Template Week 5 – Operating Systems

Student number: 582031

Assignment 5.1: Unix-like

a) Find out what the difference is between UNIX and unix-like operating systems?
UNIX is het originele besturingssysteem ontwikkeld in 1969 bij AT&T Bell Labs. Het is een geregistreerd handelsmerk en alleen systemen die gecertificeerd zijn mogen zich officieel "UNIX" noemen.

Unix-like zijn besturingssystemen die werken en aanvoelen als UNIX, maar niet officieel gecertificeerd zijn. Ze volgen dezelfde principes en structuur maar zijn niet afgeleid van de originele UNIX broncode. Voorbeelden zijn Linux en FreeBSD.

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

Medeontwikkelaar van het originele UNIX in 1969 bij Bell Labs. Hij schreef ook de eerste versie van de B programmeertaal, de voorloper van C. Later werkte hij bij Google mee aan de Go programmeertaal.

Dennis Ritchie

Ontwikkelde de programmeertaal C en schreef samen met Ken Thompson het originele UNIX. Zonder C en UNIX zou de IT-wereld er compleet anders uitzien. Bijna alle moderne besturingssystemen zijn beïnvloed door zijn werk.

Bill Joy

Medeoprichter van Sun Microsystems. Hij ontwikkelde BSD (Berkeley Software Distribution), een belangrijke UNIX-variant. Ook schreef hij de vi teksteditor en de C shell. Later werkte hij mee aan Java.

Richard Stallman

Oprichter van het GNU Project en de Free Software Foundation. Hij startte de beweging voor vrije software en schreef de GPL licentie. Zonder zijn werk zou open source software zoals we die nu kennen niet bestaan.

Linus Torvalds

Ontwikkelde in 1991 de Linux kernel als student in Finland. Samen met GNU software werd dit een volledig vrij besturingssysteem. Hij beheert de Linux kernel nog steeds. Ook maakte hij Git, het versiebeheersysteem.

c) What is the philosophy of the GNU movement?

De GNU filosofie draait om vrije software. Gebruikers moeten vier vrijheden hebben:

De vrijheid om software te gebruiken voor elk doel
De vrijheid om de broncode te bestuderen en aan te passen
De vrijheid om kopieën te verspreiden
De vrijheid om aangepaste versies te delen

Het gaat niet om gratis, maar om vrijheid. "Free as in freedom, not free as in beer."

d) Does Ubuntu as a Linux operating system conform to the philosophy of the GNU movement?
Gedeeltelijk. Ubuntu gebruikt de Linux kernel en veel GNU-software, en de meeste componenten zijn vrije software. Gebruikers kunnen de broncode bekijken en aanpassen.
Maar niet volledig: Ubuntu bevat ook proprietary software zoals closed-source drivers (NVIDIA), firmware en toegang tot niet-vrije software via de repositories. Richard Stallman keurt Ubuntu daarom niet goed als volledig vrij systeem.

e) Find out what is the Windows Subsystem for Linux?
WSL is een functie in Windows waarmee je Linux distributies kunt draaien binnen Windows zonder dual-boot of virtuele machine. Je kunt een echte Linux terminal gebruiken en Linux programma's uitvoeren naast Windows applicaties. WSL2 gebruikt een echte Linux kernel voor betere compatibiliteit en snelheid.

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

Besturingssysteem	**Familie**
Android	Linux (gebruikt de Linux kernel)
iOS	Unix (afgeleid van macOS/Darwin, gebaseerd op BSD)
ChromeOS	Linux (gebaseerd op de Linux kernel met Gentoo)

Assignment 5.2: Supercomputers and gameconsoles

a) Research on this site what supercomputers are used for and write a short summary of it:
Supercomputers worden gebruikt voor taken die enorme rekenkracht vereisen:
- Weersvoorspelling en klimaatmodellen - simuleren van atmosferische condities
- Wetenschappelijk onderzoek - moleculaire simulaties, natuurkunde, astronomie
- Nucleaire simulaties - testen van kernwapens zonder echte explosies
- Cryptografie - kraken en maken van encryptie
- Medisch onderzoek - eiwitvouwing, medicijnontwikkeling, genoomanalyse
- Kunstmatige intelligentie - trainen van grote machine learning modellen
- Luchtvaart en ruimtevaart - aerodynamische simulaties

Supercomputers zijn ontworpen om miljarden berekeningen per seconde uit te voeren voor problemen die gewone computers niet aankunnen.

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?

De PlayStation 3 gebruikte de Cell Broadband Engine processor, mede ontwikkeld door IBM (dezelfde technologie als in de Roadrunner supercomputer).
Wat is een PS3 cluster? Meerdere PlayStation 3 consoles aan elkaar gekoppeld om samen te werken als één supercomputer. Dit was goedkoper dan echte supercomputers kopen.
Waarvoor werd het gebruikt?
- US Air Force bouwde een cluster van 1760 PS3's genaamd "Condor Cluster" voor beeldverwerking en AI onderzoek
- Universiteiten gebruikten PS3 clusters voor wetenschappelijke berekeningen
- Folding@home project voor eiwitvouwing simulaties
- Wachtwoord kraken en cryptografie onderzoek

De PS3 was populair hiervoor omdat de Cell processor zeer krachtig was voor parallelle berekeningen en een PS3 veel goedkoper was dan professionele hardware.

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?
Het cluster draait op Oracle Linux, een enterprise Linux distributie gebaseerd op Red Hat Enterprise Linux. Specifiek voor de Raspberry Pi's wordt een ARM-versie van Oracle Linux gebruikt.

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, zeer waarschijnlijk niet.

- Een Raspberry Pi heeft beperkte rekenkracht (ongeveer 10 GFLOPS per Pi)
- Zelfs met 1000+ Pi's kom je op maximaal ~10-20 TFLOPS
- De langzaamste computer in de Top 500 (juni 2023) heeft ongeveer 1.6 PFLOPS (1600 TFLOPS)
- Oracle's cluster is dus minstens 100x te langzaam om in de Top 500 te komen
- Het cluster was bedoeld als demonstratie en proof-of-concept, niet voor ruwe rekenkracht

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?

CPU Architectuur: Beide consoles gebruiken **AMD x86-64 (AMD64)** architectuur, specifiek AMD Zen 2 cores.
Besturingssystemen:

Console	Besturingssysteem
PlayStation 5	Orbis OS (gebaseerd op FreeBSD, Unix-like)
Xbox Series X	Xbox OS (gebaseerd op Windows 10, aangepaste versie)

Conclusie: Moderne game consoles gebruiken dezelfde x86-64 architectuur als gewone PC's. Dit maakt het makkelijker voor ontwikkelaars om games te maken voor zowel PC als consoles. De tijd van exotische processors zoals de Cell (PS3) is voorbij. Het verschil zit nu vooral in de software en optimalisaties, niet meer in de hardware architectuur.

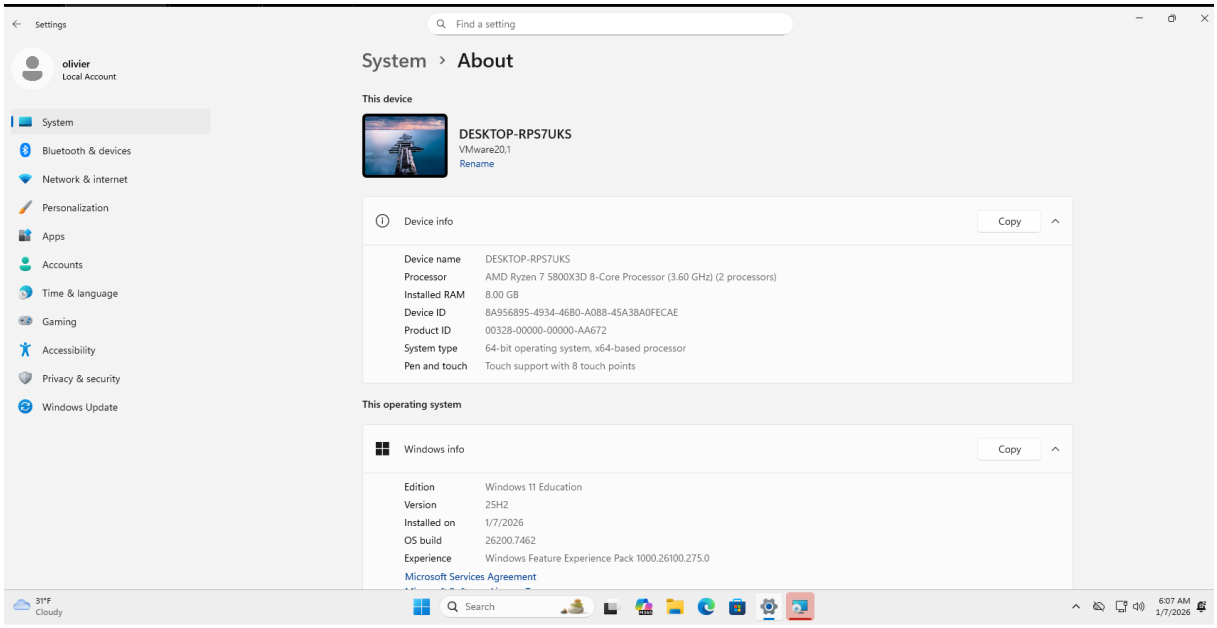
Assignment 5.3: Working with Windows

Take relevant screenshots of the assignments below

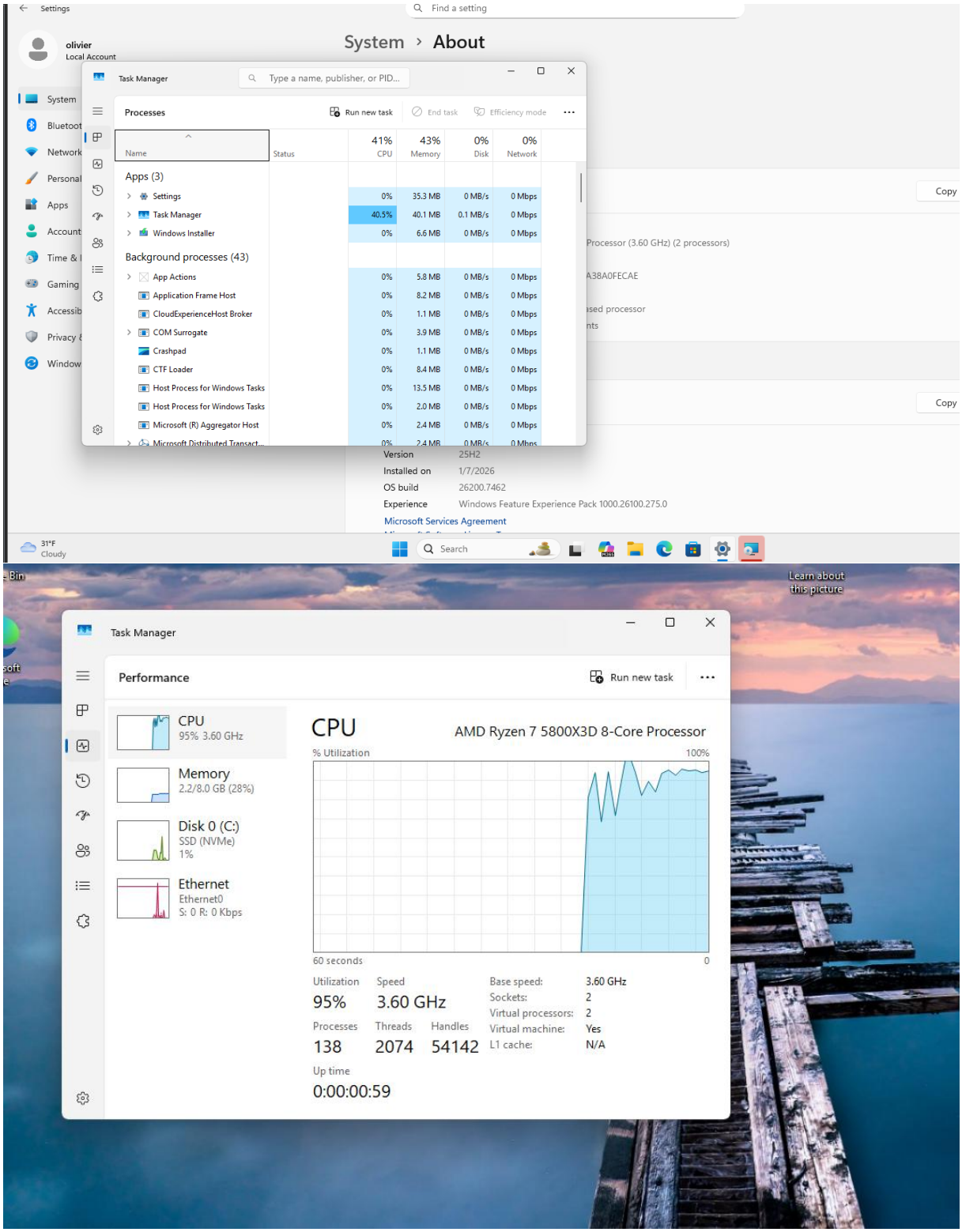
a) Practice for about 10 minutes with the ⊞ keyboard shortcuts combinations, skip the general shortcuts in this exercise. Take a look at which screens are opened.

