

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 licensed, proprietary, and certified, while **Unix-like systems are clones/inspirations, open-source, and focus on Unix philosophy** without strict official certification, though they share functionality.

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.

c)
(short version because there is a lot)

Ken Thompson:

- one of the original creators of UNIX
- designer of UNIX file system
- creator of B programming language (a predecessor to C)

Dennis Ritchie:

- Co-creator of UNIX along with Ken Thompson
- Creator of C programming language

Billy Joy:

- Played a crucial role in developing BSD UNIX
- Created vi text editor, a very important UNIX tool
- Contributor at BSD (Berkeley Software Distribution) which was the birthplace of contributions like : TCP/IP integration, c shell ,
- Also a co-founder of Java at Sun

Richard Stallman:

- Founder of the GNU Project (1983) in order to create a free UNIX-like system.
- Founded the Free Software Foundation (FSF).
- Created important GNU components: GNU Compiler Collection (GCC), GNU Emacs, GNU General Public License (GPL) — one of the most influential software licenses

His work provided essential components that, combined with the Linux kernel, created GNU/Linux. Stallman's ideas shaped the philosophy of free and open-source software (FOSS). Most open-source software today is affected by his principles and licensing structures.

Linus Torvalds

- Developed the Linux kernel in 1991 while a university student.
- Continues to oversee kernel development today.
- Created Git (2005), the distributed version control system.

Linux is one of the most important operating systems in the world because it powers most of the world's servers, cloud platforms, supercomputers, and mobile devices through Android, combined with GNU components, it forms the widely used GNU/Linux operating systems.

d) What is the philosophy of the GNU movement?

The philosophy enters on **user freedom** in computing, defining "free software" not by price but by four essential freedoms: to run, study/modify (with source code access), redistribute copies, and distribute modified versions. It's a deep ethical stance, viewing software as a communal resource that should empower users, not control them, promoting transparency, collaboration, and user control over proprietary restrictions, often using copyleft licenses like the [GPL](#) to ensure these freedoms persist.

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

Only partly since Ubuntu is built on GNU/Linux, uses much GPL-licensed free software, and supports open-source development, which aligns with the GNU philosophy. However, Ubuntu also includes proprietary drivers, firmware, and optional non-free software, which contradicts the GNU principle that all software should respect user freedom. Therefore, Ubuntu supports but does not fully conform to the strict GNU philosophy.

f) Find out what is the Windows Subsystem for Linux?

WSL and it offers access to Linux features such as full Linux command set like bash, Linux tools and utilities, Linux file system support along with a windows environment.

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

Android (Google): A Linux-based mobile OS for phones/tablets, using the Linux kernel for core functions.

iOS (Apple): Apple's mobile OS for iPhones/iPads, derived from Darwin/macOS, completely separate from Linux/Android.

ChromeOS (Google): A lightweight, Linux-based OS focused on the Chrome browser, with Android app support via a Linux environment

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 are a class of extremely powerful computers that perform overly complex tasks.

- government agencies for code-breaking and national security
- weather services for predicting storms and climate models
- car and aircraft companies to simulate crashes and designs
- pharmaceutical firms to model chemical reactions for new medicines
- research labs to analyse experimental or scientific data

- 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 PlayStation 3 cluster is a distributed computing system made by networking many PS3 consoles together to work as a supercomputer. It was used in research and scientific computing because the PS3's Cell processor was powerful and relatively cheap. Clusters have run astrophysics simulations, cryptography challenges, and even military data analysis like radar/satellite imagery.

- 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 Raspberry Pi cluster runs Oracle Linux for ARM, with the Raspberry Pi nodes network-booting that OS instead of using individual SD cards.

- 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/>

It does not seem to be present on the list. What oracle created with the Raspberry Pi supercomputer looks more like a demonstration of what can be achieved rather than a circulating product/supercomputer.


- 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 architecture: Both the PlayStation 5 and Xbox Series X use custom AMD Zen 2-based CPUs (x86-64 architecture).

Operating systems: Each console runs a custom OS based on a variant of Windows-like or embedded system tailored to gaming.

