

# Template Week 5 – Operating Systems

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## Assignment 5.1: Unix-like

- a) Find out what the difference is between UNIX and unix-like operating systems?  
*UNIX, oorspronkelijk besturingssysteem uit de jaren '70, is officieel gecertificeerd. Een besturingssysteem wordt als "unix-achtig" beschouwd wanneer het als UNIX werkt, maar niet-gecertificeerd is.*
- 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 het UNIX-besturingssysteem.*

**Dennis Ritchie**

*Mede-ontwikkelaar van UNIX.*

**Bill Joy**

*Werkte aan BSD UNIX en was mede-oprichter van Sun Microsystems.*

**Richard Stallman**

*Oprichter van het GNU-project en de Free Software Foundation. Hij zette zich in voor vrije software.*

**Linus Torvalds**

*Ontwikkelaar van de Linux kernel, de basis van veel moderne besturingssystemen.*

- c) What is the philosophy of the GNU movement?  
*De GNU-filosofie gaat over vrije software. Gebruikers moeten de vrijheid hebben om software: te gebruiken, te bestuderen, aan te passen en te delen.*
- 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 Linux en gebruikt veel GNU-software, het is open source en gratis. Maar Ubuntu kan ook niet-vrije software bevatten.*
- e) Find out what is the Windows Subsystem for Linux?  
*WSL is een onderdeel van Windows waarmee je Linux-programma's en commando's kunt gebruiken en Linux-distributies zoals Ubuntu kunt draaien binnen Windows.*
- f) Find out, which operating system family belongs to Android, iOS and ChromeOS?  
*Android = Linux  
iOS = UNIX / BSD  
ChromeOS = Linux*

## Assignment 5.2: Supercomputers and gameconsoles

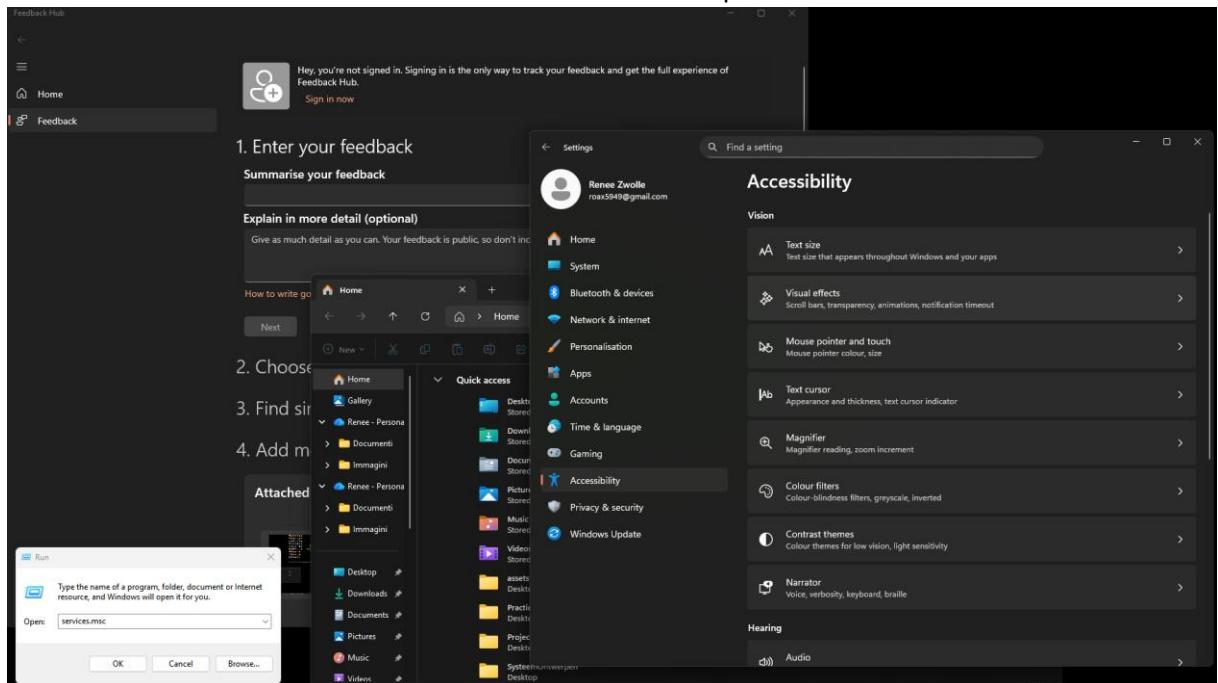
<https://www.computerhistory.org/timeline/search/?q=Supercomputer>

- a) Research on this site what supercomputers are used for and write a short summary of it:  
*Supercomputers worden gebruikt voor zware berekeningen die gewone computers niet aankunnen, zoals weersvoorspellingen en klimaatonderzoek, wetenschappelijk onderzoek, ruimteonderzoek en medisch onderzoek.*
- 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 groep PlayStation 3-consoles die samen als 1 supercomputer werken. Dit was mogelijk omdat de PS3 een krachtige Cell-processor had (afkomstig van IBM's Roadrunner), wat het een goedkope supercomputer maakte. Het werd gebruikt voor wetenschappelijk onderzoek, universiteiten en onderzoeksinstellingen, simulaties en berekeningen.*
- 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?  
*Op het Raspberry Pi-cluster van Oracle draait Oracle Linux. Dit is een Linux-besturingssysteem aangepast voor ARM-processoren zoals de Raspberry Pi.*
- 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. Dit komt doordat de Raspberry Pi's energiezuinig zijn, maar niet krachtig genoeg en Oracle-cluster vooral is bedoeld voor educatie en experimenten, niet maximale prestaties.*
- 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:*  
*PlayStation 5 = x86-64 (AMD)*  
*Xbox Series X = x86-64 (AMD)*  
*Besturingssystemen:*  
*PlayStation 5 = Eigen Sony OS (gebaseerd op BSD / UNIX-achtig)*  
*Xbox Series X = Aangepaste versie van Windows*  
  
