Template Week 5 – Operating Systems

Student number: 578634

Assignment 5.1: Unix-like

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

Unix is an operating system, developed in the 1970s, known for its modular design, hierarchical file system and a command-line interface. It supports execution of multiple tasks/processes simultaneously. Unix-like systems are those that behave similarly to Unix (same design, interfaces, and tools) but do not use the original code or do not carry the official UNIX trademark, such as GNU/Linux, BSDs, and macOS.

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: Co-created the original Unix at Bell Labs in 1969 and wrote the first Unix kernel and many early tools, also co-designed the B programming language that led to C.
- Dennis Ritchie: Co-inventor of Unix with Thompson and creator of the C programming language, which made Unix portable and strongly influenced most later systems and languages.
- Bill Joy: Co-founder of Sun Microsystems, was a major developer of BSD Unix at Berkeley, and created the vi editor and the C shell, shaping many features of modern Unix systems.
- Richard Stallman: Founded the GNU Project and the Free Software Foundation, launched key free tools (such as the GNU compiler and utilities), and defined the Free Software/GNU philosophy.
- Linus Torvalds: Created the Linux kernel in 1991 and released it as free software, which, combined with GNU components, forms most GNU/Linux systems used today.

c) What is the philosophy of the GNU movement?

The main goal of the GNU philosophy is that the user must have freedom over the software they use by four freedoms: run the program for any purpose, study and change its source, redistribute copies, and distribute modified versions. The movement also focuses that these freedoms are an ethical requirement, so software serves users and communities rather than restricting them.

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

Ubuntu is built mainly from GNU and Linux components and is distributed under free and open-source licenses which grant the four freedoms, so in general it aligns with the GNU movement's software-freedom goals. However, Ubuntu's default installation has sometimes included proprietary drivers or optional non-free software, such as some firmware or codecs, which strict GNU advocates view as a partial departure from the pure GNU ideal of only free software.

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

Windows Subsystem for Linux (WSL) is a feature of the Windows Operating System that enables you to run a GNU/Linux environment directly on Windows without the overhead of a traditional virtual machine or dual-boot setup. WSL 1 used a compatibility layer to translate Linux system calls, while WSL 2 uses a lightweight virtual machine with a full Linux kernel for better compatibility and performance.

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

- Android: A mobile OS is an open-source OS, using the Linux kernel, developed by Google, and targeting touch devices, so it falls under the category of Linux/Unix-like operating systems.
- iOS: Apple's mobile operating system built upon the Darwin foundation which in turn is derived from BSD Unix and other technologies, placing it in the Unix-like/BSD family.
- ChromeOS: Developed by Google, it is a Linux-based operating system whose main interface is the Chrome browser; therefore, it falls under the category of Linux/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

Supercomputers solve very large and complex problems that would take normal computers an inordinate amount of time. On the Computer History Museum timeline, supercomputers are repeatedly linked to tasks such as simulating nuclear reactions, modeling the Earth's climate, and supporting advanced aerospace and weapons research. They are also used for scientific simulations in physics, chemistry, and astronomy, for example to study fluid dynamics, materials, and the behaviour of galaxies. Over time, the museum's entries show supercomputers being applied to weather prediction, cryptography, and large-scale data analysis as computing power increases.

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?

The PlayStation 3 cluster is a high-performance computing cluster that is developed by connecting many PS3 consoles in a distributed system, thereby exploiting the parallelism in the Cell processor at low cost.
These types of clusters have been used in various research and government projects for scientific computation, gravity research grids, and in the case of the U.S. Air Force "Condor Cluster, for pattern recognition, satellite image processing, and radar enhancement.

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's 1,050-node Raspberry Pi supercomputer boots all the Pis over the network from a central x86 server using Oracle Linux for ARM instead of the default Raspberry Pi OS/Raspbian. A single network-boot image simplifies deployment, updates, and management across the cluster.

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 “supercomputer” is not among the TOP500 list of the 500 fastest supercomputers in the world. It is an educational or demonstration cluster of about a thousand Raspberry Pi computers, not for supercomputing performance. All Raspberry Pi computers in this cluster have minimal floating-point capability relative to the computers found in current supercomputers. TOP500-listed supercomputers are ranked for their Linpack performance, which is tens of petaflops to multi exaflops levels nowadays, many orders of magnitude more powerful than a Raspberry Pi supercomputer could ever hope to be. Additionally, it does not appear that there is any record of Oracle or Raspberry Pi contributing their Linpack performance to the TOP500 list, so both points logically indicate that it is not on the 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?