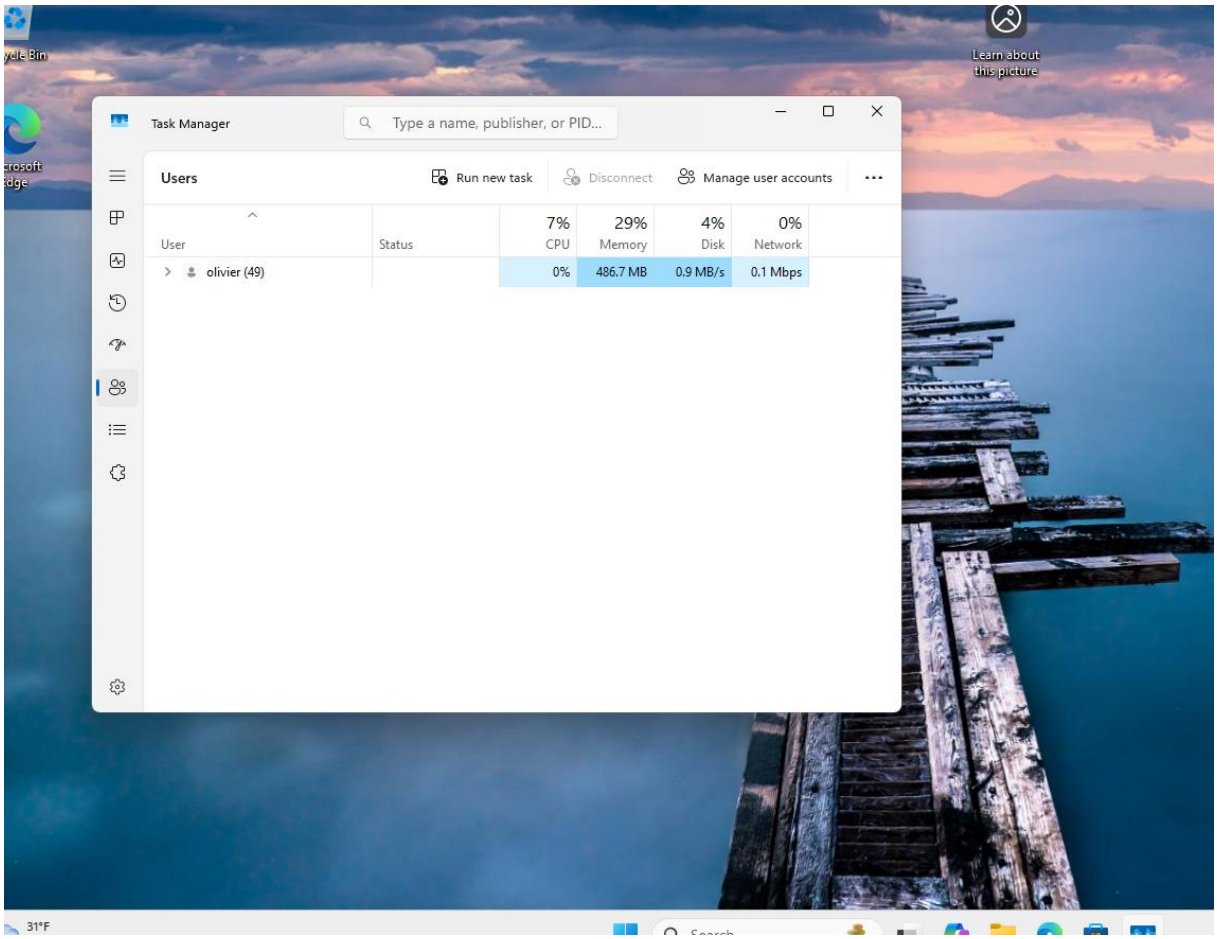
b) The file explorer can be opened with ⊞ + E, Which key combination could you also use?
Rechtermuisknop op Start → File Explorer
Of via het Start menu → File Explorer icon

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.


Settings
Find a setting
olivier
Local Account
System › About
Task Manager
Type a name, publisher, or PID...
Processes
Run new task
End task
Efficiency mode
Name
Status
41% CPU
43% Memory
0% Disk
0% Network
Apps (3)
Settings 0% 35.3 MB 0 MB/s 0 Mbps
Task Manager 40.5% 40.1 MB 0.1 MB/s 0 Mbps
Windows Installer 0% 6.6 MB 0 MB/s 0 Mbps
Background processes (43)
App Actions 0% 5.8 MB 0 MB/s 0 Mbps
Application Frame Host 0% 8.2 MB 0 MB/s 0 Mbps
CloudExperienceHost Broker 0% 1.1 MB 0 MB/s 0 Mbps
COM Surrogate 0% 3.9 MB 0 MB/s 0 Mbps
Crashpad 0% 1.1 MB 0 MB/s 0 Mbps
CTF Loader 0% 8.4 MB 0 MB/s 0 Mbps
Host Process for Windows Tasks 0% 13.5 MB 0 MB/s 0 Mbps
Host Process for Windows Tasks 0% 2.0 MB 0 MB/s 0 Mbps
Microsoft (R) Aggregator Host 0% 2.4 MB 0 MB/s 0 Mbps
Copy
Version 25H2
Installed on 1/7/2026
OS build 26200.7462
Experience Windows Feature Experience Pack 1000.26100.275.0
Microsoft Services Agreement
Search
Learn about this picture
Task Manager
Performance
Run new task
CPU
95% 3.60 GHz
Memory
2.2/8.0 GB (28%)
Disk 0 (C:)
SSD (NVMe)
1%
Ethernet
Ethernet0
S: 0 R: 0 Kbps
CPU
AMD Ryzen 7 5800X3D 8-Core Processor
% Utilization
100%
60 seconds
0
Utilization
95%
Speed
3.60 GHz
Processes
138
Threads
2074
Handles
54142
Up time
0:00:00:59
Base speed: 3.60 GHz
Sockets: 2
Virtual processors: 2
Virtual machine: Yes
L1 cache: N/A

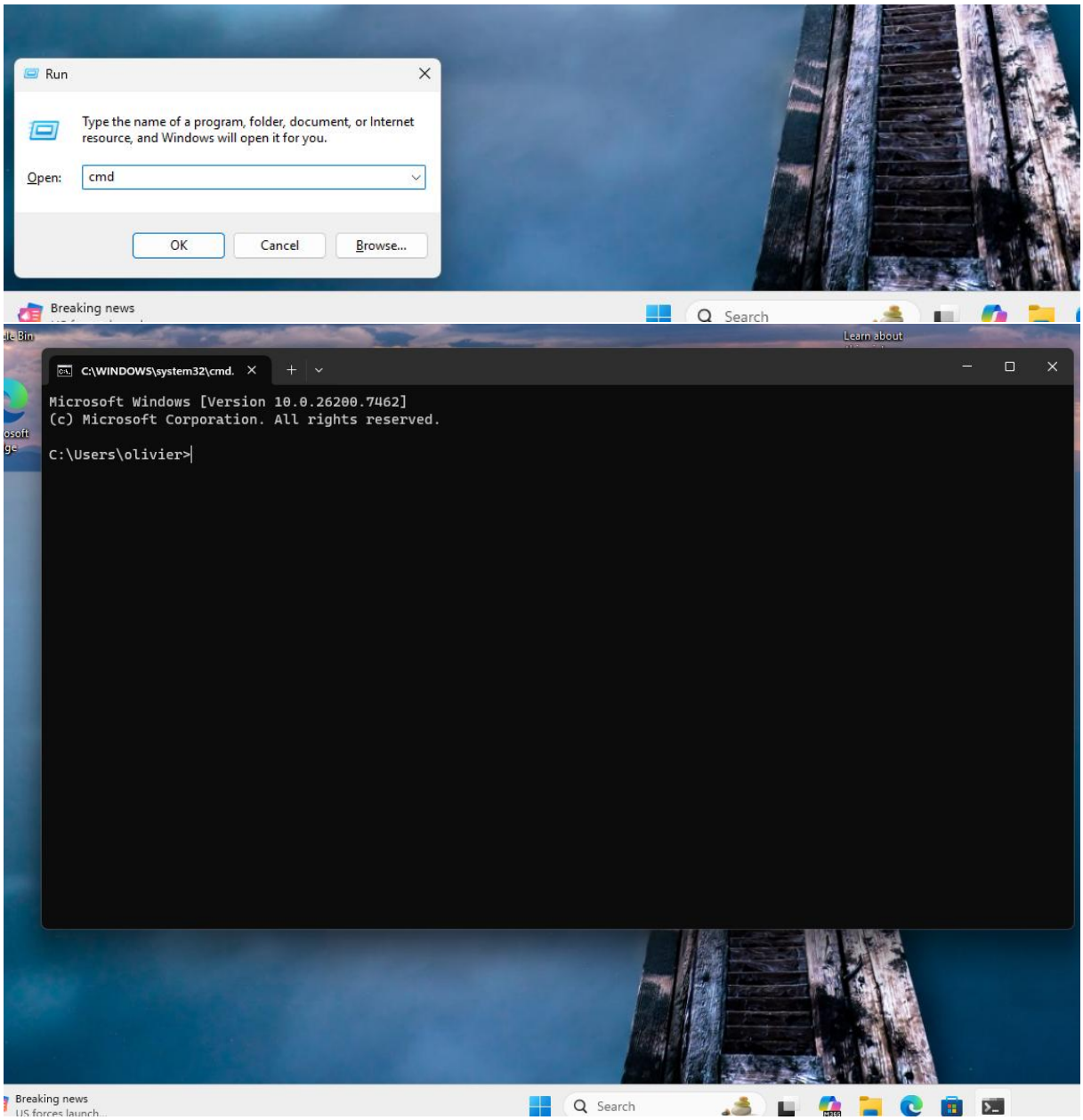


e) If you're giving a PowerPoint presentation and you connect your laptop to a projector, Windows can use the projector as a second screen. For example, you may have Outlook open on your first screen that you don't show over the projector, while the PowerPoint presentation is displayed on the projector, or the second screen. Which key combination should you use for this?

Windows + P (Presenter mode menu)

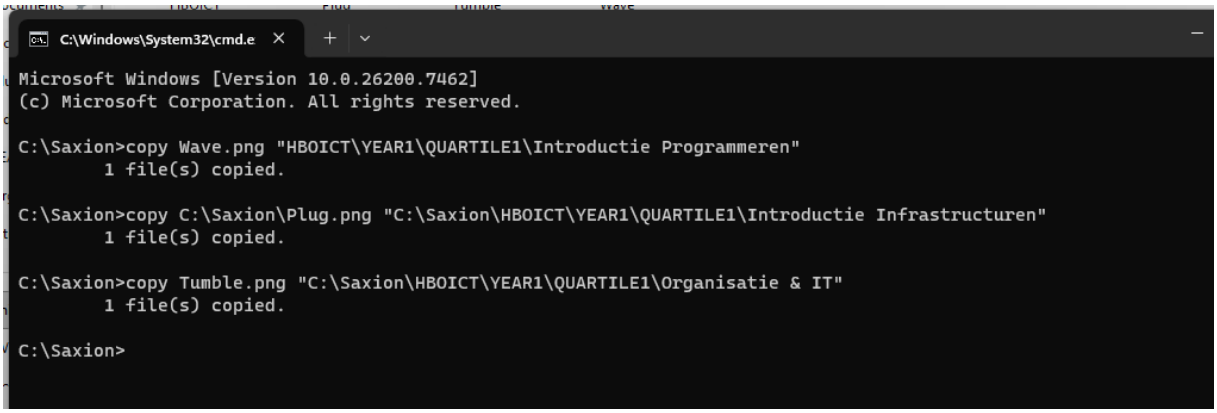
f) If you leave the classroom for a while and you leave your laptop behind, it is wise to lock the screen. Your Apps will continue to run in the background. So, for example, if you're waiting for a download that takes a while, lock the screen and get a cup of coffee. Which key combination do you use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

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.

