

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

UNIX is een oud besturingssysteem dat is gemaakt in de jaren 70.

Alleen besturingssystemen die officieel zijn goedgekeurd, mogen UNIX heten.

Unix-like

Unix-like systemen werken bijna hetzelfde als UNIX, maar zijn niet officieel gecertificeerd.

Ze gebruiken dezelfde manier van werken en dezelfde commando's. voorbeelden zijn Linux, Ubuntu, macOS, 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

1. Heeft meegewerkt aan het maken van UNIX
2. Legde de basis voor moderne besturingssystemen

Dennis Ritchie

1. Maakte de programmeertaal **C**
2. Zorgde ervoor dat UNIX op verschillende computers kon draaien

Bill Joy

1. Werkte aan BSD UNIX
2. Maakte de **vi-editor**
3. Richtte Sun Microsystems op

Richard Stallman

1. Begon het **GNU-project**
2. Vindt dat software vrij moet zijn voor iedereen
3. Maakte veel vrije software

Linus Torvalds

1. Maakte de **Linux-kernel**
2. Linux wordt wereldwijd gebruikt op servers en pc'

- c) What is the philosophy of the GNU movement?

De GNU-filosofie draait om **softwarevrijheid**.

Gebruikers moeten de vrijheid hebben om:

1. Software te gebruiken voor elk doel
2. De broncode te bestuderen en aan te passen
3. Software te verspreiden
4. Verbeteringen te delen met anderen

Vrije software betekent **vrijheid**, niet alleen gratis.

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

Ja, voor een groot deel.

Ubuntu gebruikt Linux en veel vrije software

Gebruikers mogen software aanpassen

Maar Ubuntu biedt ook niet-vrije software aan (zoals drivers)

Conclusie:

Ubuntu volgt de GNU-gedachte, maar is niet streng.

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

WSL is een Windows-functie waarmee je:

Een Linux-omgeving kunt draaien binnen Windows

Linux-commando's en tools kunt gebruiken zonder VM

Er zijn twee versies:

WSL 1: vertaalt Linux-syscalls

WSL 2: draait een echte Linux-kernel in een lichte VM

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

Android: Linux-familie

iOS: Unix / BSD-familie

ChromeOS: Linux-familie

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 worden gebruikt voor het oplossen van zeer complexe computatiewerkingen die normaal computers niet aankunnen. Ze worden ingezet in:

Wetenschappelijk onderzoek:

Klimaatmodellering en weersvoorspelling met hoge nauwkeurigheid
Genomiconderzoek en medicijnontwikkeling
Astrofysica-simulaties en ruimteonderzoek
Materiaalwetenschappen om nieuwe materialen te testen

Bedrijven en industrie:

Financiële modellering en hoogfrequente handel
Data-analyse en business intelligence
Olie- en gasexploratie met seismische gegevensanalyse
Automotive- en aeroruimte-industrie voor simulaties

Nationale veiligheid:

Nucleaire wapensimulaties (veiligheid en betrouwbaarheid testen)
Cryptanalyse en geheimschrift-onderzoek

Kunstmatige intelligentie:

Training van grote AI-modellen
Machine learning op massive datasets

- b) IBM is a company that has already built a number of supercomputers. One of them is IBM's Roadrunner. The CPU developed for this supercomputer was further developed at a later stage as the CPU for the PlayStation 3 console. Find out what a **PlayStation 3 cluster** is and what it was used for?

Een **PlayStation 3 cluster** is een gedistribueerd computersysteem gemaakt door meerdere PS3-consoles netwerk via elkaar te verbinden. Dit is mogelijk omdat de PS3 de krachtige **Cell-processor** heeft (ontwikkeld door Sony, IBM en Toshiba).

Werking:

- De Cell-processor in de PS3 heeft 1 hoofd-CPU (PPE) en 6-7 speciale computatie-engines (SPE's)
- Deze architecture maakt parallelle verwerking mogelijk
- Door meerdere PS3's te koppelen krijg je een low-cost supercomputer

Toepassingen:

- Astrophysics-simulaties (PS3 Gravity Grid)
- Cryptografie-onderzoek
- Wetenschappelijke berekeningen

Dit was een innovatief idee om goedkope gaming-hardware voor HPC (High-Performance Computing) in te zetten.

- 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 Autonomous Linux (gebaseerd op Oracle Linux for ARM)

Uitgebreid antwoord:

Oracle's cluster van 1.060 Raspberry Pi 3 B+ computers draait op **Oracle Autonomous Linux**, een speciaal "autonomoos" besturingssysteem dat Oracle in 2019 aankondigde tijdens Oracle OpenWorld. Dit systeem is gebaseerd op **Oracle Linux**, dat speciaal is aangepast voor ARM-processors.

Waarom Oracle Autonomous Linux?

Oracle koos ervoor om **network boot** te gebruiken: alle 1.060 Raspberry Pi's starten op via het netwerk vanaf één centrale Supermicro 1U Xeon-server. Dit betekent:

- Geen SD-kaarten nodig voor elke Pi (bespaart 1.060 SD-kaarten!)
- Software hoeft maar één keer geïnstalleerd te worden
- Updates gebeuren centraal op één plek
- Alle nodes draaien exact dezelfde configuratie

Oracle Autonomous Linux is gebouwd bovenop Oracle Linux, dat ook wordt gebruikt in Oracle Cloud en Oracle Engineered Systems.

d)

- e) 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 - Het is veel te langzaam.

Waarom niet?

Oracle's Raspberry Pi cluster haalt ongeveer 3-4 teraflops. Het minimum voor de TOP500 lijst is 1.022 petaflops. Dat betekent dat Oracle's cluster ongeveer 250-500 keer te langzaam is. Je zou dus veel meer Raspberry Pi's nodig hebben om überhaupt in de buurt van TOP500 te komen.

Simpel gezegd:

Oracle bouwde een cluster met 1.060 Raspberry Pi's. Dit was vooral een cool project om te laten zien dat het kan, maar voor TOP500 heb je computers nodig die miljarden keren sneller rekenen. Oracle's cluster is meer voor leren en spelen, niet voor serieuze supercomputing.

Het Grote Verschil:

Echte supercomputers hebben duizenden geavanceerde processors en GPU's. Raspberry Pi's zijn kleine, goedkope computers voor hobbyisten. Het resultaat: ze zijn totaal niet in dezelfde competitie.

Korte conclusie: Oracle's Raspberry Pi project is interessant, maar veel te zwak voor de TOP500 lijst.