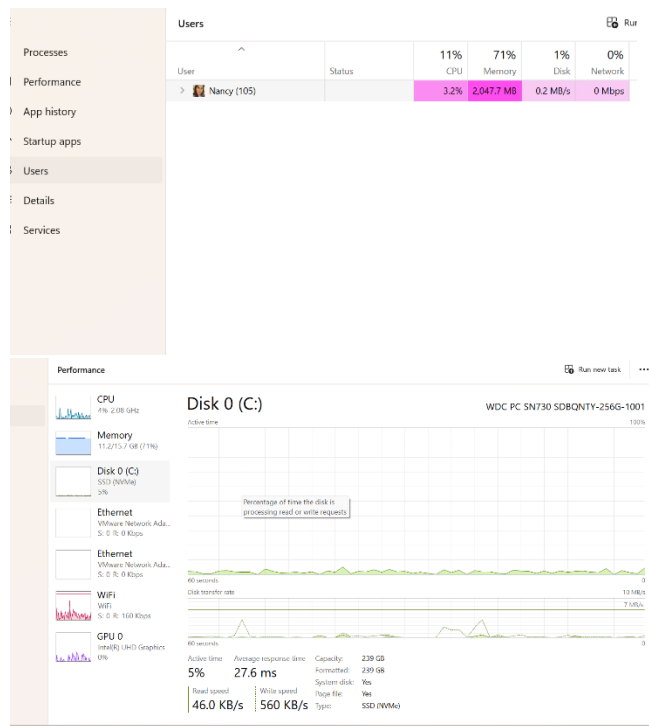
Modern game consoles now use standard PC-class CPU architectures and system software, unlike earlier consoles (e.g., PS3) which had unique hardware used also for clustering. This shows how gaming and high-performance computing have increasingly converged on common industry standards.

Take relevant screenshots of the assignments below

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

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

[illegible]



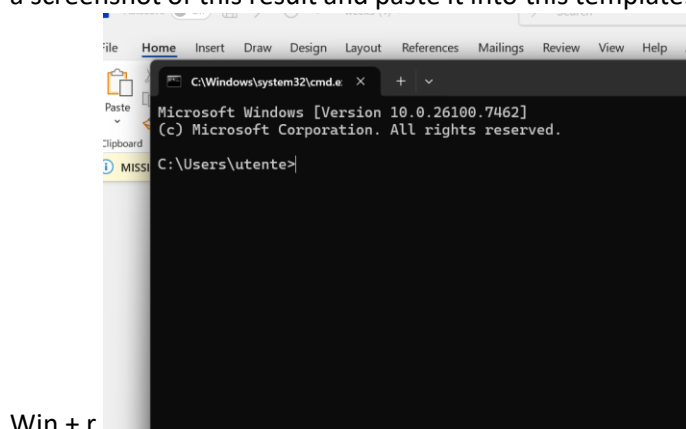
- e) If you're giving a PowerPoint presentation and you connect your laptop to a projector, Windows can use the projector as a second screen. For example, you may have Outlook open on your first screen that you don't show over the projector, while the PowerPoint presentation is displayed on the projector,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

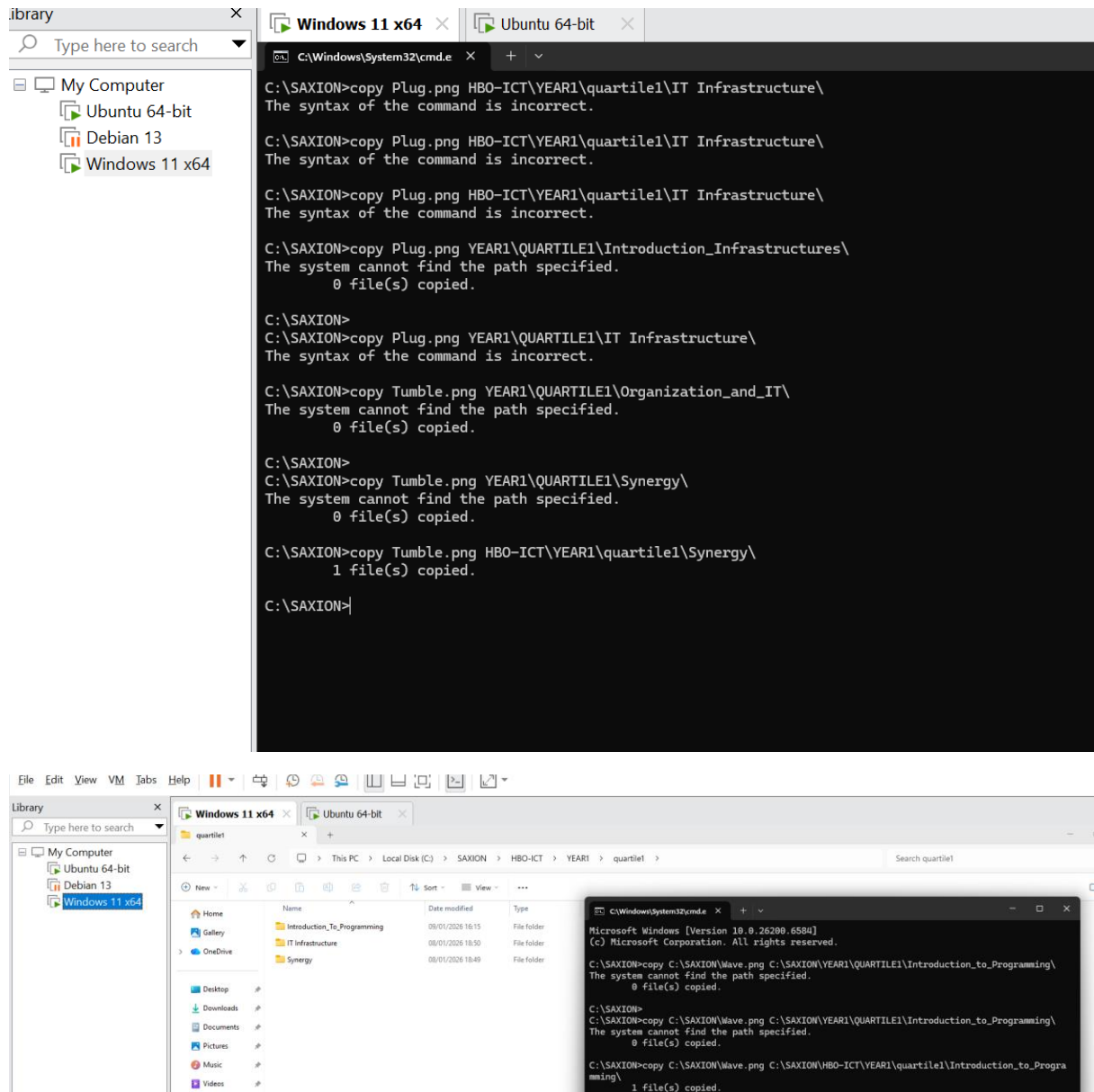
- g) Open the Run screen with a key combination. On this screen, type CMD and press <enter>. Take a screenshot of this result and paste it into this template.