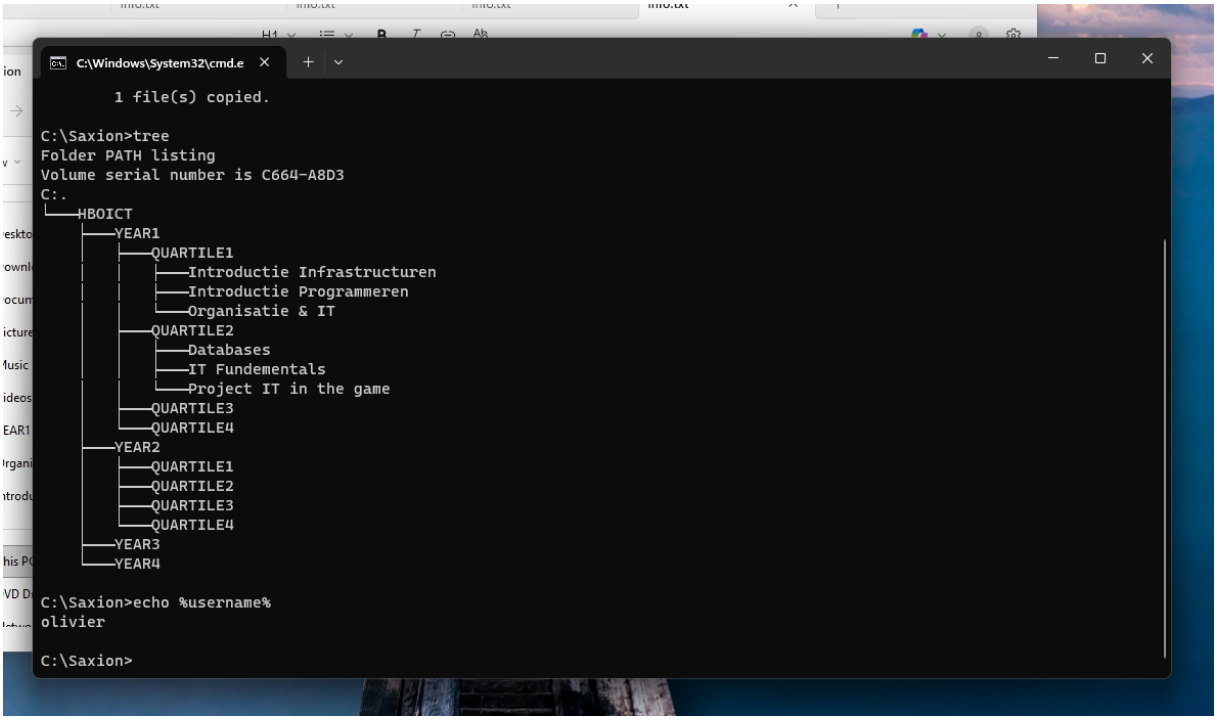


Working in the File Explorer

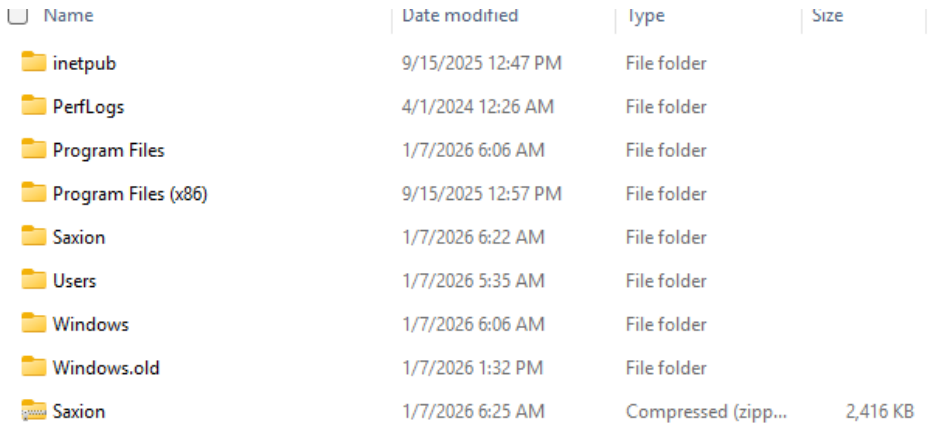
Relevant screenshots **copy** command:

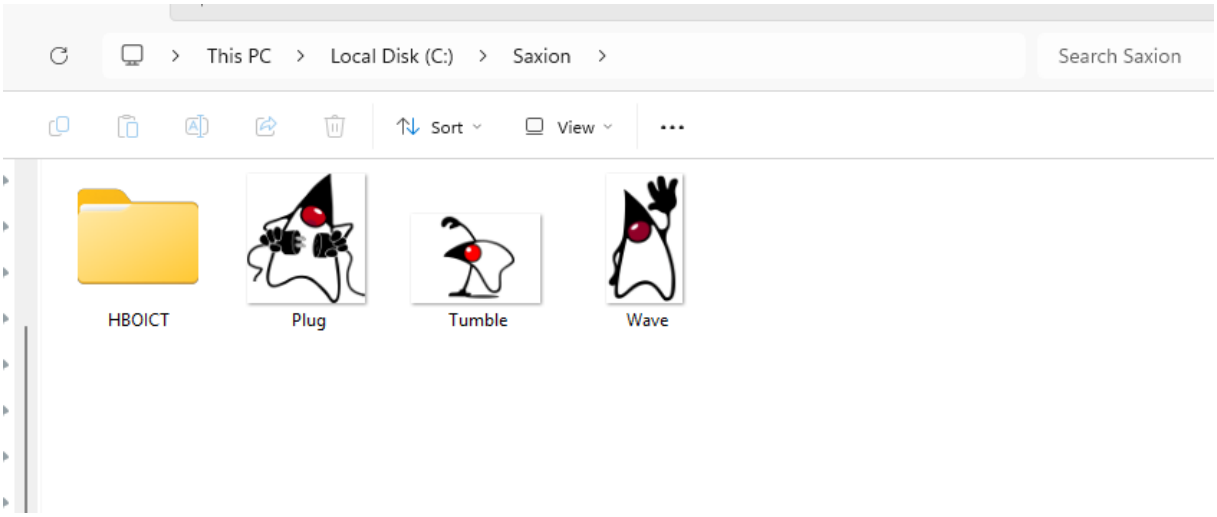


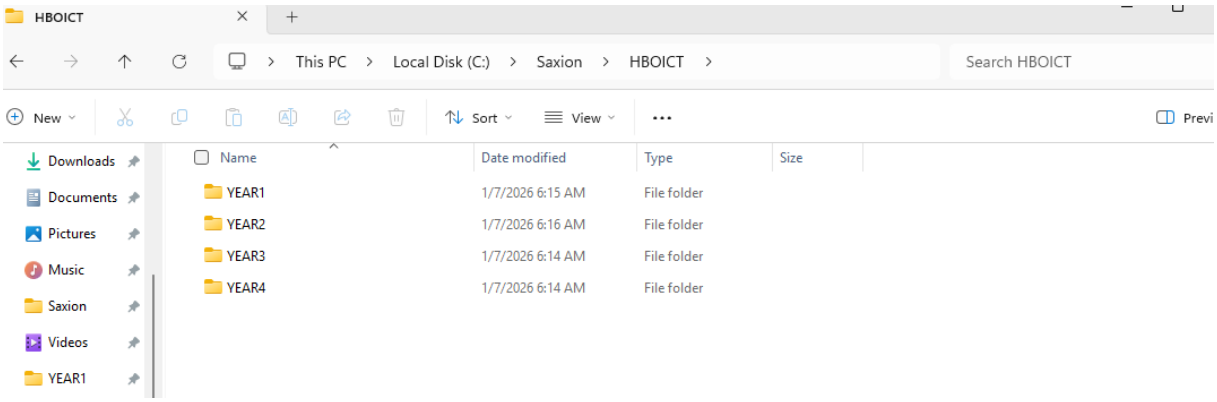
Relevant screenshots **tree** command:

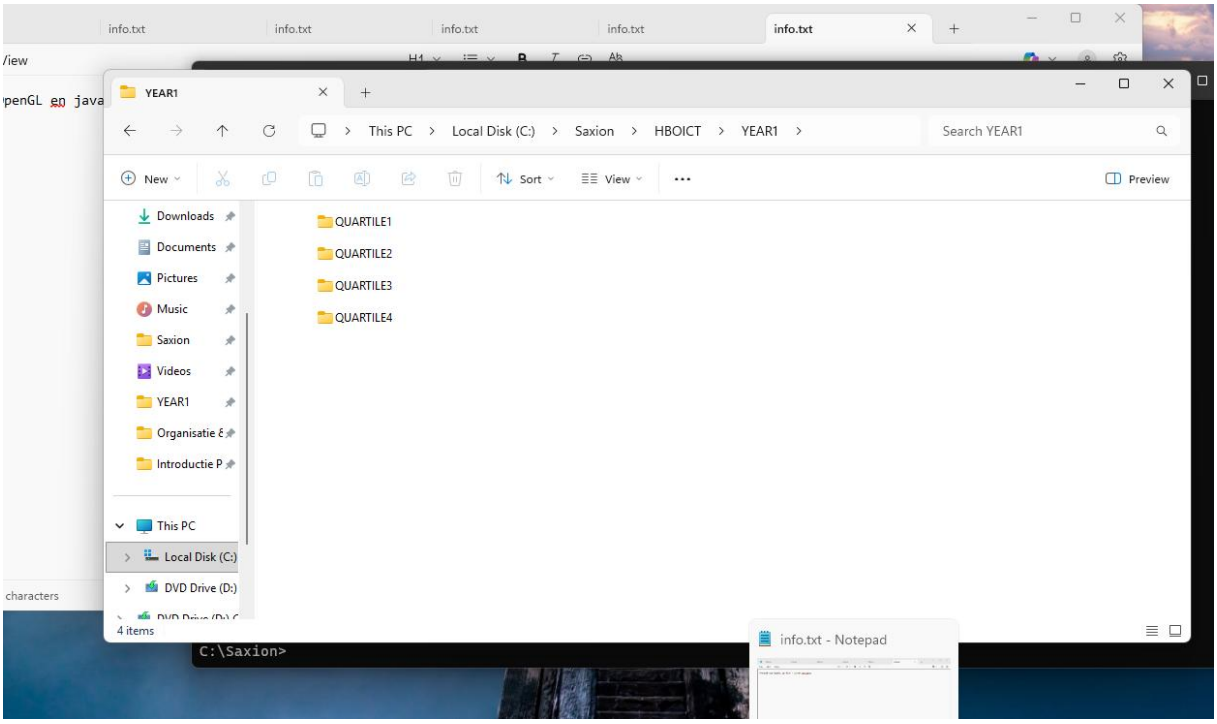


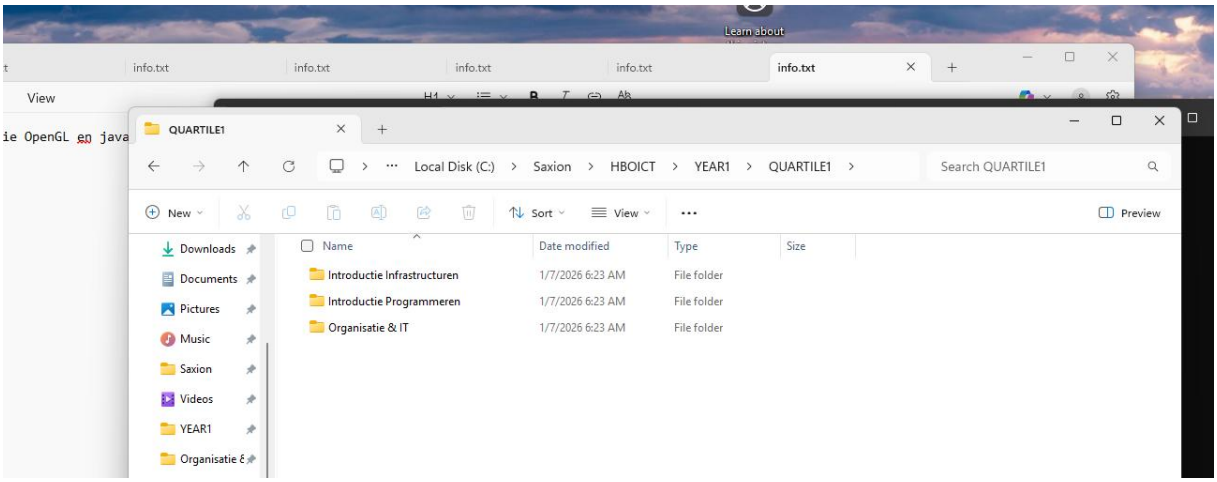
Relevant screenshots in the file explorer of the folder c:\Saxion + created zip file.

