

Template Week 5 – Operating Systems

Student number:

Assignment 5.1: Unix-like

- a) Find out what the difference is between UNIX and unix-like operating systems?
UNIX is a registered trademark. If an OS wants to be called UNIX the owner of that OS must buy UNIX trademark. Unix-like operating systems are designed to behave very similar to UNIX, however they are not totally UNIX and do not have its trademark (they are mostly open-source projects).

- 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 is the father of UNIX who wrote the original version in 1969.

Dennis Ritchie created the C programming language. This enabled UNIX to run on any computer.

Bill Joy created BSD Unix and the TCP/IP software that allows computers to connect to the internet.

Richard Stallman was an activist who founded GNU and the Free Software Movement, believing all code should be open-source.

Linus Torvalds is the creator of Linux kernel and git. Linux Kernel + GNU makes the modern Linux OS.

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

The freedom to run the program as you wish, for any purpose.

The freedom to study how the program works and change it.

The freedom to redistribute copies so you can help your neighbor.

The freedom to distribute copies of your modified versions to others.

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

Not entirely. Although Ubuntu is based on Linux/GNU, it contains non-free softwares in the kernel. Also, it promotes its Snap Store (a software store for Ubuntu machines) that contains non-free softwares. Plus, Richard Stallman as the founder of GNU stated before that Ubuntu does not conform to the philosophy of the GNU movement.

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

WSL (Windows subsystem for linux) is a feature in Windows 10 and Windows 11 that allows developers to run a Linux environment directly on Windows without the overhead of a traditional virtual machine or dual-boot setup.

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

Android → Linux family (Unix-like)

iOS → BSD based. It shares the same core with macOS. Since macOS is a certified UNIX system, iOS is a direct descendant of UNIX.

ChromeOS → Linux family (Unix-like)

Assignment 5.2: Supercomputers and gameconsoles

- a) Research on this site what supercomputers are used for and write a short summary of it:

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

A supercomputer is an extremely powerful computer designed to perform billions (or even quadrillions) of calculations per second. supercomputers are used for specialized tasks that require processing huge amounts of data:

- *Simulating the Planet: The Earth Simulator (2002) was designed to create virtual models of the Earth to predict climate change and weather patterns.*
- *Space Research: The Columbia supercomputer (2005) was used by NASA at the Ames Research Center to help with space exploration and aeronautics research.*
- *Artificial Intelligence & Games: The Deep Blue supercomputer (1997) was famous for using its immense processing power to calculate chess moves, eventually defeating world champion Garry Kasparov.*
- *Scientific & Government Research: Machines like the Cray-1 (1976), ASCI Red (1997), and Roadrunner (2009) were built to handle the most difficult calculations for government labs and scientific institutes, often speeding up research that would take humans or normal computers years to finish.*

- 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?

A PS3 cluster is a collection of dozens to thousands of PS3 consoles connected via Ethernet running Linux (which Sony officially supported on early PS3 models via "OtherOS"). It is programmed using MPI (Message Passing Interface) or similar parallel frameworks. Together, these consoles acted as a distributed supercomputer.

It was used for:

- ***scientific researches***
- ***Defense and government research***
- ***Academic supercomputing***
- ***Distributed computing projects***

- 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 Linux for ARM. It is Oracle-made Linux distribution tailored for ARM architectures rather than the default Raspberry Pi OS.

- 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/>

No, Oracle's raspberryPi supercomputer does not appear in the list of the 500 fastest supercomputers in the world. A cluster made of hundreds or even a thousand Raspberry Pi boards has very limited floating-point throughput compared to real HPC systems built with server-class CPUs + GPUs + low-latency interconnects.

- e) What CPU architecture is used for the PlayStation 5 and Xbox Series X?

They both use x86-64

What operating systems run on these consoles?

Xbox series X → Runs on a specialized version of Microsoft Windows.




PlayStation 5 → Runs Orbis OS, which is a modified version of FreeBSD.

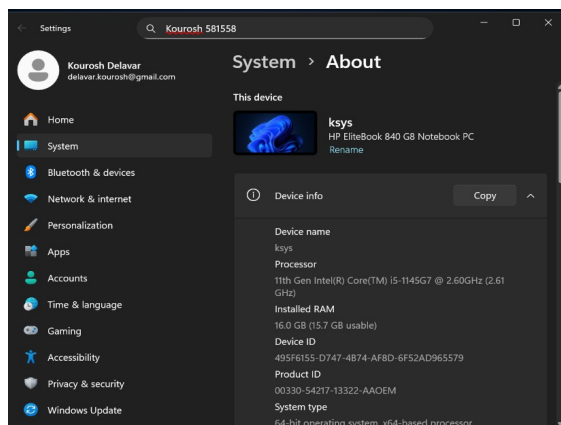
What conclusion can you draw from the answer to the previous question?