Win + r

Working in the File Explorer

Relevant screenshots **copy** command:

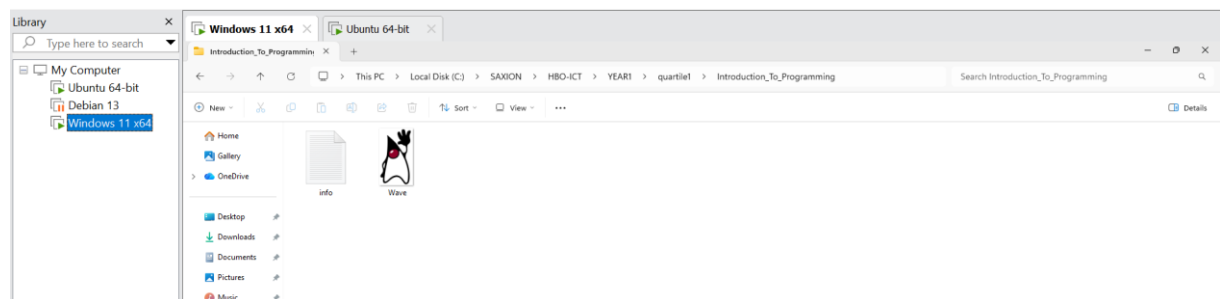


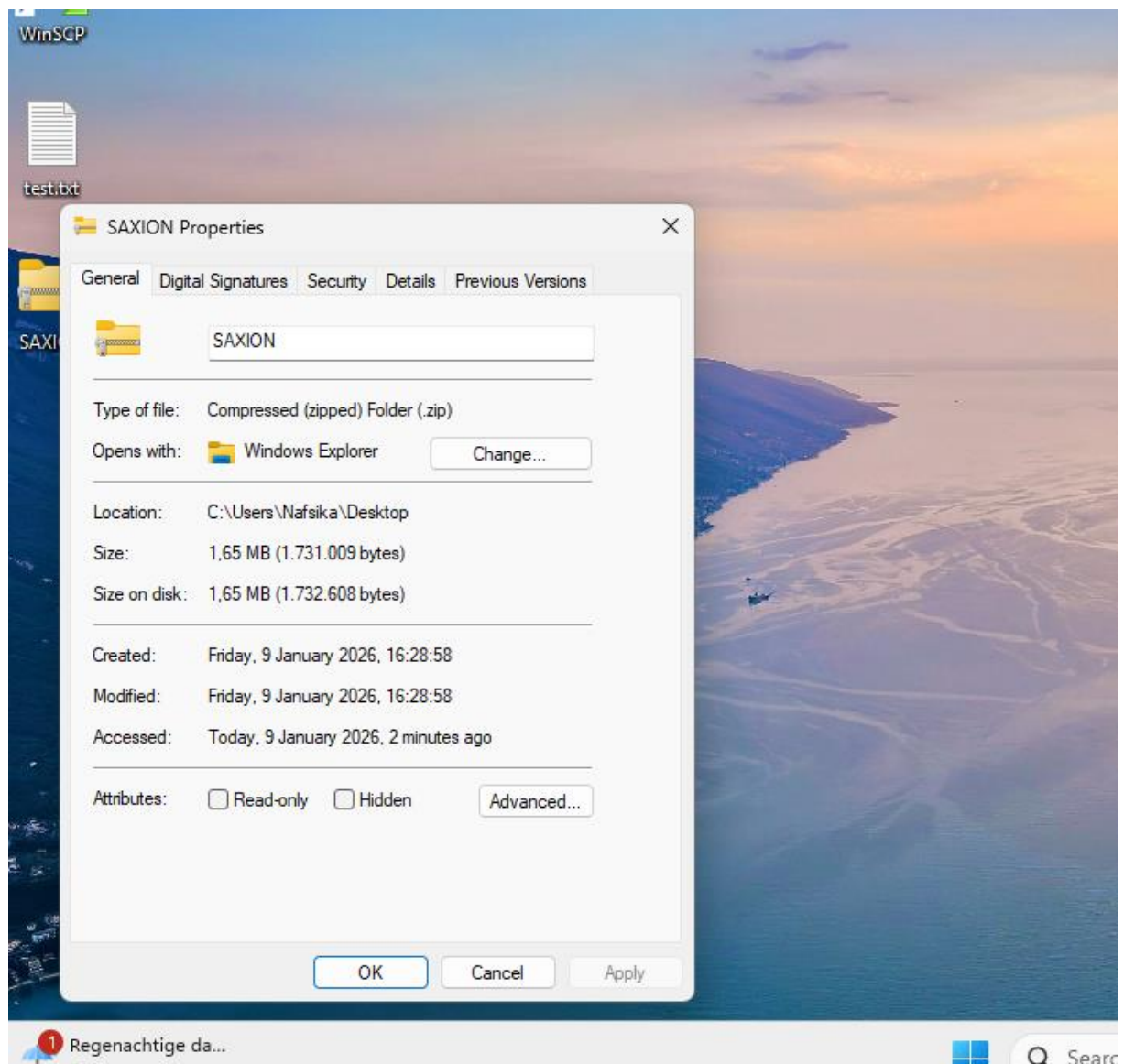
Relevant screenshots **tree** command:

```
Windows 11 x64
C:\SAXION>
C:\SAXION>copy Plug.png HBO-ICT\YEAR1\quartile1\IT Infrastructure\
The syntax of the command is incorrect.

C:\SAXION>tree
Folder PATH listing
Volume serial number is CCDE-C7D8
C:.
├── HBO-ICT
│   ├── YEAR1
│   │   ├── quartile1
│   │   │   ├── Introduction_To_Programming
