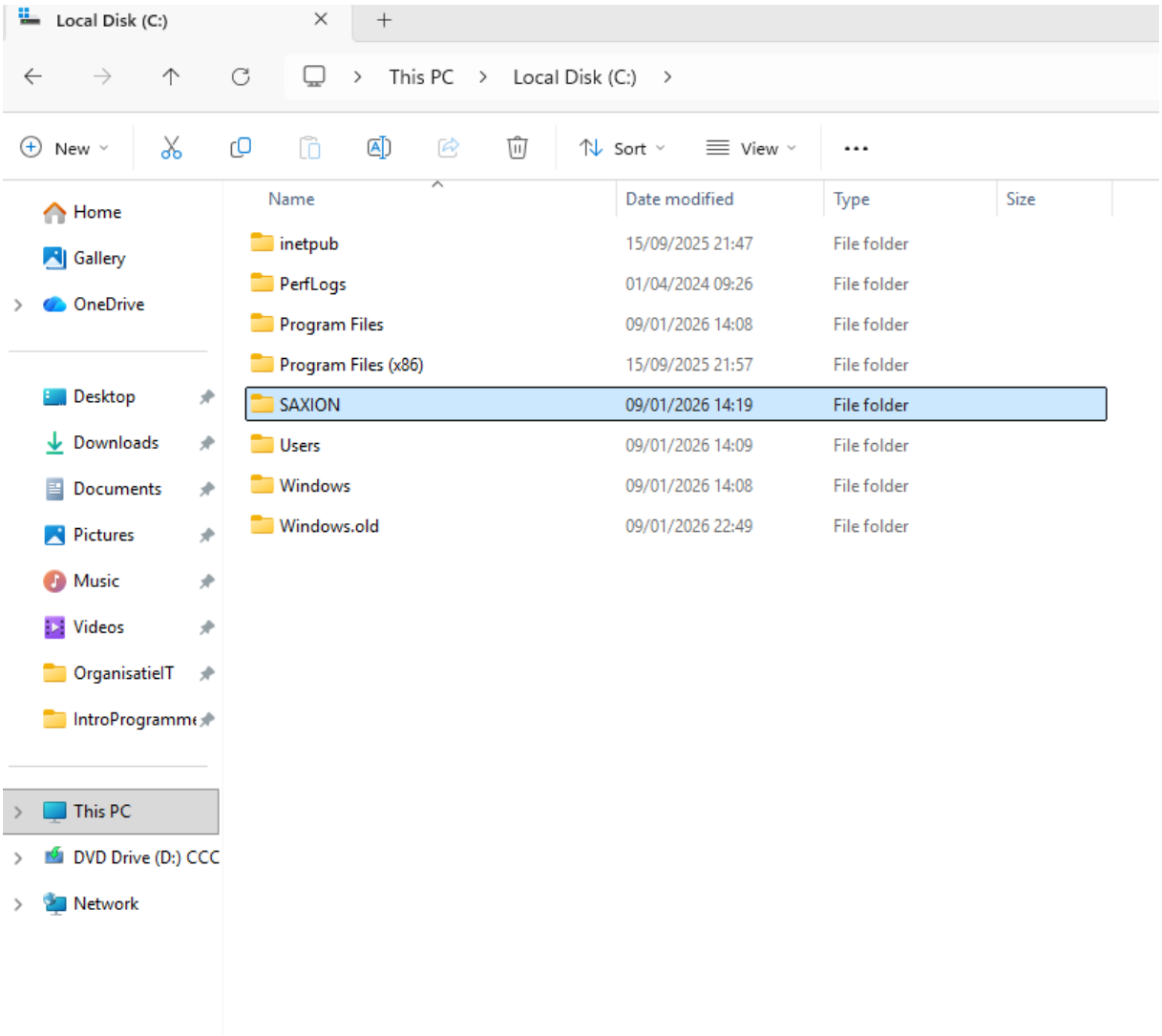
```
C:\SAXION>tree
Folder PATH listing
Volume serial number is A03E-133A
C:.
└───HBOICT
    ├───YEAR1
    │   ├───QUARTILE1
    │   │   ├───Infrastructuur
    │   │   ├───IntroProgrammeren
    │   │   └───OrganisatieIT
    │   ├───QUARTILE2
    │   │   ├───Databases
    │   │   ├───IT Fundementals
    │   │   └───Its in the Game
    │   ├───QUARTILE3
    │   └───QUARTILE4
    ├───YEAR2
    │   ├───QUARTILE1
    │   ├───QUARTILE2
    │   ├───QUARTILE3
    │   └───QUARTILE4
    ├───YEAR3
    └───YEAR4

C:\SAXION>echo %wout%
%wout%

C:\SAXION>
```

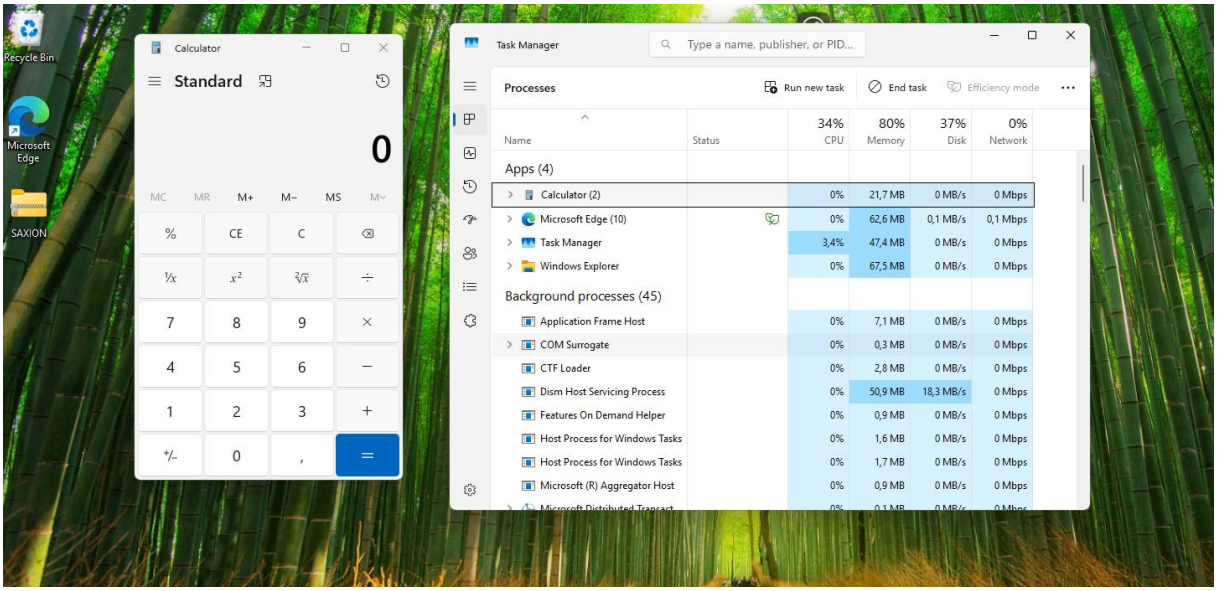
Relevant screenshots in the file explorer of the folder c:\Saxion + created zip file.



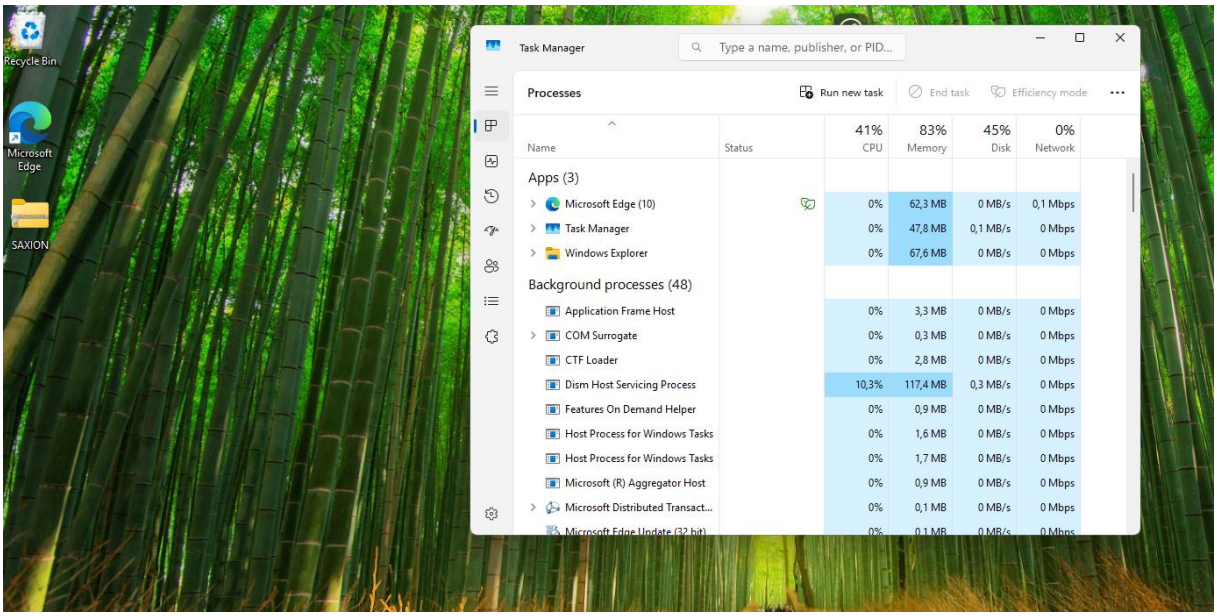

Local Disk (C:)
This PC
Local Disk (C:)
New
Sort
View
Home
Gallery
OneDrive
Desktop
Downloads
Documents
Pictures
Music
Videos
OrganisatieIT
IntroProgramme
This PC
DVD Drive (D:) CCC
Network
Name
Date modified
Type
Size
inetpub 15/09/2025 21:47 File folder
PerfLogs 01/04/2024 09:26 File folder
Program Files 09/01/2026 14:08 File folder
Program Files (x86) 15/09/2025 21:57 File folder
SAXION 09/01/2026 14:19 File folder
Users 09/01/2026 14:09 File folder
Windows 09/01/2026 14:08 File folder
Windows.old 09/01/2026 22:49 File folder

