

# Template Week 5 – Operating Systems

Student number: 585303

## Assignment 5.1: Unix-like

- a) Find out what the difference is between UNIX and unix-like operating systems?

UNIX is an original operating system created at Bell Labs in the 1970s.

The name UNIX is a trademark, and only systems that are officially certified can use this name.

Unix-like operating systems work in the same way as UNIX but are not officially certified.

They follow the same ideas, commands, and system structure.

### Difference in short:

UNIX

- Official and certified
- Usually commercial
- Examples: AIX, HP-UX, Solaris

Unix-like

- Not certified
- Often free and open source
- Examples: Linux, macOS, FreeBSD

Unix-like systems behave like UNIX but are not UNIX.

- 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.

Using the UNIX timeline image and external English-language sources, the following individuals played major roles:

### Ken Thompson

- Co-creator of UNIX at Bell Labs
- Developed the original UNIX operating system
- Designed the first UNIX file system and shell

### Dennis Ritchie

- Co-creator of UNIX with Ken Thompson
- Creator of the “C programming language”
- C allowed UNIX to be portable across different hardware platforms

### Bill Joy

- Key developer of BSD (Berkeley Software Distribution)
- Contributed to tools like vi and TCP/IP networking
- BSD became the foundation for FreeBSD, OpenBSD, NetBSD, and macOS

### **Richard Stallman**

- Founder of the GNU Project
- Advocated for free software
- Created essential GNU tools (GCC, Bash, core utilities)
- GNU aimed to create a free UNIX-compatible system

### **Linus Torvalds**

- Creator of the Linux kernel
- Combined with GNU tools to form GNU/Linux
- Enabled the widespread use of free Unix-like operating systems
- These contributions are visible in the UNIX family tree shown in the assignment image

c) What is the philosophy of the GNU movement?

The GNU movement believes that software should be free.

Free means:

- You can use the software
- You can study how it works
- You can change it
- You can share it with others

The goal is to give users control over their computers.

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

Yes, Ubuntu mostly follows the GNU philosophy.

Ubuntu:

- Uses the Linux kernel
- Uses many GNU tools
- Is mostly open source

Ubuntu sometimes includes optional closed software, but the main system is free and open.

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

WSL allows users to run Linux on Windows.

With WSL you can:

- Use Linux commands
- Run Linux programs
- Work without a virtual machine

Windows stays the main system, Linux runs inside it.

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

Operating System	OS Family
Android	Unix-like (Linux)
iOS	Unix-like (BSD / Darwin)
ChromeOS	Unix-like (Linux)

### **Assignment 5.2: Supercomputers and game consoles**

- 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 used to solve very complex problems that normal computers cannot handle. They can process huge amounts of data at very high speed by using many processors at the same time. Supercomputers are often used for weather forecasting, climate simulations, scientific research, medical simulations, artificial intelligence, and space research. Because of their high performance, they are essential for tasks that require a lot of calculations in a short amount of time.

- 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 group of PlayStation 3 consoles connected together so they work as one powerful computer. This was possible because the PlayStation 3 used the Cell processor, which was very good at parallel processing. These clusters were used mainly for scientific and academic research, such as simulations and experiments at universities. IBM also used similar Cell processor technology in its Roadrunner supercomputer, which shows that hardware designed for gaming can also be used for serious computing tasks.

- 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 built a large computer cluster using many Raspberry Pi devices. The operating system running on this cluster is Linux, using a Linux distribution designed for Raspberry Pi hardware. Linux is used because it is stable, flexible, lightweight, and easy to adapt for cluster computing. For these reasons, Linux is very popular in servers and supercomputers.

- 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/>

Oracle's Raspberry Pi cluster does not appear in the TOP500 list of the fastest supercomputers in the world. This is logical because the TOP500 list focuses on extreme performance systems used for heavy scientific calculations. Raspberry Pi clusters are mainly built for learning, testing, and experimentation, not for maximum computing power. Therefore, they are not fast enough to compete with professional supercomputers on the TOP500 list.

- 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?

The PlayStation 5 and the Xbox Series X both use the x86-64 CPU architecture developed by AMD. This is the same type of architecture that is used in most modern personal computers. Because this architecture is widely used, it helps game developers create games more easily and efficiently.

Even though both consoles use the same CPU architecture, they run different operating systems. The PlayStation 5 runs a custom Unix-like operating system based on BSD, which is specially designed for Sony's console environment. The Xbox Series X runs a custom operating system based on the Windows NT kernel, developed by Microsoft and adapted for use on a gaming console.

From this, we can conclude that the same hardware can support different operating systems. Hardware and software are independent from each other, and companies can choose an operating system that best fits their goals, even when the underlying hardware is very similar.

## Assignment 5.3: Working with Windows

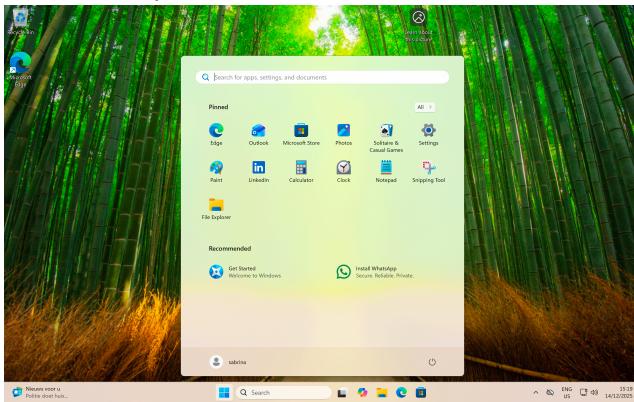
Take relevant screenshots of the assignments below

- 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.

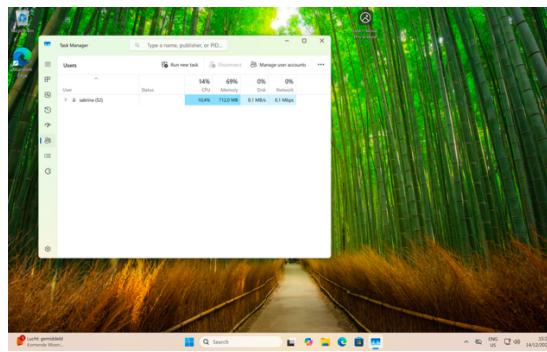
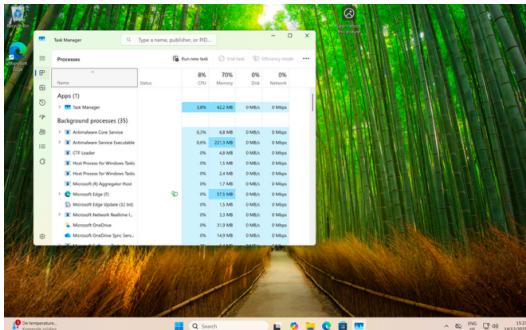
- b) The file explorer can be opened with **Windows** + E, Which key combination could you also use?:

**Windows** + number

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



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



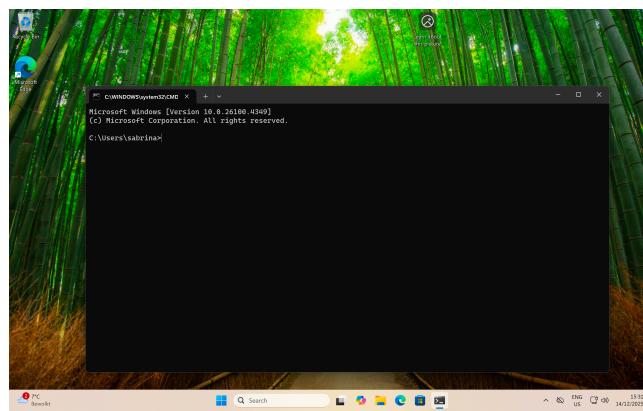
- e) If you're giving a PowerPoint presentation and you connect your laptop to a projector, Windows can use the projector as a second screen. For example, you may have Outlook open on your first screen that you don't show over the projector, while the PowerPoint presentation is displayed on the projector,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

❖ + 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?