│   │   │   ├── IT_Infrastructure
│   │   │   ├── Synergy
│   │   ├── quartile2
│   │   │   ├── Databases
│   │   │   ├── IT_fundamentals
│   │   │   └── Project_IT_in_the_Game
│   │   ├── quartile3
│   │   └── quartile4
│   └── YEAR2
│       ├── quartile1
│       ├── quartile2
│       ├── quartile3
│       └── quartile4
└──
```

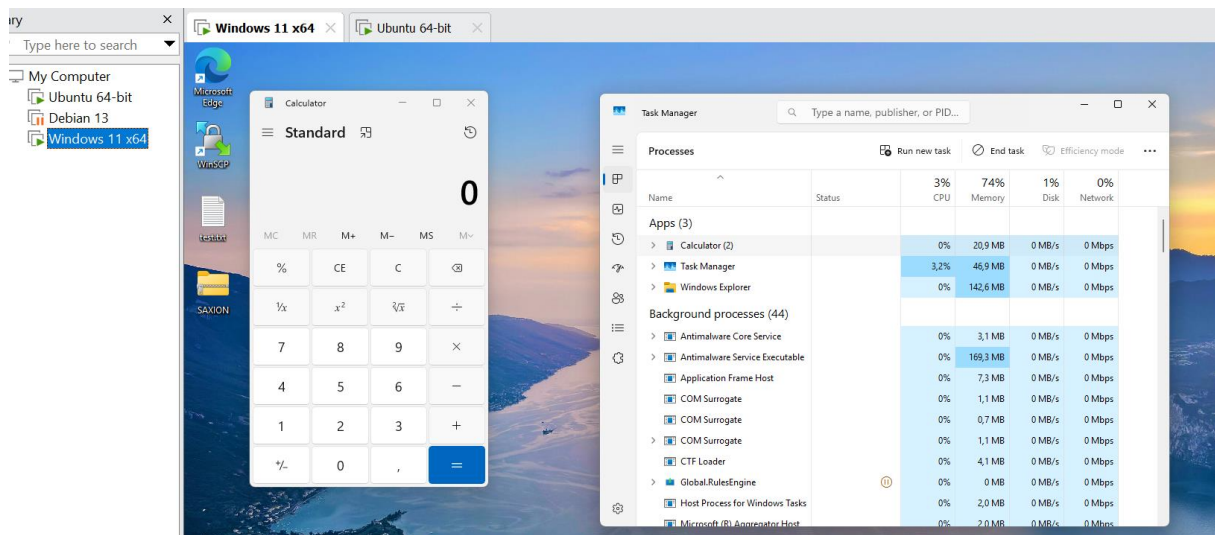
Relevant screenshots in the file explorer of the folder c:\Saxion + created zip file.