Terminating Processes

Relevant Screenshots Task Manager Window:



Taak beëindigt:

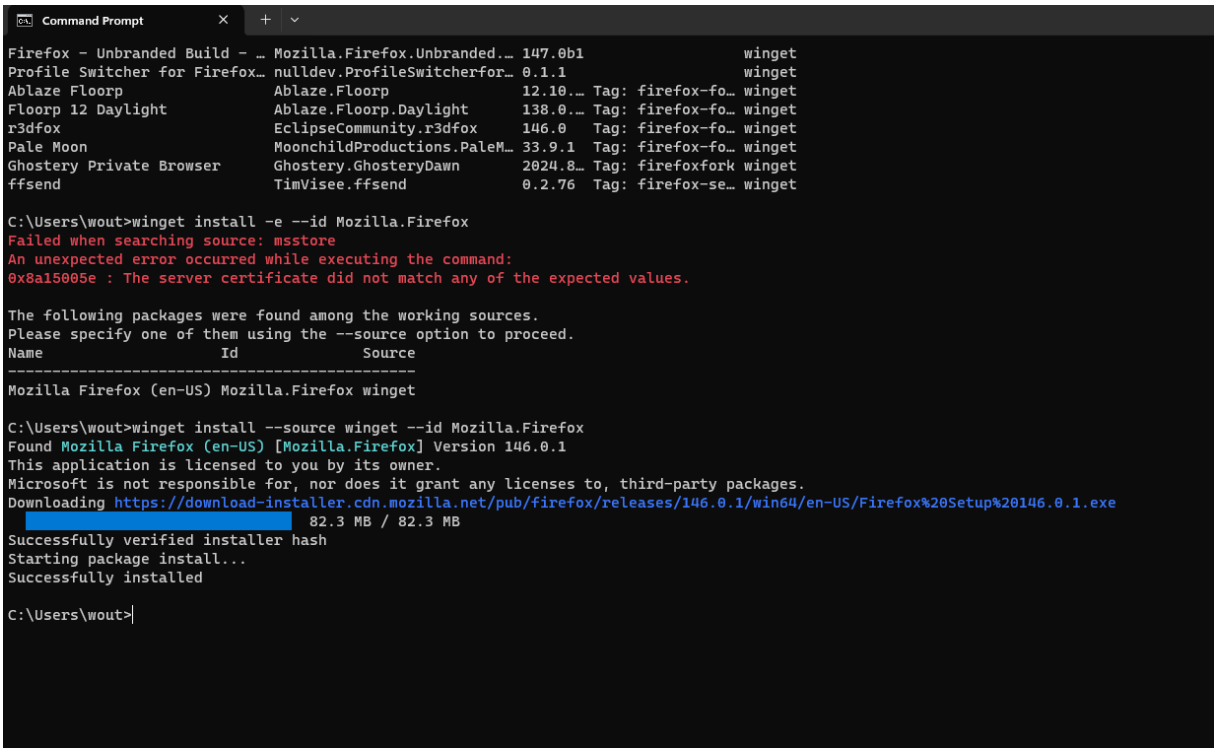


Install Software

Relevant screenshots that the following software is installed with winget:

- **WinSCP**
- **Notepad++**
- **7zip**

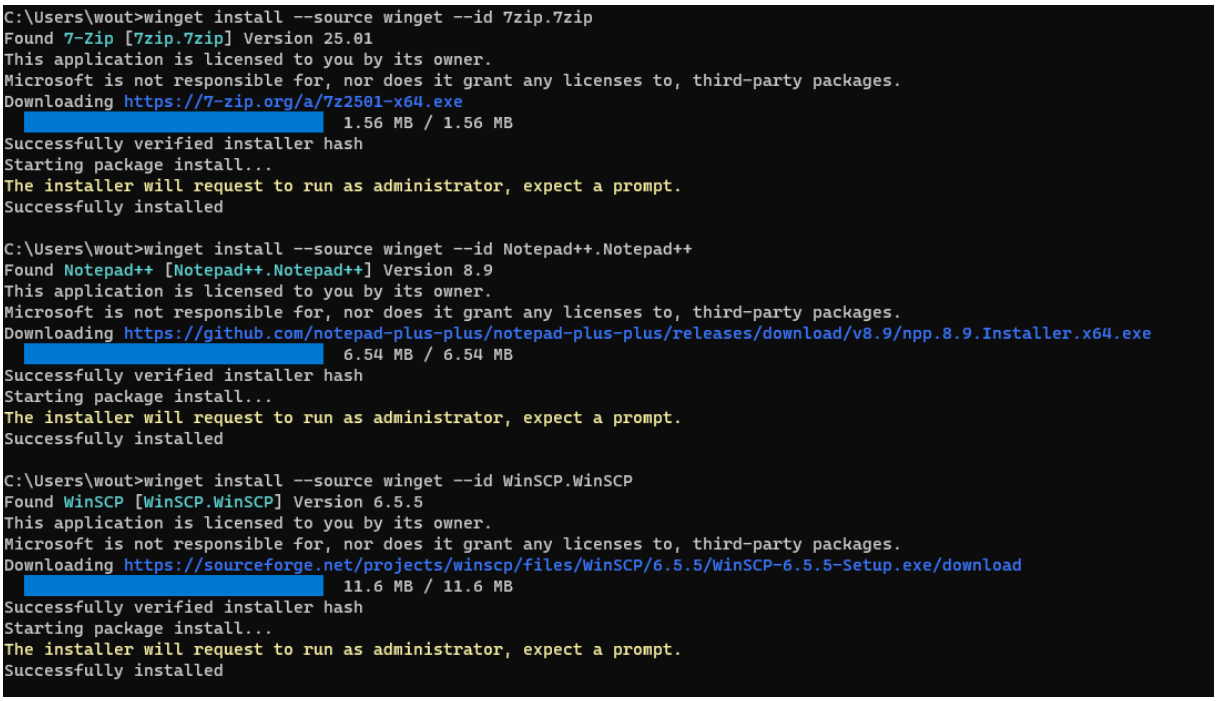
Installeer Firefox:



De -e staat voor dat wat ik opgeef exact overeen moet komen met wat er gedownload moet worden.

De --id geeft aan dat je een specifiek pakket wilt installeren op basis van zijn unieke identificatiecode.

Alle overige apps gedownload:

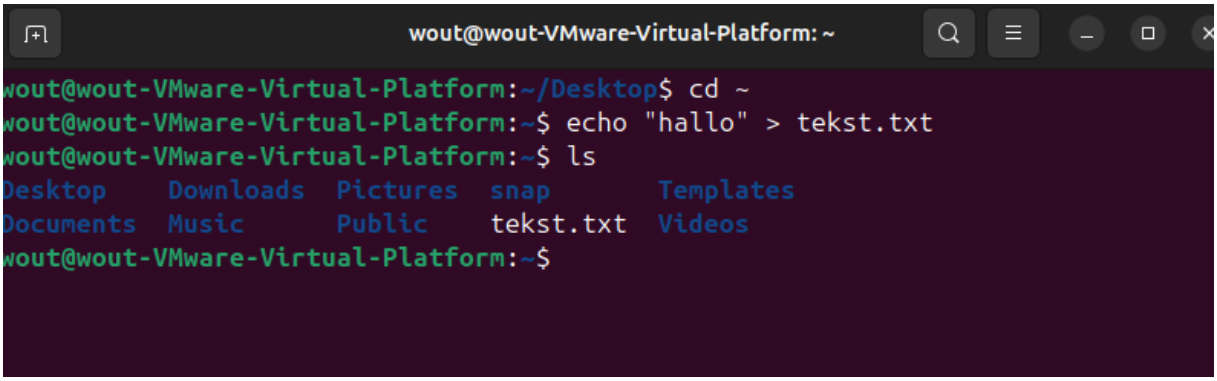


Assignment 5.4: Working with Linux

Relevant screenshots + motivation

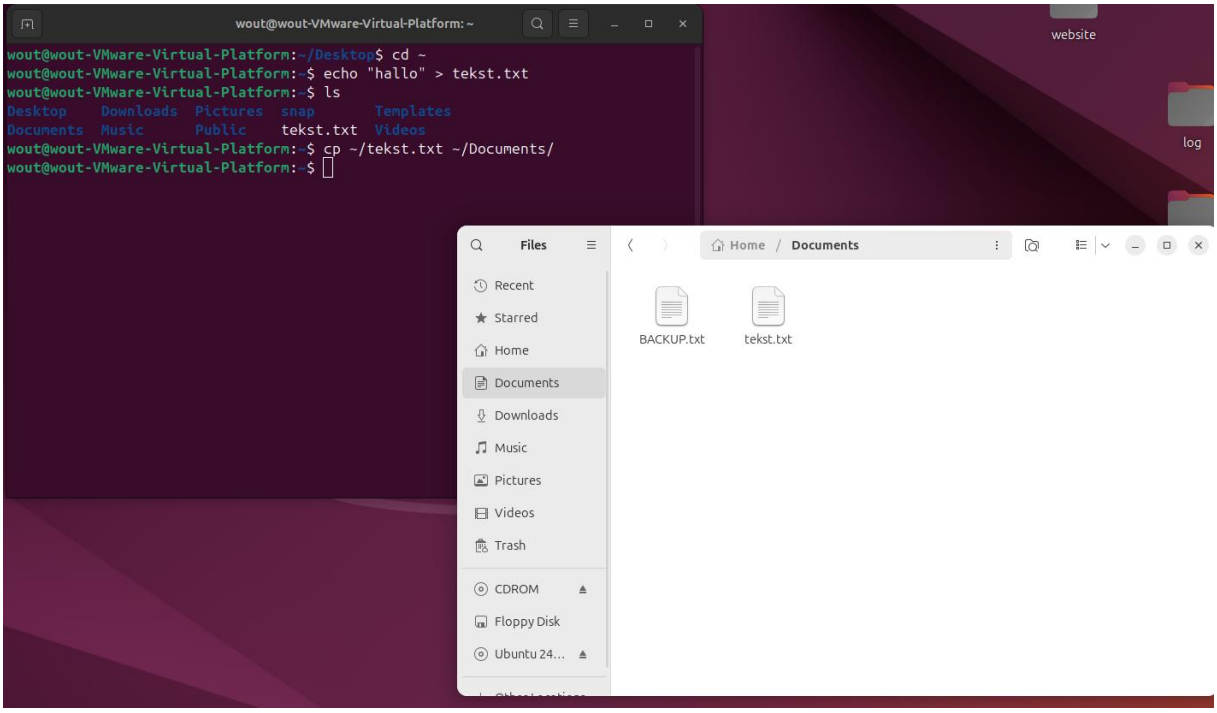
Create a text file in your user home directory:

Tekst aanmaken met terminal:

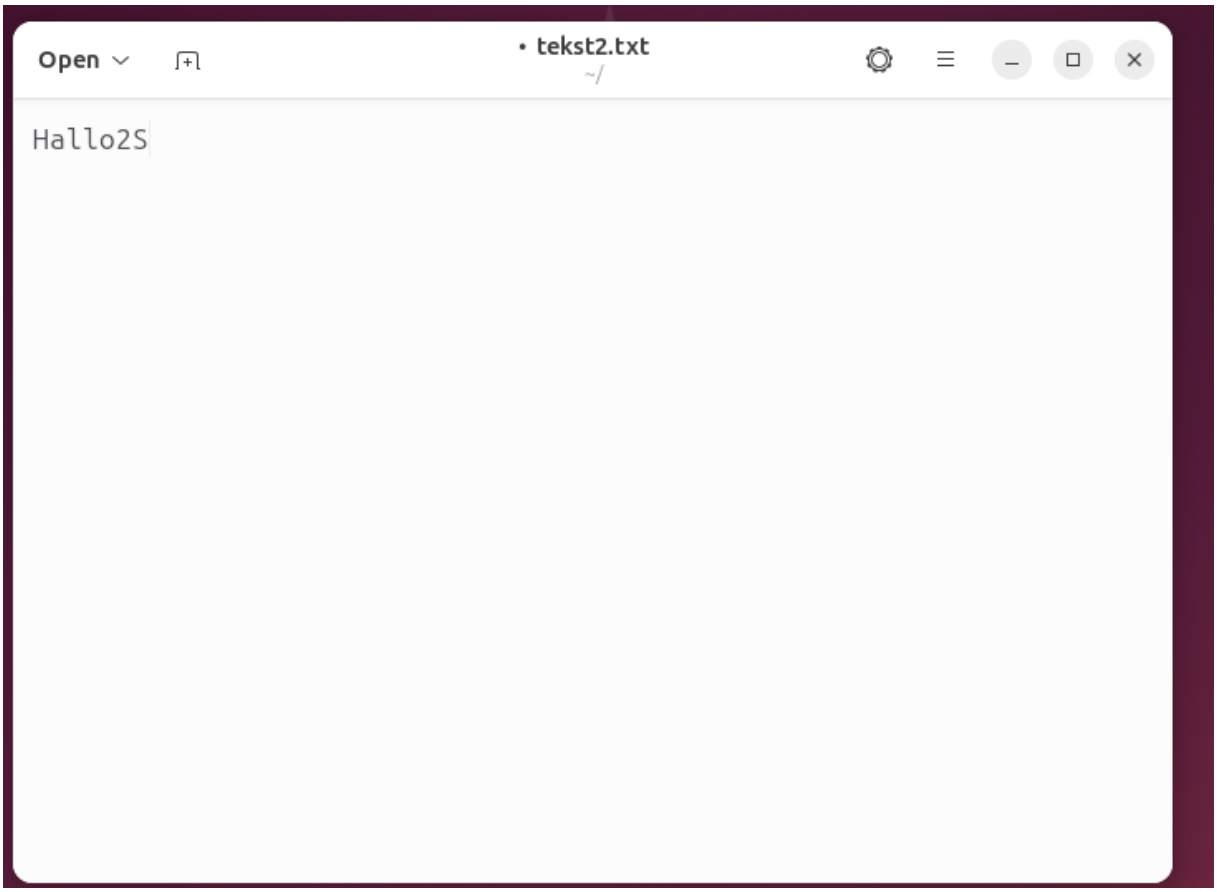


Show that you can copy this file from the home directory to the Documents directory both in the file explorer and in the terminal.

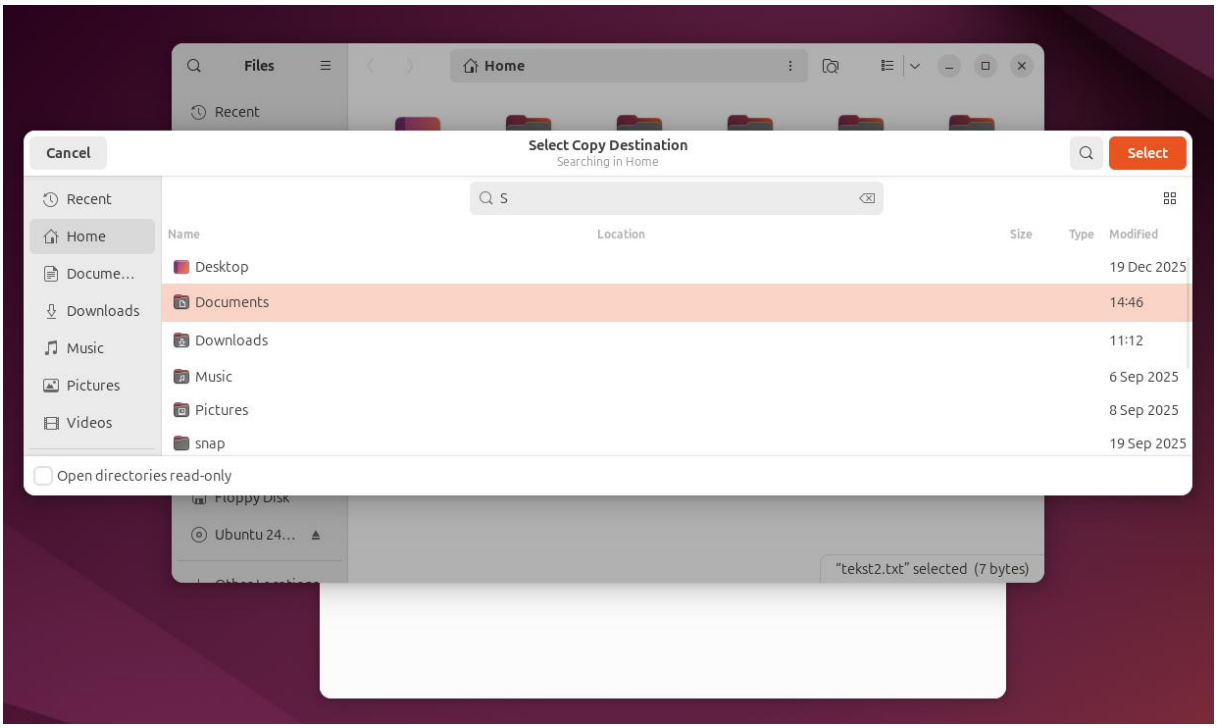
Kopieer bestand met de terminal:



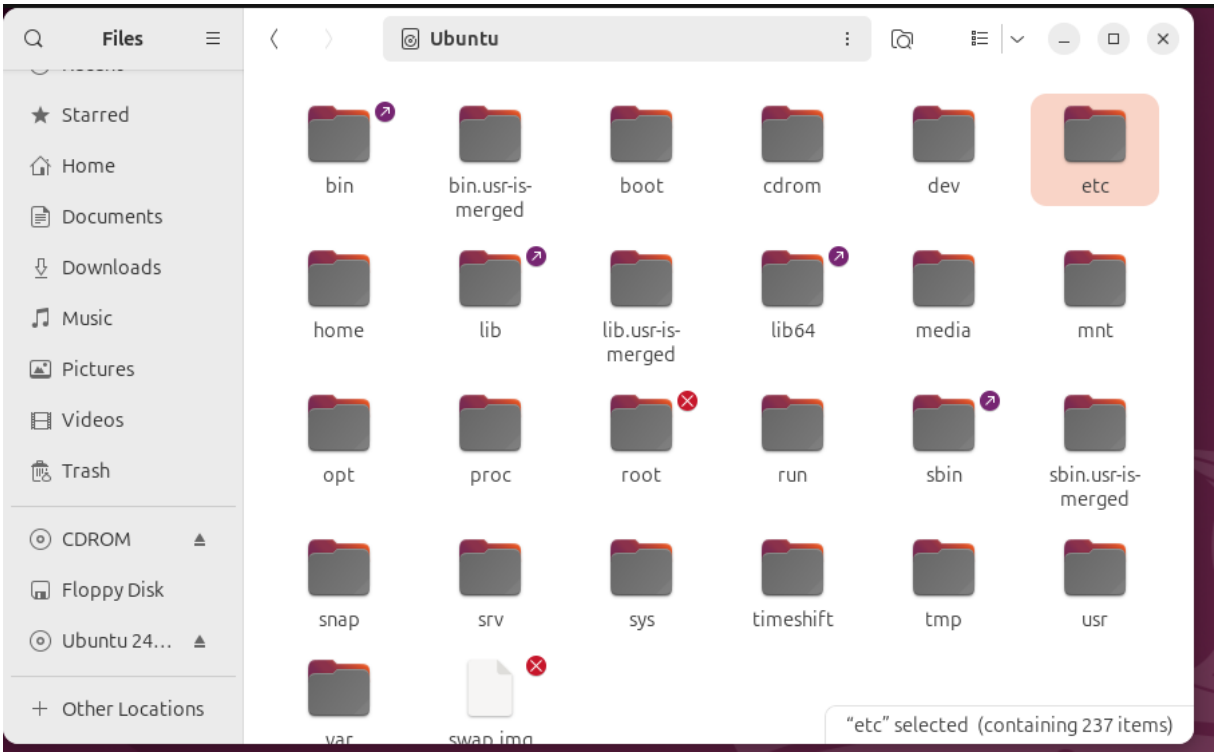
Normaal een tekst bestand aanmaken:



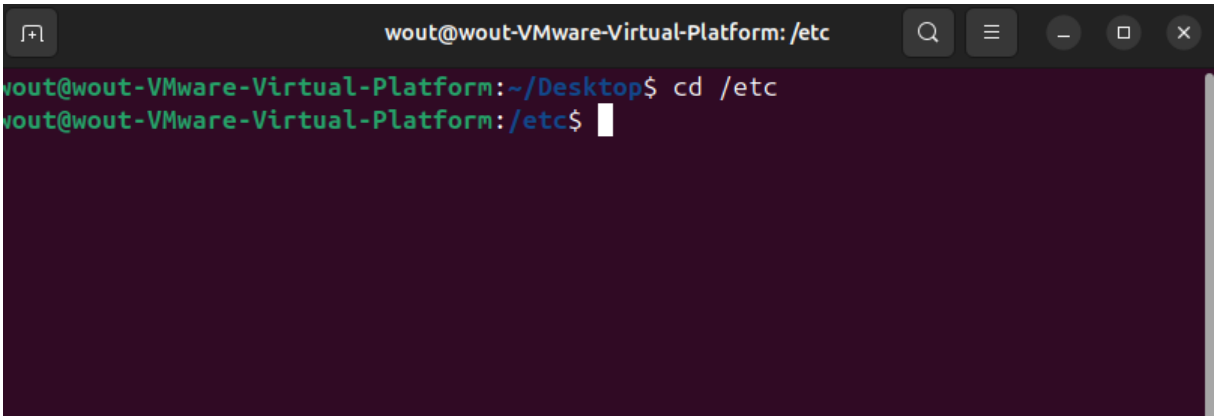
Normaal een bestand kopiëren:



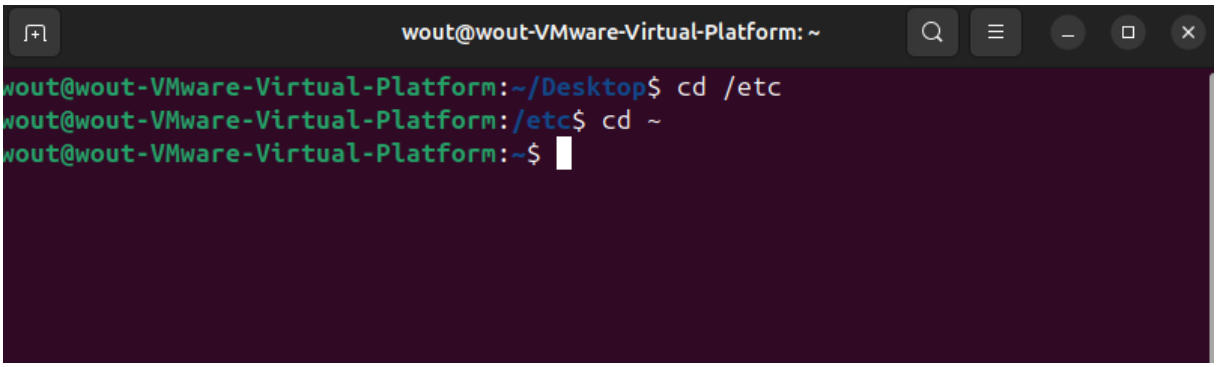
Navigate to the /etc folder in the file explorer:



Navigate to the /etc folder in the terminal:



How to get back to your home folder in the terminal?



Name one significant difference in Linux's file structure when comparing it to Windows:

Linux heeft een enkele root directory, waar alles onder hangt.

Windows gebruikt meerdere schijven met letters, zoals C:\

What is the /etc directory usually used for?