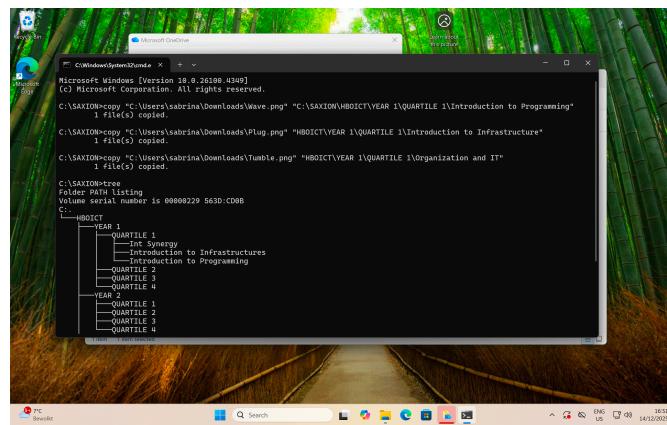
❖ + L

- 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.

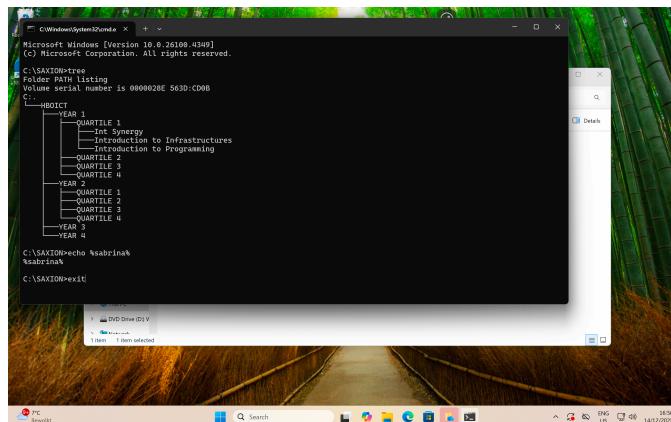


## Working in the File Explorer

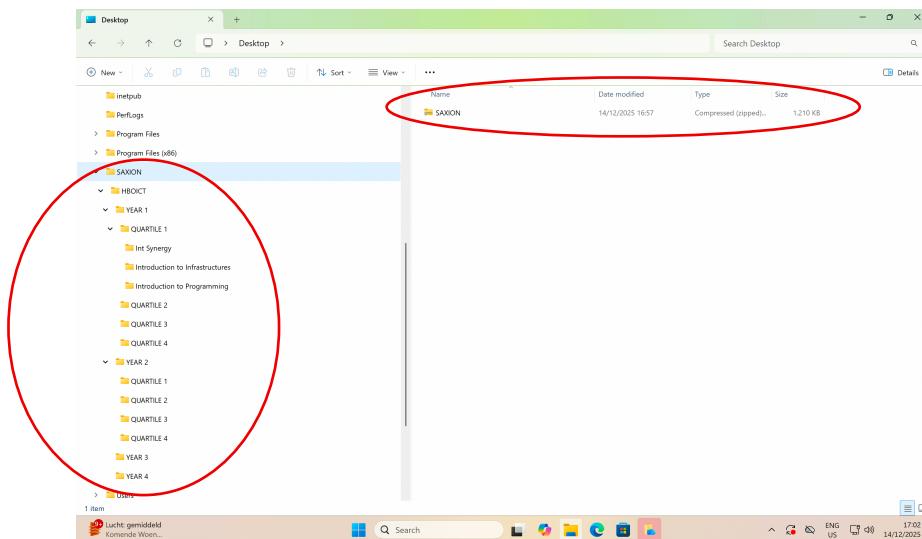
Relevant screenshots **copy** command:



Relevant screenshots tree command:

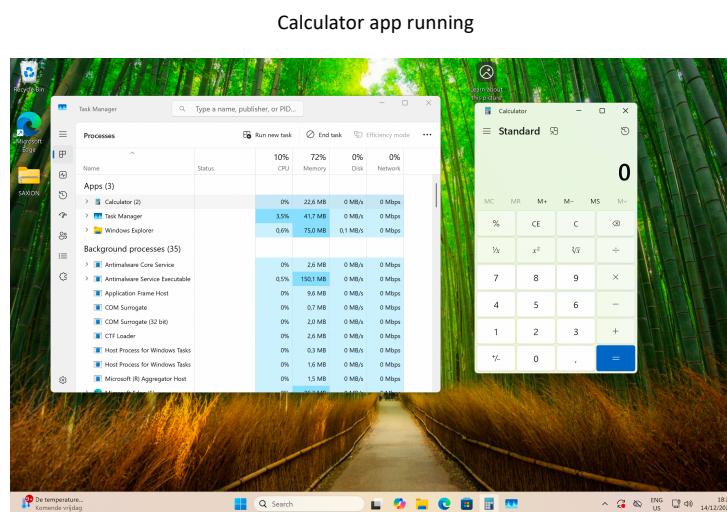


Relevant screenshots in the file explorer of the folder c:\Saxion + created zip file.

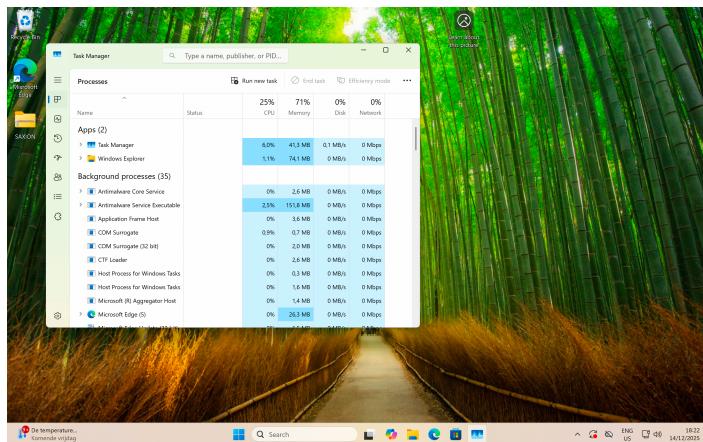


## Terminating Processes

Relevant Screenshots Task Manager Window:



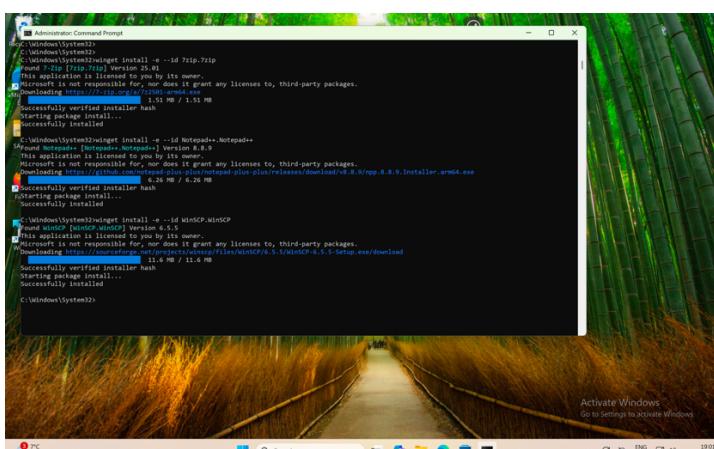
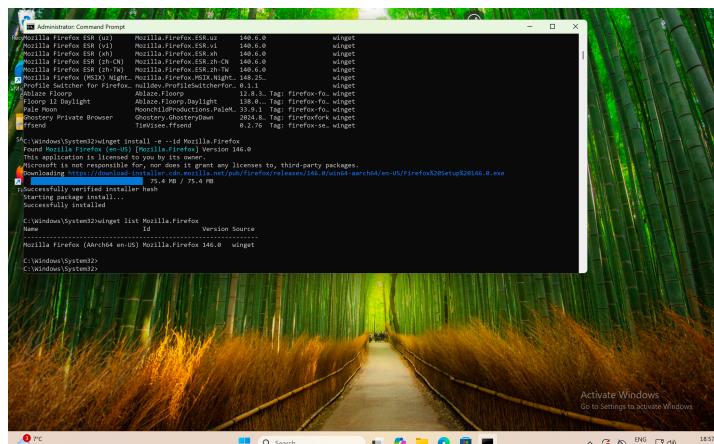
Task Manager after ending the Calculator application.



## Install Software

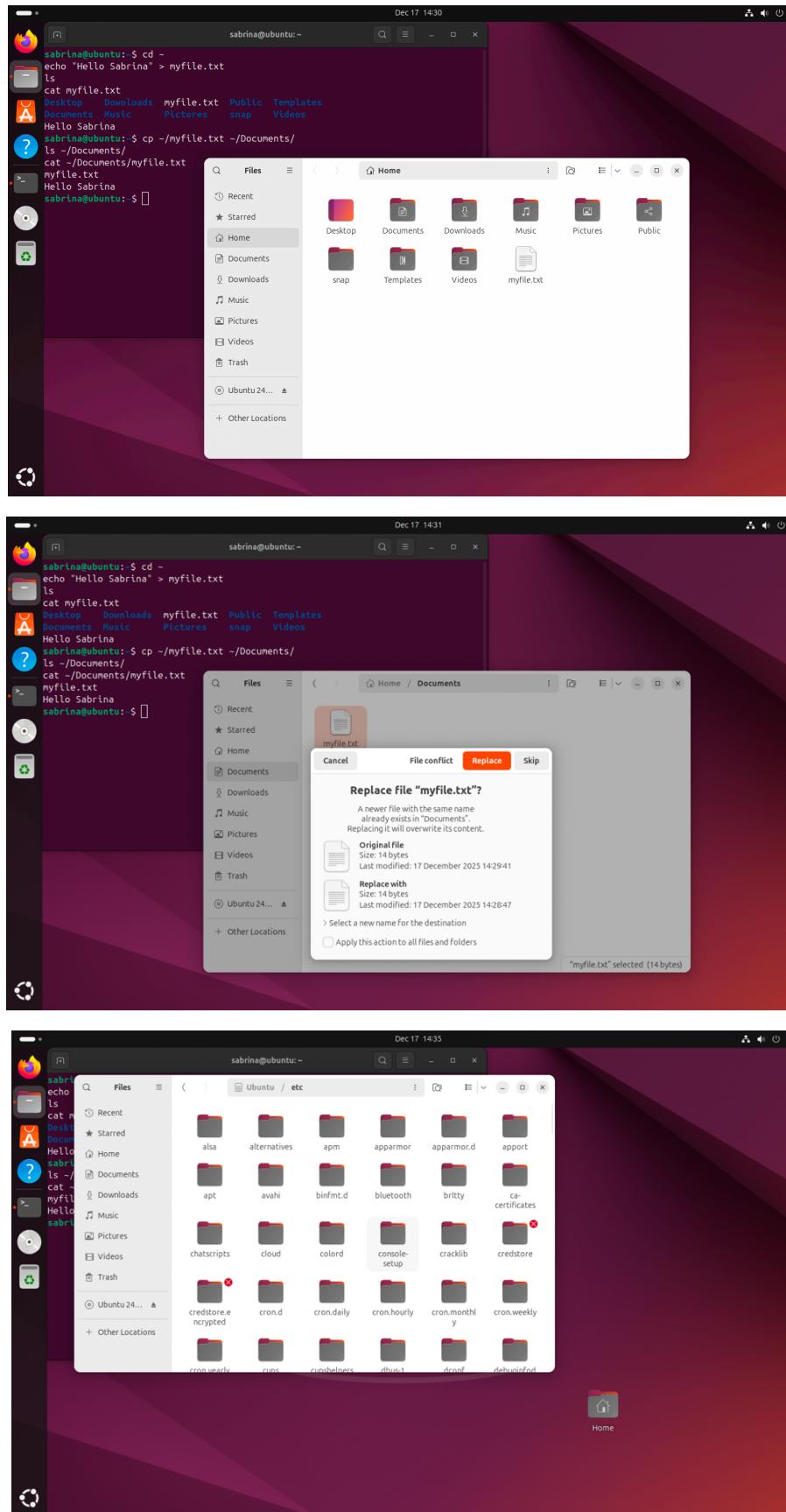
Relevant screenshots that the following software is installed with winget:

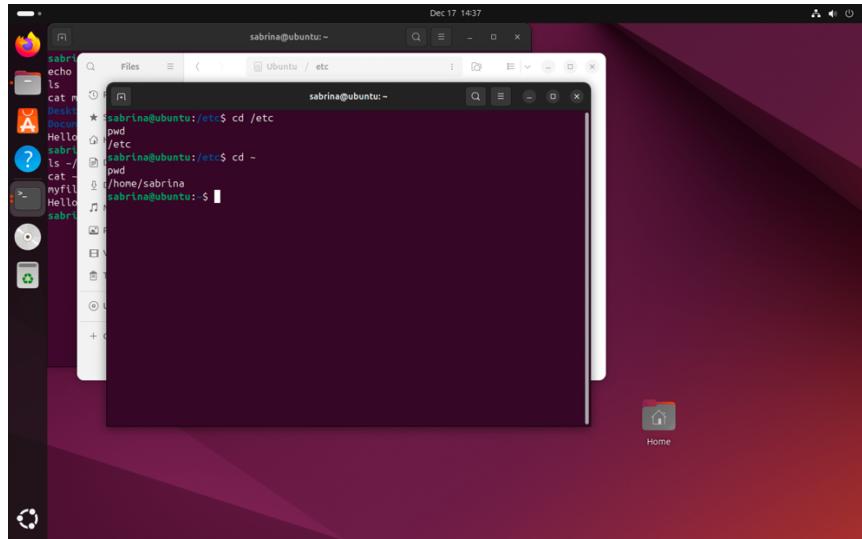
- WinSCP
  - Notepad++
  - 7zip



## Assignment 5.4: Working with Linux

## Relevant screenshots + motivation





- Name one significant difference in Linux's file structure when comparing it to Windows.  
Linux starts from one root folder **/**, Windows uses drive letters like **C:\**

- What is the **/etc** directory usually used for?