Terminating Processes

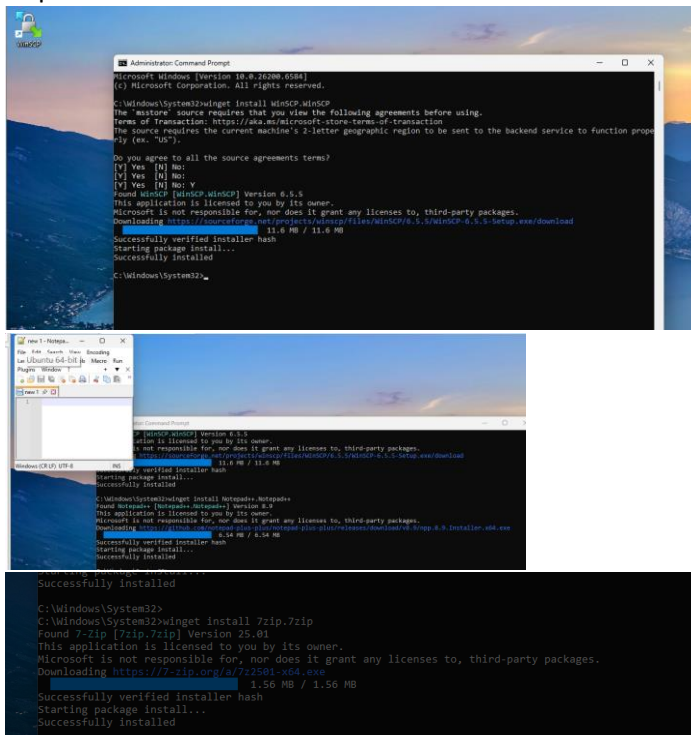
Relevant Screenshots Task Manager Window:



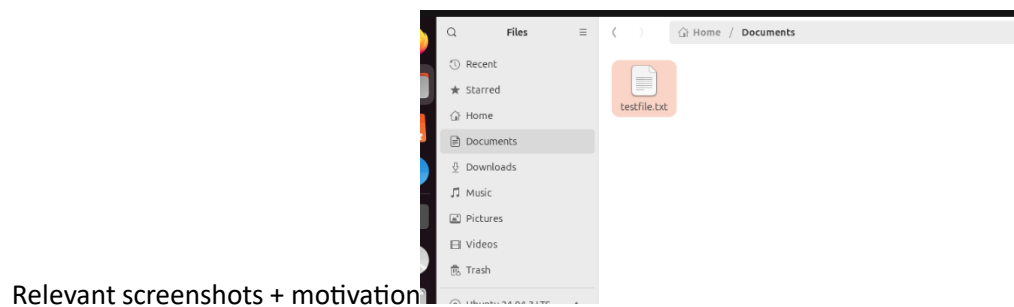
Install Software

Relevant screenshots that the following software is installed with winget:

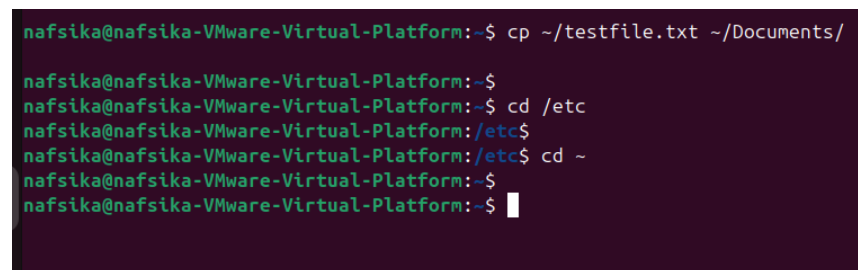
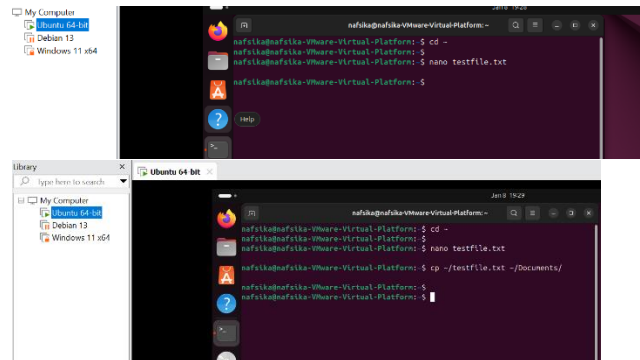
- WinSCP
- Notepad++
- 7zip