- netwerkconfiguratie
- gebruikersbeheer
- services
- systeeminstellingen

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

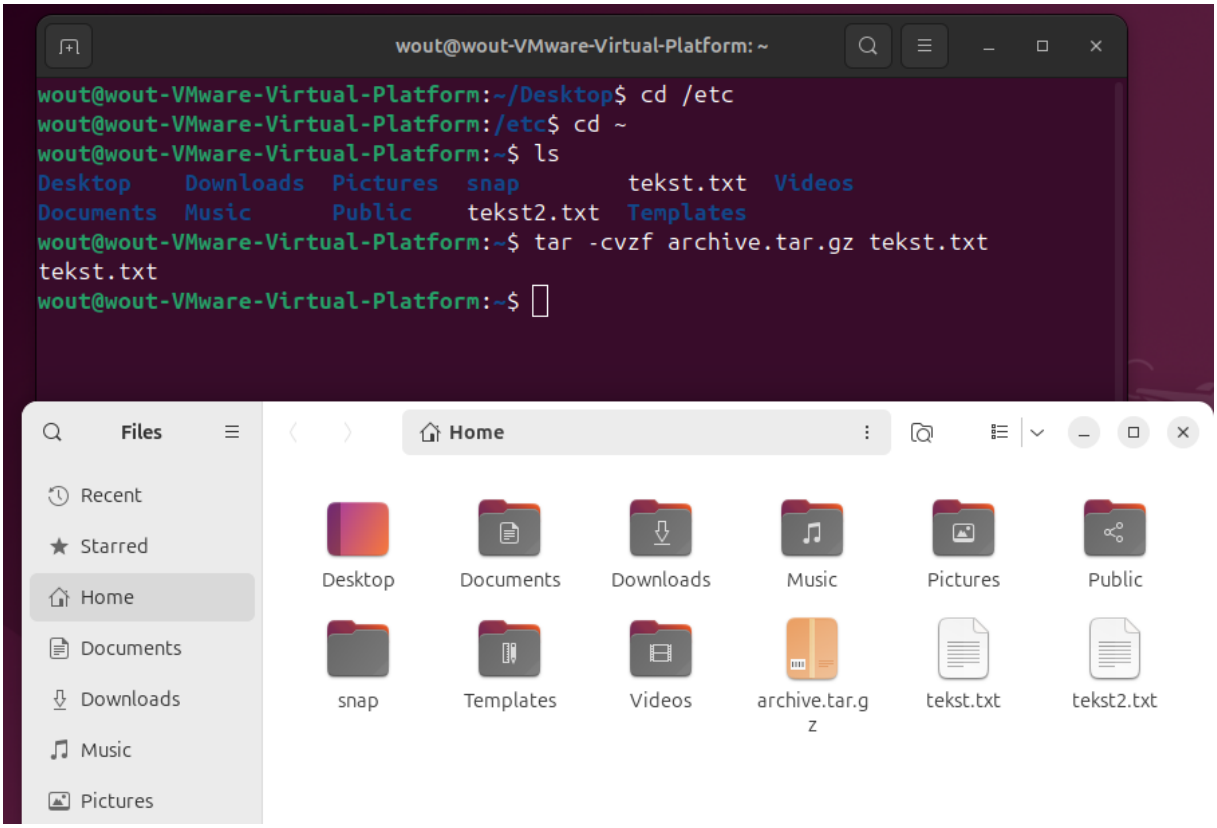
tar -cvf archive.tar tekst.txt

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 tekst.txt

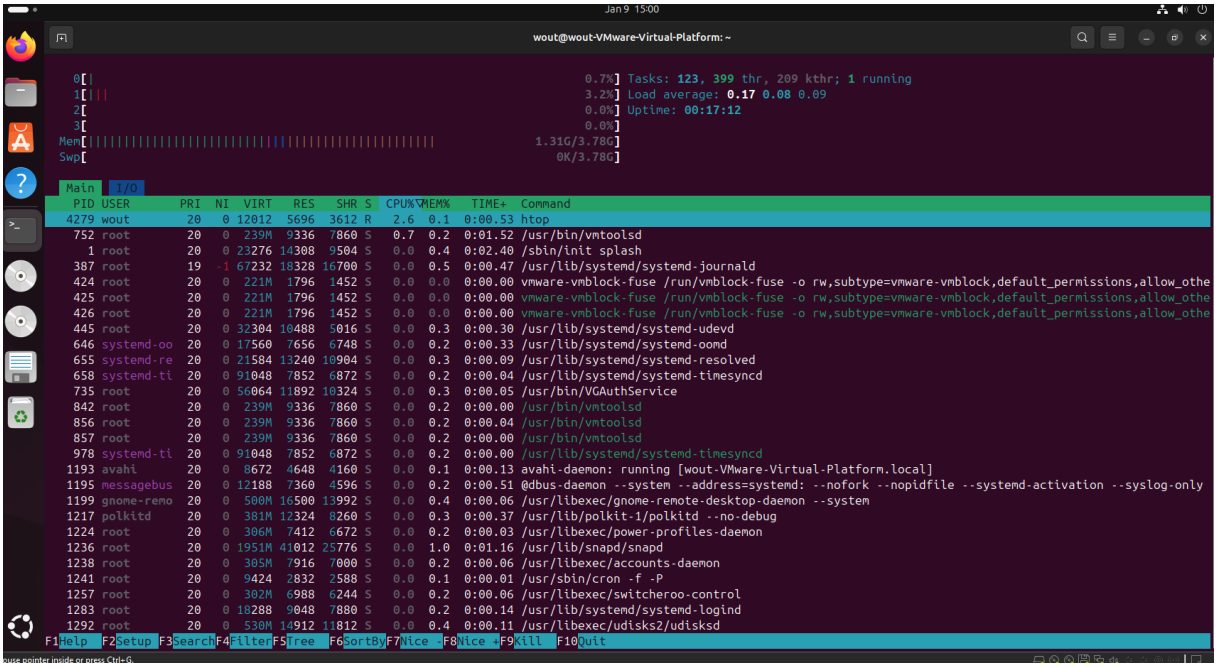


Install the application htop via a terminal command

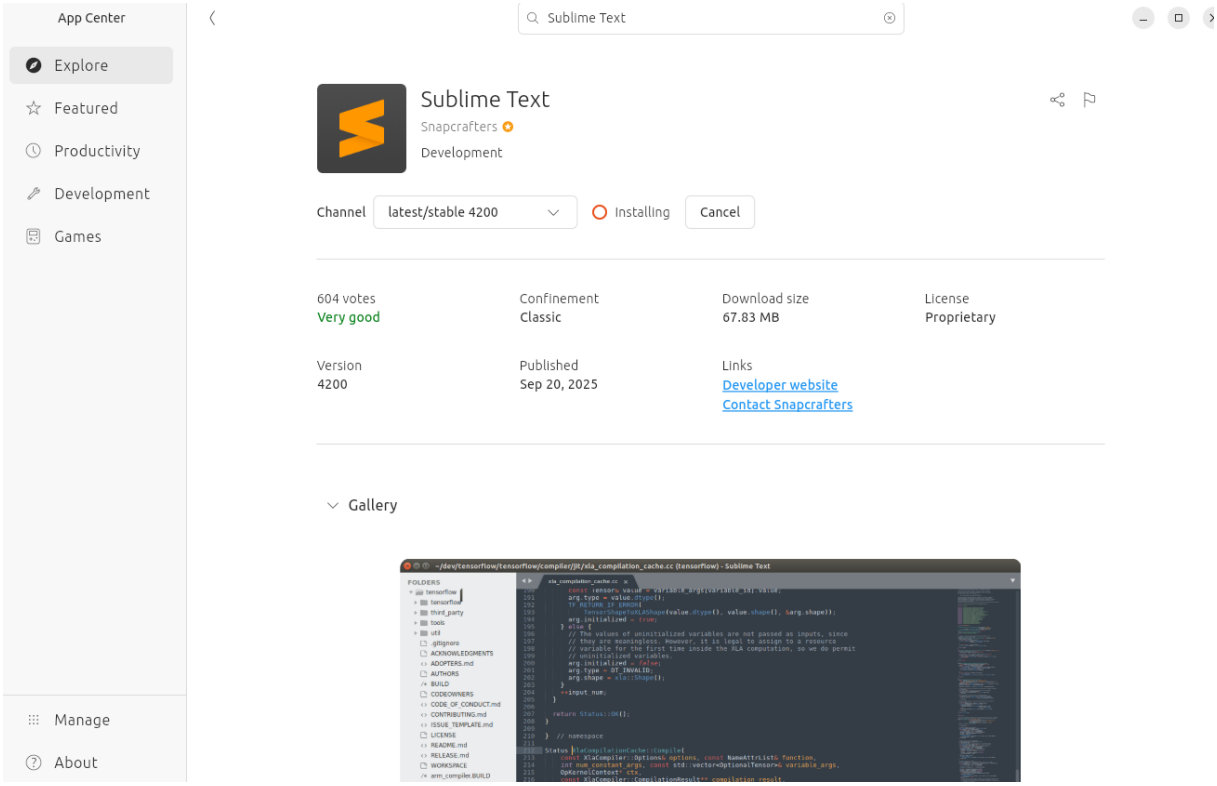
sudo apt install htop

Launch the htop application. Explain what this application shows.

De applicatie geeft een real-time overzicht van alle actieve processen.



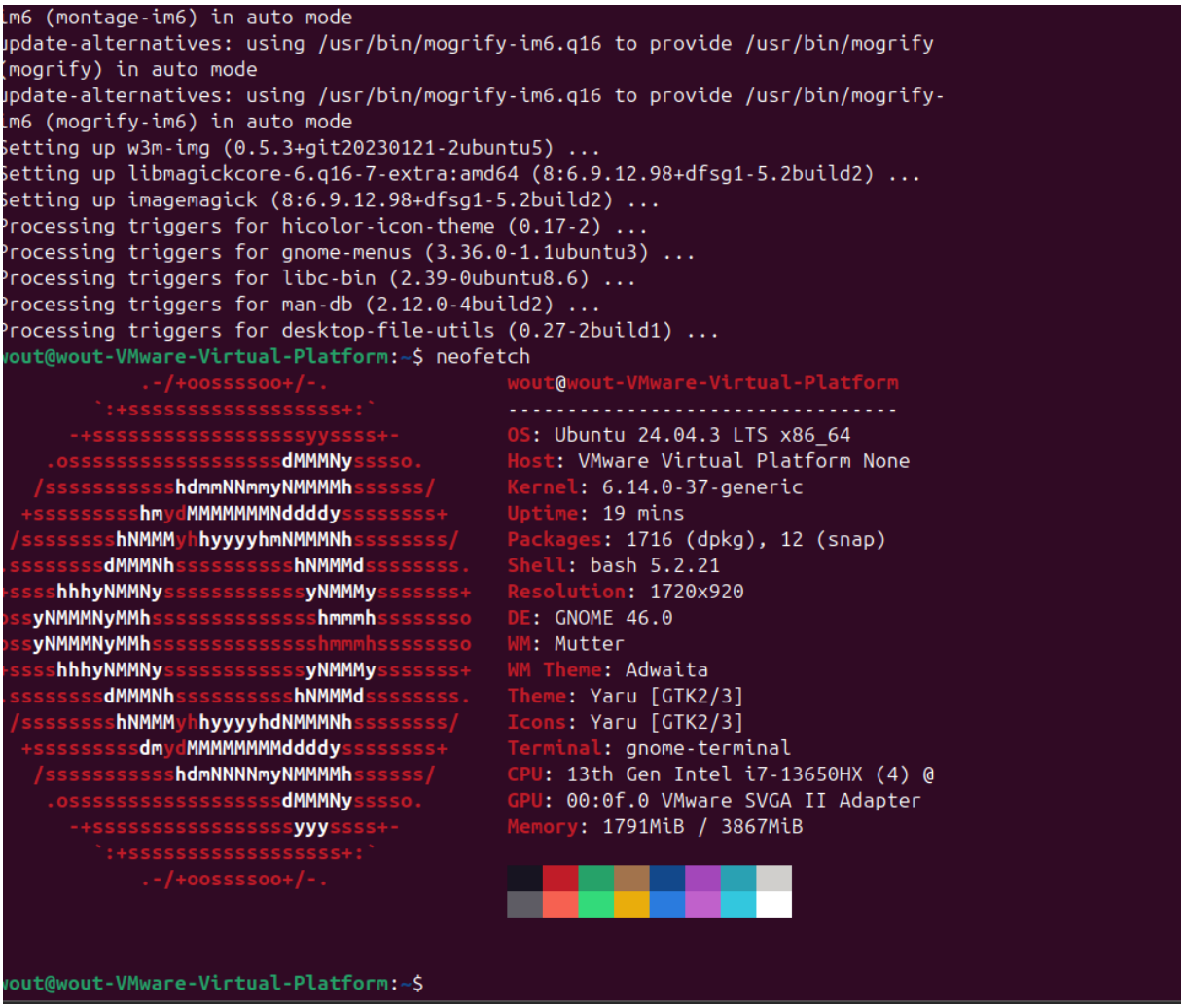
Software can be installed via the terminal in Ubuntu as we just did in the previous assignment, but it can also be installed in Ubuntu via the Software center. Find and install the Sublime Text application on your Ubuntu VM.