It usually stores system configuration files.

```

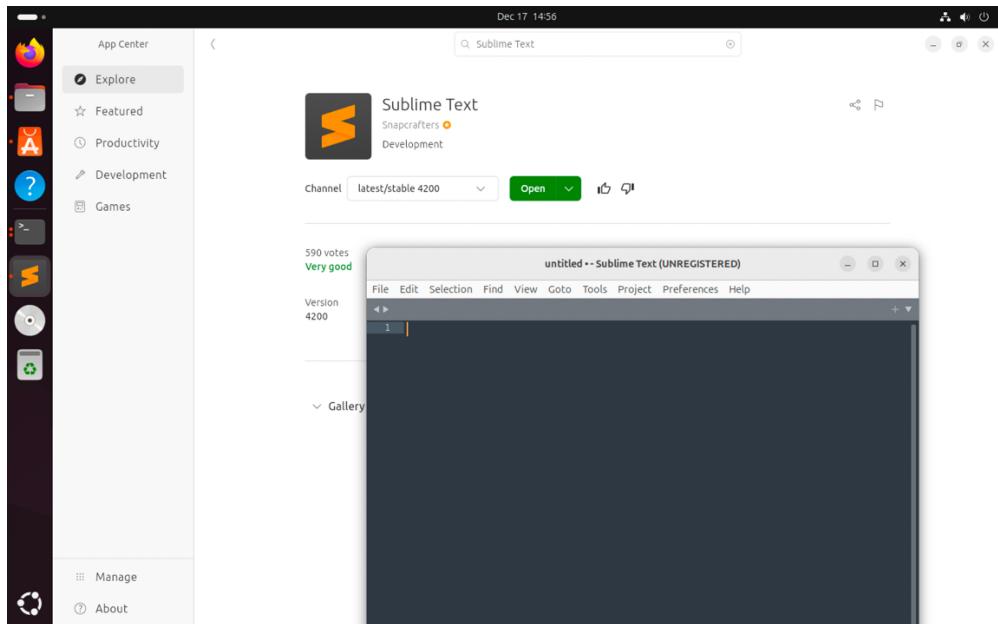
Dec 17 14:47
sabrina@ubuntu:~$ cd -
tar -cvf myfile.tar myfile.txt
ls -l myfile.tar
myfile.txt
-rw-rw-r-- 1 sabrina sabrina 10240 Dec 17 14:45 myfile.tar
myfile
sabrina@ubuntu:~$ tar -xvf myfile.tar
myfile.txt
sabrina@ubuntu:~$ tar -czvf myfile.tar.gz myfile.txt
ls -l myfile.tar.gz
myfile.txt
-rw-rw-r-- 1 sabrina sabrina 141 Dec 17 14:46 myfile.tar.gz
sabrina@ubuntu:~$ tar -xzvf myfile.tar.gz
myfile.txt
sabrina@ubuntu:~$ 

Dec 17 14:49
sabrina@ubuntu:~$ sudo apt update
[sudo] password for sabrina:
Hit:1 http://ports.ubuntu.com/ubuntu-ports noble InRelease
Hit:2 http://ports.ubuntu.com/ubuntu-ports noble-updates InRelease
Hit:3 http://ports.ubuntu.com/ubuntu-ports noble-backports InRelease
Hit:4 http://ports.ubuntu.com/ubuntu-ports noble-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
39 packages can be upgraded. Run 'apt list --upgradable' to see them.
[sudo] password for sabrina:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Suggested packages:
  lm-sensors
The following NEW packages will be installed:
  htop
0 upgraded, 1 newly installed, 0 to remove and 39 not upgraded.
Need to get 171 kB of additional disk space will be used.
After this operation, 455 kB of additional disk space will be used.
Get:1 http://ports.ubuntu.com/ubuntu-ports/noble/main arm64 htop arm64 3.3.0-4build1 [171 kB]
Fetched 171 kB in 1s (223 kB/s)
Selecting previously unselected package htop.
(Reading database ... 163888 files and directories currently installed.)
Preparing to unpack .../htop_3.3.0-4build1_arm64.deb ...
Unpacking htop (3.3.0-4build1) ...
Setting up htop (3.3.0-4build1) ...
Processing triggers for desktop-file-utils (0.27-2build1) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for gnome-menus (3.36.0-1.ubuntu3) ...
Processing triggers for man-db (2.12.0-4build2) ...
sabrina@ubuntu:~$ 

```

The screenshot shows the htop command-line interface running in a terminal window. The title bar indicates it's on a 'Ubuntu' system at 'Dec 17 14:50'. The interface displays a hierarchical tree of processes. At the top, it shows system statistics: 'Tasks: 118, 348 thr, 144 kthr; 1 running', 'Load average: 0.11 0.04 0.01', and 'Uptime: 00:24:35'. Below this is a table with columns: PID, USER, PRI, NI, VIRT, RES, SHR, %CPU, %MEM, TIME+, and Command. The table lists numerous processes, including system daemons like 'systemd', 'systemd-resolved', and 'systemd-timesyncd', as well as user applications like 'gnome-shell', 'htop', and various system tools. The bottom of the screen shows a series of function keys: F1 through F10.

- htop shows a real-time list of running processes on the system, including CPU usage, memory usage, and process details such as PID, user, and command. It allows monitoring and managing system processes interactively.



```

[sabrina@ubuntu:~] neofetch
[sabrina@ubuntu:~] ls -l
[sabrina@ubuntu:~] ./neofetch
[sabrina@ubuntu:~] 
```

- neofetch displays system information such as the operating system, kernel version, uptime, CPU, memory, and other hardware details, along with an ASCII logo of the Linux distribution.

### Assignment 5.5: Users and permissions on Linux

Relevant screenshots + motivation

```

[sabrina@ubuntu:~] mkdir -/hello
[sabrina@ubuntu:~] cd -/hello
[sabrina@ubuntu:-/hello] nano hello.sh
[sabrina@ubuntu:-/hello] cat hello.sh
#!/bin/bash
echo Hello Sabrina, $85303!

[sabrina@ubuntu:-/hello] chmod +x hello.sh
[sabrina@ubuntu:-/hello] ls -l hello.sh
-rwxrwxr-x 1 sabrina sabrina 42 Dec 17 15:13 hello.sh
[sabrina@ubuntu:-/hello] ./hello.sh
Hello Sabrina, 585303!
[sabrina@ubuntu:-/hello] chmod 744 hello.sh
[sabrina@ubuntu:-/hello] ls -l hello.sh
-rwxr--r-- 1 sabrina sabrina 42 Dec 17 15:13 hello.sh
[sabrina@ubuntu:-/hello] 
```

## Assignment 5.6: View the contents of files

Relevant screenshots + motivation

**cat**

Displays the entire contents of a file in the terminal.

**wc**

Counts the number of lines, words, and characters in a file.

**less**

Allows viewing a file page by page and scrolling up and down.

**head**

Shows the first lines of a file (by default the first 10 lines).

**tail**

Shows the last lines of a file (by default the last 10 lines).

**grep**

Searches for specific words or patterns inside a file.

The image consists of two vertically stacked screenshots of a Linux desktop environment, likely Ubuntu, showing a terminal window and a file manager window.