Consoles are just specialized PCs for gaming uses. There is a rivalry between Windows and Unix even in consoles industry.

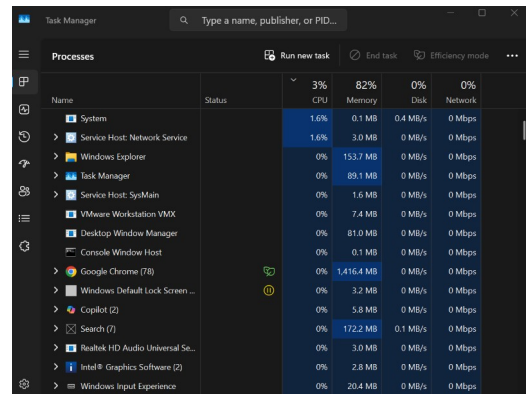
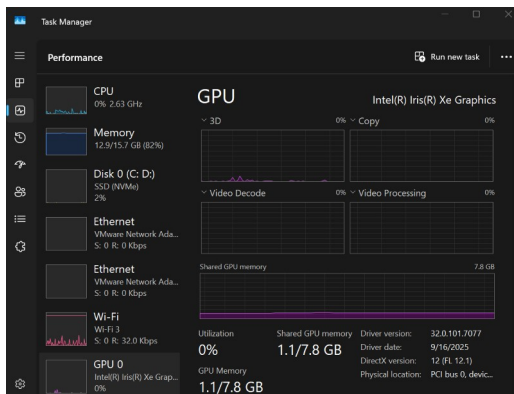
Assignment 5.3: Working with Windows

Take relevant screenshots of the assignments below

- 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.
- The file explorer can be opened with  + E, Which key combination could you also use?
Win + X, then press E
- Open the system properties with a  key combination, take a screenshot of the open screen. Paste this screenshot into this template.

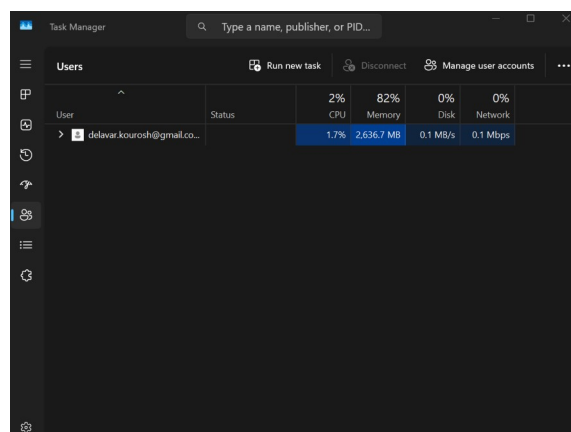


- Open task manager with a key combination. Take screenshots of the tabs: processes (shows active processes), performance, and users. Place these three screenshots in this template.



The screenshot shows the Windows Task Manager application, specifically the 'Processes' tab. The table lists active processes and their resource usage.

Name	Status	CPU	Memory	Disk	Network
System		3%	82%	0%	0%
Service Host: Network Service		1.6%	0.1 MB	0.4 MB/s	0 Mbps
Windows Explorer		1.6%	3.0 MB	0 MB/s	0 Mbps
Task Manager		0%	153.7 MB	0 MB/s	0 Mbps
Service Host: SysMain		0%	89.1 MB	0 MB/s	0 Mbps
VMware Workstation VMX		0%	1.6 MB	0 MB/s	0 Mbps
Desktop Window Manager		0%	7.4 MB	0 MB/s	0 Mbps
Console Window Host		0%	81.0 MB	0 MB/s	0 Mbps
Google Chrome (78)		0%	0.1 MB	0 MB/s	0 Mbps
Windows Default Lock Screen		0%	1,416.4 MB	0 MB/s	0 Mbps
Copilot (2)		0%	3.2 MB	0 MB/s	0 Mbps
Search (7)		0%	5.8 MB	0 MB/s	0 Mbps
Realtek HD Audio Universal Se...		0%	172.2 MB	0.1 MB/s	0 Mbps
Intel(R) Graphics Software (2)		0%	3.0 MB	0 MB/s	0 Mbps
Windows Input Experience		0%	2.8 MB	0 MB/s	0 Mbps
		0%	20.4 MB	0 MB/s	0 Mbps



The screenshot shows the Windows Task Manager application, specifically the 'Users' tab. The table lists active users and their resource usage.