- f) 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 en Xbox Series X: CPU en Besturingssysteem

a) CPU Architectuur

Beide consoles gebruiken vrijwel dezelfde processor:

PlayStation 5:

1. 8 cores gebaseerd op AMD **Zen 2**
2. Snelheid: 3,5 GHz
3. 16 threads

Xbox Series X:

1. 8 cores gebaseerd op AMD **Zen 2**
2. Snelheid: 3,8 GHz
3. 16 threads

Ze gebruiken dus dezelfde AMD-processor, maar met kleine verschillen in snelheid.

b) Besturingssystemen

PlayStation 5:

1. Gebruikt **Orbis OS 2.0**
2. Gebaseerd op **FreeBSD** (een Unix-achtig systeem)
3. Speciaal gemaakt voor Sony en PlayStation-games

Xbox Series X:

1. Gebruikt **Xbox OS**
2. Gebaseerd op **Windows NT** (hetzelfde als normale Windows computers)
3. Meer verbonden met Windows en PC-gaming

c) Conclusie

Beide consoles hebben dezelfde CPU (AMD Zen 2), maar gebruiken **totaal verschillende besturingssystemen**:

1. **PlayStation 5** draait op Unix (FreeBSD)
2. **Xbox Series X** draait op Windows

Wat betekent dit?

1. **Spellen moeten apart gemaakt worden:** Ook al hebben beide dezelfde processor, developers moeten voor elke console een apart spel maken omdat de besturingssystemen anders werken.
2. **Xbox is meer zoals een PC:** Omdat Xbox Windows gebruikt, kunnen spellen makkelijker tussen Xbox en Windows PC worden gedeeld.
3. **PlayStation is meer uniek:** PlayStation's FreeBSD-systeem is specifieker en anders dan gewone computers, dus het is meer eigen aan Sony.

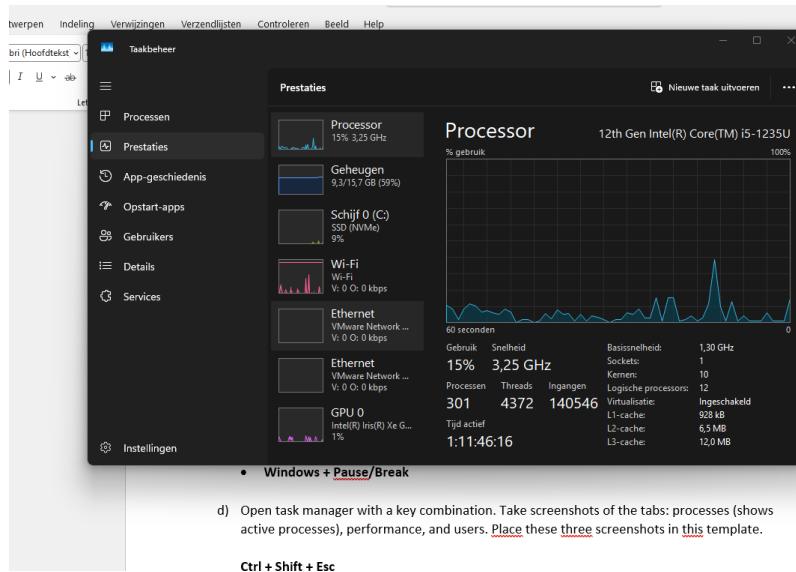
Kortom: Dezelfde hardware, maar totaal andere software - dus totaal andere systemen!

Assignment 5.3: Working with Windows

Take relevant screenshots of the assignments below

- 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.
- The file explorer can be opened with **Windows** + E, Which key combination could you also use?
 - **Rechtermuisknop op Start-knop → Verkenner**
 - **Of typ gewoon "Verkenner" in de zoekbalk**
- Open the system properties with a **Windows** key combination, take a screenshot of the open screen. Paste this screenshot into this template.
 - **Windows + Pause/Break**
- 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



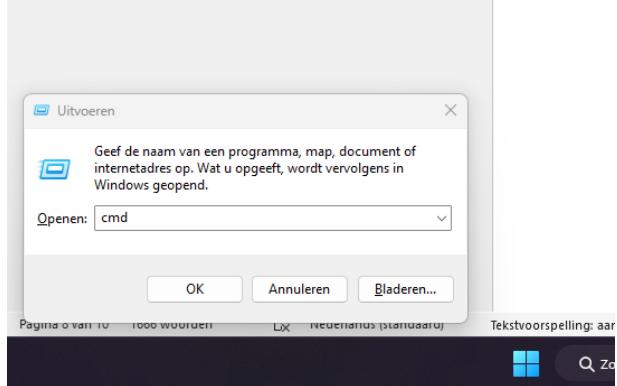
- If you're giving a PowerPoint presentation and you connect your laptop to a projector, Windows can use the projector as a second screen. For example, you may have Outlook open on your first screen that you don't show over the projector, while the PowerPoint presentation is displayed on the projector,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

Windows + P

- If you leave the classroom for a while and you leave your laptop behind, it is wise to lock the screen. Your Apps will continue to run in the background. So, for example, if you're waiting for a download that takes a while, lock the screen and get a cup of coffee. Which key combination do you use for this?

Windows + L

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



Working in the File Explorer

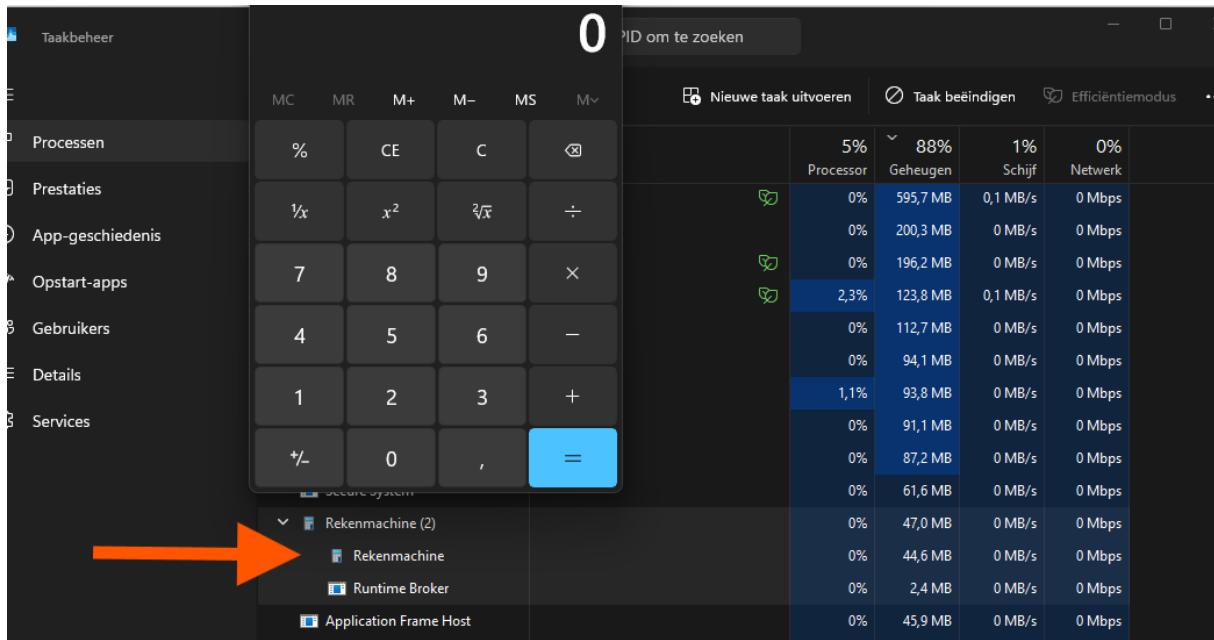
Relevant screenshots **copy** command:

Relevant screenshots **tree** command:

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

Terminating Processes

Relevant Screenshots Task Manager Window:



Explain in your own words what exactly the above command does, explain the -e and --id options used as well. Use this site:

Het winget install commando installeert programma's vanaf de commandoregel.

De --id optie specificeert de unieke identificatiecode van het pakket dat je wilt installeren

De -e optie zorgt voor exacte matching - het zoekt naar een letterlijk exacte overeenkomst zonder fuzzy matching.

Bij elkaar: winget install --id Git.Git -e installeert exact het pakket met die ID, zonder verwarring of meerdere keuzes

Install Software

```
C:\Windows\System32>winget install -e --id Mozilla.Firefox
The 'msstore' source requires that you view the following agreements before using.
Terms of Transaction: https://aka.ms/microsoft-store-terms-of-transaction
The source requires the current machine's 2-letter geographic region to be sent to the backend serv
Do you agree to all the source agreements terms?
[Y] Yes [N] No: Y
Found Mozilla Firefox (en-US) [Mozilla.Firefox] Version 146.0
This application is licensed to you by its owner.
Microsoft is not responsible for, nor does it grant any licenses to, third-party packages.
> A: [REDACTED] 82.2 MB / 82.2 MB
A: Successfully verified installer hash
B:Starting package install...
C:Successfully installed
> C:\Windows\System32>
> C:\Windows\System32>
> C:\Windows\System32>
```

```
Microsoft Windows [Version 10.0.26200.6584]
(c) Microsoft Corporation. All rights reserved.

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

```
C:\Users\Furkan>winget install -e --id Notepad++.Notepad++
Found Notepad++ [Notepad++.Notepad++] Version 8.8.9
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/v8.8.9/npp.8.
r.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
```

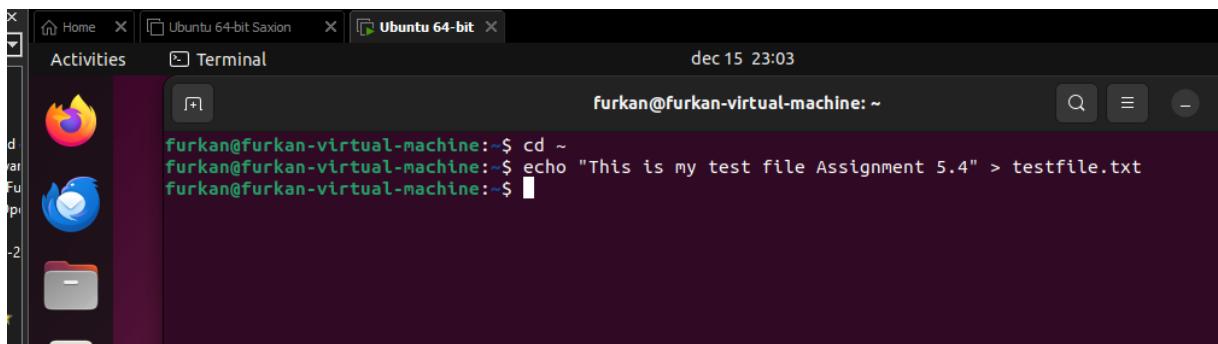
```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.26200.6584]
(c) Microsoft Corporation. All rights reserved.

C:\Windows\System32>winget install -e --id 7zip.7zip
Found an existing package already installed. Trying to upgrade the installed package...
No available upgrade found.
No newer package versions are available from the configured sources.