**Top Screenshot:** A terminal window titled "sabrina@ubuntu:" is open, showing the command "wget" being used to download a file from Project Gutenberg. The output shows the progress of the download, including the URL, file name, and download speed.

```
sabrina@ubuntu: ~ cd ~
sabrina@ubuntu: ~ wget https://www.gutenberg.org/files/1661/1661-0.txt -O SherlockHolmes.txt
--2025-12-17 18:18:48- https://www.gutenberg.org/files/1661/1661-0.txt
Resolving www.gutenberg.org (www.gutenberg.org)... 152.19.134.47
Connecting to www.gutenberg.org (www.gutenberg.org)|152.19.134.47|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 607504 (593K) [text/plain]
Saving to: 'SherlockHolmes.txt'

SherlockHolmes.txt 100%[=====] 593.27K 1.00MB/s   in 0.5s
2025-12-17 18:18:49 (1.00 MB/s) - 'SherlockHolmes.txt' saved [607504/607504]
```

A file manager window is visible in the background, showing a desktop with icons for Home, Desktop, hello, myfile.tar.gz, Public, Templates, Documents, Music, myfile.txt, SherlockHolmes.txt, Pictures, Videos, Downloads, and myfile.tar.

**Bottom Screenshot:** Another terminal window titled "sabrina@ubuntu:" is open, displaying the contents of the downloaded "SherlockHolmes.txt" file. The text includes information about Project Gutenberg's donation policies and a section about the originator of the project.

```
International donations are gratefully accepted, but we cannot make any statements concerning tax treatment of donations received from outside the United States. U.S. laws alone swamp our small staff.
Please check the Project Gutenberg web pages for current donation methods and addresses. Donations are accepted in a number of other ways including checks, online payments and credit card donations. To donate, please visit: www.gutenberg.org/donate.

Section 5. General Information About Project Gutenberg™ electronic works

Professor Michael S. Hart was the originator of the Project Gutenberg™ concept of a library of electronic works that could be freely shared with anyone. For forty years, he produced and distributed Project Gutenberg™ eBooks with only a loose network of volunteer support.

Project Gutenberg™ eBooks are often created from several printed editions, all of which are confirmed as not protected by copyright in the U.S. unless a copyright notice is included. Thus, we do not necessarily keep eBooks in compliance with any particular paper edition.

Most people start at our website which has the main PG search facility: www.gutenberg.org.

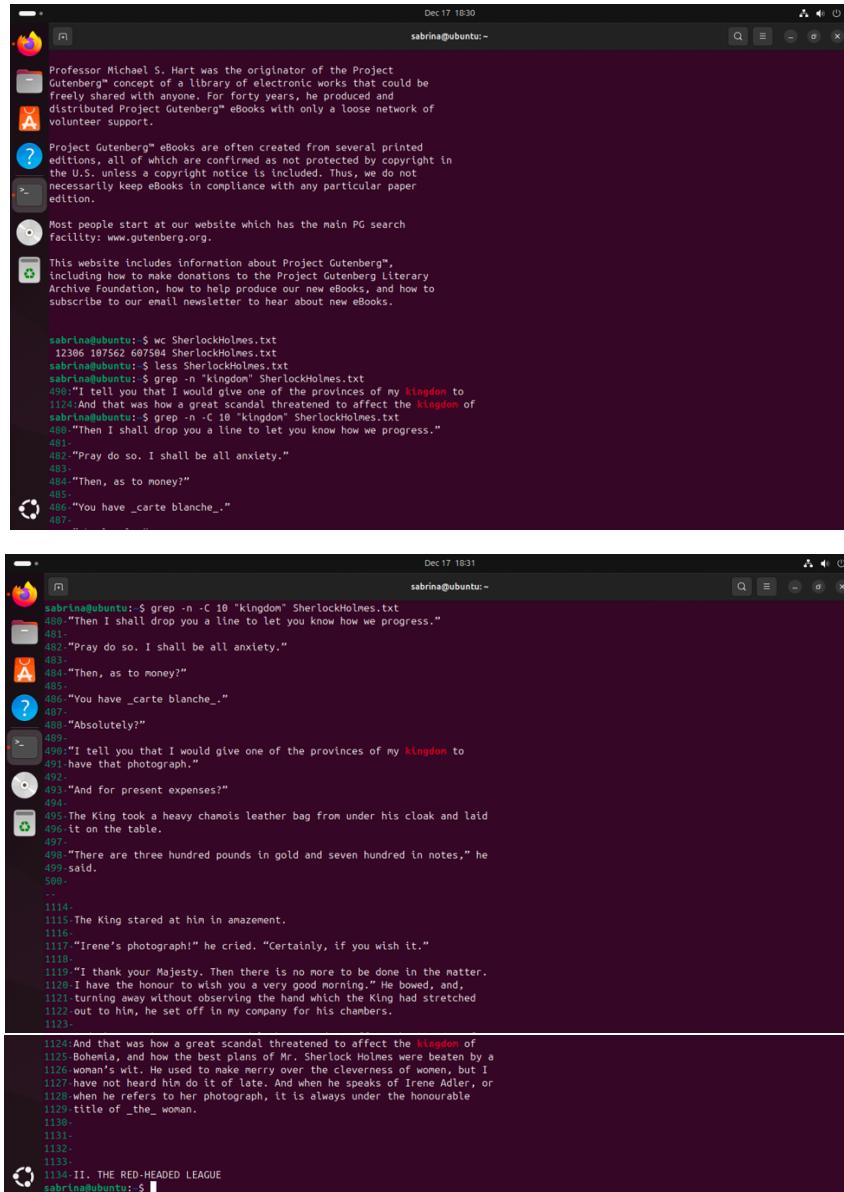
This website includes information about Project Gutenberg™, including how to make donations to the Project Gutenberg Literary Archive Foundation, how to help produce our new eBooks, and how to subscribe to our email newsletter to hear about new eBooks.
```

```
sabrina@ubuntu: ~ cat SherlockHolmes.txt
12386 107562 607504 SherlockHolmes.txt
sabrina@ubuntu: ~
```