User	Status	CPU	Memory	Disk	Network
delavar.kouroush@gmail.co...		2%	82%	0%	0%
		1.7%	2,636.7 MB	0.1 MB/s	0.1 Mbps

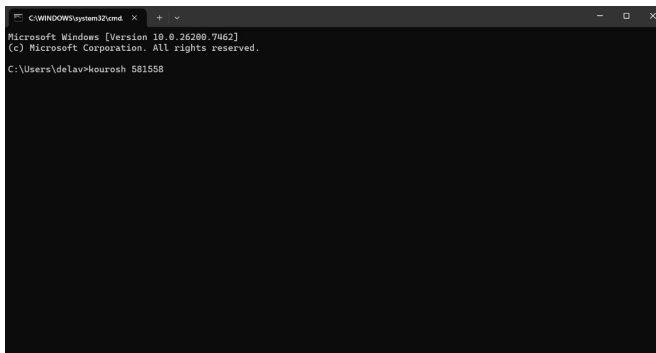
- e) If you're giving a PowerPoint presentation and you connect your laptop to a projector, Windows can use the projector as a second screen. For example, you may have Outlook open on your first screen that you don't show over the projector, while the PowerPoint presentation is displayed on the projector,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

Win + P

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

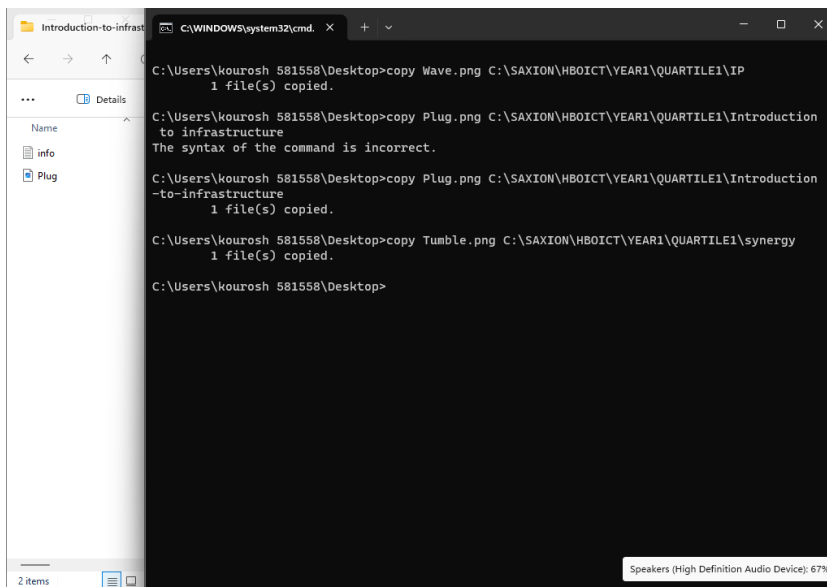
Win + L

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

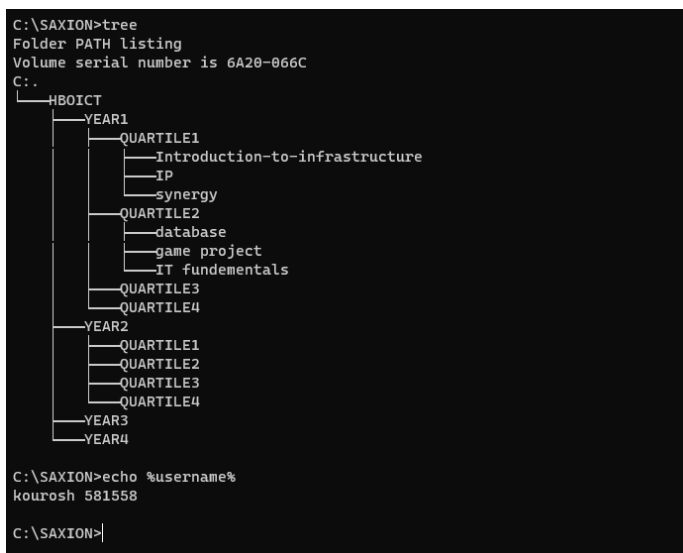


Working in the File Explorer

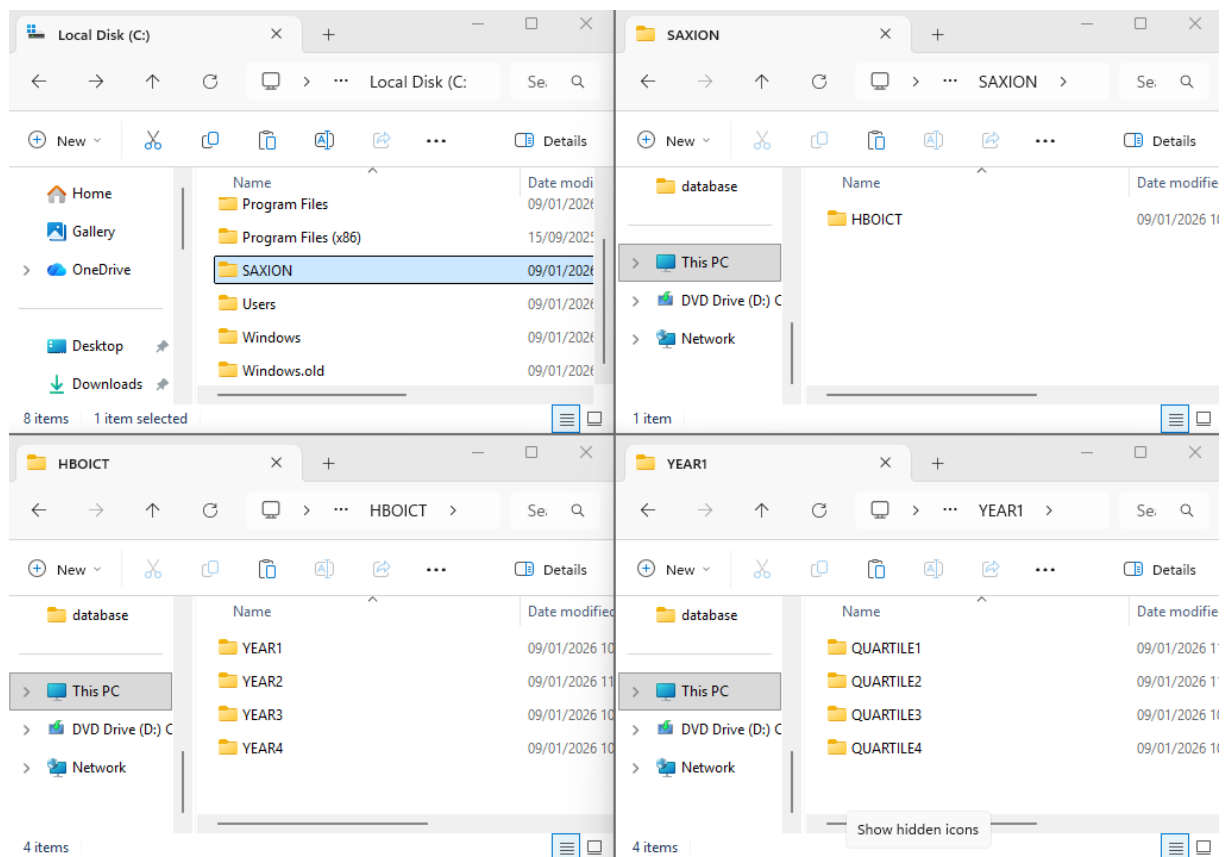
Relevant screenshots **copy** command:



Relevant screenshots **tree** command:



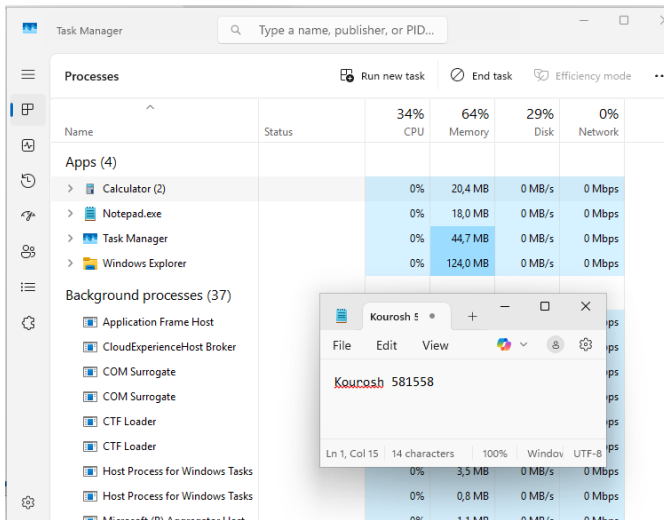
Relevant screenshots in the file explorer of the folder c:\Saxion + created zip file.