C:\Windows\System32>
C:\Windows\System32>
C:\Windows\System32>
```

Assignment 5.4: Working with Linux

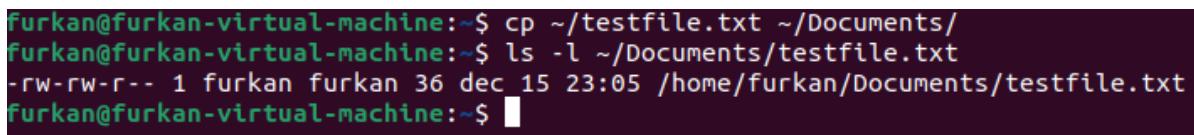
Relevant screenshots + motivation



A screenshot of a Linux desktop environment. On the left is a dock with icons for Home, Activities, Terminal, and a file manager. The terminal window is open and shows the following command-line session:

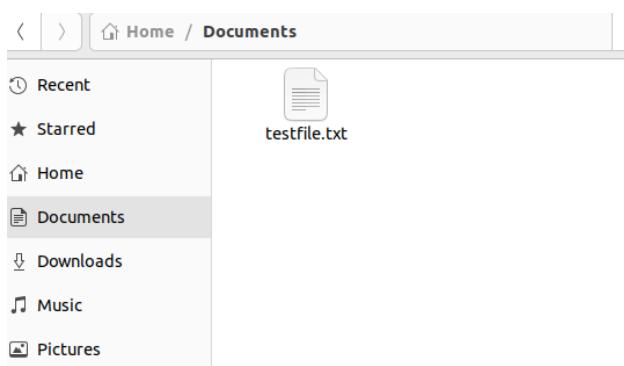
```
furkan@furkan-virtual-machine:~$ cd ~  
furkan@furkan-virtual-machine:~$ echo "This is my test file Assignment 5.4" > testfile.txt  
furkan@furkan-virtual-machine:~$
```

Text file

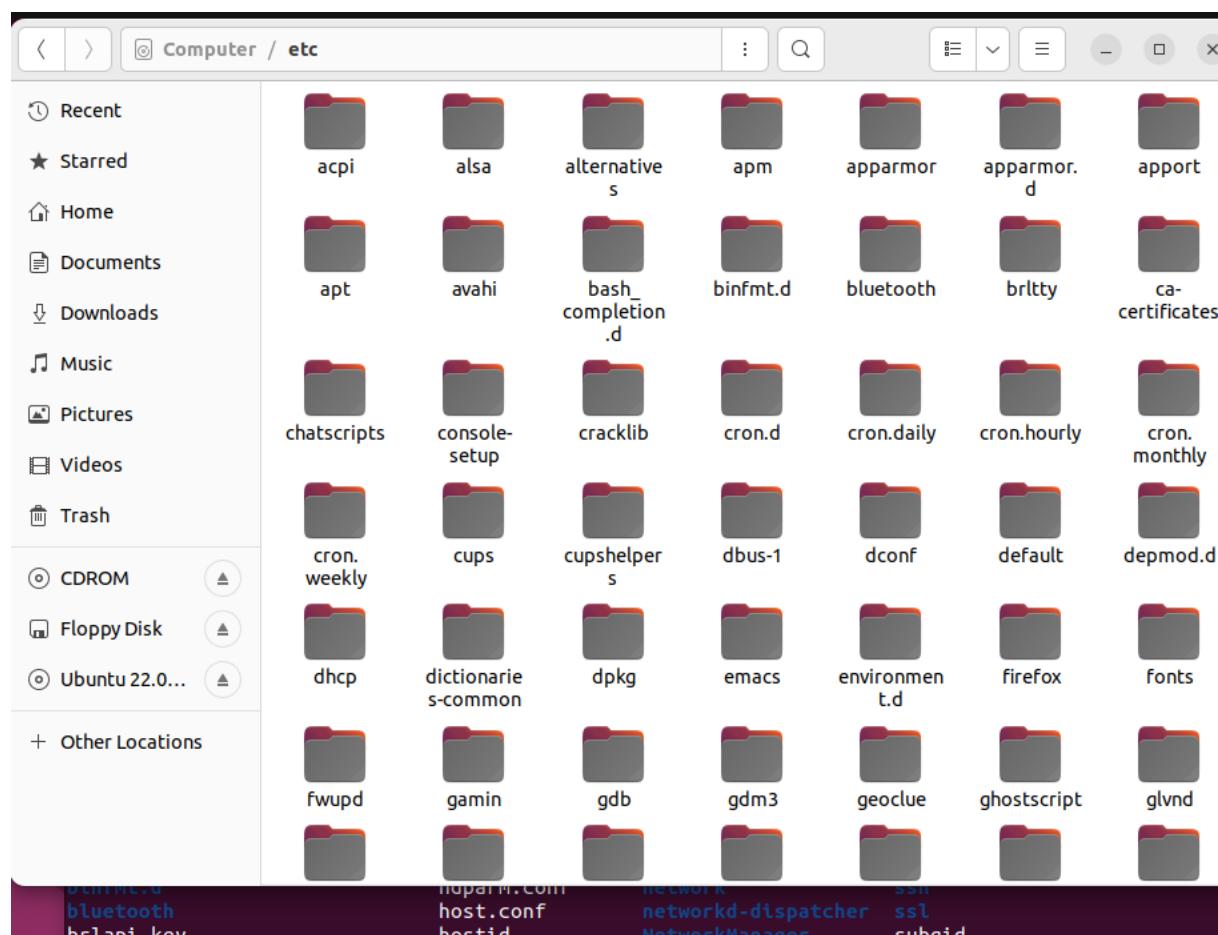


```
furkan@furkan-virtual-machine:~$ cp ~/testfile.txt ~/Documents/  
furkan@furkan-virtual-machine:~$ ls -l ~/Documents/testfile.txt  
-rw-rw-r-- 1 furkan furkan 36 dec 15 23:05 /home/furkan/Documents/testfile.txt  
furkan@furkan-virtual-machine:~$
```

Copying textFile to Documents folder



```
/etc
Furkan@furkan-virtual-machine:/etc$ ls
acpi                      gai.conf          lsb-release        rpc
adduser.conf               gamin             machine-id       rsyslog.conf
alsa                      gdb               magic            rsyslog.d
alternatives               gdm3              magic.mime       rygel.conf
anacrontab                 geoclue           mailcap          sane.d
apg.conf                   ghostscript       mailcap.order    security
apm                       glvnd             manpath.config  selinux
apparmor                  gnome             mime.types      sensors3.conf
apparmor.d                 groff             mke2fs.conf     sensors.d
apport                     group             ModemManager   services
apppstream.conf            grub.d            modules         sgml
apt                       group-            modprobe.d     shadow
avahi                     gshadow           modules-load.d shells
bash.bashrc                gshadow-          mtab            skel
bash_completion            gss               nanorc          snmp
bash_completion.d          gtk-2.0          netconfig       speech-dispatcher
bindresvport.blacklist     gtk-3.0          netplan          ssh
binfmt.d                  hdparm.conf       network         ssl
bluetooth                 host.conf         networkd-dispatcher
brlapi.key                 hostid            NetworkManager
brltty                     hostname          networks        subgid
brltty.conf                hosts             newt            subgid-
ca-certificates           hosts.allow       nftables.conf  subuid
ca-certificates.conf       hosts.deny        nsswitch.conf  subuid-
ca-certificates.conf.dpkg-old hp               openvpn         sudo.conf
chatscripts                ifplugd          opt             sudoers
console-setup              init              os-release     sudoers.d
cracklib                  init.d            PackageKit    sudo_logsrvd.conf
                           init.d            sysctl.conf
```



ETC folder

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

cd ~

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

Een belangrijk verschil is hoe het bestandssysteem is georganiseerd:

Linux gebruikt één enkele hoofdmap (/) waar alles onder valt. Alle mappen, bestanden en schijven zijn onderdeel van één grote boomstructuur die begint bij /.

Windows gebruikt aparte stationsletters zoals C:, D:, E: voor elke schijf. Elke schijf heeft zijn eigen hoofdmap.

What is the /etc directory usually used for?

De /etc map wordt gebruikt voor systeembrede **configuratiebestanden** en **beheersinstellingen**.

In deze map staan alle belangrijke instellingen voor:

- Het besturingssysteem zelf
- Geïnstalleerde programma's
- Netwerkconfiguratie
- Gebruikersinformatie
- Services en diensten

Voorbeelden van bestanden in /etc:

- /etc/passwd - informatie over gebruikersaccounts
- /etc/hosts - hostnaam en IP-adres koppelingen

Compress files

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

archive? **tar -cvf archief.tar testfile.txt**

```
furkan@furkan-virtual-machine:~$ tar -cvf myarchive.tar testfile.txt  
testfile.txt  
furkan@furkan-virtual-machine:~$
```

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

tar -xvf archief.tar

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