Lines: 12306

Words: 107562

Characters: 607504



The image shows two screenshots of a terminal window on an Ubuntu system. The top screenshot displays the Project Gutenberg website's home page, featuring text about the originator of the Project Gutenberg concept and links to search and donation facilities. The bottom screenshot shows a command-line search for the word "Kingdom" in the Sherlock Holmes text file. The terminal output includes line numbers from 480 to 1134, the grep command, and the extracted text from the file.

```

Dec 17 18:30
sabrina@ubuntu:~$ 

Professor Michael S. Hart was the originator of the Project
Gutenberg™ concept of a library of electronic works that could be
freely shared with anyone. For forty years, he produced and
distributed Project Gutenberg™ eBooks with only a loose network of
volunteer support.

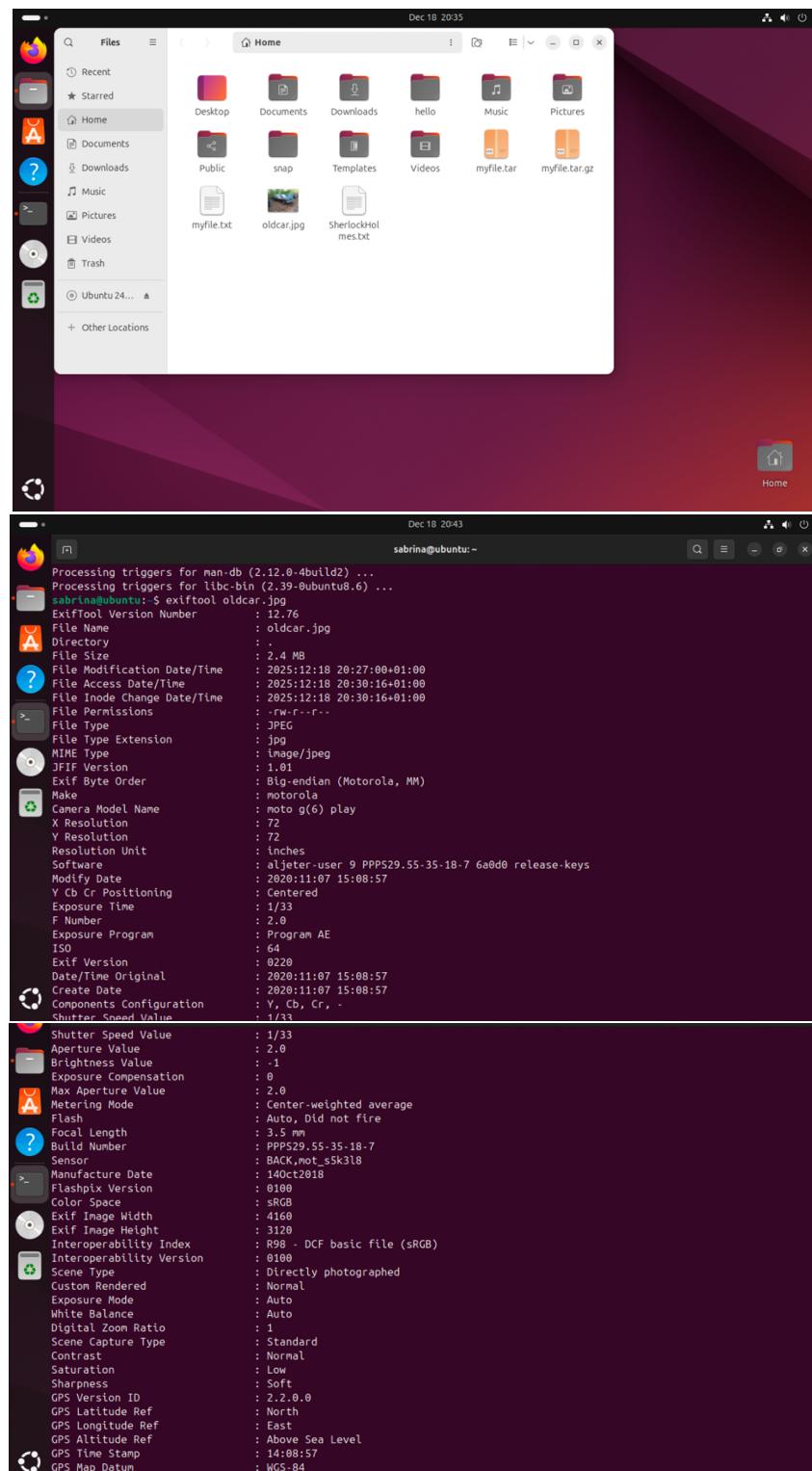
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the U.S. unless a copyright notice is included. Thus, we do not
necessarily keep eBooks in compliance with any particular paper
edition.

Most people start at our website which has the main PG search
facility: www.gutenberg.org.

This website includes information about Project Gutenberg™,
including how to make donations to the Project Gutenberg Literary
Archive Foundation, how to help produce our new eBooks, and how to
subscribe to our email newsletter to hear about new eBooks.

sabrina@ubuntu: ~$ wc SherlockHolmes.txt
12386 187562 607594 SherlockHolmes.txt
sabrina@ubuntu: ~$ less SherlockHolmes.txt
sabrina@ubuntu: ~$ grep -n -C 10 "Kingdom" SherlockHolmes.txt
480:"I tell you that I would give one of the provinces of my Kingdom to
481:And that was how a great scandal threatened to affect the Kingdom of
sabrina@ubuntu: ~$ grep -n -C 10 "Kingdom" SherlockHolmes.txt
480:"Then I shall drop you a line to let you know how we progress."
481:
482:"Pray do so. I shall be all anxiety."
483:
484:"Then, as to money?"
485:
486:"You have _carte blanche_."
487:
488:"Absolutely?"
489:
490:"I tell you that I would give one of the provinces of my Kingdom to
491:have that photograph."
492:
493:"And for present expenses?"
494:
495:The King took a heavy chamois leather bag from under his cloak and laid
496:it on the table.
497:
498:"There are three hundred pounds in gold and seven hundred in notes," he
499:said.
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## Assignment 5.7: Digital forensics



```

? 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 14:08:57Z
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

```

### Identify phone brand/type

Make: Motorola

Camera Model Name: moto g(6) play

The photo was taken with a Motorola Moto G(6) Play smartphone.

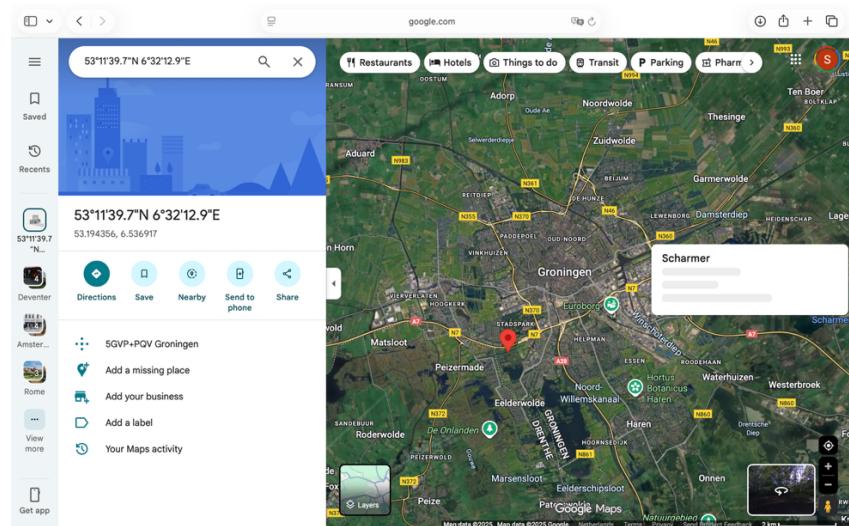
### Are there GPS coordinates known?

GPS Latitude : 53 deg 11' 39.68" N

GPS Longitude : 6 deg 32' 12.90" E

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

53°11'39.68"N, 6°32'12.90"E



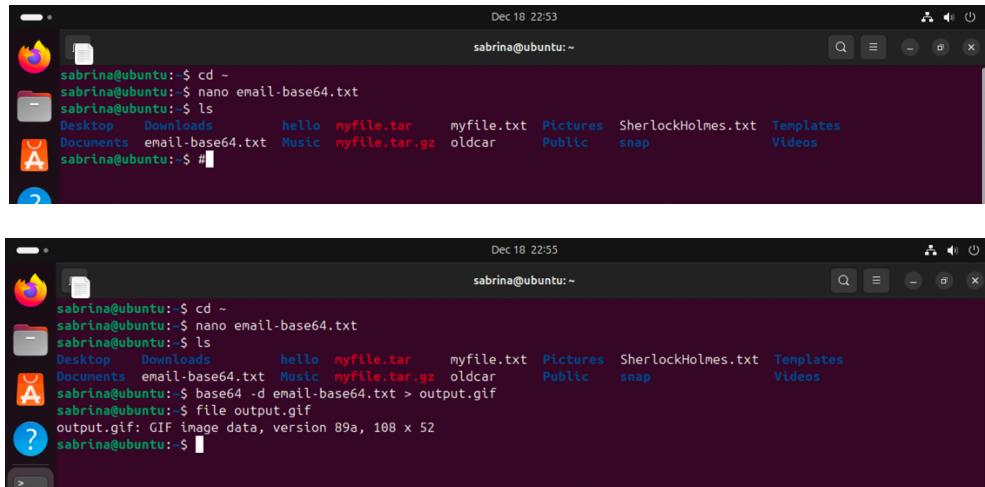
### In which city was this photo taken?

- City: Groningen
- Country: The Netherlands



### Does Ubuntu still consider it to be a JPG file?

Yes, Ubuntu still considers the file to be a JPEG image. Even though the file extension was removed, the file command shows that the file contains JPEG image data. Ubuntu determines the file type based on the file's internal structure (magic bytes), not the filename extension.



### BASE64 explanation

This is an encoding method used to represent binary data using readable ASCII characters. It is commonly used to send binary data such as images via e-mail.

### How the file was decoded

The data was decoded using the `base64 -d` command. The output was redirected to a file using the `>` operator and saved as a binary GIF image.

### Result

After decoding, the file was identified as a GIF image using the `file` command, confirming that the BASE64 data contained an image.

## Assignment 5.8: Steganography

The terminal window shows two sessions. The first session at 23:17 shows the output of the command `sabrina@ubuntu:~$ ls`, followed by `sabrina@ubuntu:~$ sudo apt update`. The second session at 23:18 shows the output of `sabrina@ubuntu:~$ steghide --help`.