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 19:44	File folder	
Program Files (x86)	15/09/2025 21:57	File folder	
SAXION	09/01/2026 10:58	File folder	
Users	09/01/2026 11:09	File folder	
Windows	09/01/2026 10:49	File folder	
Windows.old	09/01/2026 19:43	File folder	
SAXION	09/01/2026 11:27	Compressed (zipp...	1.211 KB

Terminating Processes

Relevant Screenshots Task Manager Window:



Install Software

Relevant screenshots that the following software is installed with winget:

- WinSCP
- Notepad++
- 7zip

```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.26200.7462]
(c) Microsoft Corporation. All rights reserved.

C:\Windows\System32>winget install -e --id 7zip.7zip
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 service to function properly (ex. "US").
Do you agree to all the source agreements terms?
[Y] Yes [N] No: y
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...
Successfully installed

C:\Windows\System32>echo %username%
kourosh 581558

C:\Windows\System32>
```

```
C:\Windows\System32>winget install -e --id 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
6.54 MB / 6.54 MB
Successfully verified installer hash
Starting package install...
Successfully installed

C:\Windows\System32>echo %username%
kourosh 581558
```

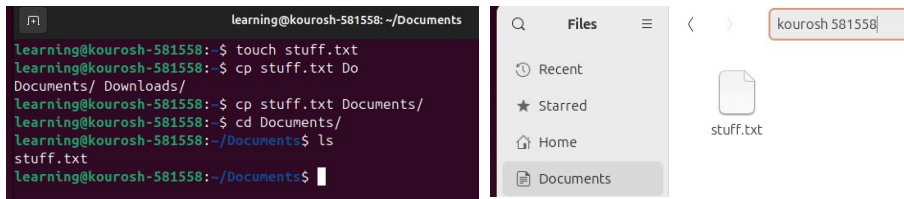
```
C:\Windows\System32>winget install -e --id WinSCP.WinSCP
Found WinSCP [WinSCP.WinSCP] Version 6.5.5
This application is licensed to you by its owner.
Microsoft is not responsible for, nor does it grant any licenses to, third-party packages.
Downloading https://sourceforge.net/projects/winscp/files/WinSCP/6.5.5/WinSCP-6.5.5-Setup.exe/download
11.6 MB / 11.6 MB
Successfully verified installer hash
Starting package install...
Successfully installed

C:\Windows\System32>echo %username%
kourosh 581558
```

Assignment 5.4: Working with Linux

Relevant screenshots + motivation

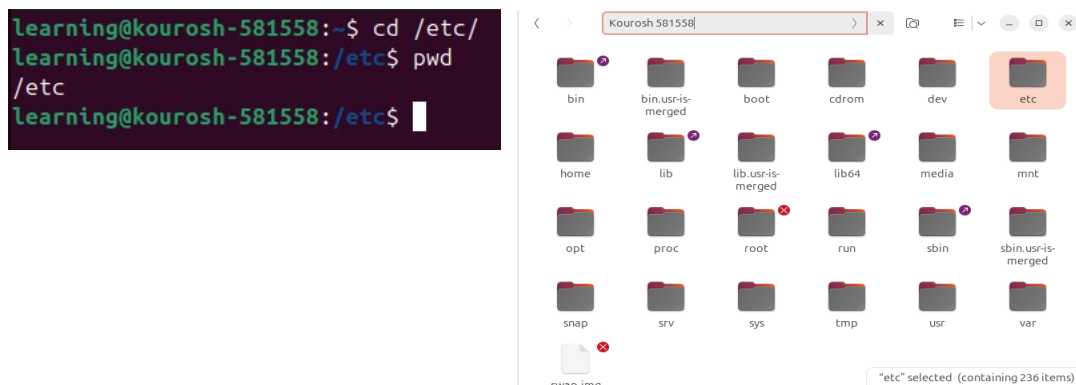
Copying files:



Navigating the file structure:

in Gnome file explorer:

1. open the file explorer and check the left bar
2. click on "other locations" and then navigate through "Ubuntu". We must find the /etc directory there.