Assignment 5.4: Working with Linux

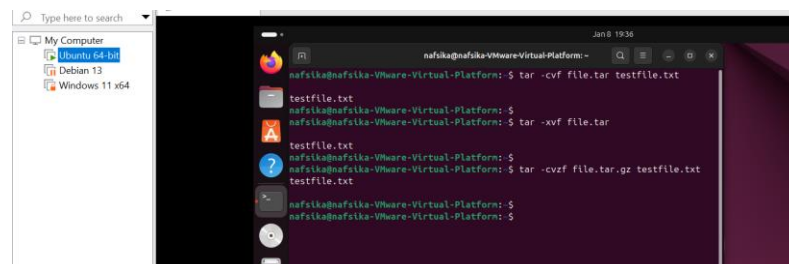


Relevant screenshots + motivation

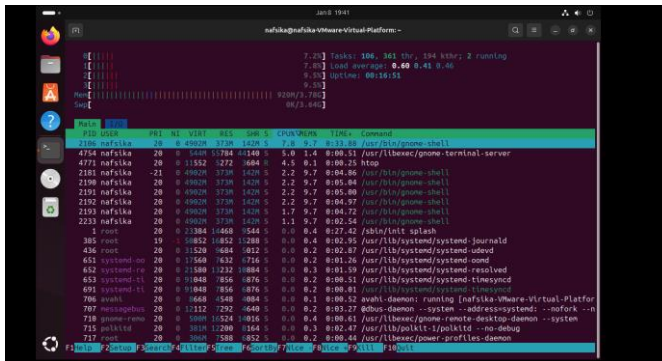
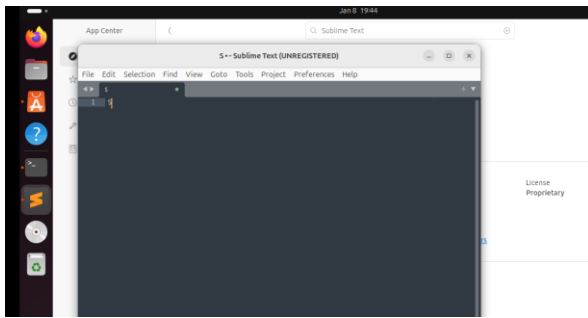


Difference between Linux and Windows :

Linux has a single root directory whereas Windows uses multiple drive letters (C,D, etc)

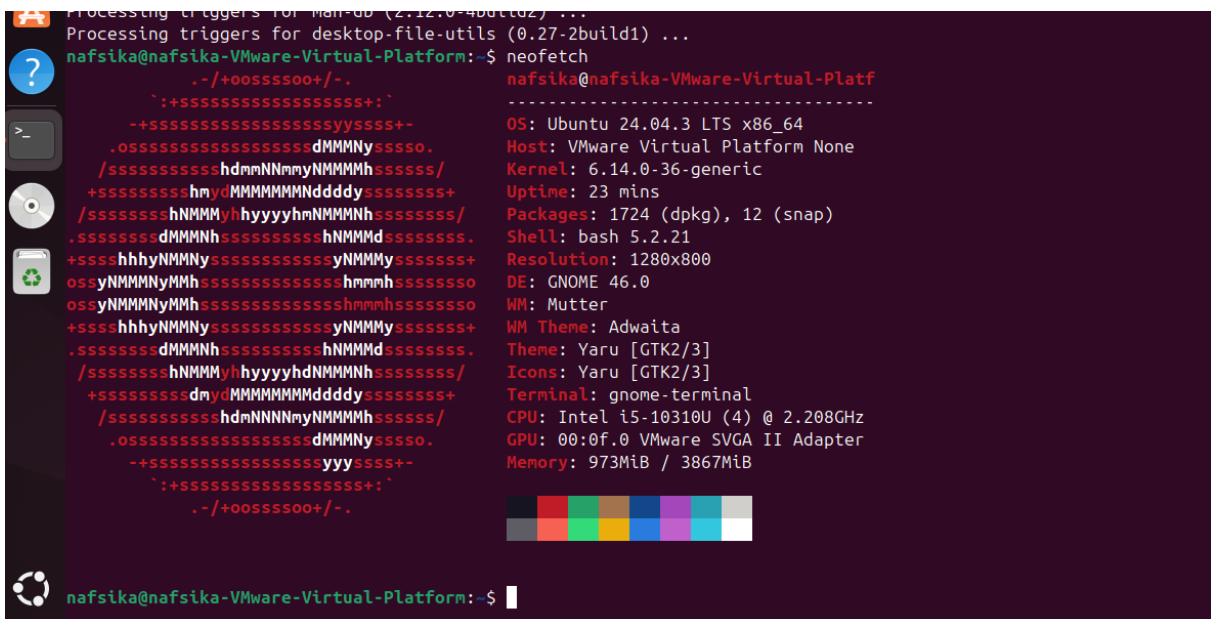


Htop : It shows running processes, cpu usage, memory usage and allows the user to engage in performance usage