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

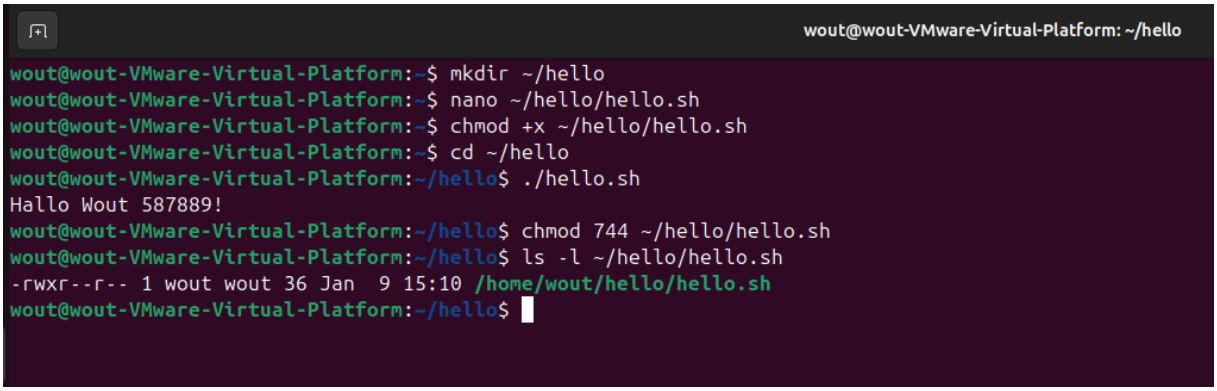
Het toont:

OS-versie, Kernel, CPU, GPU, RAM, Shell



Assignment 5.5: Users and permissions on Linux

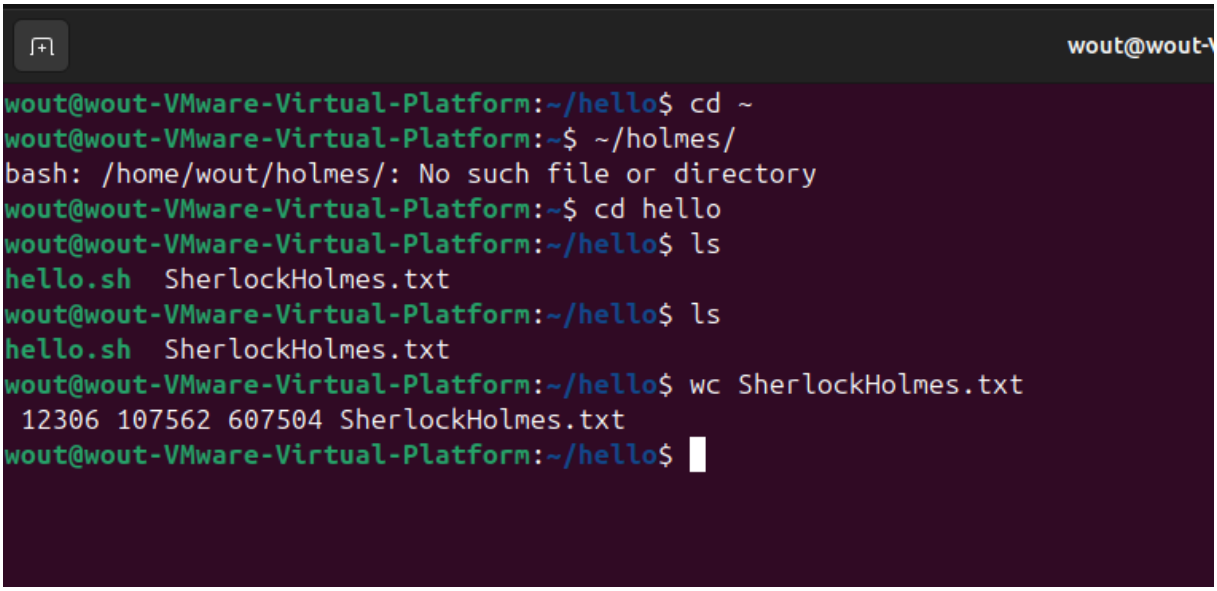
Use the chmod command to make the file executable only for the logged-in user. Other users are only allowed to view the file via a text edit command such as cat or less. See the man pages of chmod how you could do this. TIP! Use chmod Numeric notation.



Assignment 5.6: View the contents of files

cat	Toont de volledige inhoud van een ebstand op het scherm.
wc	Telt regels, woorden en karakters die in een bestand zitten.
less	Bekijkt een bestand pagina voor pagina
head	Toont de eerste regels van een bestand
tail	Toont de laatste regels van een bestand
grep	Zoekt naar tekst in een bestand

Hoeveel regels, woorden en karakters?

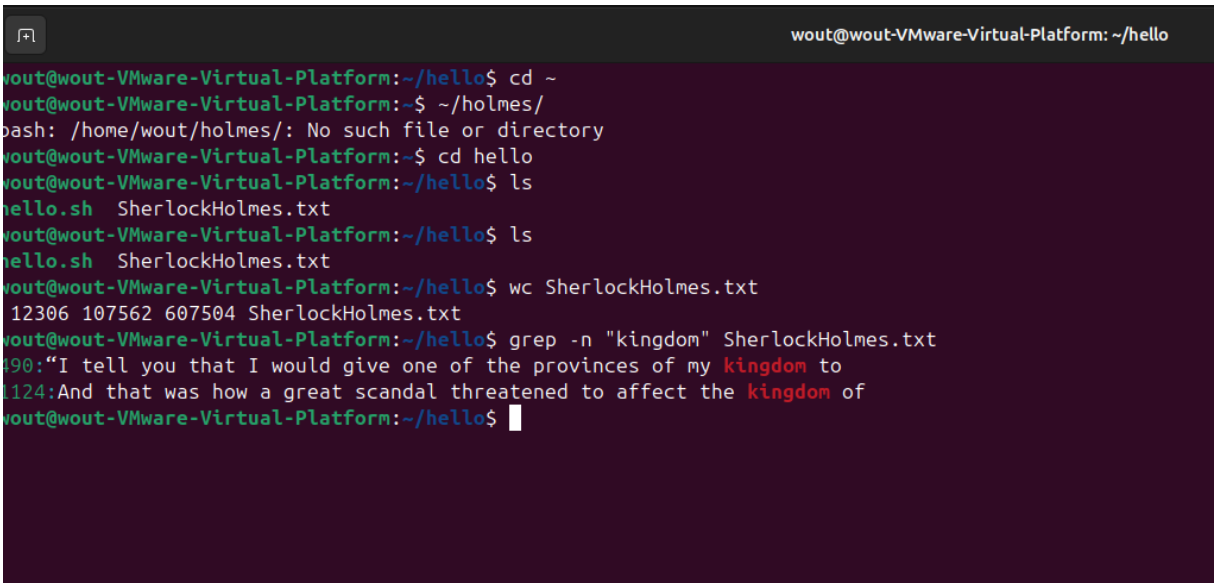


12306 = aantal regels

107562 = aantal woorden

607504 = aantal karakters

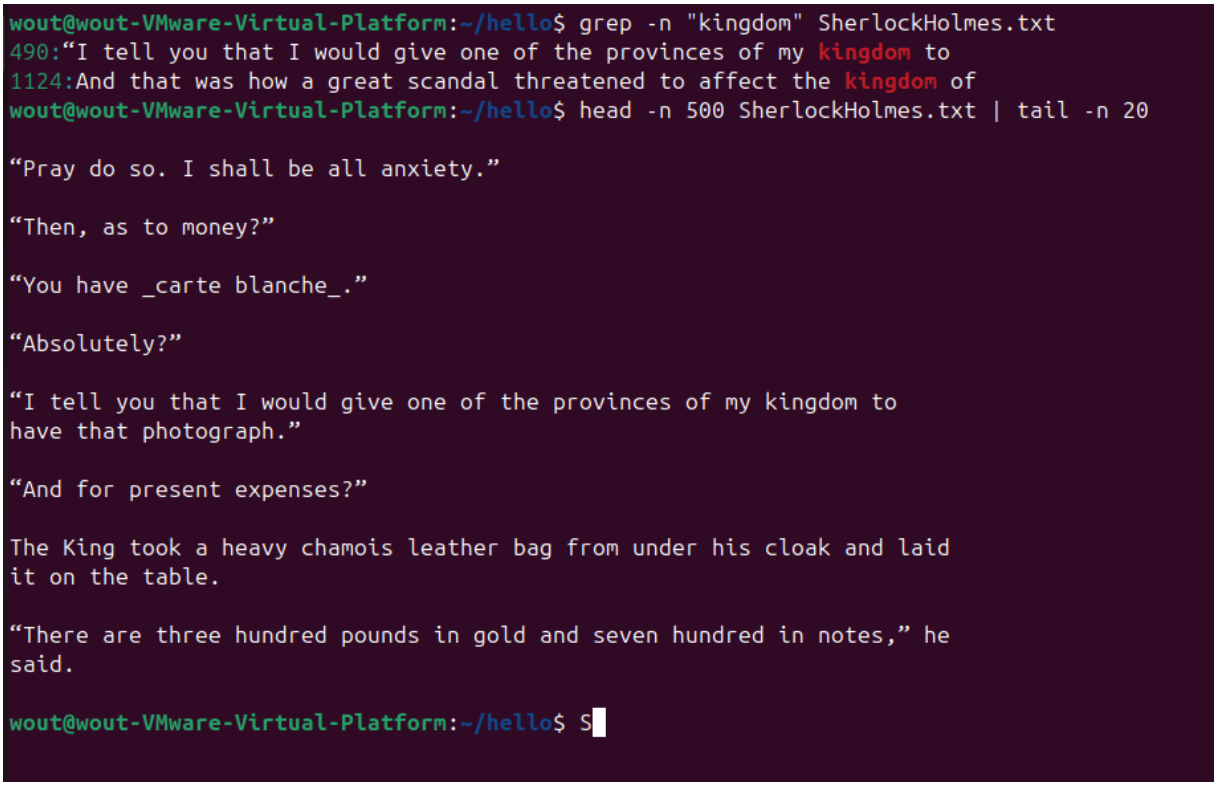
Op welke regels staat het woord "kingdom"?