How to get back to your home folder in the terminal? **Using "cd ~" command**

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

storage on windows is separated to drivers, each have its own root, but on Linux there is only one root and no driver structure

What is the /etc directory usually used for? **It stores information and configurations of the system in plain text files (Can be edited)**

Compress files:

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

tar -cvf archive.tar file.txt

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

tar -xvf archive.tar

```

learning@kourosh-581558: ~
learning@kourosh-581558:~$ ls
Desktop  Downloads  Pictures  snap      Templates
Documents Music      Public   stuff.txt Videos
learning@kourosh-581558:~$ tar -cvf archive.tar stuff.txt
stuff.txt
learning@kourosh-581558:~$ ls
archive.tar Documents Music      Public  stuff.txt Videos
Desktop  Downloads Pictures  snap    Templates
learning@kourosh-581558:~$

```

```

learning@kourosh-581558:~$ gzip archive.tar
learning@kourosh-581558:~$ ls
archive.tar.gz Documents Music      Public  stuff.txt Videos
Desktop  Downloads Pictures  snap    Templates
learning@kourosh-581558:~$

```

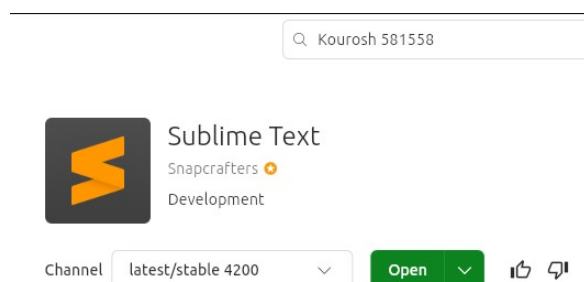
View processes:

Launch the htop application. Explain what this application shows:

htop is a interactive system monitoring application which provides more readability and insight compared to “top”.

The screenshot shows the htop application interface. At the top, it displays system statistics: 5.9% CPU usage, 4.6% memory usage, 115 tasks, 365 threads, 208 kthreads, and 1 running process. The load average is 0.56, 0.31, 0.15. Memory usage is 1006M/3.78G, and swap usage is 0K/3.64G. The uptime is 00:06:53. Below the statistics, there is a table of running processes with columns for PID, USER, PRI, NI, VIRT, RES, SHR, S, CPU%, MEM%, TIME+, and Command. The processes listed include learning (gnome-terminal), root (init), root (systemd-oomd), root (systemd-repl), root (systemd-timedate), and root (systemd-timedate). The interface also includes a menu bar at the bottom with options like F1 Help, F2 Setup, F3 Search, F4 Filter, F5 Tree, F6 Sort By, F7 Nice, F8 Kill, and F10 Quit.

Install Software:



The screenshot shows the neofetch application output. It displays system information in a stylized ASCII art format. The information includes: OS: Ubuntu 24.04.3 LTS x86_64, Host: VMware Virtual Platform None, Kernel: 6.14.0-37-generic, Uptime: 11 mins, Packages: 1659 (dpkg), 12 (snap), Shell: bash 5.2.21, Resolution: 1664x835, DE: GNOME 46.0, WM: Mutter, WM Theme: Adwaita, Theme: Yaru [GTK2/3], Icons: Yaru [GTK2/3], Terminal: gnome-terminal, CPU: 11th Gen Intel i5-1145G7 (2) @, GPU: 00:0F.0 VMware SVGA II Adapter, Memory: 1047MiB / 3867MiB.

What does neofetch application show when you launch it? **A summary of hardware resources and UI configurations**

Assignment 5.5: Users and permissions on Linux

Relevant screenshots + motivation

```
learning@kourosch-581558: ~/hello
learning@kourosch-581558:~/hello$ ls
hello.sh
learning@kourosch-581558:~/hello$ chmod 744 hello.sh
learning@kourosch-581558:~/hello$ ./hello.sh
Hello Kourosh 581558 !
learning@kourosch-581558:~/hello$
```

Assignment 5.6: View the contents of files

Relevant screenshots + motivation

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

Using “wc” command gives us three numbers which are the number of lines, the number of words and characters respectively.

```
learning@kourosch-581558:~/Desktop$ wc Sherlock.txt
12306 107562 595195 Sherlock.txt
```

On which lines is the word "kingdom" in the file?

Using grep we can filter a view.

```
learning@kourosch-581558:~/Desktop$ cat Sherlock.txt | grep "kingdom"
"I tell you that I would give one of the provinces of my kingdom to
And that was how a great scandal threatened to affect the kingdom of
```

```
learning@kourosch-581558:~/Desktop$ head -n 60 Sherlock.txt | tail -n 21
III. A Case of Identity
IV. The Boscombe Valley Mystery
V. The Five Orange Pips
VI. The Man with the Twisted Lip
VII. The Adventure of the Blue Carbuncle
VIII. The Adventure of the Speckled Band
IX. The Adventure of the Engineer's Thumb
X. The Adventure of the Noble Bachelor
XI. The Adventure of the Beryl Coronet
XII. The Adventure of the Copper Beeches

I. A SCANDAL IN BOHEMIA

I.

To Sherlock Holmes she is always _the_ woman. I have seldom heard him
mention her under any other name. In his eyes she eclipses and
```