```
Dec 18 23:17
sabrina@ubuntu:~$ ls
apple2.jpg  Documents  email-base64.txt  Music      myfile.tar.gz  oldcar    Pictures  SherlockHolmes.txt  Templates
Desktop   Downloads  hello        myfile.tar  myfile.txt    output.gif  Public     snap           Videos
sabrina@ubuntu:~$ sudo apt update
[sudo] password for sabrina:
0% [Working]
Hit:1 http://ports.ubuntu.com/ubuntu-ports noble InRelease
Get:2 http://ports.ubuntu.com/ubuntu-ports noble-updates InRelease [126 kB]
Get:3 http://ports.ubuntu.com/ubuntu-ports noble-backports InRelease [126 kB]
Get:4 http://ports.ubuntu.com/ubuntu-ports noble-security InRelease [126 kB]
Get:5 http://ports.ubuntu.com/ubuntu-ports noble-updates/main arm64 Components [172 kB]
Get:6 http://ports.ubuntu.com/ubuntu-ports noble-updates/restricted arm64 Components [212 kB]
Get:7 http://ports.ubuntu.com/ubuntu-ports noble-updates/universe arm64 Components [377 kB]
Get:8 http://ports.ubuntu.com/ubuntu-ports noble-updates/multiverse arm64 Components [212 kB]
Get:9 http://ports.ubuntu.com/ubuntu-ports noble-backports/main arm64 Components [3,580 kB]
Get:10 http://ports.ubuntu.com/ubuntu-ports noble-backports/restricted arm64 Components [216 kB]
Get:11 http://ports.ubuntu.com/ubuntu-ports noble-backports/universe arm64 Components [10.5 kB]
Get:12 http://ports.ubuntu.com/ubuntu-ports noble-backports/multiverse arm64 Components [212 kB]
Get:13 http://ports.ubuntu.com/ubuntu-ports noble-security/main arm64 Components [18.4 kB]
Get:14 http://ports.ubuntu.com/ubuntu-ports noble-security/restricted arm64 Components [212 kB]
Get:15 http://ports.ubuntu.com/ubuntu-ports noble-security/universe arm64 Components [71.4 kB]
Get:16 http://ports.ubuntu.com/ubuntu-ports noble-security/multiverse arm64 Components [212 kB]
Fetched 1,032 kB in 1s (1,447 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
39 packages can be upgraded. Run 'apt list --upgradable' to see them.
sabrina@ubuntu:~$ 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).
0 upgraded, 0 newly installed, 0 to remove and 39 not upgraded.

Dec 18 23:18
sabrina@ubuntu:~$ steghide --help
steghide version 0.5.1

the first argument must be one of the following:
embed, --embed      embed data
extract, --extract  extract data
info, --info        display information about a cover- or stego-file
encinfo, --encinfo  display information about <filename>
version, --version  display a list of supported encryption algorithms
license, --license  display steghide's license
help, --help         display this usage information

embedding options:
-ef, --embedfile    select file to be embedded
-ef <filename>      embed the file <filename>
-cf, --coverfile    select cover-file
-cf <filename>      embed into the file <filename>
-p, --passphrase    specify passphrase
-p <passphrase>    use <passphrase> to embed data
-sf, --stegofile    select stego file
-sf <filename>      write result to <filename> instead of cover-file
-e, --encryption    select encryption parameters
-e <a>[<m>][<n>]    specify an encryption algorithm and/or mode
-e none             do not encrypt data before embedding
-z, --compress      compress data before embedding (default)
-z <l>              using level <l> (1 best speed...9 best compression)
-Z, --dontcompress  do not compress data before embedding
-K, --nochecksum    do not embed crc32 checksum of embedded data
-N, --dontembedname do not embed the name of the original file
-f, --force          overwrite existing files

-q, --quiet          suppress information messages
-v, --verbose        display detailed information

extracting options:
-sf, --stegofile    select stego file
-sf <filename>      extract data from <filename>
-p, --passphrase    specify passphrase
-p <passphrase>    use <passphrase> to extract data
-xf, --extractfile  select file name for extracted data
-xf <filename>      write the extracted data to <filename>
-f, --force          overwrite existing files
-q, --quiet          suppress information messages
-v, --verbose        display detailed information

options for the info command:
-p, --passphrase    specify passphrase
-p <passphrase>    use <passphrase> to get info about embedded data

To embed emb.txt in cvr.jpg: steghide embed -cf cvr.jpg -ef emb.txt
To extract embedded data from stg.jpg: steghide extract -sf stg.jpg
sabrina@ubuntu:~$
```

```
Dec 18 23:22 sabrina@ubuntu:~  
-N, --dontembedname do not embed the name of the original file  
-f, --force overwrite existing files  
-q, --quiet suppress information messages  
-v, --verbose display detailed information  
  
extracting options:  
-sf, --stegofile select stego file  
-sf <filename> extract data from <filename>  
-p, --passphrase specify passphrase  
-p <passphrase> use <passphrases> to extract data  
-xf, --extractfile select file name for extracted data  
-xf <filename> write the extracted data to <filename>  
-f, --force overwrite existing files  
-q, --quiet suppress information messages  
-v, --verbose display detailed information  
  
options for the info command:  
-P, --passphrase specify passphrase  
-p <passphrase> use <passphrases> to get info about embedded data  
  
To embed emb.txt in cvr.jpg: steghide embed -cf cvr.jpg -ef emb.txt  
To extract embedded data from stg.jpg: steghide extract -sf stg.jpg  
sabrina@ubuntu: $ steghide extract -sf apple2.jpg  
Enter passphrase:  
wrote extracted data to "message.txt".  
sabrina@ubuntu: $ ls  
apple2.jpg  Downloads  message.txt  myfile.tar.gz  output.gif  SherlockHolmes.txt  Videos  
Desktop  email-base64.txt  Music  myfile.txt  Pictures  snap  
Documents  hello  myfile.tar  oldcar  Public  Templates
```