```
tar -czvf myarchive.tar.gz testfile.txt
```

```
furkan@furkan-virtual-machine:~$ tar -czvf myarchive.tar.gz testfile.txt
testfile.txt
furkan@furkan-virtual-machine:~$
```

- **View processes**

- o Install the application htop via a terminal command

```
furkan@furkan-virtual-machine:~$ sudo apt install htop -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libwpe-1.0-1 libwpebackend-fdo-1.0-1
Use 'sudo apt autoremove' to remove them.
Suggested packages:
  lm-sensors
The following NEW packages will be installed:
  htop
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 128 kB of archives.
After this operation, 342 kB of additional disk space will be used.
Get:1 http://nl.archive.ubuntu.com/ubuntu jammy/main amd64 htop amd64 3.0.5-7build2 [128 kB]
Fetched 128 kB in 0s (910 kB/s)
Selecting previously unselected package htop.
(Reading database ... 213535 files and directories currently installed.)
Preparing to unpack .../htop_3.0.5-7build2_amd64.deb ...
Unpacking htop (3.0.5-7build2) ...
Setting up htop (3.0.5-7build2) ...
Processing triggers for man-db (2.10.2-1) ...
Progress: [ 80%] [########################################.....]
```

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

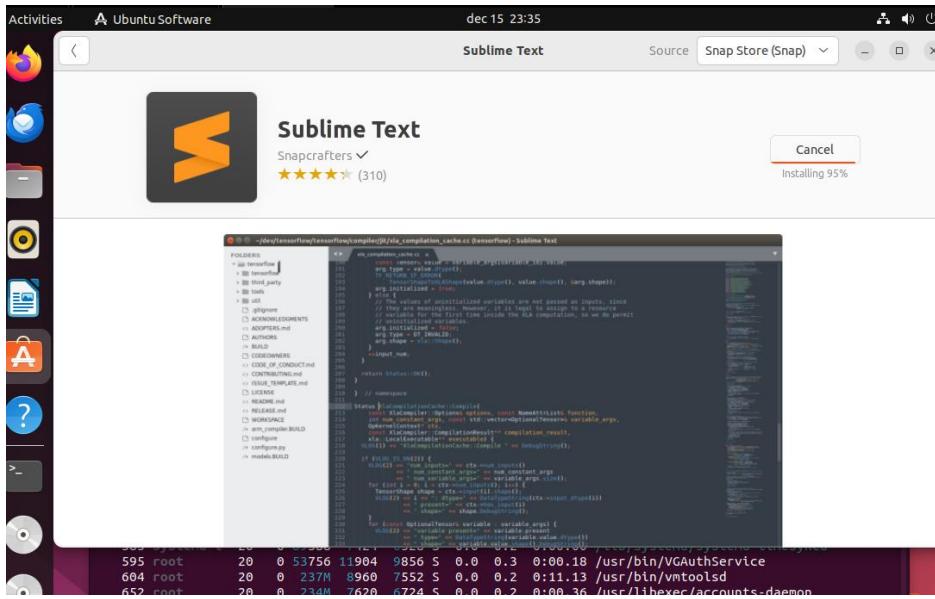
htop laat zien:

- CPU gebruik per core
- Geheugen en swap gebruik
- Lijst met alle processen (PID, user, CPU%, MEM%, command)
- Real-time updates

Je kunt processen sorteren, filteren en stoppen.

- Install Software

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



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

```

furkan@furkan-virtual-machine:~$ 
furkan@furkan-virtual-machine:~$ sudo apt install neofetch -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libwpe-1.0-1 libwpebackend-fdo-1.0-1
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  caca-utils chafa gsfonds imagemagick imagemagick-6-common imagemagick-6.q16 jp2a libao3m libcl
  libdavid5 libde265-0 libfftw3-double3 libheif1 libid3tag0 libilmbase25 libmlib2 libjxr-tools
  libjxr0 liblqr-1-0 libmagickcore-6.q16-6 libmagickcore-6.q16-6-extra libmagickwand-6.q16-6
  libnetpbm10 libopenexr25 libpixellib1 libx265-199 netpbm toilet toilet-fonts w3m w3m
Suggested packages:
  imagemagick-doc autotrace curl enscript ffmpeg gimp gnuplot grads graphviz hp2xx html2ps libw
  mplayer povray radiance texlive-base-bin transfig ufraw-batch libfftw3-bin libfftw3-dev inksca
  figlet cmigem dict dict-wm dictd w3m-el xsel
The following NEW packages will be installed:
  caca-utils chafa gsfonds imagemagick imagemagick-6-common imagemagick-6.q16 jp2a libao3m libcl
  libdavid5 libde265-0 libfftw3-double3 libheif1 libid3tag0 libilmbase25 libmlib2 libjxr-tools
  libjxr0 liblqr-1-0 libmagickcore-6.q16-6 libmagickcore-6.q16-6-extra libmagickwand-6.q16-6
  libnetpbm10 libopenexr25 libpixellib1 libx265-199 neofetch netpbm toilet toilet-fonts
  w3m-img
0 upgraded, 33 newly installed, 0 to remove and 22 not upgraded.

```

```

furkan@furkan-virtual-machine:~$ 
furkan@furkan-virtual-machine:~$ 
furkan@furkan-virtual-machine:~$ neofetch
  .--/+oossssoo+/-.
  `:+ssssssssssssssssss+:' 
  +-ssssssssssssssssssyssss+-.
  .osssssssssssssssssdMMMNysssso.
  /sssssssssshdmNNNmyNMMMHssssss/
  +ssssssssshnydMMMMMMNdddyssssss+
  /ssssssshNMMyhyyyyhNMMyssssss/
  .sssssssdMMMNhssssssssshNMMyssssss.
  +ssshhyNMNysssssssssyNMMyssssss+
  osyNMMNyMhssssssssssshmmhssssssso
  osyNMMNyMhssssssssssshmmhssssssso
  +ssshhyNMNysssssssssyNMMyssssss+
  .sssssssdMMMNhssssssssshNMMyssssss.
  /ssssssshNMMyhyyyyhdNMMyssssss/
  +sssssssssdnydMMMMMMMdddyssssss+
  /sssssssssshdmNNNmyNMMMHssssss/
  .osssssssssssssssdMMMNysssso.
  -+ssssssssssssssyyssss+-.
  `:+ssssssssssssssss+:' 
  .-/+oossssoo+/-.

furkan@furkan-virtual-machine:~$ 

```

neofetch laat je systeem info zien:

- OS en versie
- Kernel
- Uptime
- CPU
- GPU
- RAM
- Shell
- Desktop Environment

Met een kleurig Linux logo ernaast.

Assignment 5.5: Users and permissions on Linux

Relevant screenshots + motivation