*Mijn conclusie is dat moderne consoles dezelfde CPU-architectuur gebruiken als pc's. Consoles zijn dus eigenlijk gespecialiseerde computers, geoptimaliseerd voor games, niet voor zware berekeningen.*

## Assignment 5.3: Working with Windows

Take relevant screenshots of the assignments below

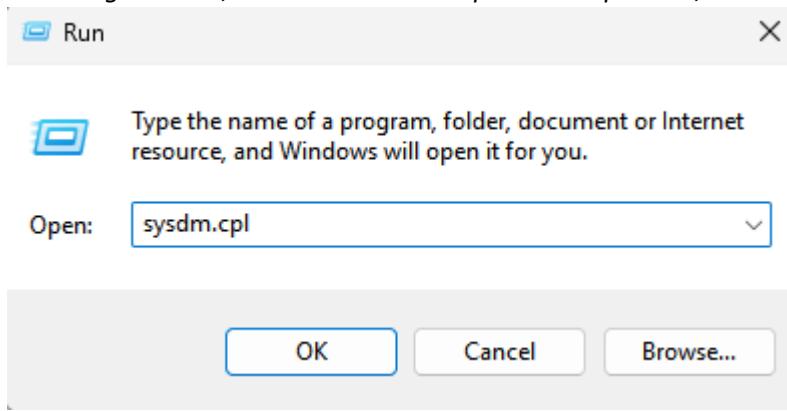
- a) Practice for about 10 minutes with the **Windows** keyboard shortcuts combinations, skip the general shortcuts in this exercise. Take a look at which screens are opened.

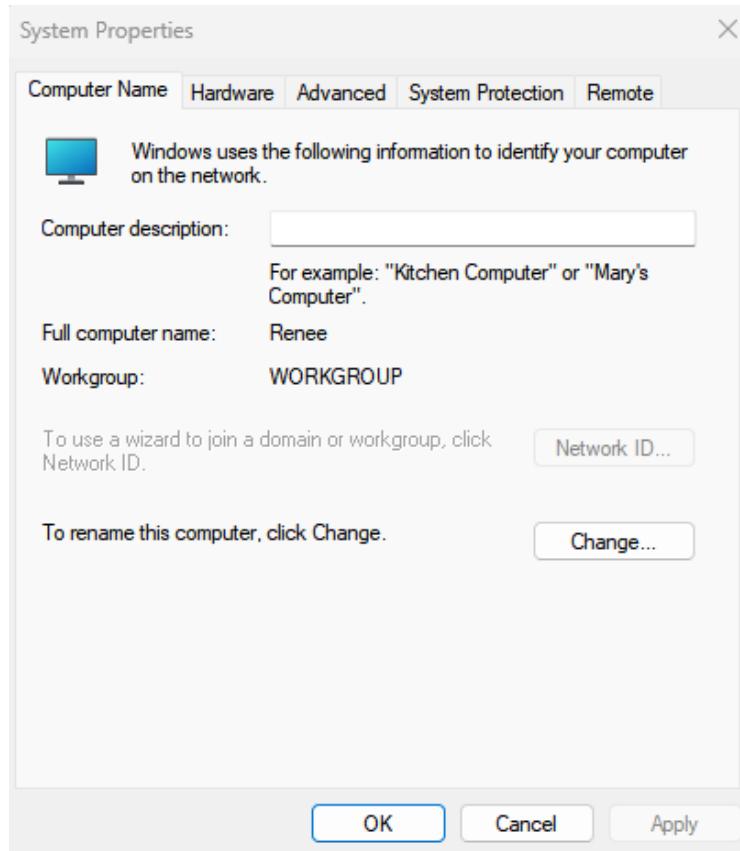


Dit ongeveer (ik begrijp niet dat ik hiervan een screenshot moet maken).