```
Dec 18 23:24 sabrina@ubuntu:~  
Hello class.  
You have almost completed Week 5.  
message.txt (END)
```

## 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.

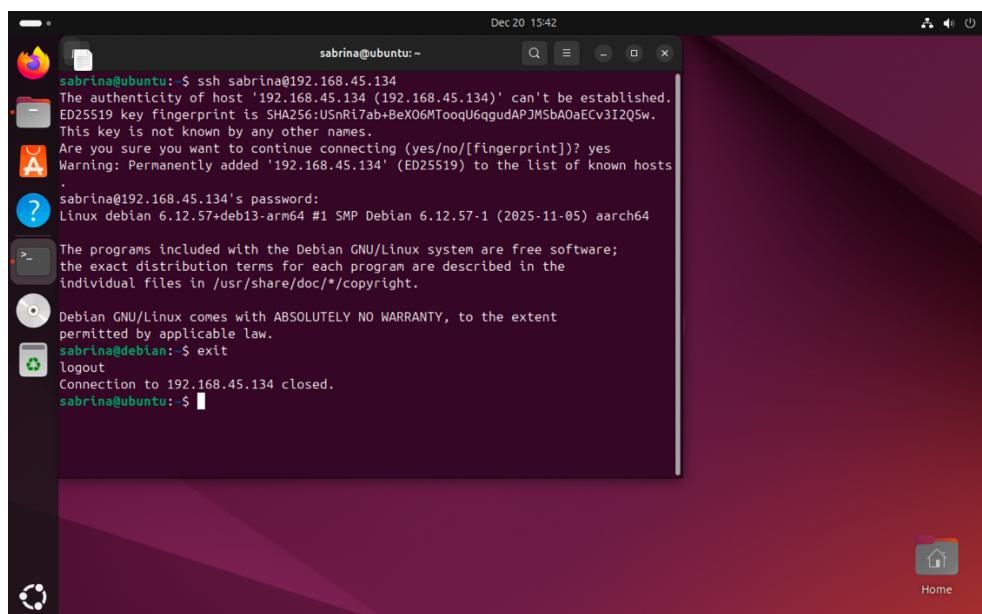
```
sabrina@debian:~$ sudo apt update
Hit:1 http://deb.debian.org/debian trixie InRelease
Hit:2 http://security.debian.org/debian-security trixie-security InRelease
Hit:3 http://deb.debian.org/debian trixie-updates InRelease
All packages are up to date.
sabrina@debian:~$ sudo apt install openssh-server -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
sabrina@debian:~$ 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
sabrina@debian:~$ systemctl status ssh -nomo-pager
● ssh.service - OpenBSD Secure Shell server
    Loaded: loaded (/usr/lib/systemd/system/ssh.service; enabled; preset: enabled)
      Active: active (running) since Sat 2025-12-20 14:07:12 CET; 10min ago
        Invocation: 5ae543fc0f894b0e94be536743a13022
          Docs: man:sshd(8)
                  man:sshd_config(5)
        Main PID: 852 (sshd)
          Tasks: 1 (limit: 2244)
         Memory: 2.4M (peak: 2.8M)
            CPU: 168ms
           CGrou...
             └─ 852 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Warning: some journal files were not opened due to insufficient permissions.
sabrina@debian:~$ sudo mkdir -p /srv/images
sabrina@debian:~$ sudo chown $USER:$USER /srv/images
sabrina@debian:~$ ls -ld /srv/images
drwxr-xr-x 2 sabrina sabrina 4096 Dec 20 14:26 /srv/images
sabrina@debian:~$
```

```
sabrina@debian:~$ 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 brd 0.0.0.0 scope host lo
    valid_lft forever preferred_lft forever
  inette.../128 scope host noprefixroute
    valid_lft forever preferred_lft forever
2: enp2s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
  link/ether 00:0c:29:13:fb:28 brd ff:ff:ff:ff:ff:ff
  altname enx00c2913fb28
  inet 192.168.45.134/24 brd 192.168.45.255 scope global dynamic noprefixroute enp2s0
    valid_lft 1795sec preferred_lft 1560sec
  inetc6 fe80::7ad:deb:cc30:3ac5%64 scope link
    valid_lft forever preferred_lft forever
sabrina@debian:~$
```

inet 192.168.45.134/24

DEBIAN SERVER IP = 192.168.45.134



```

sabrina@ubuntu:~$ lsblk
NAME    MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
loop0      7:0    0   4K  1 loop /snap/bare/5
loop1      7:1    0 59.6M  1 loop /snap/core20/2690
loop2      7:2    0 235.1M 1 loop /snap/firefox/7474
loop3      7:3    0 68.9M  1 loop /snap/core22/2164
loop4      7:4    0 493.6M 1 loop /snap/gnome-42-2204/228
loop5      7:5    0 91.7M  1 loop /snap/gtk-common-themes/1535
loop6      7:6    0 10M   1 loop /snap/snap-store/1271
loop7      7:7    0 44.3M  1 loop /snap/snapd/25585
loop8      7:8    0 552K  1 loop /snap/snapd-desktop-integration/316
loop9      7:9    0 64.4M  1 loop /snap/sublime-text/218
loop10     7:10   0 234.7M 1 loop /snap/firefox/7563
sr0       11:0   1  3.3G  0 rom  /media/sabrina/Ubuntu 24.04.3 LTS arm64
nvme0n1    259:0  0  64G  0 disk
└─nvme0n1p1 259:1  0  1G  0 part /boot/efi
└─nvme0n1p2 259:2  0 62.9G 0 part /
sabrina@ubuntu: $ sudo dd if=/dev/nvme0n1 bs=4M status=progress | gzip | ssh sabrina@192.168.45.134 "cat > /srv/images/ubuntu2404_vm.img.gz"
sabrina@192.168.45.134's password:
7260340224 bytes (7.3 GB, 6.8 GiB) copied, 59 s, 123 MB/s

sabrina@debian:~$ ls -lh /srv/images
total 2.3G
-rw-rw-r-- 1 sabrina sabrina 2.3G Dec 20 16:05 ubuntu2404_vm.img.gz
sabrina@debian:~$
```

```

sabrina@ubuntu:~$ lsblk
NAME    MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
loop2      7:2    0 235.1M 1 loop /snap/firefox/7474
loop3      7:3    0 68.9M  1 loop /snap/core22/2164
loop4      7:4    0 493.6M 1 loop /snap/gnome-42-2204/228
loop5      7:5    0 91.7M  1 loop /snap/gtk-common-themes/1535
loop6      7:6    0 10M   1 loop /snap/snap-store/1271
loop7      7:7    0 44.3M  1 loop /snap/snapd/25585
loop8      7:8    0 552K  1 loop /snap/snapd-desktop-integration/316
loop9      7:9    0 64.4M  1 loop /snap/sublime-text/218
loop10     7:10   0 234.7M 1 loop /snap/firefox/7563
sr0       11:0   1  3.3G  0 rom  /media/sabrina/Ubuntu 24.04.3 LTS arm64
nvme0n1    259:0  0  64G  0 disk
└─nvme0n1p1 259:1  0  1G  0 part /boot/efi
└─nvme0n1p2 259:2  0 62.9G 0 part /
sabrina@ubuntu: $ sudo dd if=/dev/nvme0n1 bs=4M status=progress | gzip | ssh sabrina@192.168.45.134 "cat > /srv/images/ubuntu2404_vm.img.gz"
sabrina@192.168.45.134's password:
68715282432 bytes (69 GB, 64 GiB) copied, 1149 s, 59.8 MB/s
16384+0 records in
16384+0 records out
68719476736 bytes (69 GB, 64 GiB) copied, 1149.04 s, 59.8 MB/s
sabrina@ubuntu: $
```