```
? furkan@furkan-virtual-machine:~$ cd ~
furkan@furkan-virtual-machine:~$ mkdir hello
furkan@furkan-virtual-machine:~$ cd hello
furkan@furkan-virtual-machine:~/hello$ echo "#!/bin/bash" > hello.sh
bash: !/bin/bash: event not found
furkan@furkan-virtual-machine:~/hello$ echo "#!/bin/bash" > hello.sh
bash: !/bin/bash: event not found
furkan@furkan-virtual-machine:~/hello$ sudo echo "#!/bin/bash" > hello.sh
bash: !/bin/bash: event not found
furkan@furkan-virtual-machine:~/hello$ echo "echo Hello!" >> hello.sh
furkan@furkan-virtual-machine:~/hello$ cat hello.sh
echo Hello!
furkan@furkan-virtual-machine:~/hello$ chmod +x hello.sh
furkan@furkan-virtual-machine:~/hello$ ./hello.sh
Hello!
furkan@furkan-virtual-machine:~/hello$ ./hello.sh
furkan@furkan-virtual-machine:~/hello$ ./hello.sh
furkan@furkan-virtual-machine:~/hello$ chmod 744 hello.sh
furkan@furkan-virtual-machine:~/hello$ ls -l hello.sh
-rwxr--r-- 1 furkan furkan 12 dec 16 01:14 hello.sh
furkan@furkan-virtual-machine:~/hello$
```

Assignment 5.6: View the contents of files

Relevant screenshots + motivation

Assignment 5.6: View the contents of files

For this assignment, you can use the following commands: cat, wc, less, tail, head & grep.

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

cat - Laat het hele bestand zien

wc - Telt regels, woorden en karakters

less - Blader door het bestand pagina voor pagina

tail - Laat de laatste 10 regels zien

head - Laat de eerste 10 regels zien

grep - Zoekt naar woorden in het bestand

- Download the file SherlockHolmes.txt from Brightspace and place it in a directory on your VM.

Or download the file directly from <https://www.gutenberg.org/files/1661/1661-0.txt>.

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

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

```
wc: SherlockHolmes.txt: No such file or directory
furkan@furkan-virtual-machine:~/sherlock$ wc SherlockHolmes.txt
12306 107562 607504 SherlockHolmes.txt
furkan@furkan-virtual-machine:~/sherlock$
```

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

```
furkan@furkan-virtual-machine:~/sherlock$ 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
furkan@furkan-virtual-machine:~/sherlock$
```

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

```
Mr. Jabez Wilson started up in his chair, with his forefinger upon the
paper, but his eyes upon my companion.

"How, in the name of good-fortune, did you know all that, Mr. Holmes?" he
asked. "How did you know, for example, that I did manual labour. It's as true as gospel, for I began as a ship's carpenter." 

>Your hands, my dear sir. Your right hand is quite a size larger than
your left. You have worked with it, and the muscles are more
developed." 

"Well, the snuff, then, and the Freemasonry?" 

>I won't insult your intelligence by telling you how I read that,
especially as, rather against the strict rules of your order, you use
an arc-and-compass breastpin." 

>Ah, of course, I forgot that. But the writing?" 

>What else can be indicated by that right cuff so very shiny for five
furkan@furkan-virtual-machine:~/sherlock$
```

Assignment 5.7: Digital forensics

Relevant screenshots + motivation

```
furkan@furkan-virtual-machine:~/forensics$ exiftool oldcar.jpg
ExifTool Version Number      : 12.40
File Name                   : oldcar.jpg
Directory                   : .
File Size                   : 2.3 MiB
File Modification Date/Time : 2025:12:16 01:33:21+01:00
File Access Date/Time       : 2025:12:16 01:36:19+01:00
File Inode Change Date/Time: 2025:12:16 01:36:19+01:00
File Permissions            : -RW-RW-R--
File Type                   : JPEG
File Type Extension         : jpg
MIME Type                   : image/jpeg
JFIF Version               : 1.01
Exif Byte Order             : Big-endian (Motorola, MM)
Make                         : motorola
Camera Model Name           : moto g(6) play
X Resolution                : 72
Y Resolution                : 72
Resolution Unit             : inches
Software                     : aljeter-user 9 PPPS29.55-35-18-7 6a0d0 release-keys
Modify Date                 : 2020:11:07 15:08:57
Y Cb Cr Positioning        : Centered
Exposure Time               : 1/33
F Number                     : 2.0
Exposure Program            : Program AE
ISO                          : 64
Exif Version                : 0220
Date/Time Original          : 2020:11:07 15:08:57
Create Date                 : 2020:11:07 15:08:57
Components Configuration    : Y, Cb, Cr, -
Shutter Speed Value         : 1/33
Aperture Value              : 2.0
Brightness Value            : -1
Exposure Compensation       : 0
Max Aperture Value          : 2.0
Metering Mode               : Center-weighted average
Flash                        : Auto, Did not fire
Focal Length                : 3.5 mm
Build Number                : PPPS29.55-35-18-7
Sensor                       : BACK,mot_s5k3l8
Manufacture Date            : 14Oct2018
Flashpix Version            : 0100
Color Space                  : sRGB
Exif Image Width             : 4160
```



```
Manufacture Date            : 14Oct2018
Flashpix Version            : 0100
Color Space                  : sRGB
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 14:08:57
GPS Latitude                 : 53 deg 11' 39.68" N
GPS Longitude                : 6 deg 32' 12.98" E
Focal Length                 : 3.5 mm
GPS Position                 : 53 deg 11' 39.68" N, 6 deg 32' 12.98" E
Light Value                  : 7.7
furkan@furkan-virtual-machine:~/forensics$ ^C
```

Identify phone brand/type

Motorola Moto G(6) Play

- Are there GPS coordinates known?

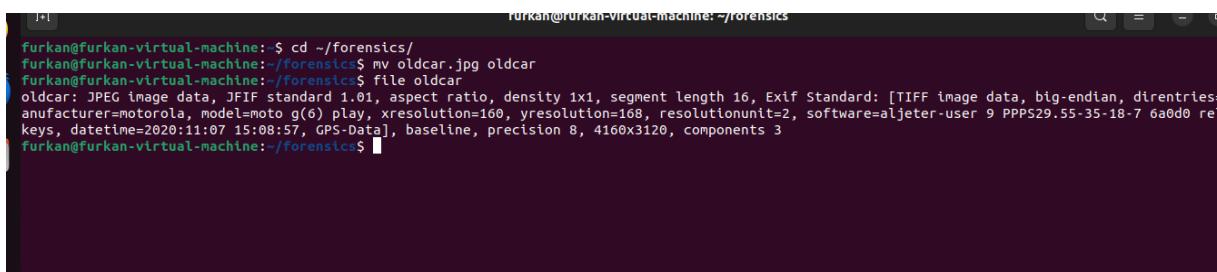
- **Latitude:** 53° 11' 39.68" N
- **Longitude:** 6° 32' 12.90" E

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

Groningen, Nederland

- o In which city was this photo taken?

centrum van Groningen