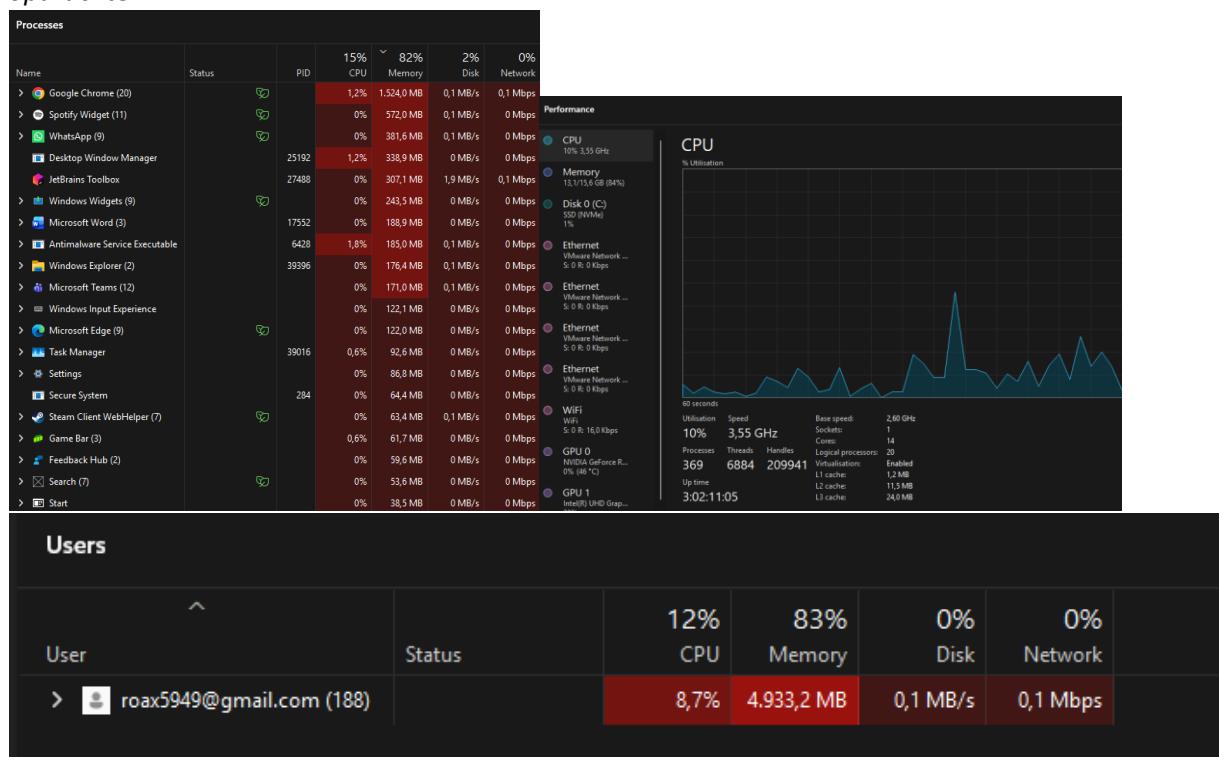
- b) The file explorer can be opened with **Windows + E**, Which key combination could you also use?  
**Ctrl + Shift + E**
- c) Open the system properties with a **Windows** key combination, take a screenshot of the open screen.  
Paste this screenshot into this template.

*Super gaaf, ik heb geen pause knop op mijn laptop waardoor ik een andere key combination zou moeten gebruiken, die doet het niet. Super leuke opdracht, ik doe het anders.*





- 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.
- Doe niet alsof we nog nooit een laptop hebben aangeraakt, wat zijn dit voor zwakzinnige opdrachten.*

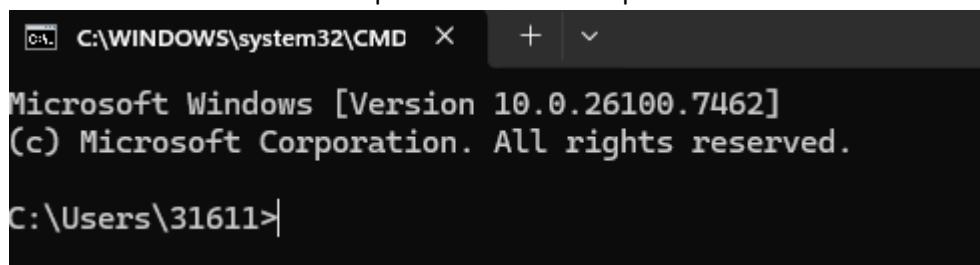


- e) If you're giving a PowerPoint presentation and you connect your laptop to a projector, Windows can use the projector as a second screen. For example, you may have Outlook open on your first screen that you don't show over the projector, while the PowerPoint presentation is displayed on the projector,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