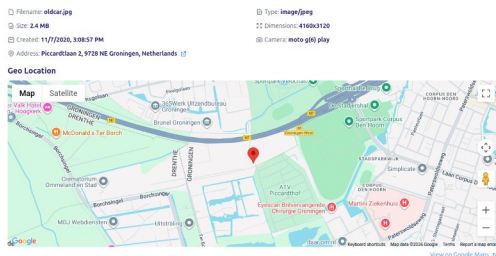
Assignment 5.7: Digital forensics

Relevant screenshots + motivation

Identify phone brand/type → ***moto g(6) play***

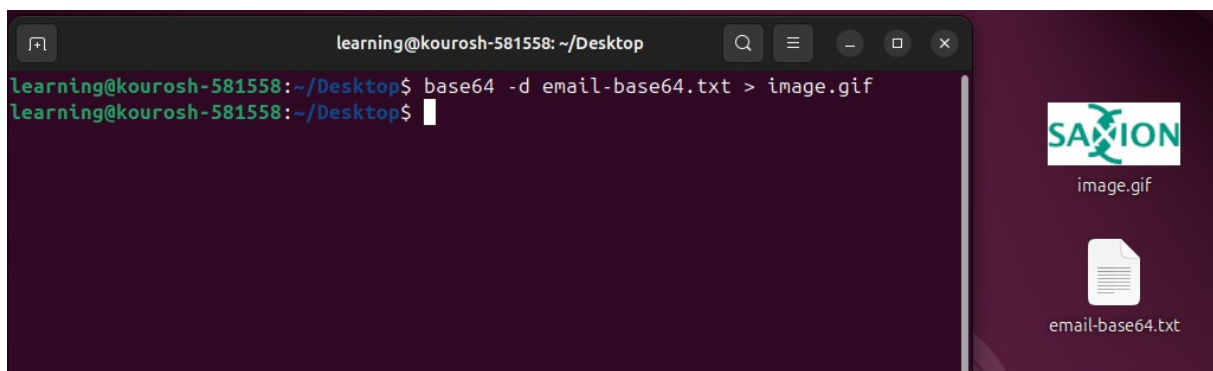
Are there GPS coordinates known? **Yes**

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



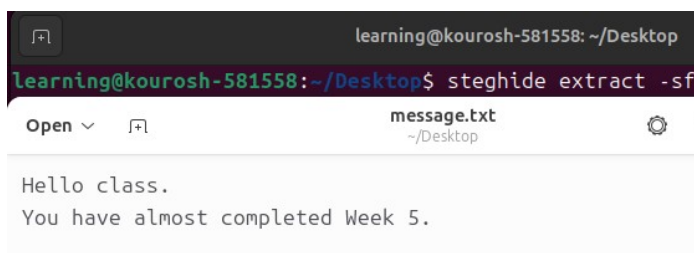
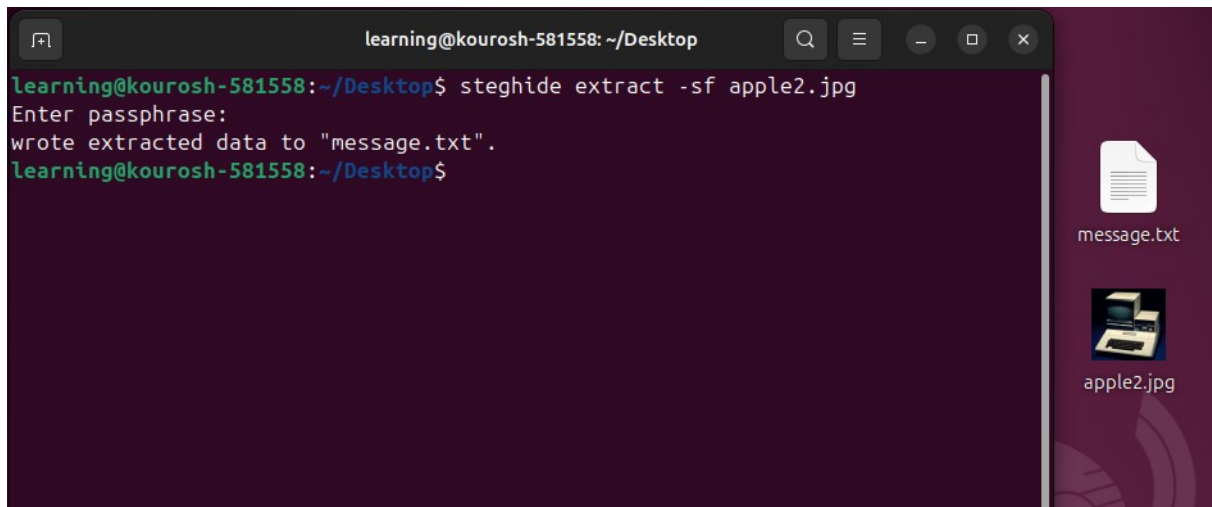
In which city was this photo taken? ***Groningen***