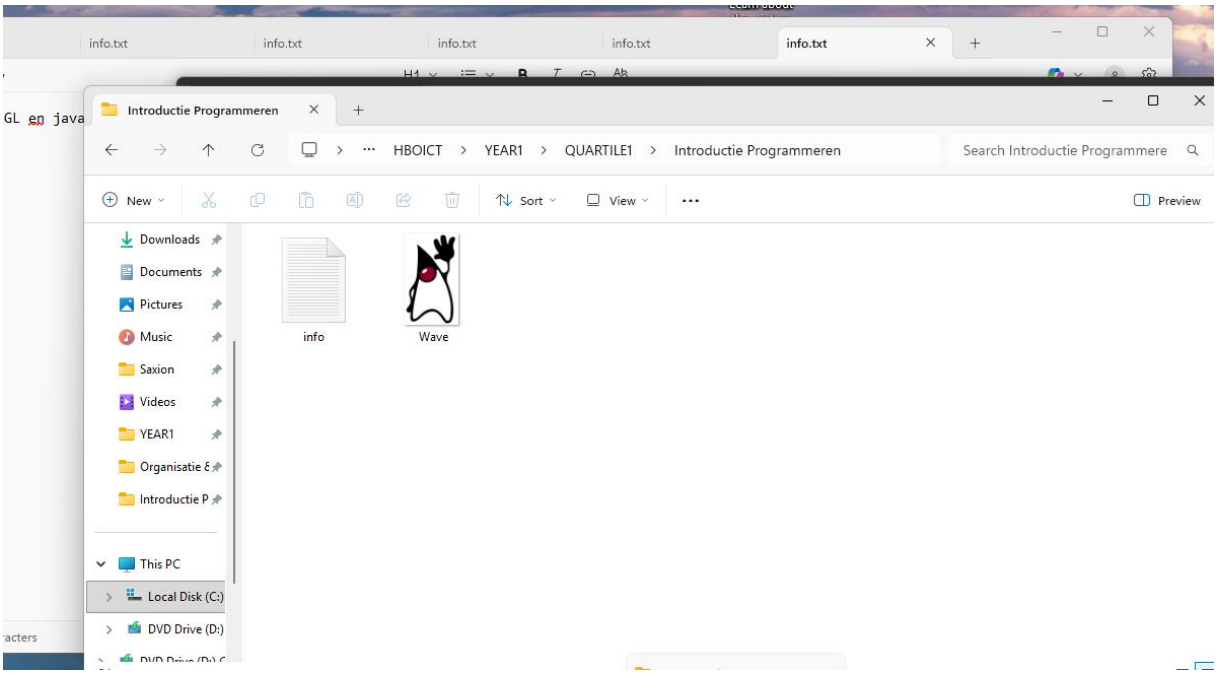



This PC
Local Disk (C:)
Saxion
Search Saxion
Sort
View
HBOICT
Plug
Tumble
Wave


HBOICT
This PC
Local Disk (C:)
Saxion
HBOICT
Search HBOICT
New
Sort
View
Downloads
Documents
Pictures
Music
Saxion
Videos
YEAR1
Name
Date modified
Type
Size
YEAR1 1/7/2026 6:15 AM File folder
YEAR2 1/7/2026 6:16 AM File folder
YEAR3 1/7/2026 6:14 AM File folder
YEAR4 1/7/2026 6:14 AM File folder

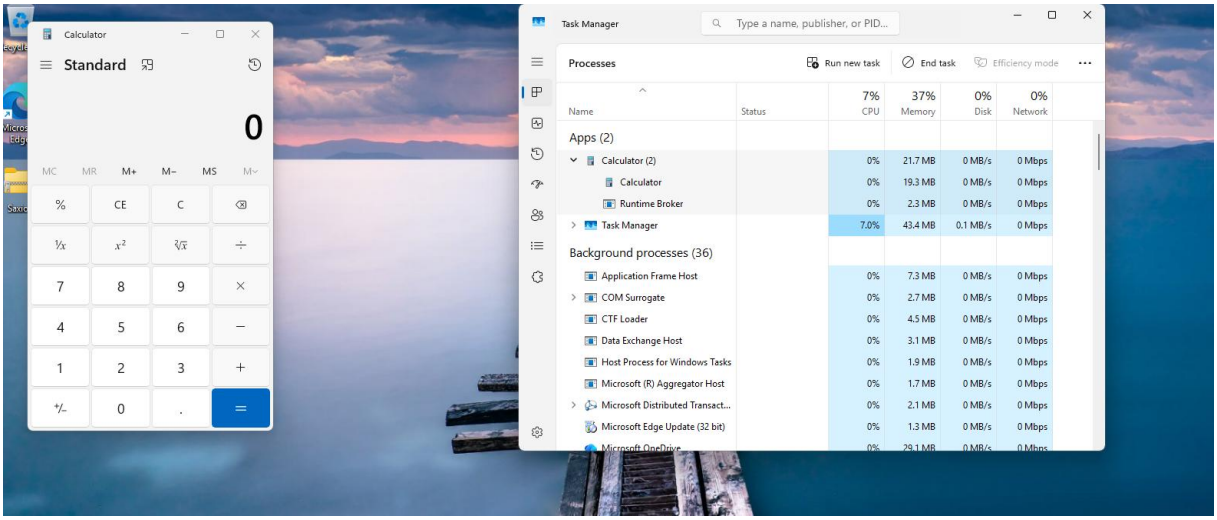

info.txt
YEAR1
This PC
Local Disk (C:)
Saxion
HBOICT
YEAR1
Search YEAR1
New
Sort
View
Preview
QUARTILE1
QUARTILE2
QUARTILE3
QUARTILE4
4 items
C:\Saxion>
info.txt - Notepad

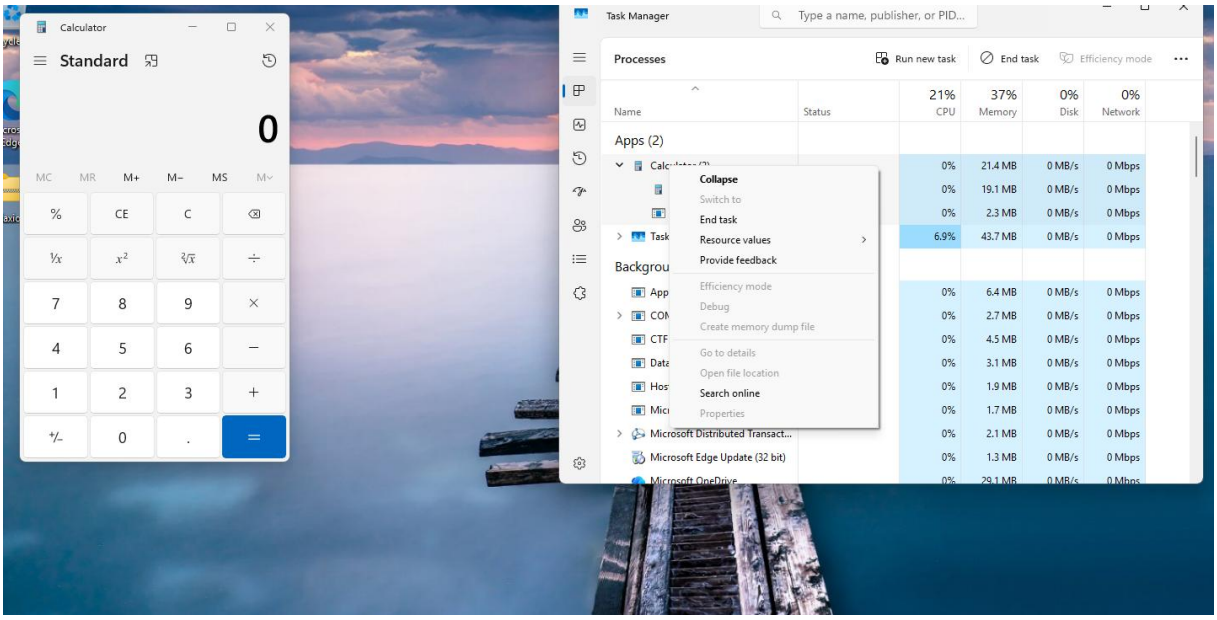


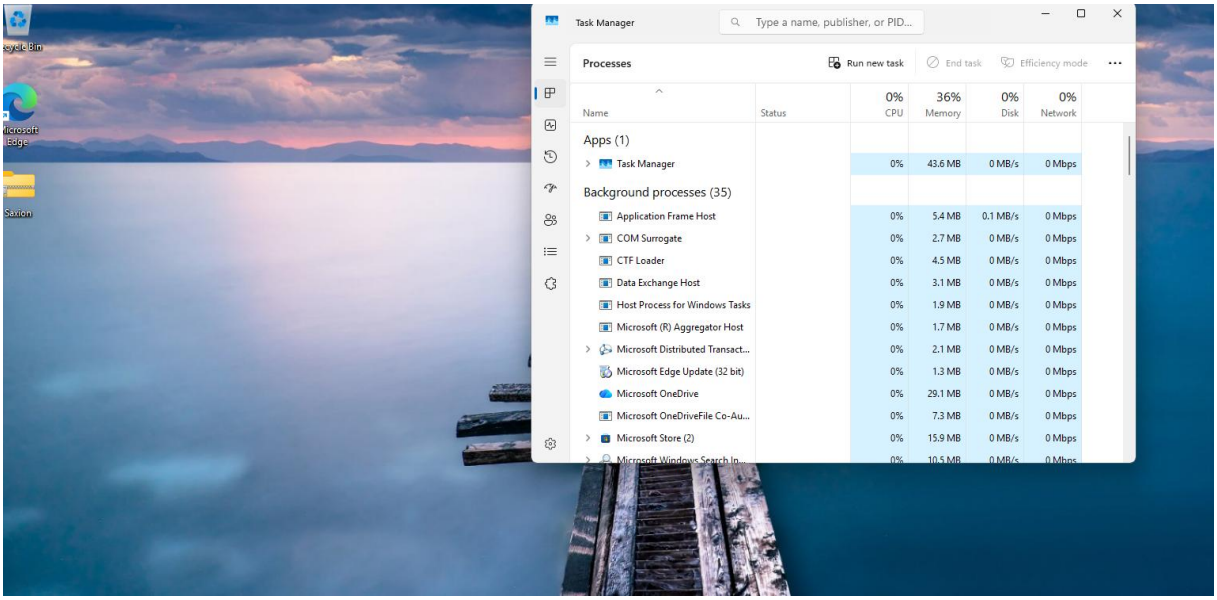


Terminating Processes

Relevant Screenshots Task Manager Window:



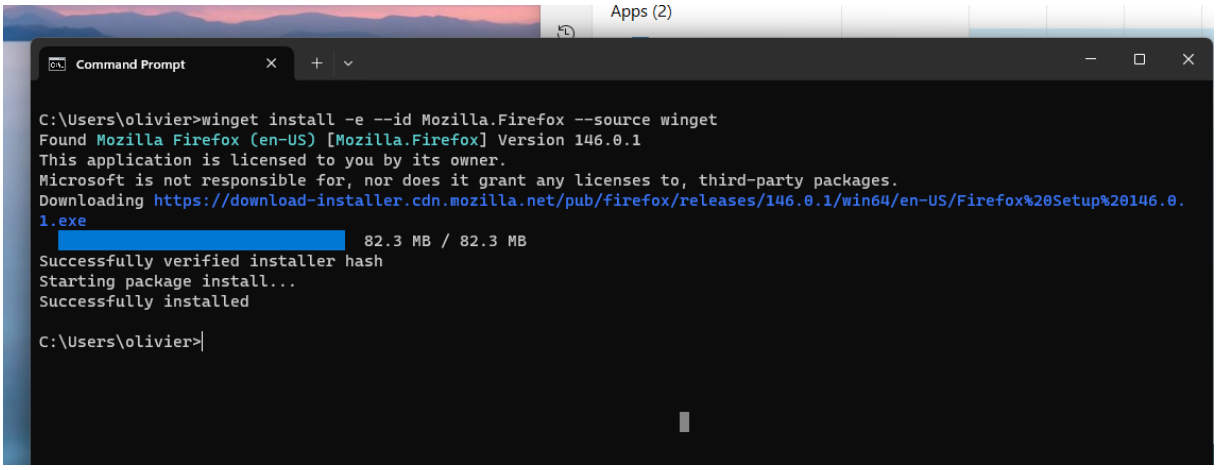




Install Software

Relevant screenshots that the following software is installed with winget:

- WinSCP
- Notepad++
- 7zip



winget install -e --id Mozilla.Firefox --source winget

Dit commando installeert Firefox automatisch via de Windows Package Manager zonder handmatig een installer te downloaden.