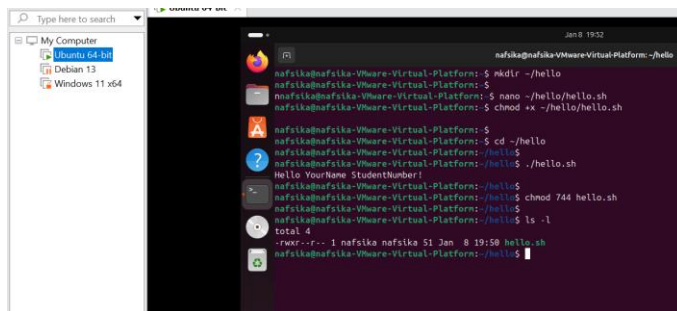
Neofetch :

Neofetch shows system information like OS version, kernel,cpu,ram,disk usage, desktop environment.



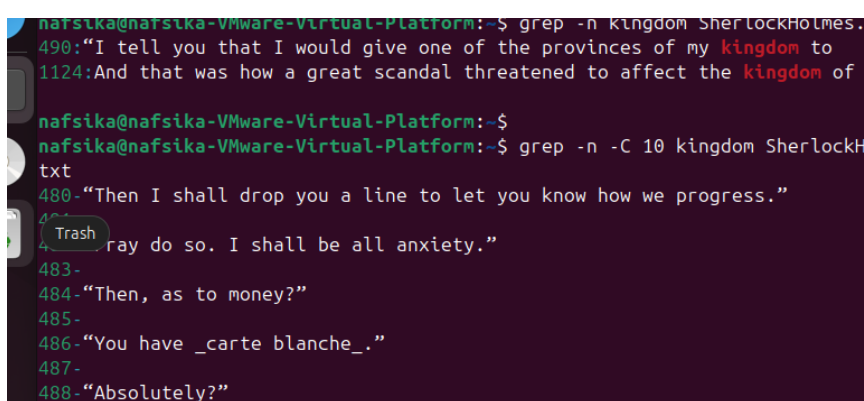
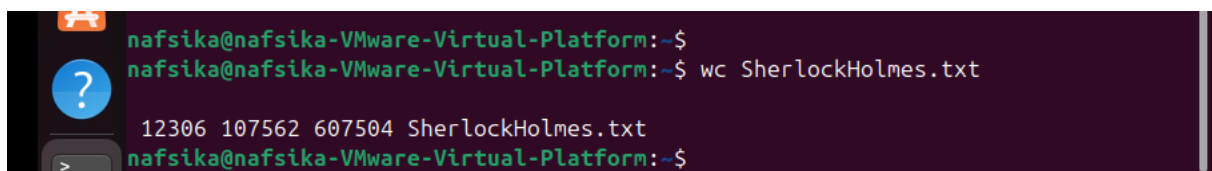
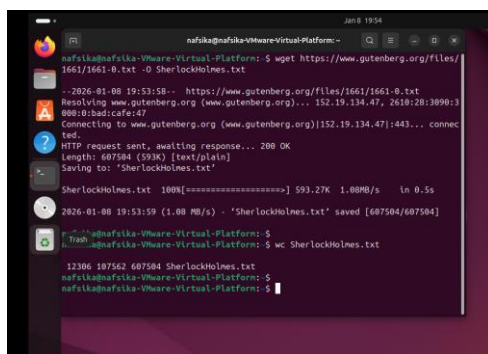
Assignment 5.5: Users and permissions on Linux

Relevant screenshots + motivation



Assignment 5.6: View the contents of files

Relevant screenshots + motivation



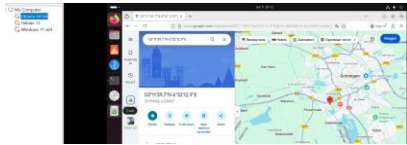
Assignment 5.7: Digital forensics

Relevant screenshots + motivation

Brand : The phone is manufactured by motorola

```
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 : 14:00:57
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 14:00:57Z
GPS Latitude : 53 deg 11' 39.68" N
GPS Longitude : 6 deg 32' 12.90" E
Focal Length : 3.5 mm
GPS Position : 53 deg 11' 39.68" N, 6 deg 32' 12.90" E
Light Value : 7.7
nafsika@nafsika-Vmware-Virtual-Platform:~/Downloads$
```

```
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 14:00:57Z
GPS Latitude : 53 deg 11' 39.68" N
GPS Longitude : 6 deg 32' 12.90" E
Focal Length : 3.5 mm
GPS Position : 53 deg 11' 39.68" N, 6 deg 32' 12.90" E
Light Value : 7.7
nafsika@nafsika-Vmware-Virtual-Platform:~/Downloads$
```



```
nafsika@nafsika-Vmware-Virtual-Platform:~/Downloads$ mv oldcar.jpg oldcar
nafsika@nafsika-Vmware-Virtual-Platform:~/Downloads$
nafsika@nafsika-Vmware-Virtual-Platform:~/Downloads$ 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=10, manufacturer=Motorola, model=Moto G(6) Play, xresolution=160, yresolution=160, resolution unit=2, software=aljetter-user 9 PPP529.55-35-10-7 6a00b release-keys, datetime=2020:11:07 15:00:57, GPS-Data], baseline, precision 8, 4160x3120, components 3
nafsika@nafsika-Vmware-Virtual-Platform:~/Downloads$
nafsika@nafsika-Vmware-Virtual-Platform:~/Downloads$
```