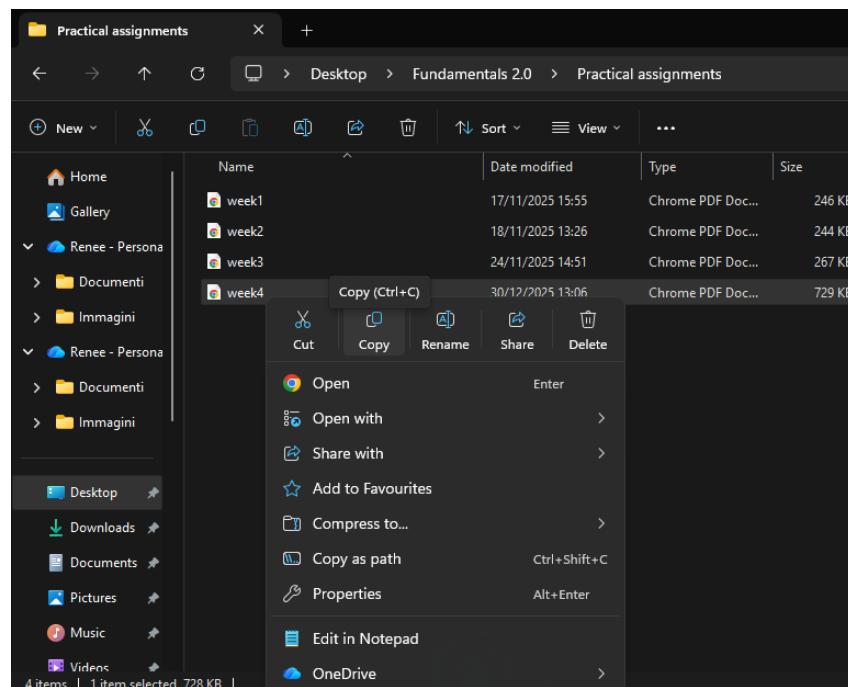


A screenshot of a Windows Command Prompt window. The title bar says 'C:\WINDOWS\system32\cmd'. The window shows the following text:  
Microsoft Windows [Version 10.0.26100.7462]  
(c) Microsoft Corporation. All rights reserved.  
C:\Users\31611>

## Working in the File Explorer

Relevant screenshots **copy** command:

*Ik voel me echt debiel dat ik dit allemaal moet doen.*

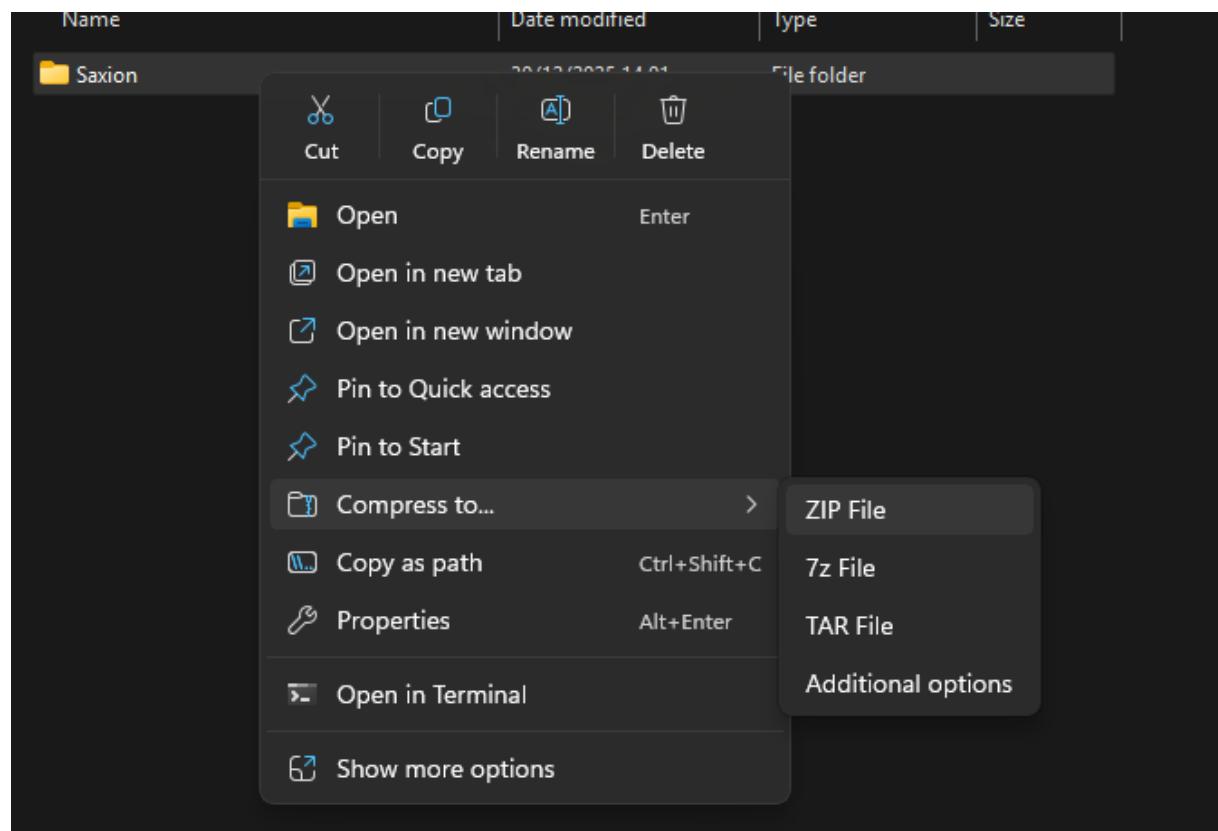


Relevant screenshots **tree** command:

```
C:\Users\31611>tree "C:\Users\31611\Desktop\Fundamentals 2.0"
Folder PATH listing for volume OS
Volume serial number is D6DC-0B70
C:\USERS\31611\DESKTOP\FUNDAMENTALS 2.0
└─Practical assignments
```

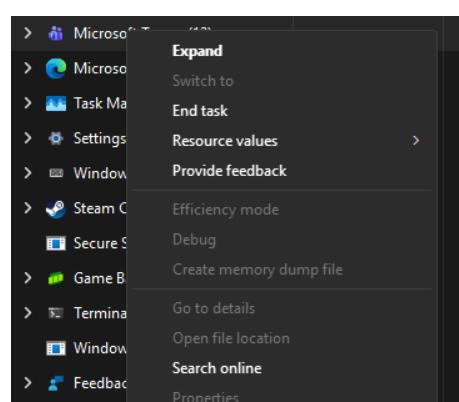
```
C:\Users\31611>
```

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



## Terminating Processes

Relevant Screenshots Task Manager Window:



## Install Software

Relevant screenshots that the following software is installed with winget:

- WinSCP
- Notepad++
- 7zip

```
C:\Users\31611>winget list
Name           Id          Version      Available    Source
draw.io        JGraph.Draw 28.2.5     29.0.3       winget
7-Zip         7zip.7zip   24.09      25.01       winget
C:\Users\31611>kut opdracht
'kut' is not recognized as an internal or external command,
operable program or batch file.

C:\Users\31611>winget install 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
[redacted] 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\31611>winget install 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.x64.exe
[redacted] 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
```

## Assignment 5.4: Working with Linux

Leuk dat de opdrachten hier niet instaan.