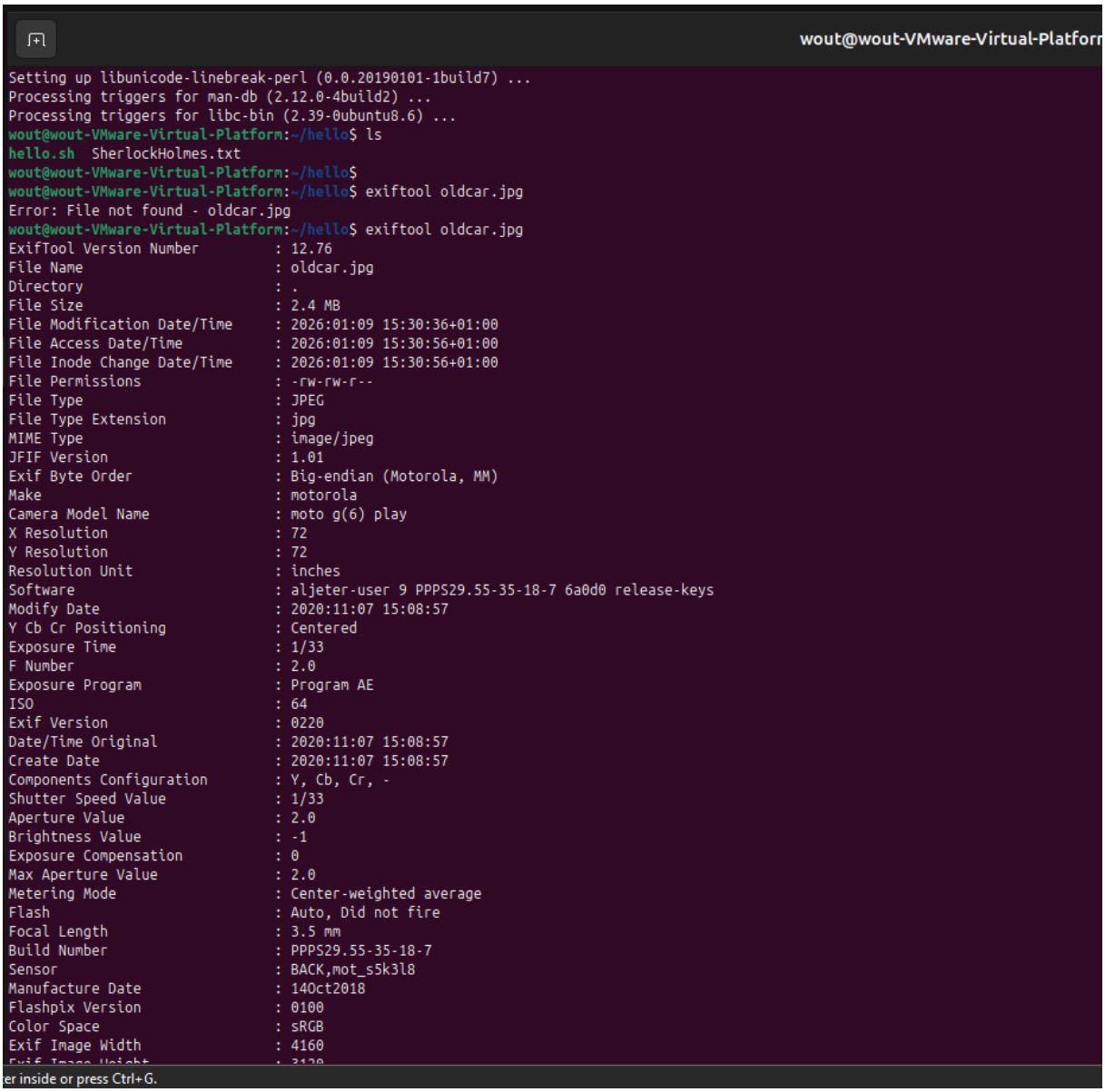
Regelnummer: 490 en 1124

Toon de 10 regels boven en onder het woord "kingdom"

Ik hier hiervoor om regel 490 te gebruiken.



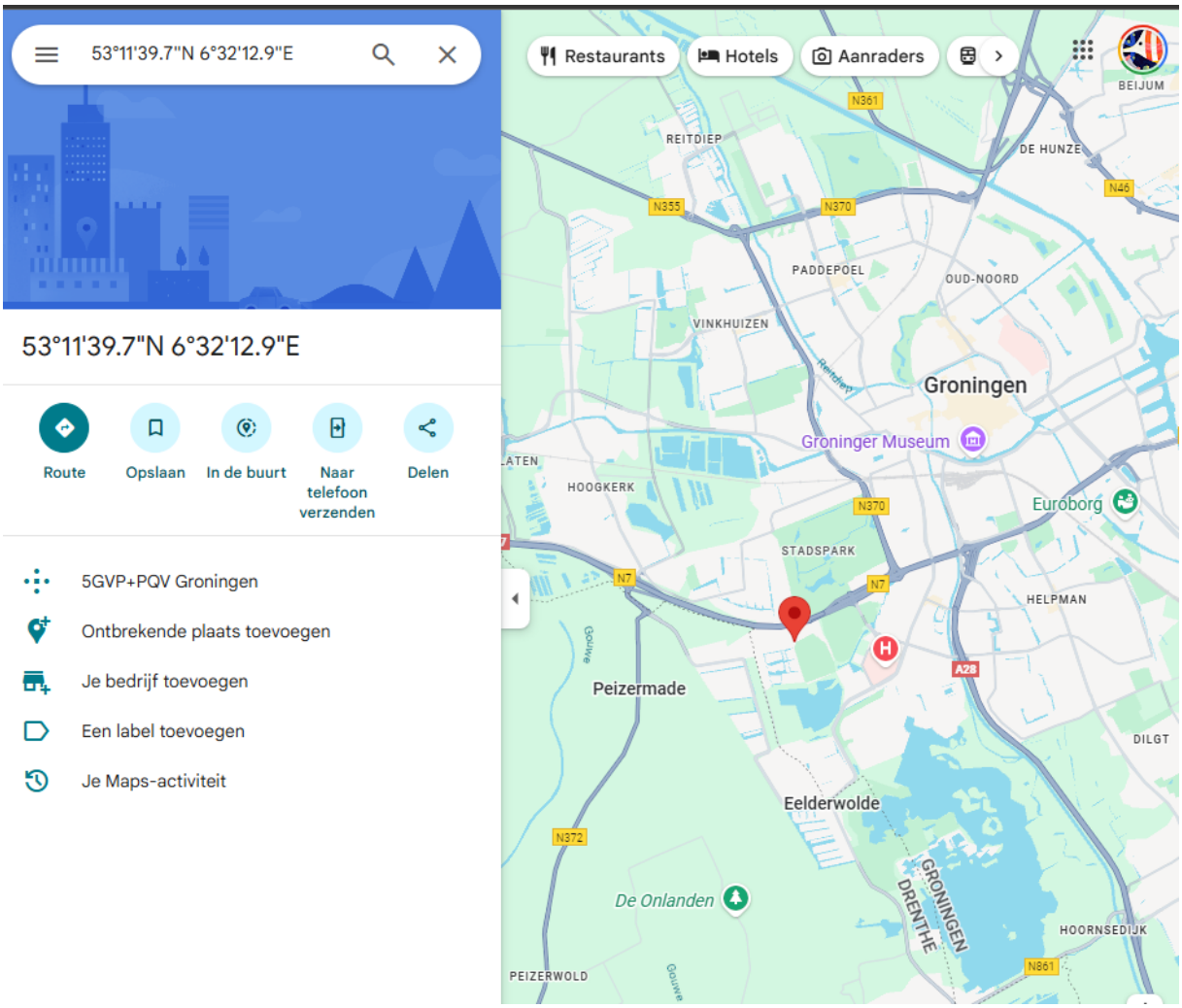
Assignment 5.7: Digital forensics



```
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
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
wout@wout-VMware-Virtual-Platform:~/hello$
```