```
furkan@furkan-virtual-machine:~$ cd ~/forensics/
furkan@furkan-virtual-machine:~/forensics$ mv oldcar.jpg oldcar
furkan@furkan-virtual-machine:~/forensics$ file oldcar
oldcar: JPEG image data, JFIF standard 1.01, aspect ratio, density 1x1, segment length 16, Exif Standard: [TIFF image data, big-endian, direntries=1, manufacturer=motorola, model=moto g(6) play, xresolution=168, yresolution=168, resolutionunit=2, software=aljeter-user 9 PPPS29.55-35-18-7 6a0d0 re
keys, datetimest=2020:11:07 15:08:57, GPS-Data], baseline, precision 8, 4160x3120, components 3
furkan@furkan-virtual-machine:~/forensics$
```

Rename the file to oldcar. (So you've removed the file extension) • In the terminal, type the command file oldcar. • Does Ubuntu still consider it to be a jpg file?

GNU nano 6.2 email-base64.txt
R0lGODlhBAAPcAAAAAAAAAAwAAzGAAmQAAzAAA/wArAArMwArZgArnQArzAar/wBVAABVmWbV
ZgBVmQBVzABV/wCAACAMwCzAgCmPQzAcA/wCqAACmMwCzQzCmPQczAc/wDVAADVmDVzGdV
mQDvzAdV/wD/AD/MwD/ZgD/mQD/zAD//zMAADMzMzMAzJMaMzTAzDMA/zMrADMzMrzJMrnTMr
zDr//ZNADNVmZnvZjNvMtnZDNv/zOAAoAmzoAzJoAtOzD0A/zQdAdQmzQzJ0qmToQzD0q
/zPVADPvMzPVzjPvMzDpVzDpVzP/ADP/MzP/z3P/nTP/zDP//2YAGYAM2YAzmYamWYZazGYA/2YR
AGYrM2YrZmYrmWYrzGyr/2ZVAGZVmZvZmVmZvZGzV/2aAGaAm2aAZmaAmWaAzGaA/2aqAGa
M2aqpZnaqmWagzGaq/2bVAGBm2bVmbWbzGbV/zb/AGB/Mzb/Nmb/wlbzGb//SKAA3kAm5ka
ZpkAmZkAzJkA/5kArMsKrzpkrmzkrzJk/5lVAjlvM5lvZlpVmZvJlV/5mAAM5mAzm
mZmAzJm/5mqAJmqM5mqZpmqnZmqzJmq/5nVAjnvM5nVzpnmVznVzJnV/5n/AJn/M5n/Zpn/mzn/
zJn//BwAAmWAm8wAzwSmcwAzmwA/8wRAmWrM8wrZswrmcwzMrw/BxVAMxVm8xVzsxVmcsxVzmxV
/8yAAMyAm8yAqMyAcyAyMzA/8yqAymqM8yqzSyqmczyqMz/8zVAMzVm8zVzsZVmCzVzHvz/8z/
AHz/Mbz/Zsz/mcz/mz//8AAP8AM/8AZV8Amf8A2P8A//8rAP8MrM/8rzV8rnf8rzP8r//9VAP9V
M/9VzV9VmF9VzP9V//+AAP+AM/+Avz+Amf+AzP+A/+qAP+oM/+qZv+qmf+qzP+q//VAP/VM//V
Zv/Vnf/VzP//V//V//Zv//mf//zP//wAAAAAAAAMAAAAAAACH5BAEAAPWALAAAABsADQA
AAj/APcJHeiwoMGDCBmQxiwoc0HeAswoachQhe70CJg3MixojeFtDUpLdhjceTKFNk1LCBjmSK
G1gUUUmzJkQ7RURWoACzwoaHdmwKhaOpoufJBNGUwYKFNGnK1IqCnMSYkg6MKe2Jaa1a8eWG3pc
gxMT7E+Ky7y1Whk0GwGSpMB1V2HyoJ21EnyogaqdWmzB3yHgnghMzKhuquLHCsu+Bmss
smhCYGGKDBsT8eXHE83qobhnB82NQcUX/HGlaobKldwvOpazJ8zWHF8rIxqtZcysJROCYrl1YTR9
0eL6lMw1NsGcIhPakcwzZhHnB02sTmsQ1E84A1GH/+zZN2F1mLgZj/j/qGFFoCtwJop49u2V6gnC0
Uijg4w7A5Jy9u0ooetX0H0HQ+CtxQ8MthSRnBb3VxWkgaMKMF1LjVlpBdZy1wYH7eLcBePu8IRMe
/7k3w0UeOrQffphSSzJabwAm0hvoAdhsixqesFZtkPyk1CiqZwxHchtoS0jAOA7UfoRnVRdhXCAK
NFp8+2Dl4yvhftFkxc0iNnyh+5Ql40EodjsjGzsZkbtGU00gJhabBfw1r9pNBU/m3D1ln2ahQ
WBQ41RNRMSxJEHXae5UmBoG1V6J0Vf5H50Bv2MdZoV200FBPjyoEoAaWcnZQalwJB50z80VwXGS
CF9qkFyxAlFVf6A6EZmmJveHmQHkhqlxcmq540YwVytzTweJFkFbP7olGy+CSRiouvA
Su1bbkbamZJaqshAS90vlfCt6IVGy1YRFhpc7Z6lScscdkLzeGuoqwoG21Gq12HzmEGHj8uo
Uu0exJdn1t644LYIZUohlc42ppFPiWkmlyhILsXR0IOqVOYn8JVKoyefbbben4eNgp0c25J3Ykd
GwtlhxFbHfJ6Vkp0KUCRnxpfZ4qpxEx+bwUiD0keTzFBV3PPVByw07zXrunkCvdbATZKniecv18
KsAcQxJxfBSP1FvNbfS1FvNbfS1FvNbfS1FvNbfS1FvNbfS1FvNbfS1FvNbfS1FvNbfS1FvNbfS1
WzD5+ROEY+4osQaa1KnZkLwBhA4Dt0MJC9RqhTQWRxhtCPFZEI61s0y5XeAp1ldBcDR2czM
M3leTPFfa1CeYzrL06ik2jezsIDTrNFOYRzRcfbyfwmz1NoUthP6cycK65xTgeE2KHa8AUcdcdS8
T/YP6ckYcCnRa36b0jfvFmrtF6bg0vx7zL1CehPdBrA6tNcq40GgvYrZfAY+Ba@ocwlsRign25
T2ZCChcMgqU6HKSAEewGrap4Ec0tCphB1tVDoLvhSJhgHxMhwbarCaLkV4tRuiCDryozAB
HX2Iknn1b0s9JKJNchUztCkrh3AgzFSS+MQqaiQgADs=