### Making a testfile.txt file

```
roax@webserverrrz:~$ cd ~
roax@webserverrrz:~$ echo "This is a test file" > testfile.txt
roax@webserverrrz:~$ ls
install-sftpserver.sh  install-webserver.sh  jeez  testfile.txt
roax@webserverrrz:~$ ls
install-sftpserver.sh  install-webserver.sh  jeez  testfile.txt
roax@webserverrrz:~$ mkdir -p ~/Documents
roax@webserverrrz:~$ cp testfile.txt ~/Documents/
roax@webserverrrz:~$ ls ~/Documents
testfile.txt
roax@webserverrrz:~$
```

**How do you get back to your home folder in the terminal?**

By using cd or cd ~

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

Linux uses one single root directory /, Windows uses drive letters like C:\ and D:\

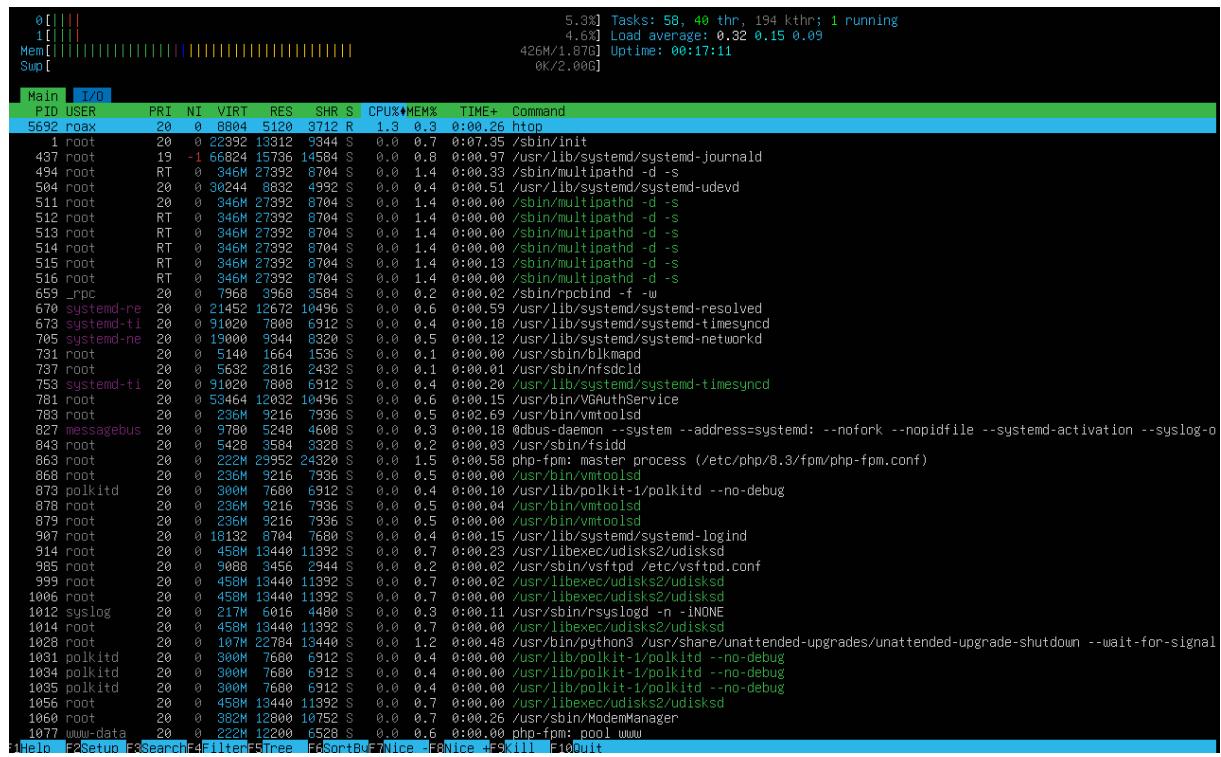
## Purpose of /etc

The /etc directory is used for system and application configuration files.