Opties:

- -e (--exact) = zoekt alleen op exacte match, niet op gedeeltelijke naam
- --id = specificeert de unieke package identifier (Mozilla.Firefox)
- --source winget = gebruikt de winget repository in plaats van Microsoft Store (msstore is broken door bug vandaar moet dit even)

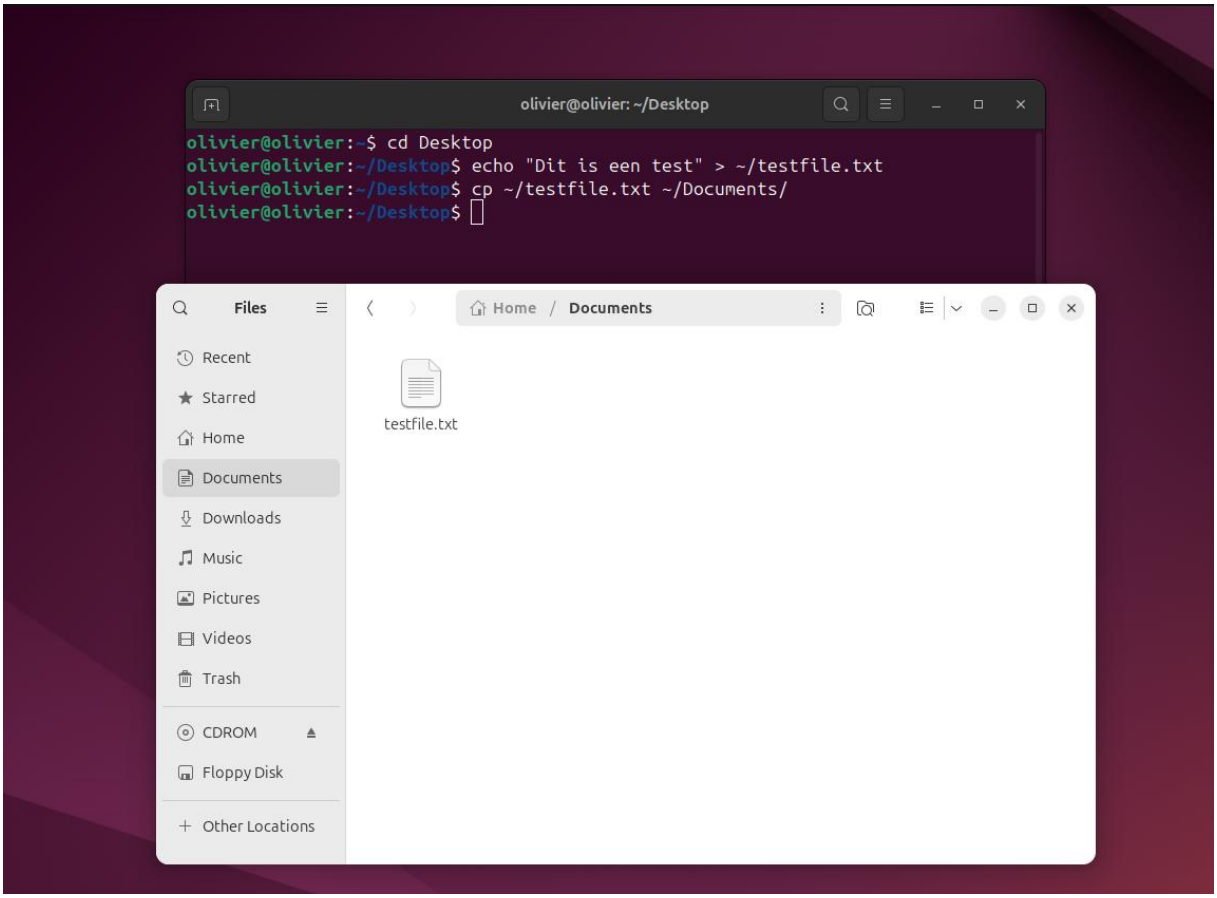
```
C:\Users\olivier>winget install -e --id 7zip.7zip --source winget
Found 7-Zip [7zip.7zip] Version 25.01
This application is licensed to you by its owner.
Microsoft is not responsible for, nor does it grant any licenses to, third-party packages.
Downloading https://7-zip.org/a/7z2501-x64.exe
  1.56 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\olivier>
```

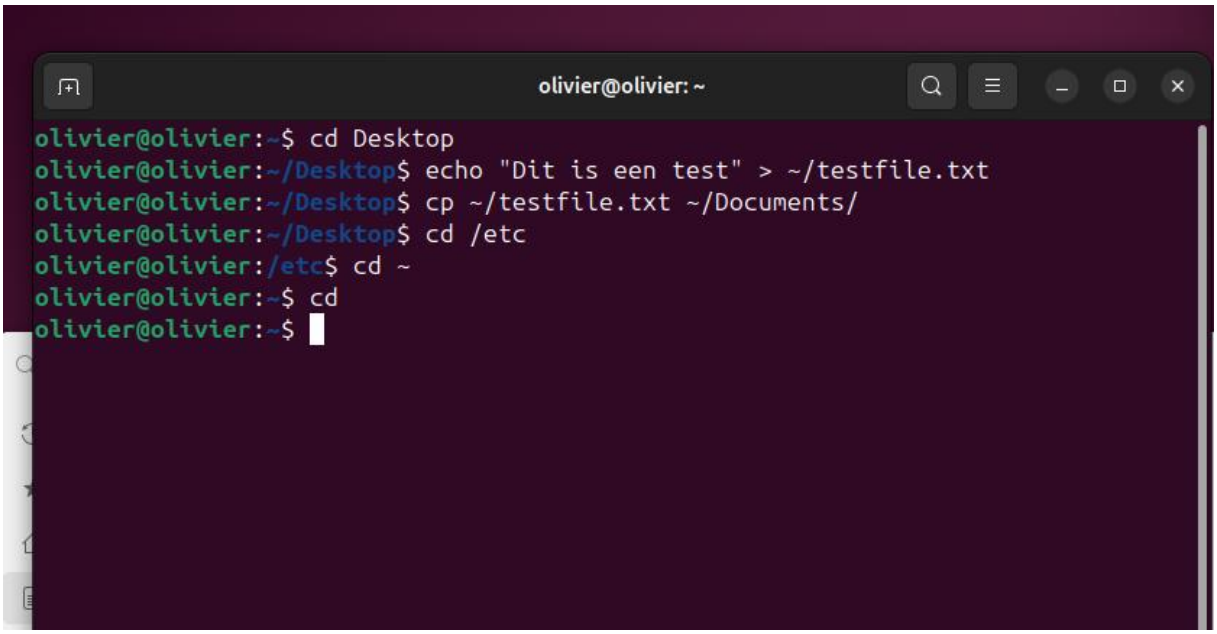
```
C:\Users\olivier>winget install -e --id Notepad++.Notepad++ --source winget
Found Notepad++ [Notepad++.Notepad++] Version 8.9
This application is licensed to you by its owner.
Microsoft is not responsible for, nor does it grant any licenses to, third-party packages.
Downloading https://github.com/notepad-plus-plus/notepad-plus-plus/releases/download/v8.9/npp.8.9.Installer.x64.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
```

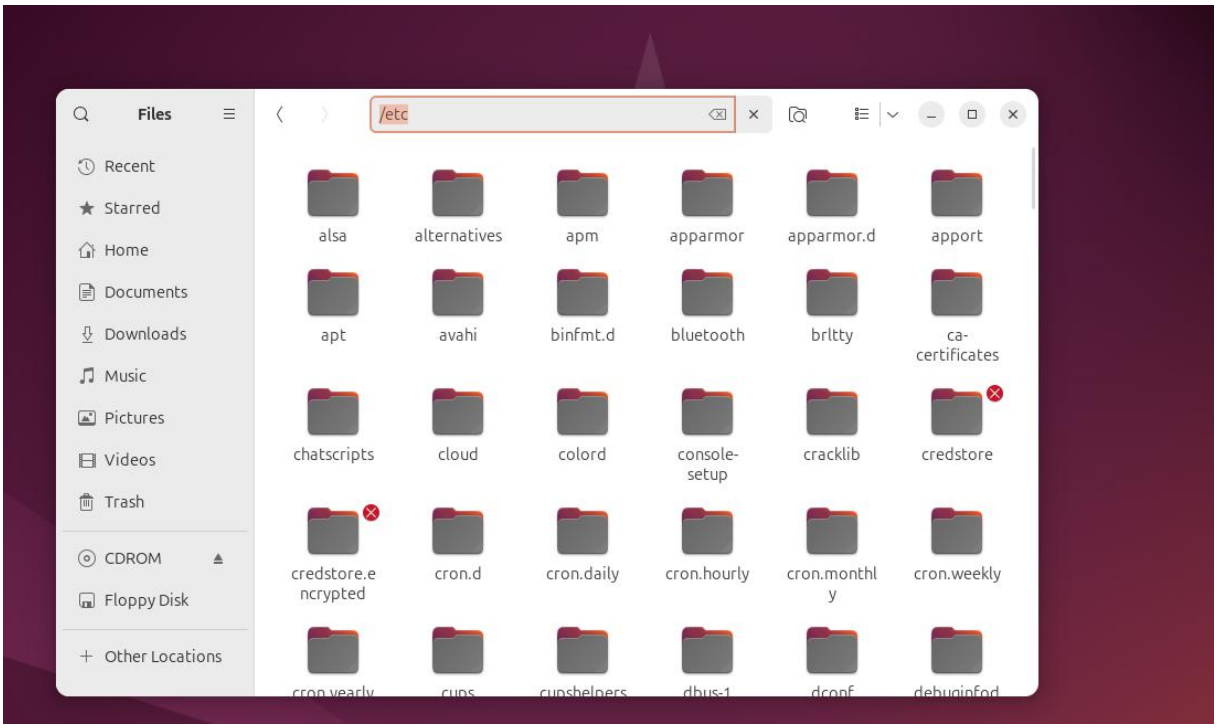
```
C:\Users\olivier>winget install -e --id WinSCP.WinSCP --source winget
Found WinSCP [WinSCP.WinSCP] Version 6.5.5
This application is licensed to you by its owner.
Microsoft is not responsible for, nor does it grant any licenses to, third-party packages.
Downloading https://sourceforge.net/projects/winscp/files/WinSCP/6.5.5/WinSCP-6.5.5-Setup.exe/download
  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
```