```
furkan@furkan-virtual-machine:~/forensics$ base64 -d email-base64.txt > output.gif  
furkan@furkan-virtual-machine:~/forensics$
```

```
furkan@furkan-virtual-machine:~/forensics$ file output.gif
output.gif: GIF image data, version 89a, 108 x 52
furkan@furkan-virtual-machine:~/forensics$ █
```

A screenshot of a terminal window titled 'forensics'. The command 'xdg-open output.gif' is being run, and the resulting image is displayed in a file viewer window. The viewer has a dark theme with a search bar at the top. In the center, there is a large image of the SAXION logo, which features the word 'SAXION' in white and green, with a stylized figure in the background.

Assignment 5.8: Steganography

Relevant screenshots + motivation

```
furkan@furkan-virtual-machine:~/forensics$ sudo apt install steghide
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
steghide is already the newest version (0.5.1-15).
The following packages were automatically installed and are no longer required:
  libwpe-1.0-1 libwpebackend-fdo-1.0-1
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 22 not upgraded.
furkan@furkan-virtual-machine:~/forensics$ cd ~/forensics/
furkan@furkan-virtual-machine:~/forensics$ steghide extract -sf apple2.jpg
Enter passphrase:
steghide: could not open the file "apple2.jpg".
furkan@furkan-virtual-machine:~/forensics$ steghide extract -sf apple2.jpg
Enter passphrase:
wrote extracted data to "message.txt".
furkan@furkan-virtual-machine:~/forensics$ cat message.txt
Hello class.
You have almost completed Week 5.

furkan@furkan-virtual-machine:~/forensics$
```

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.

The screenshot shows a terminal window titled "furkan@furkan-virtual-machine: ~". The terminal output is as follows:

```
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
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:d5:00:ad brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    inet 192.168.139.131/24 brd 192.168.139.255 scope global dynamic noprefixroute ens33
        valid_lft 969sec preferred_lft 969sec
        inet6 fe80::7816:d008:fc:6f72/64 scope link noprefixroute
            valid_lft forever preferred_lft forever
furkan@furkan-virtual-machine: ~ ssh furkan@192.168.139.134
The authenticity of host '192.168.139.134' (192.168.139.134) can't be established.
ED25519 key fingerprint is SHA256:MuglGdbfnxP3z7hGQwy0hpFItZ3TLH4/Kd2FFQ68jRk.
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 '192.168.139.134' (ED25519) to the list of known hosts.
furkan@192.168.139.134'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.
furkan@debian: ~
furkan@debian: ~
furkan@debian: ~
furkan@debian: ~ exit
uitgeologd
Connection to 192.168.139.134 closed.
furkan@furkan-virtual-machine: ~ sudo dd if=/dev/sda bs=4M status=progress | gzip | ssh furkan@192.168.139.134 "cat > /srv/images/ubuntu2404_vm.img.gz"
furkan@192.168.139.134's password:
239075328 bytes (239 MB, 228 MiB) copied 276824064 bytes (277 MB, 264 MiB) 801 MB, 764 MiB) copied, 3813694976 b14050911413480441488977920 by149736651505
1669332992 bytes (1,7 GB, 1,6 GiB) copied, 87 s, 19,2 MB/s
```

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

The screenshot shows a terminal window with a root shell. The command "ls -lh /srv/images/" is run, showing the backup image "ubuntu2404_vm.img.gz".

```
root@debian: ~#
root@debian: ~# ls -lh /srv/images/
totaal 8,2G
-rw-rw-r-- 1 furkan furkan 8,2G 20 dec 02:06 ubuntu2404_vm.img.gz
root@debian: ~#
```

```

System information as of Tue Dec 30 10:05:04 PM UTC 2025
System load: 0.06572265625 Processes: 241
Usage of /: 33.8% of 9.756B Users logged in: 0
Memory usage: 8% IPv4 address for ens33: 192.168.139.135
Swap usage: 0%

Expanded Security Maintenance for Applications is not enabled.
85 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

New release '24.04.3 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Last login: Tue Dec 30 20:40:22 UTC 2025 on ttys000
test@test:~$ ls -lh /srv/images/
ls: cannot access '/srv/images/': No such file or directory
test@test:~$ lsblk
NAME      MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
loop0      7:0    0   87M  1 loop /snap/lxd/27087
loop1      7:1    0 63.8M  1 loop /snap/core20/2686
loop2      7:2    0 40.4M  1 loop /snap/snappy/20671
loop3      7:3    0 63.9M  1 loop /snap/core20/2105
loop4      7:4    0 91.4M  1 loop /snap/lxd/36918
sda       8:0    0   20G  0 disk
└─sda1     8:1    0   1M  0 part
└─sda2     8:2    0  1.8G  0 part /boot
└─sda3     8:3    0 18.2G  0 part
  └─ubuntu--vg-ubuntu--lv 253:0   0 10G  0 lvm /
sr0       11:0   1 1024M 0 rom
test@test:~$ 

```

1. Debian 13 image server voorbereiden

Op de Debian-server (ingelogd als gebruiker furkan):

Systeem bijwerken en SSH installeren:

`SU -`

`apt update`

`apt install openssh-server -y`

`systemctl enable --now ssh`

Map voor images aanmaken en rechten goed zetten:

`sudo mkdir -p /srv/images`

`sudo chown $USER:$USER /srv/images`

IP-adres van de Debian-server bepalen (nodig voor alle verbindingen):

ip a

192.168.139.134

Korte samenvatting

1. Debian 13 server met SSH ingericht en map /srv/images gemaakt als opslag voor images.
2. Ubuntu 24.04 VM via **Try Ubuntu (live)** gestart, met lsblk de hoofddisk /dev/sda bepaald.
3. Volledige disk ge-imaged en gecomprimeerd naar Debian gestuurd:
`sudo dd if=/dev/sda bs=4M status=progress | gzip | ssh furkan@192.168.139.134 "cat > /srv/images/ubuntu2404_vm.img.gz".`
4. Nieuwe lege Ubuntu-VM gemaakt met dezelfde hardware-instellingen en in live-modus gestart.
5. Image teruggezet naar de lege disk met:
`ssh furkan@192.168.139.134 "cat /srv/images/ubuntu2404_vm.img.gz" | gzip -d | sudo dd of=/dev/sda bs=4M status=progress.`
6. ISO ontkoppeld; herstelde VM start normaal in Ubuntu 24.04 → bewijs dat backup en restore werken.

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