Merk telefoon en model: Motorola g6 play

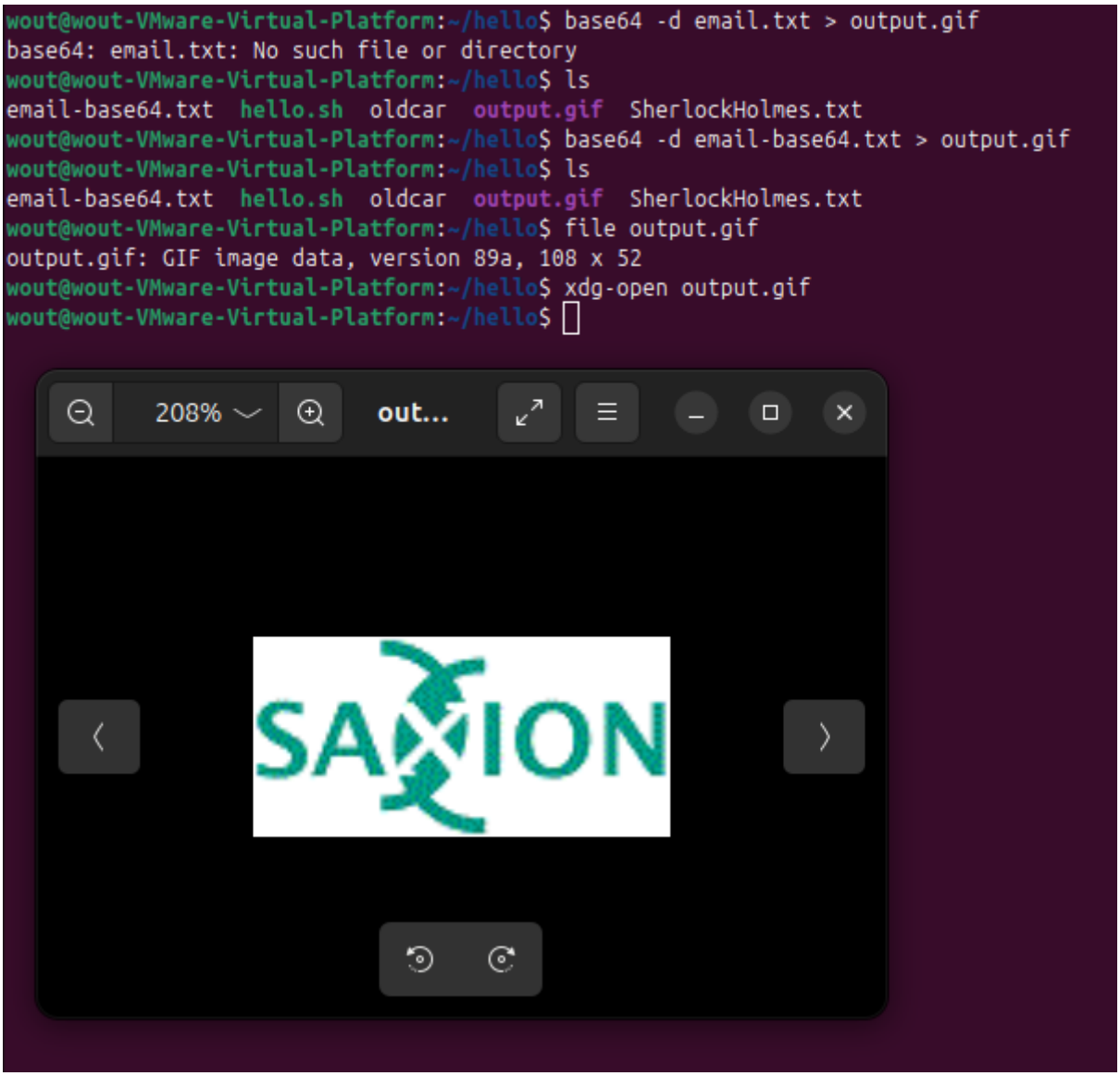
De foto is gemaakt in Groningen.



Filename extensions

Het bestand word nog steeds herkend als een jpg file.

Tekst file -> Gif file



Assignment 5.8: Steganography

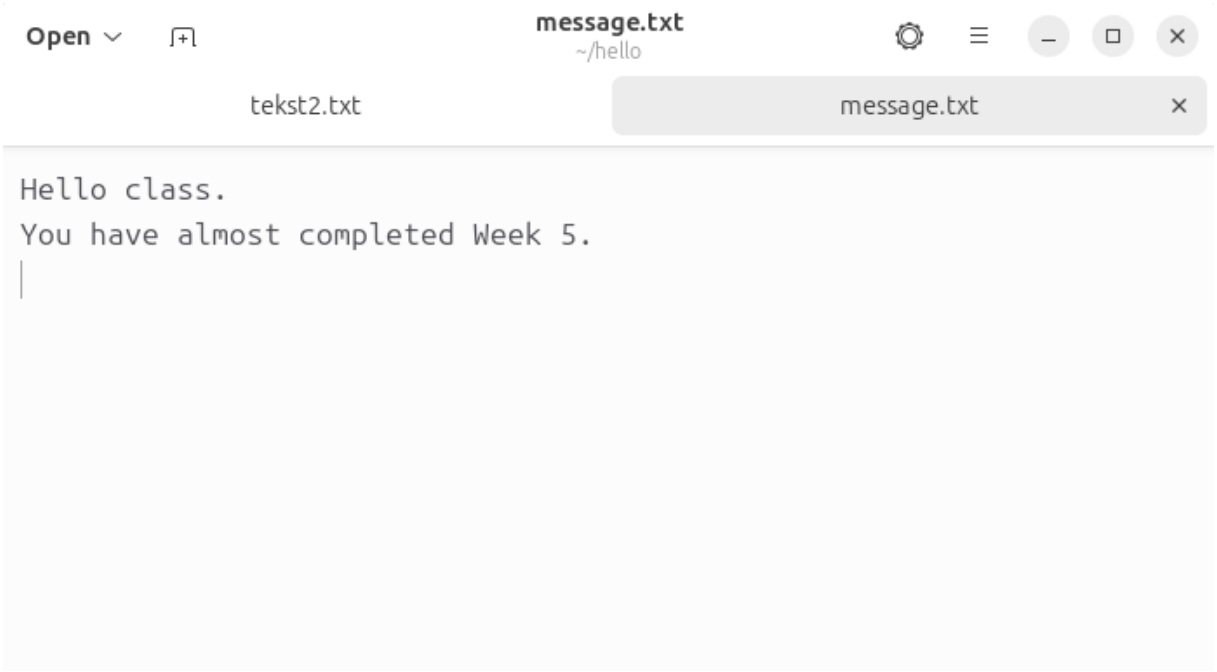
```
the first argument must be one of the following:
 embed, --embed           embed data
 extract, --extract       extract data
 info, --info             display information about a cover- or stego-file
   info <filename>        display information about <filename>
 encinfo, --encinfo       display 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
wout@wout-VMware-Virtual-Platform:~/hello$ steghide extract -sf apple2.jpg
Enter passphrase:
wrote extracted data to "message.txt".
wout@wout-VMware-Virtual-Platform:~/hello$
```



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.

```
wout@omv587889:~$ systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
     Loaded: loaded (/lib/systemd/system/ssh.service; enabled; preset: enabled)
     Active: active (running) since Fri 2026-01-09 16:56:25 CET; 3min 3s ago
       Docs: man:sshd(8)
             man:sshd_config(5)
   Main PID: 1025 (sshd)
      Tasks: 1 (limit: 4593)
     Memory: 2.6M
        CPU: 31ms
     CGroup: /system.slice/ssh.service
             └─1025 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Warning: some journal files were not opened due to insufficient permissions.
wout@omv587889:~$ _
```

```
wout@omv587889:~$ sudo mkdir -p /srv/images
wout@omv587889:~$ sudo chown $USER:$USER /srv/images
wout@omv587889:~$
```

```
wout@omv587889:~$ 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:29:0b:f7:02 brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    inet 192.168.139.11/24 brd 192.168.139.255 scope global ens33
       valid_lft forever preferred_lft forever
3: docker0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc noqueue state DOWN group default
    link/ether f2:68:b9:81:a5:11 brd ff:ff:ff:ff:ff:ff
    inet 172.17.0.1/16 brd 172.17.255.255 scope global docker0
       valid_lft forever preferred_lft forever
4: br-900f2eacde0c: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default
    link/ether 32:de:9a:49:8c:8a brd ff:ff:ff:ff:ff:ff
    inet 172.18.0.1/16 brd 172.18.255.255 scope global br-900f2eacde0c
       valid_lft forever preferred_lft forever
    inet6 fe80::30de:9aff:fe49:8c8a/64 scope link
       valid_lft forever preferred_lft forever
5: vethc772191@if2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue master br-900f2eacde0c state UP group default
    link/ether ba:e8:22:b6:e9:7b brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet6 fe80::b8e8:22ff:feb6:e97b/64 scope link
       valid_lft forever preferred_lft forever
8: vethe4370ae@if2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue master br-900f2eacde0c state UP group default
    link/ether aa:d9:40:e6:28:5a brd ff:ff:ff:ff:ff:ff link-netnsid 1
    inet6 fe80::a8d9:40ff:fee6:285a/64 scope link
       valid_lft forever preferred_lft forever
wout@omv587889:~$
```

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