Assignment 5.4: Working with Linux

Relevant screenshots + motivation





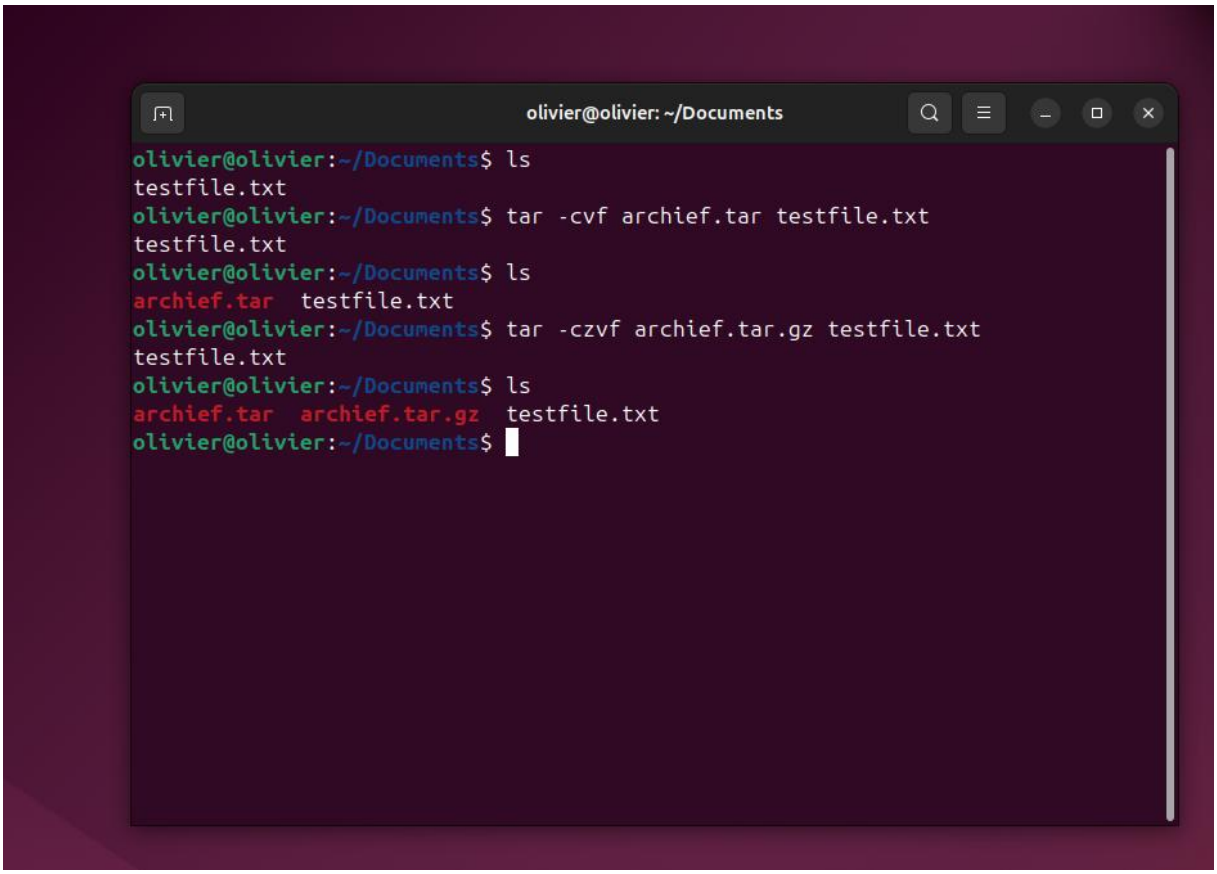


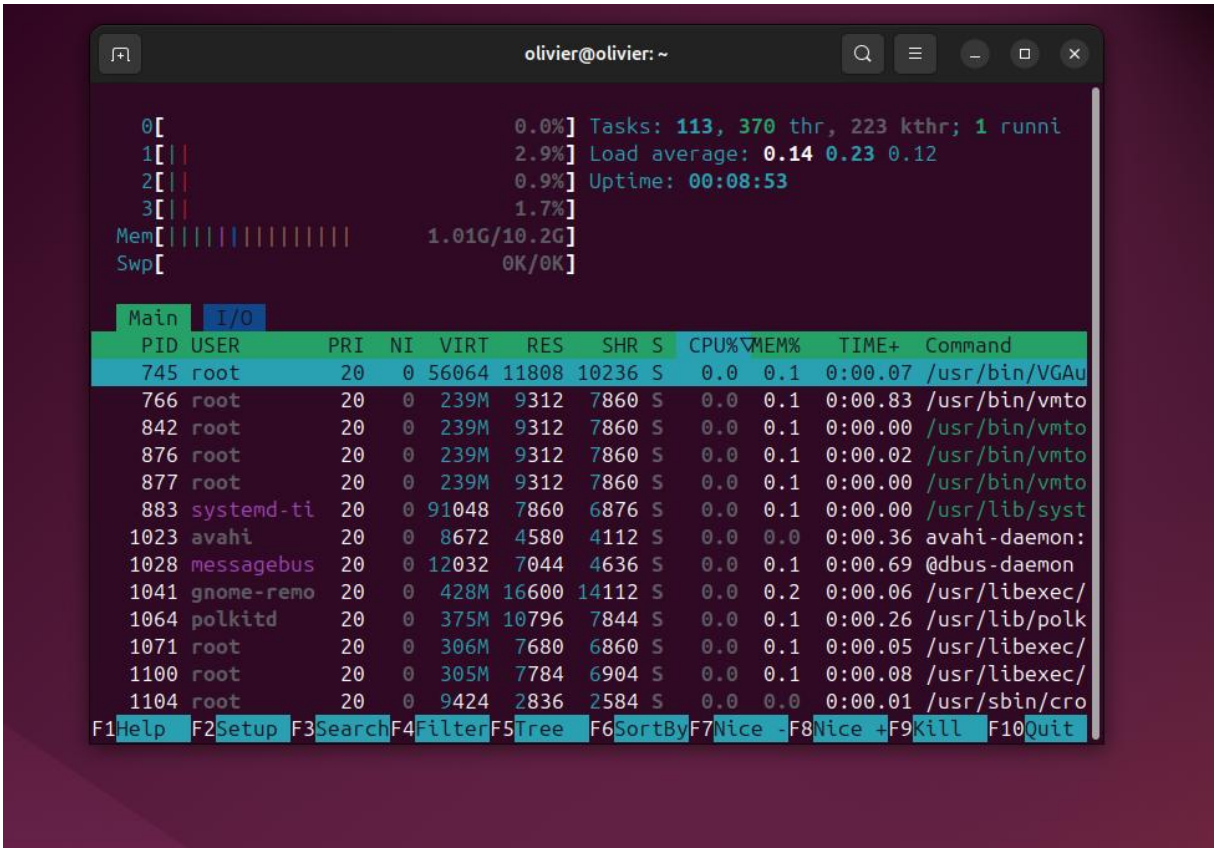
Verschil Linux vs Windows:

Linux gebruikt een root directory (/) waar alles onder valt. Windows gebruikt drive letters (C:, D:, etc.) voor verschillende schijven.

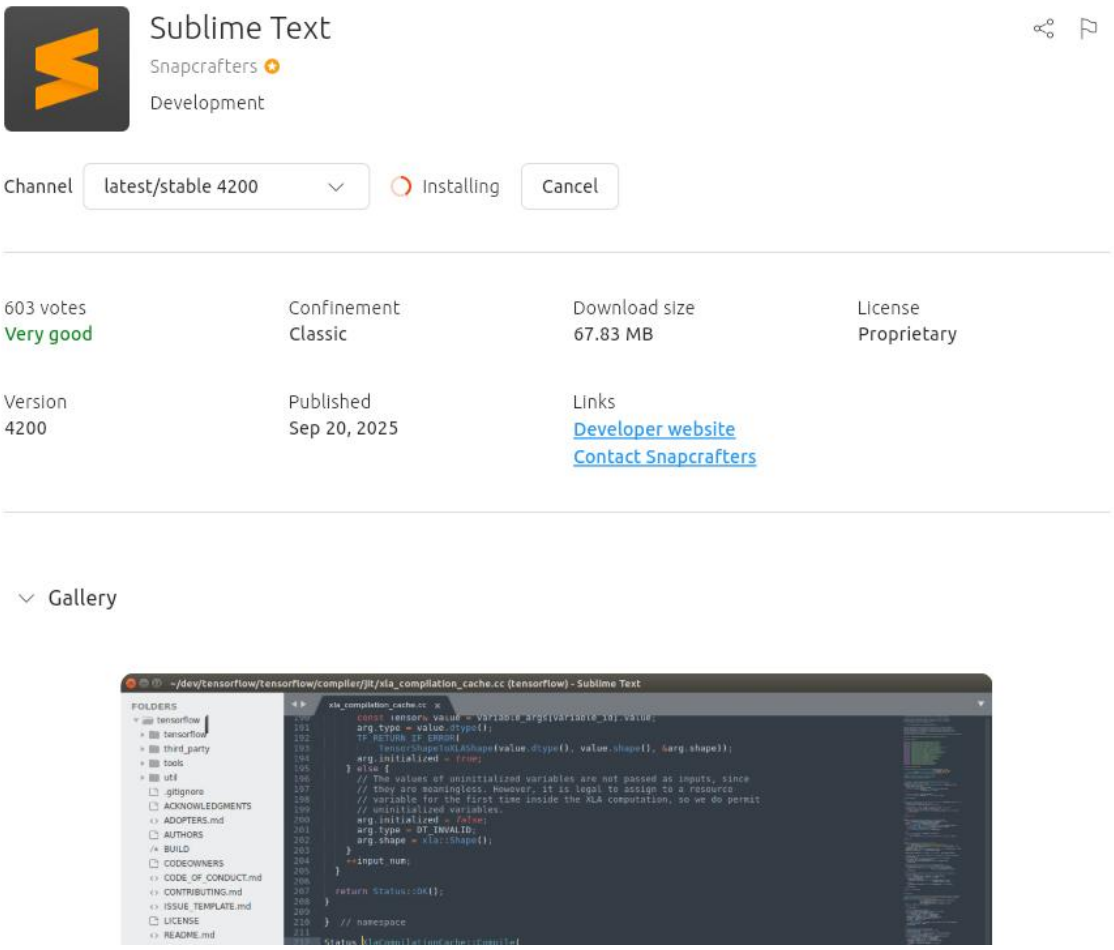
Waar is /etc voor:

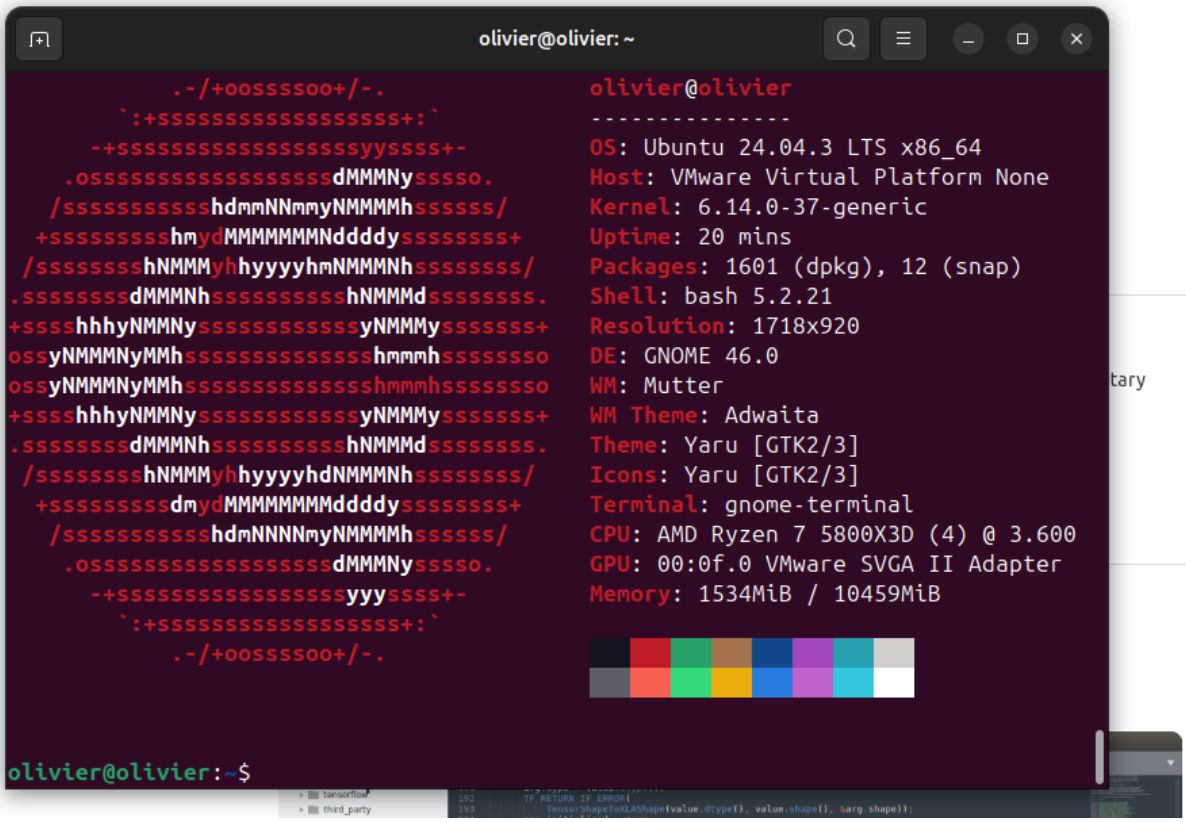
De /etc directory bevat systeemconfiguratiebestanden. Hier staan instellingen voor services, netwerk, gebruikers en andere systeemconfiguraties.


olivier@olivier: ~/Documents
olivier@olivier:~/Documents$ ls
testfile.txt
olivier@olivier:~/Documents$ tar -cvf archief.tar testfile.txt
testfile.txt
olivier@olivier:~/Documents$ ls
archief.tar testfile.txt
olivier@olivier:~/Documents$ tar -czvf archief.tar.gz testfile.txt
testfile.txt
olivier@olivier:~/Documents$ ls
archief.tar archief.tar.gz testfile.txt
olivier@olivier:~/Documents$


olivier@olivier: ~
0[0.0%] Tasks: 113, 370 thr, 223 kthr; 1 runni
1[|| 2.9%] Load average: 0.14 0.23 0.12
2[|| 0.9%] Uptime: 00:08:53
3[|| 1.7%]
Mem[|||||||||||| 1.01G/10.2G]
Swp[0K/0K]
Main I/O
PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
745 root 20 0 56064 11808 10236 S 0.0 0.1 0:00.07 /usr/bin/VGAu
766 root 20 0 239M 9312 7860 S 0.0 0.1 0:00.83 /usr/bin/vmto
842 root 20 0 239M 9312 7860 S 0.0 0.1 0:00.00 /usr/bin/vmto
876 root 20 0 239M 9312 7860 S 0.0 0.1 0:00.02 /usr/bin/vmto
877 root 20 0 239M 9312 7860 S 0.0 0.1 0:00.00 /usr/bin/vmto
883 systemd-ti 20 0 91048 7860 6876 S 0.0 0.1 0:00.00 /usr/lib/syst
1023 avahi 20 0 8672 4580 4112 S 0.0 0.0 0:00.36 avahi-daemon:
1028 messagebus 20 0 12032 7044 4636 S 0.0 0.1 0:00.69 @dbus-daemon
1041 gnome-remo 20 0 428M 16600 14112 S 0.0 0.2 0:00.06 /usr/libexec/
1064 polkitd 20 0 375M 10796 7844 S 0.0 0.1 0:00.26 /usr/lib/polk
1071 root 20 0 306M 7680 6860 S 0.0 0.1 0:00.05 /usr/libexec/
1100 root 20 0 305M 7784 6904 S 0.0 0.1 0:00.08 /usr/libexec/
1104 root 20 0 9424 2836 2584 S 0.0 0.0 0:00.01 /usr/sbin/cro
F1Help F2Setup F3SearchF4FilterF5Tree F6SortByF7Nice -F8Nice +F9Kill F10Quit