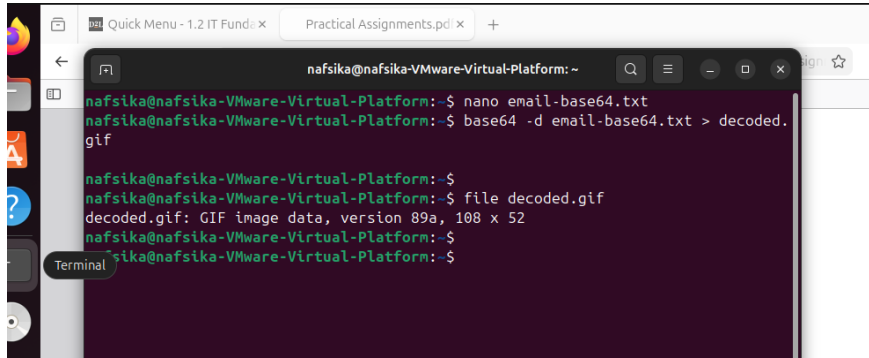
The file is still recognizable because ubuntu categorises files by content and not by the extension

Assignment 5.8: Steganography

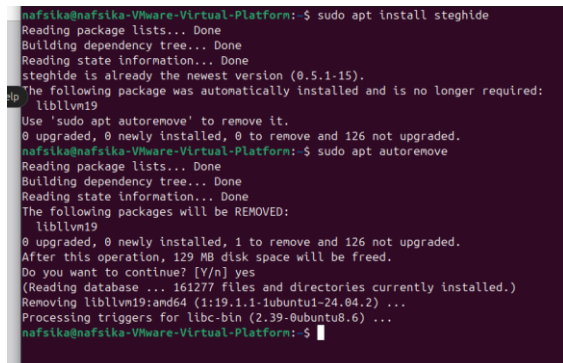
Relevant screenshots + motivation

The BASE64 string was decoded using the base64 -d command, Output redirection (>) was used to save the binary data to a file instead of displaying it on the terminal

The decoded file was verified to be a GIF image using the file command



```
nafsika@nafsika-VMware-Virtual-Platform: ~  
nafsika@nafsika-VMware-Virtual-Platform:~$ nano email-base64.txt  
nafsika@nafsika-VMware-Virtual-Platform:~$ base64 -d email-base64.txt > decoded.gif  
nafsika@nafsika-VMware-Virtual-Platform:~$  
nafsika@nafsika-VMware-Virtual-Platform:~$ file decoded.gif  
decoded.gif: GIF image data, version 89a, 108 x 52  
nafsika@nafsika-VMware-Virtual-Platform:~$
```



```
nafsika@nafsika-VMware-Virtual-Platform:~$ 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 package was automatically installed and is no longer required:  
  libllvm19  
Use 'sudo apt autoremove' to remove it.  
0 upgraded, 0 newly installed, 0 to remove and 126 not upgraded.  
nafsika@nafsika-VMware-Virtual-Platform:~$ sudo apt autoremove  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
The following packages will be REMOVED:  
  libllvm19  
0 upgraded, 0 newly installed, 1 to remove and 126 not upgraded.  
After this operation, 129 MB disk space will be freed.  
Do you want to continue? [Y/n] yes  
(Reading database ... 161277 files and directories currently installed.)  
Removing libllvm19:amd64 (1:19.1.1-1ubuntu1-24.04.2) ...  
Processing triggers for libc-bin (2.39-0ubuntu8.6) ...  
nafsika@nafsika-VMware-Virtual-Platform:~$
```



```
nafsika@nafsika-VMware-Virtual-Platform:~/Downloads$ steghide extract -sf apple2.jpg  
Enter passphrase:  
steghide: could not extract any data with that passphrase!  
nafsika@nafsika-VMware-Virtual-Platform:~/Downloads$ steghide extract -sf apple2.jpg  
Enter passphrase:  
wrote extracted data to "message.txt".  
nafsika@nafsika-VMware-Virtual-Platform:~/Downloads$ cat message.txt  
Hello class.  
You have almost completed Week 5.  
nafsika@nafsika-VMware-Virtual-Platform:~/Downloads$
```

Steghide was used to extract hidden data from the image.

The tool reads least significant bits (LSB) in the image to recover embedded files without visible changes.

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.

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