BASE64:



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.

```
Debian GNU/Linux 13 kourosh581558 tty1
kourosh581558 login: Welkom01
Password:
Login incorrect

kourosh581558 login: kourosh581558
Password:
Linux kourosh581558 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.
kourosh581558@kourosh581558:~$ sudo apt update
[sudo] password for kourosh581558:
Hit:1 http://deb.debian.org/debian trixie InRelease
Hit:2 http://deb.debian.org/debian trixie-updates InRelease
Hit:3 http://security.debian.org/debian-security trixie-security InRelease
All packages are up to date.
kourosh581558@kourosh581558:~$ sudo apt install openssh-server -y
openssh-server is already the newest version (1:10.0p1-7).
openssh-server set to manually installed.
Summary:
Upgrading: 0, Installing: 0, Removing: 0, Not Upgrading: 0
kourosh581558@kourosh581558:~$ sudo systemctl enable --now ssh
Synchronizing state of ssh.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable ssh
kourosh581558@kourosh581558:~$ sudo mkdir -p /srv/images
kourosh581558@kourosh581558:~$ sudo chown $USER:$USER /srv/images
kourosh581558@kourosh581558:~$ 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:be:78:4f brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    altname enx00c29be784f
    inet 192.168.23.130/24 brd 192.168.23.255 scope global dynamic noprefixroute ens33
        valid_lft 1256sec preferred_lft 1031sec
    inet6 fe80::5a35:c29d:c0e2:4f25/64 scope link
        valid_lft forever preferred_lft forever
kourosh581558@kourosh581558:~$
```

```
Learning@kourosh-581558:~/Desktop$ ssh kourosh581558@192.168.23.130
kourosh581558@192.168.23.130's password:
Linux kourosh581558 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.
kourosh581558@kourosh581558:~$
```

Backup captured:

```
ubuntu@ubuntu:~$ sudo dd if=/dev/sda bs=4M status=progress | gzip | ssh kourosh581558@192.168.23.130 "cat > /srv/images/ubuntu2404_vm.img.gz"
The authenticity of host '192.168.23.130 (192.168.23.130)' can't be established.
ED25519 key fingerprint is SHA256:Qh0+nOa5Mzu2RL08zQK3p1pB9SvDPI5JYU9jMLfItI.
This key is not known by any other names.
239075328 bytes (239 MB, 228 MiB) copied, 1 s, 238 MB/s[syserror]
Warning: Permanently added '192.168.23.130' (ED25519) to the list of known hosts.
kourosh581558@192.168.23.130's password:
Permission denied, please try again.
kourosh581558@192.168.23.130's password:
Permission denied, please try again.
kourosh581558@192.168.23.130's password:
21269315584 bytes (21 GB, 20 GiB) copied, 130 s, 164 MB/s
5120+0 records in
5120+0 records out
21474836480 bytes (21 GB, 20 GiB) copied, 131.172 s, 164 MB/s
ubuntu@ubuntu:~$
```

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

Restored in the target storage

```
ubuntu@ubuntu:~$ ssh kourosh581558@192.168.23.130 "cat /srv/images/ubuntu2404_vm
.img.gz" | gzip -d | sudo dd of=/dev/sda bs=4M status=progress
The authenticity of host '192.168.23.130 (192.168.23.130)' can't be established.
ED25519 key fingerprint is SHA256:Qh0+n0a5Mzu2RL08zQK3p1pB9SvDPI5JYU9jMLfltsI.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.23.130' (ED25519) to the list of known hosts
.
kourosh581558@192.168.23.130's password:
21387476992 bytes (21 GB, 20 GiB) copied, 93 s, 230 MB/s
0+649863 records in
0+649863 records out
21474836480 bytes (21 GB, 20 GiB) copied, 93.6449 s, 229 MB/s
ubuntu@ubuntu:~$
```

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