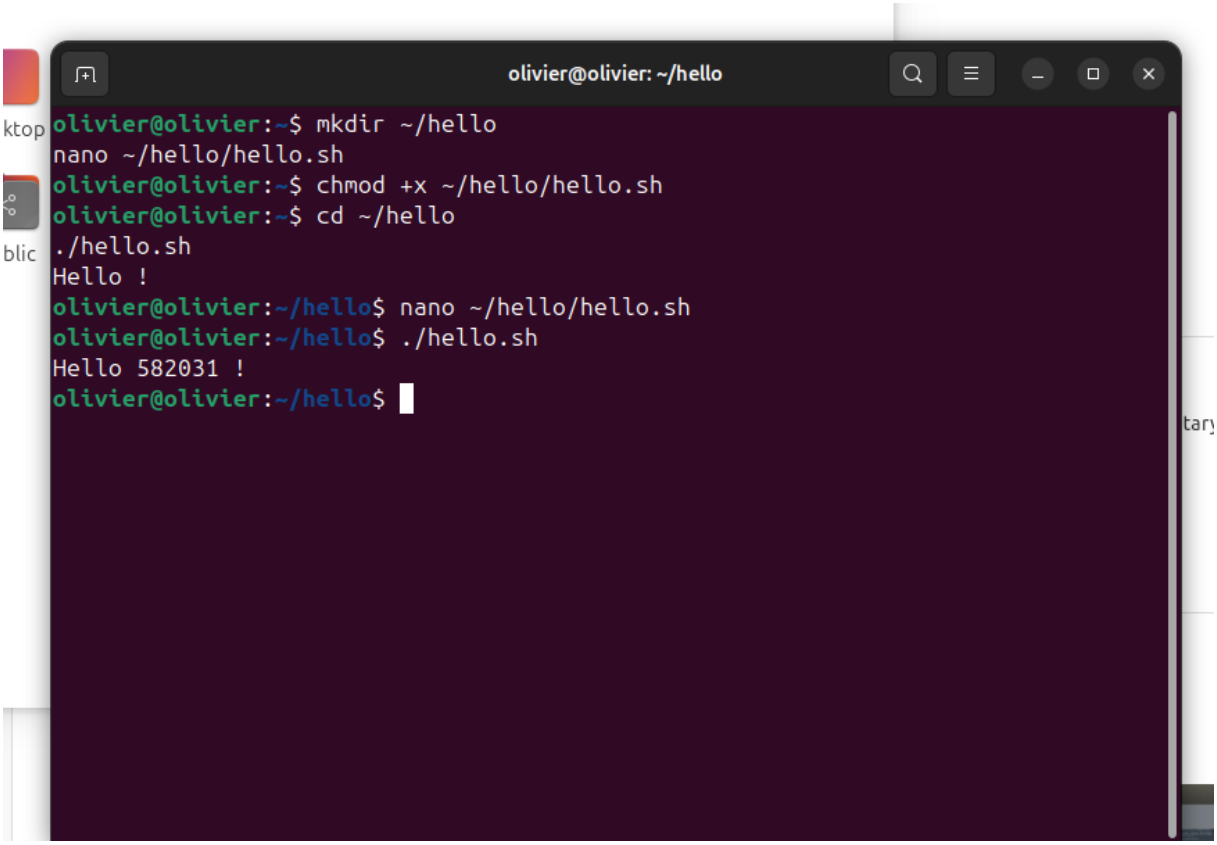
htop is een interactieve process viewer die real-time CPU gebruik, geheugengebruik, actieve processen en systeembelasting toont. Je kunt processen sorteren, zoeken en beëindigen.





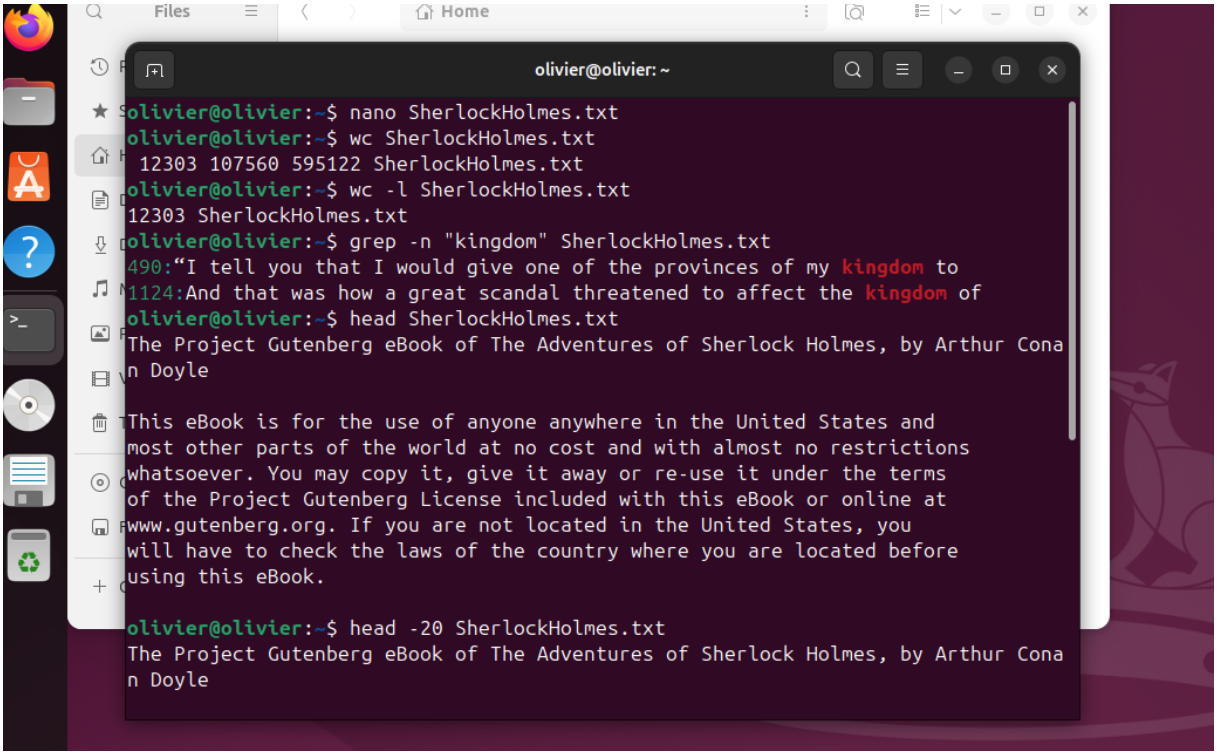
Assignment 5.5: Users and permissions on Linux