## Compress testfile.txt.

```
roax@webserverrrz:/etc$ cd ~  
roax@webserverrrz:~$ tar -cvf testfile.tar testfile.txt  
  
testfile.txt  
roax@webserverrrz:~$  
roax@webserverrrz:~$ tar -xvf testfile.tar  
  
testfile.txt  
roax@webserverrrz:~$  
roax@webserverrrz:~$ ls  
Documents install-sftpserver.sh install-webserver.sh jeez testfile.tar testfile.tar.gz testfile.txt  
roax@webserverrrz:~$
```

## Htop running



## What does htop show?

Running processes, CPU usage, memory usage, users and process IDs.

```

roax@webserverrrz:~$ neofetch
.-/+o0ssss00+/-.
` :+ssssssssssssssssss+:` -----
. +ssssssssssssssssssyssss+- OS: Ubuntu 24.04.1 LTS x86_64
. ooooooooooooooNmmmyNMMMHssssso. Host: VMware Virtual Platform None
/ ssssssssssshdmmMNmmmyNMMMHssssso. Kernel: 6.8.0-51-generic
+ sssssssssshmydMMMMMMMdffffyssssss+ Uptime: 2 mins
/ ssssssssshhNMMMMyhhyyyyhmNMMMHssssss/ Packages: 957 (dpkg)
, sssssssssdMMMNhsssssssssshhNMMDssssss. Shell: bash 5.2.21
+ ssss hhhyNMMMNyssssssssssyNMMMYssssss+ Resolution: 1280x800
. ssyyNMMMNyMMhsssssssssssshhmmhssssso Terminal: /dev/tty1
. ssyyNMMMNyMMhsssssssssssshhmmhssssso CPU: 13th Gen Intel i7-13650HX (2) @ 2.80GHz
+ ssss hhhyNMMMNyssssssssssyNMMMYssssss+ GPU: 00:0f.0 VMware SVGA II Adapter
. sssssssssdMMMNhsssssssssshhNMMDssssss. Memory: 420MiB / 1919MiB
/ ssssssssshhNMMMYhhyyyyhdNMMMNhssssss/ -----
+ ssssssssssdmydMMMMMMMdffffyssssss+ /sssssssssssshdmmNNNmyNMMMHssssss/
. ooooooooooooooNmmmyNMMMHssssso. .+ssssssssssssssssyssssss+-
` :+ssssssssssssssssss+:` -----
. -/+o0ssss00+/-.

```

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### **What does neofetch show?**

*OS name, kernel version, CPU and GPU, RAM usage, system uptime.*

### **Assignment 5.5: Users and permissions on Linux**

```

roax@webserverrrz:~/hello$ ls -l hello.sh
-rw-rw-r-- 1 roax roax 45 Jan  1 15:59 hello.sh
roax@webserverrrz:~/hello$ ./hello.sh
bash: ./hello.sh: Permission denied
roax@webserverrrz:~/hello$ ls -l hello.sh
-rw-rw-r-- 1 roax roax 45 Jan  1 15:59 hello.sh
roax@webserverrrz:~/hello$ ./hello.sh
bash: ./hello.sh: Permission denied
roax@webserverrrz:~/hello$ ls -l ~/hello/hello.sh
-rw-rw-r-- 1 roax roax 45 Jan  1 15:59 /home/roax/hello/hello.sh
roax@webserverrrz:~/hello$ chmod 744 ~/hello/hello.sh
roax@webserverrrz:~/hello$ whoami
roax
roax@webserverrrz:~/hello$ ls -l ~/hello/hello.sh
-rwxr--r-- 1 roax roax 45 Jan  1 15:59 /home/roax/hello/hello.sh
roax@webserverrrz:~/hello$ ./hello.sh
Hello Renee Zwolle 562594!
roax@webserverrrz:~/hello$ _

```

## Assignment 5.6: View the contents of files

Relevant screenshots + motivation

*cat = Shows the whole content of a file*

*wc = Counts lines, words, and characters in a file*

*less = Lets you scroll through a file page by page*

*head = Shows the first 10 lines of a file (or more with -n)*

*tail = Shows the last 10 lines of a file (or more with -n)*

*grep = Searches for a word or pattern in a file (use -n for line numbers)*

```
roax@webserverrrz:~/assignments$ wc SherlockHolmes.txt  
12306 107562 607504 SherlockHolmes.txt
```

12306 lines, 107562 words and 607504 characters.

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

```
roax@webserverrrz:~/assignments$ grep -C 10 "kingdom" SherlockHolmes.txt  
'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.

--

The King stared at him in amazement.

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

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

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

```
II. THE RED-HEADED LEAGUE
```

## Assignment 5.7: Digital forensics

Relevant screenshots + motivation

```
roax@webserverrrz:~$ exiftool oldcar.jpg
ExifTool Version Number      : 12.76
File Name                   : oldcar.jpg
Directory                   : .
File Size                   : 29 kB
File Modification Date/Time : 2026:01:04 12:04:33+00:00
File Access Date/Time       : 2026:01:04 12:04:32+00:00
File Inode Change Date/Time: 2026:01:04 12:04:33+00:00
File Permissions            : -rw-rw-r--
File Type                   : HTML
File Type Extension         : html
MIME Type                   : text/html
HTTP Equiv XUA Compatible  : IE=edge
Viewport                    : width=device-width, initial-scale=1.0, user-scalable=1
Content Type                : text/html; charset=UTF-8
Cache Control               : no-cache,no-store
Pragma                      : no-cache
Expires                     : -1
Mswebdialog Title           : Connecting to Saxion
Title                       : Aanmelden
```

Ik kon oldCar.jpg niet downloaden/kopieren naar mijn UbuntuVM.