Relevant screenshots + motivation



Assignment 5.6: View the contents of files

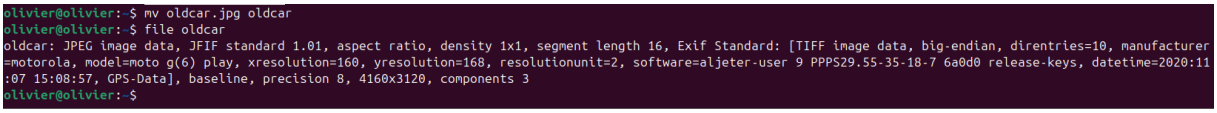
Relevant screenshots + motivation

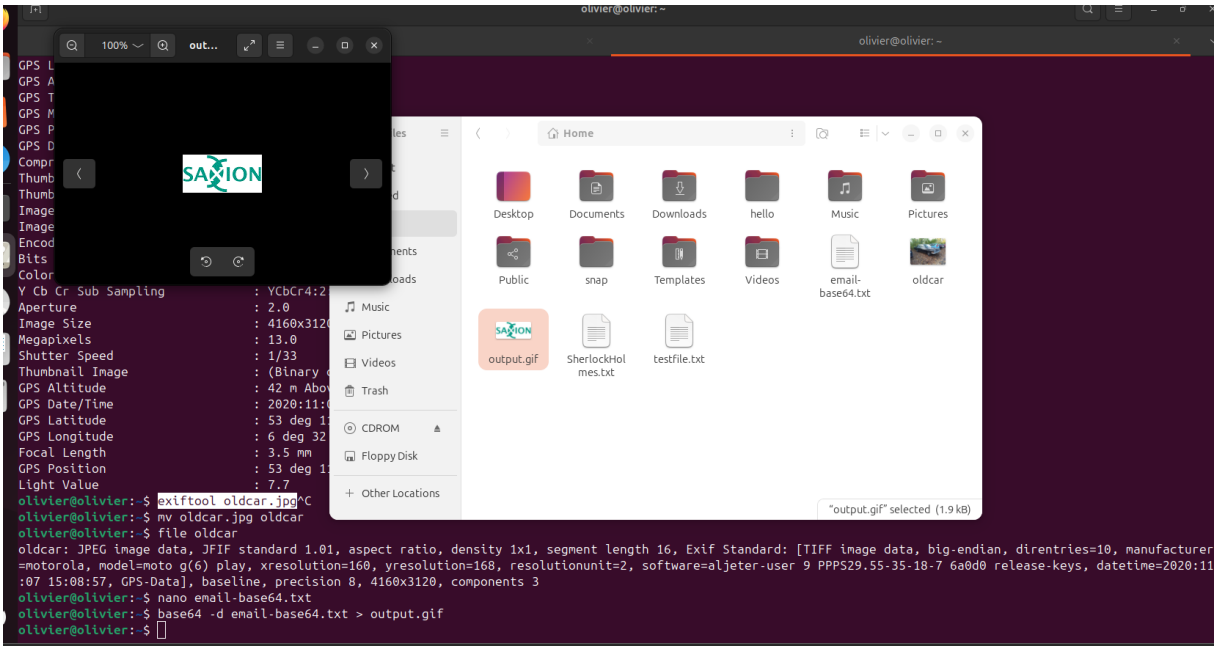


53 deg 11' 39.68" N, 6 deg 32' 12.90" E

Provincie: Groningen

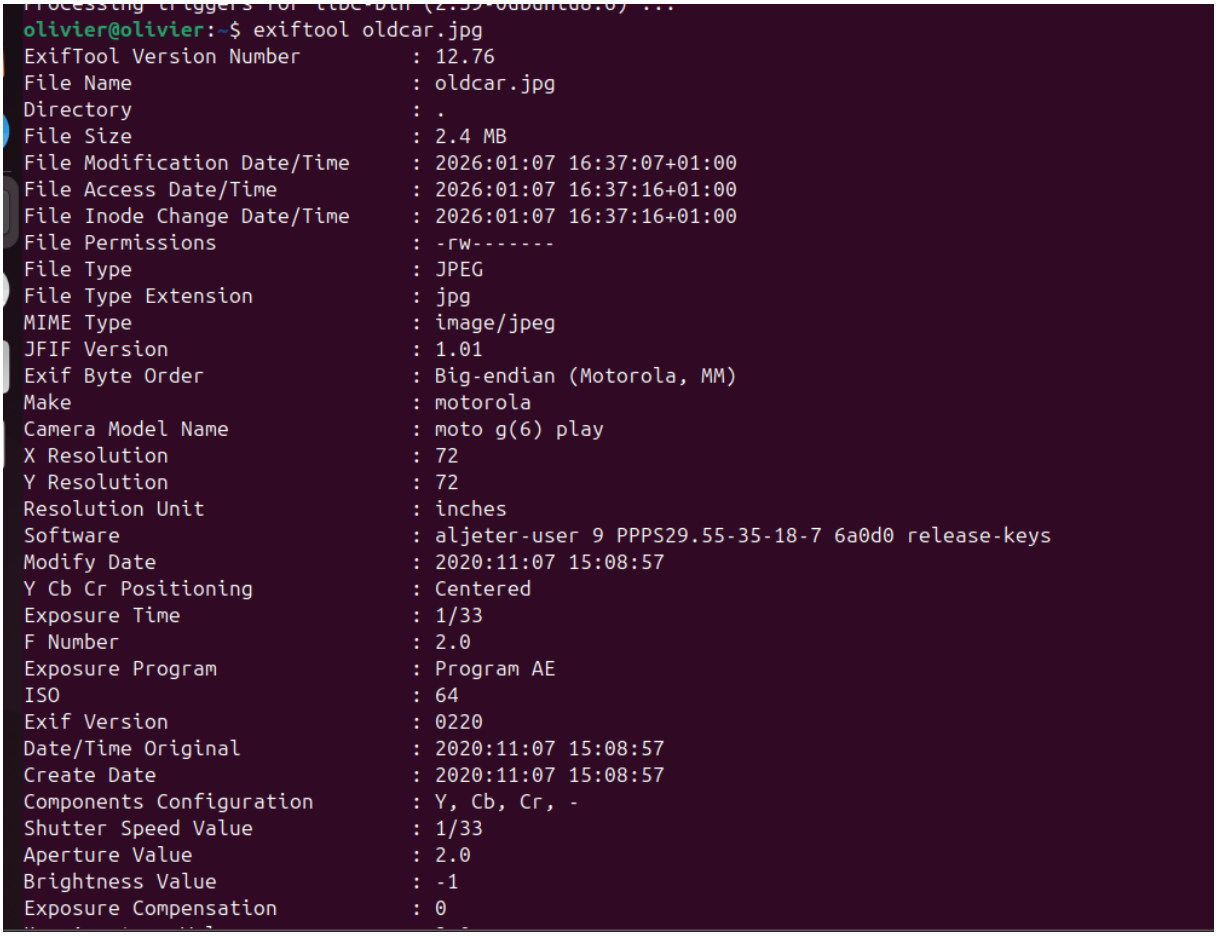
Dichtstbijzijnde plek: Hoogkerk





Assignment 5.7: Digital forensics

Relevant screenshots + motivation

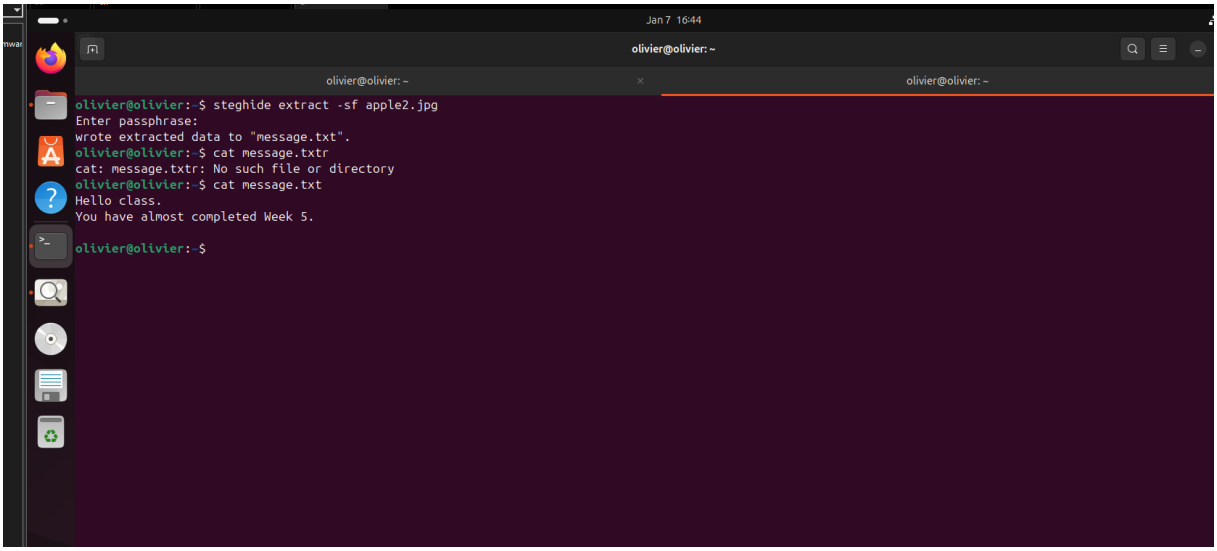


Motorola G(6)

53 deg 11' 39.68" N, 6 deg 32' 12.90" E

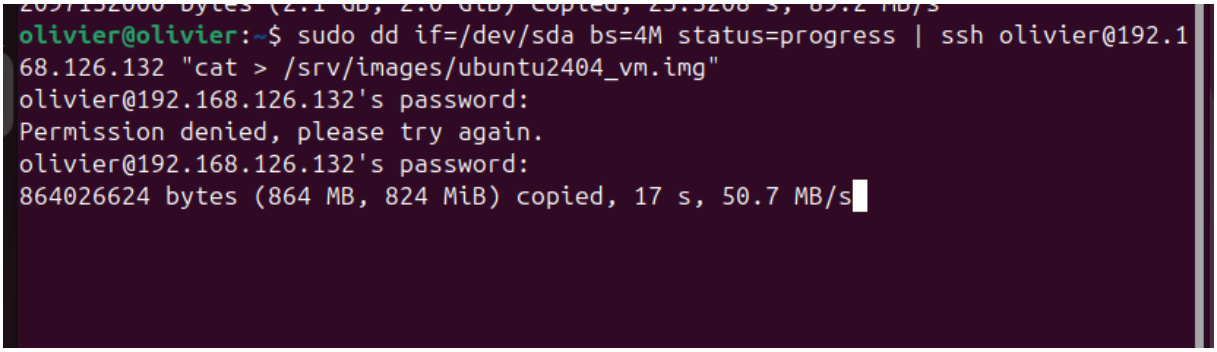
Assignment 5.8: Steganography

Relevant screenshots + motivation

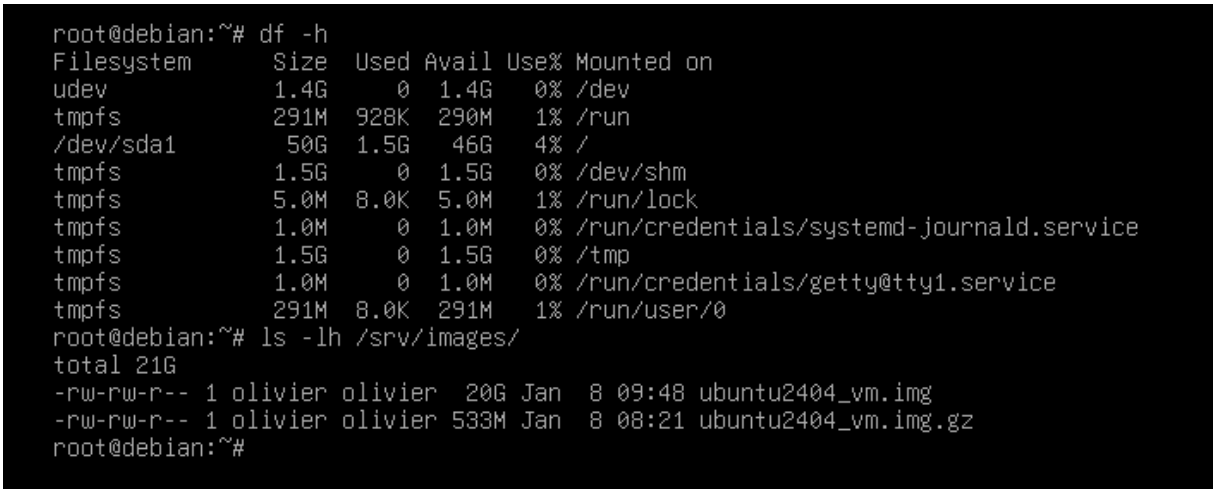


Assignment 5.9: Capture disk images

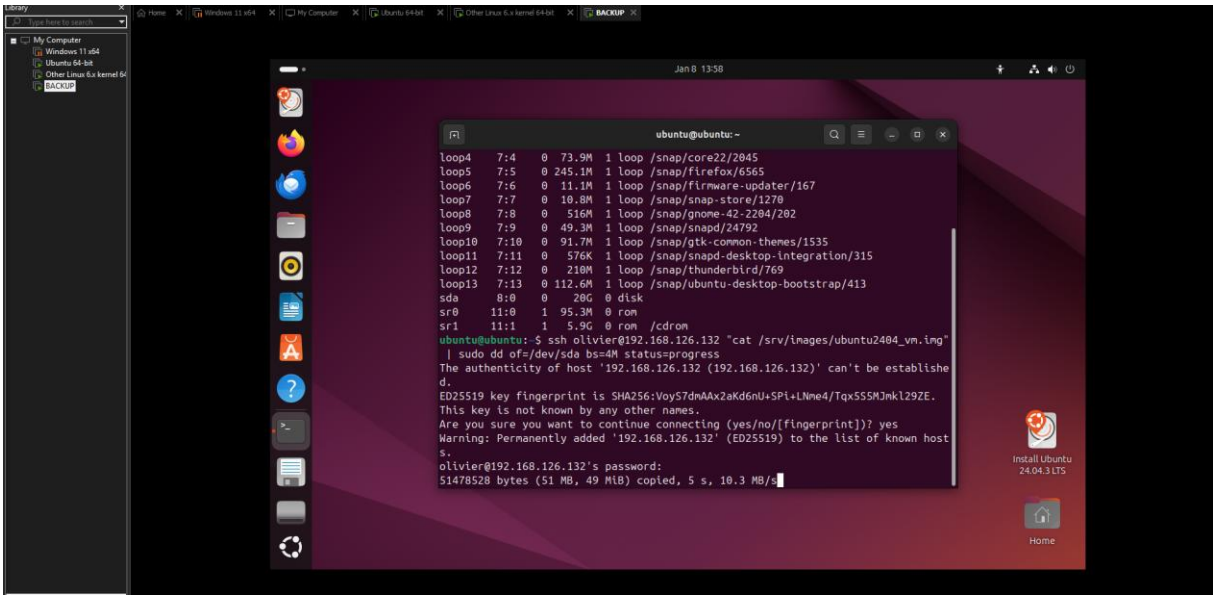
Make relevant screenshots + motivation:

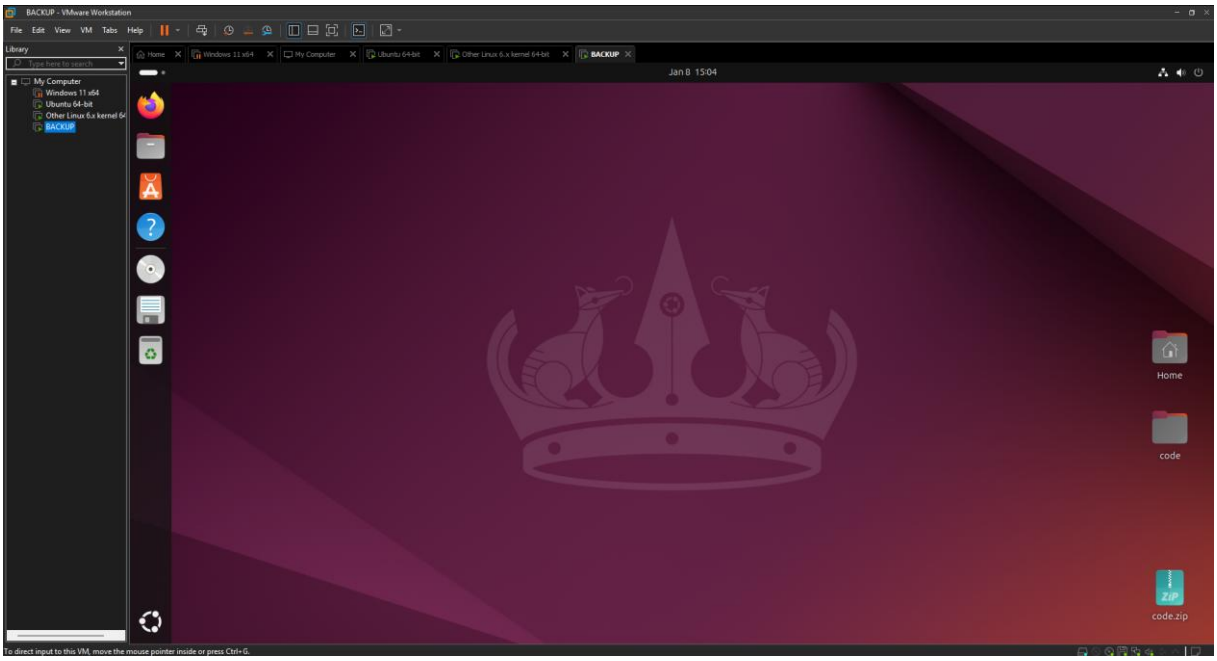


- Proof that the Debian 13 server stored a back-up image of the Ubuntu 24.04 Desktop VM.



- Proof that you can restore the back-up image into an empty VM.

- 



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