```
roax@webserverrrz:~$ file image.gif
image.gif: GIF image data, version 89a, 108 x 52
```

## Assignment 5.8: Steganography

Relevant screenshots + motivation

```
2026-01-04 12:16:51 (5.42 MB/s) - 'apple2.jpg?ou=131366' saved [28955/28955]

roax@webserverrrz:~$ ls
'apple2.jpg?ou=131366'    clean-base64.txt    email-base64.txt    image.gif
 assignments             Documents          hello           install-sftpserver.sh
roax@webserverrrz:~$ steghide extract -sf apple2.jpg

Enter passphrase:
steghide: could not open the file "apple2.jpg".
roax@webserverrrz:~$ steghide extract -sf apple2.jpg?ou=131366
Enter passphrase:
steghide: the file format of the file "apple2.jpg?ou=131366" is not supported.
roax@webserverrrz:~$ _
```

### 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.

```
roax@webserverrrz:~$ ssh debian13@192.168.1.200
The authenticity of host '192.168.1.200 (192.168.1.200)' can't be established.
ED25519 key fingerprint is SHA256:ODSDwFv8cmQaYHGuMP3TuawLhAWl+DbhUQn9eFdKCQM.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? y
Please type 'yes', 'no' or the fingerprint: yes
Warning: Permanently added '192.168.1.200' (ED25519) to the list of known hosts.
debian13@192.168.1.200's password:
Linux debian 6.12.57+deb13-amd64 #1 SMP PREEMPT_DYNAMIC Debian 6.12.57-1 (2025-11-05) x86_64

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

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
debian13@debian:~$
```

Van de ubuntu server naar de debian server ssh.

```
ubuntu@ubuntu:~
```

The terminal window shows the command being run to capture the disk image:

```
ubuntu@ubuntu:~$ sudo dd if=/dev/sda bs=4M status=progress | gzip | ssh debian13@192.168.1.200 "cat > /srv/images/ubuntu2404_vm.img.gz"
```

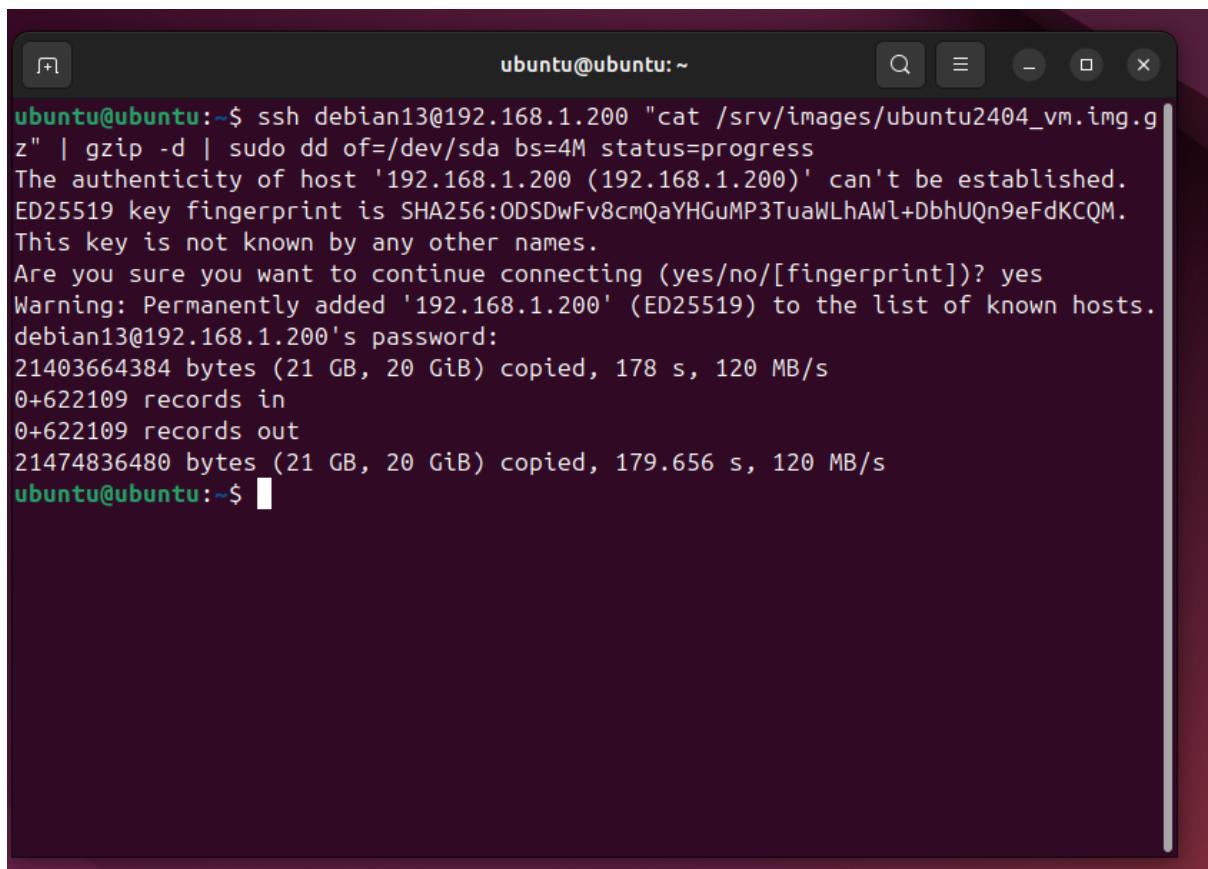
The terminal then displays the progress of the data transfer:

```
The authenticity of host '192.168.1.200 (192.168.1.200)' can't be established.
ED25519 key fingerprint is SHA256:ODSDwFv8cmQaYHGuMP3TuawLhAWl+DbhUQn9eFdKCQM.
This key is not known by any other names.
163577856 bytes (164 MB, 156 MiB) copied, 2 s, 80.4 MB/ssgerprint]?
Warning: Permanently added '192.168.1.200' (ED25519) to the list of known hosts.
239075328 bytes (239 MB, 228 MiB) copied, 3 s, 79.2 MB/s
Permission denied, please try again.
debian13@192.168.1.200's password:
21374173184 bytes (21 GB, 20 GiB) copied, 264 s, 81.0 MB/s
5120+0 records in
5120+0 records out
21474836480 bytes (21 GB, 20 GiB) copied, 265.473 s, 80.9 MB/s
ubuntu@ubuntu:~$
```

Copy live iso naar de debian installatie

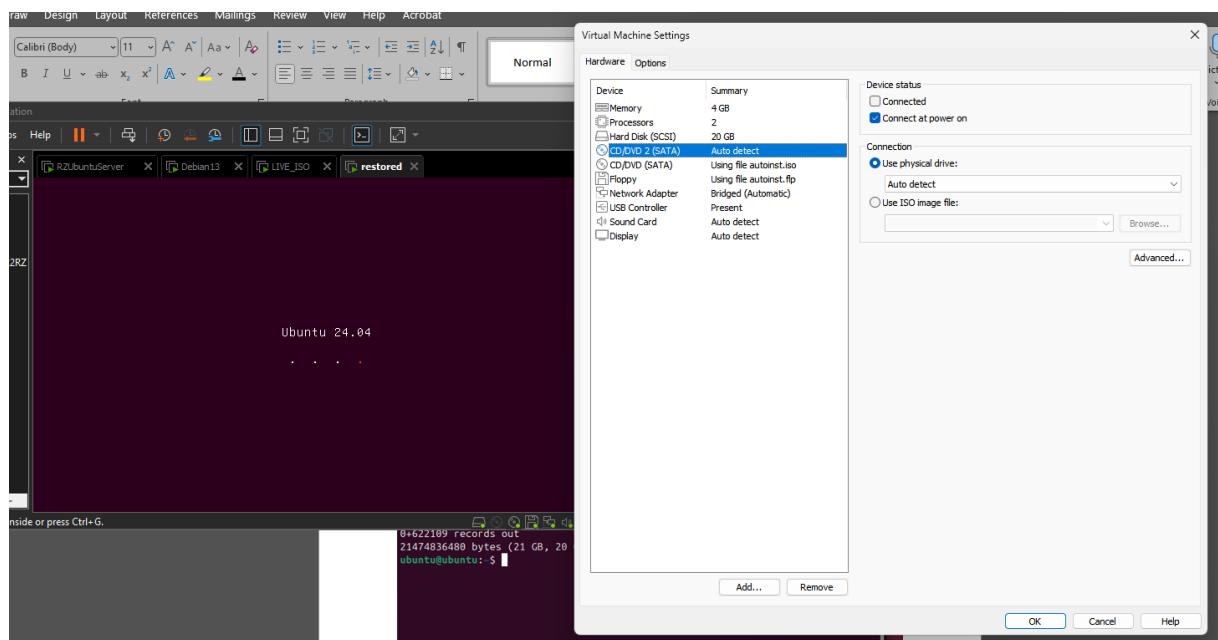
```
debian13@debian:~$ cd ..
debian13@debian:/home$ ls
debian13
debian13@debian:/home$ cd ..
debian13@debian:$ ls
bin dev home      initrd.img.old lib64      media  opt   root  sbin  sys  usr  vmlinuz
boot etc initrd.img lib      lost+found  mnt    proc  run   srv   tmp  var  vmlinuz.old
debian13@debian:$ cd srv
debian13@debian:/srv$ ls
images
debian13@debian:/srv$ cd home
bash: cd: home: No such file or directory
debian13@debian:/srv$ cd ..
debian13@debian:$ 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
debian13@debian:$ cd home
debian13@debian:/home$ ls
debian13
debian13@debian:/home$ cd debian13/
debian13@debian:~$ ls /srv
images
debian13@debian:~$ ls /srv/images
ubuntu2404_vm.img.gz
debian13@debian:~$
```

Succes van het overzetten van de image



```
ubuntu@ubuntu:~$ ssh debian13@192.168.1.200 "cat /srv/images/ubuntu2404_vm.img.gz" | gzip -d | sudo dd of=/dev/sda bs=4M status=progress
The authenticity of host '192.168.1.200 (192.168.1.200)' can't be established.
ED25519 key fingerprint is SHA256:ODSDwFv8cmQaYHGuMP3TuaWLhAWl+DbhUQn9eFdKCQM.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.1.200' (ED25519) to the list of known hosts.
debian13@192.168.1.200's password:
21403664384 bytes (21 GB, 20 GiB) copied, 178 s, 120 MB/s
0+622109 records in
0+622109 records out
21474836480 bytes (21 GB, 20 GiB) copied, 179.656 s, 120 MB/s
ubuntu@ubuntu:~$
```

Pullen van de image naar de nieuwe live boot vm.



Ubuntu laad van de hard drive ipv iso file.

Ready? Save this file and export it as a pdf file with the name: [week5.pdf](#)