PlayStation 5 and Xbox Series X both are powered by custom AMD system-on-chips, with an 8-core Zen 2 CPU combined in a chip with RDNA 2-based GPUs. PS5 runs Sony's custom PlayStation 5 system software, which is a proprietary OS derived from earlier PlayStation OS designs, while Xbox Series X runs Microsoft's Xbox system software, based on a customized Windows/Hyper-V-based environment.

There is a clear takeaway from this: the modern console has converged on very similar PC-like AMD architectures and OS stacks, much closer to specialized gaming PCs than the exotic architectures such as Cell used in earlier generations, which makes them easier to target for game and potentially HPC-style workloads.

Assignment 5.3: Working with Windows

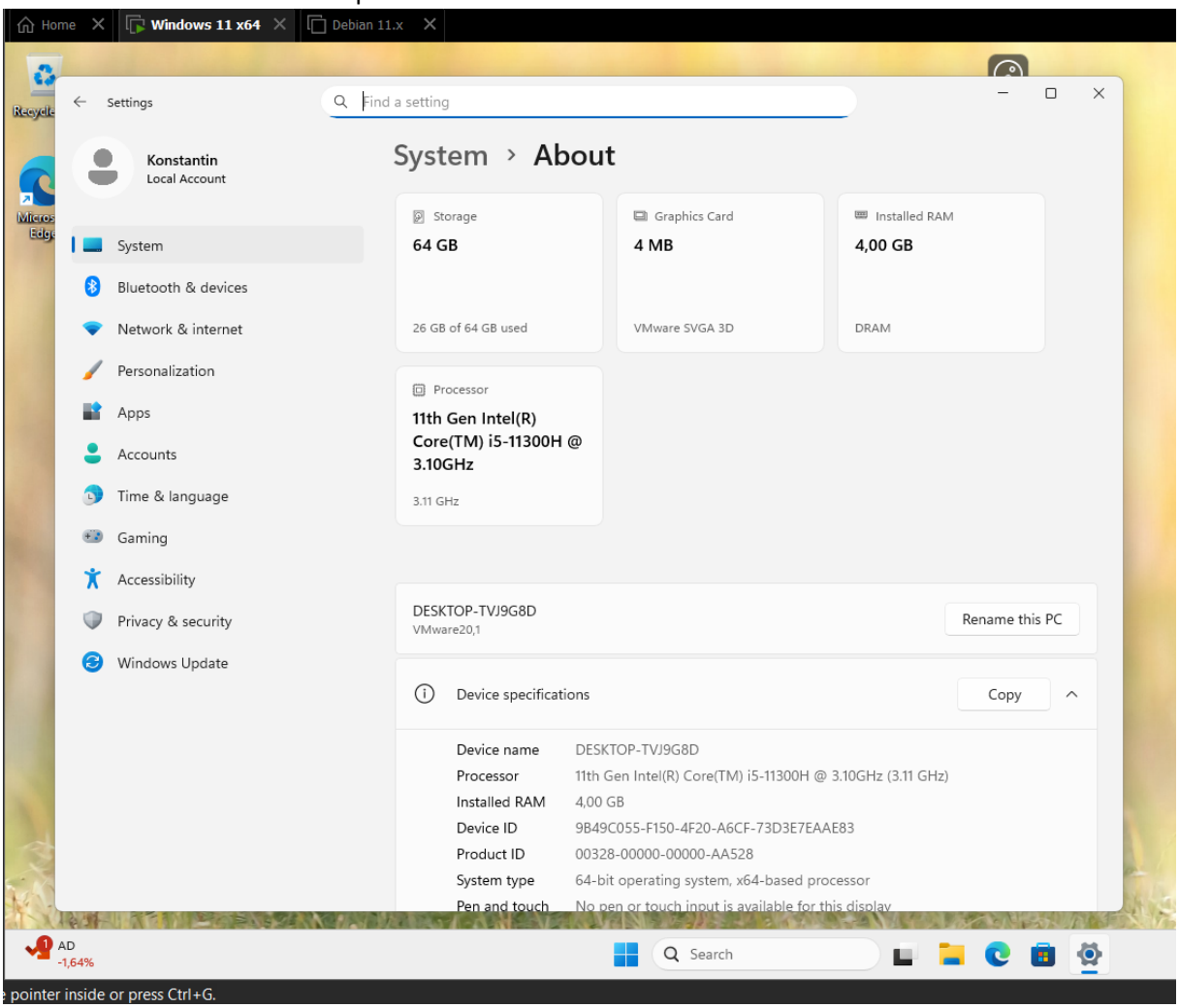
Take relevant screenshots of the assignments below

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

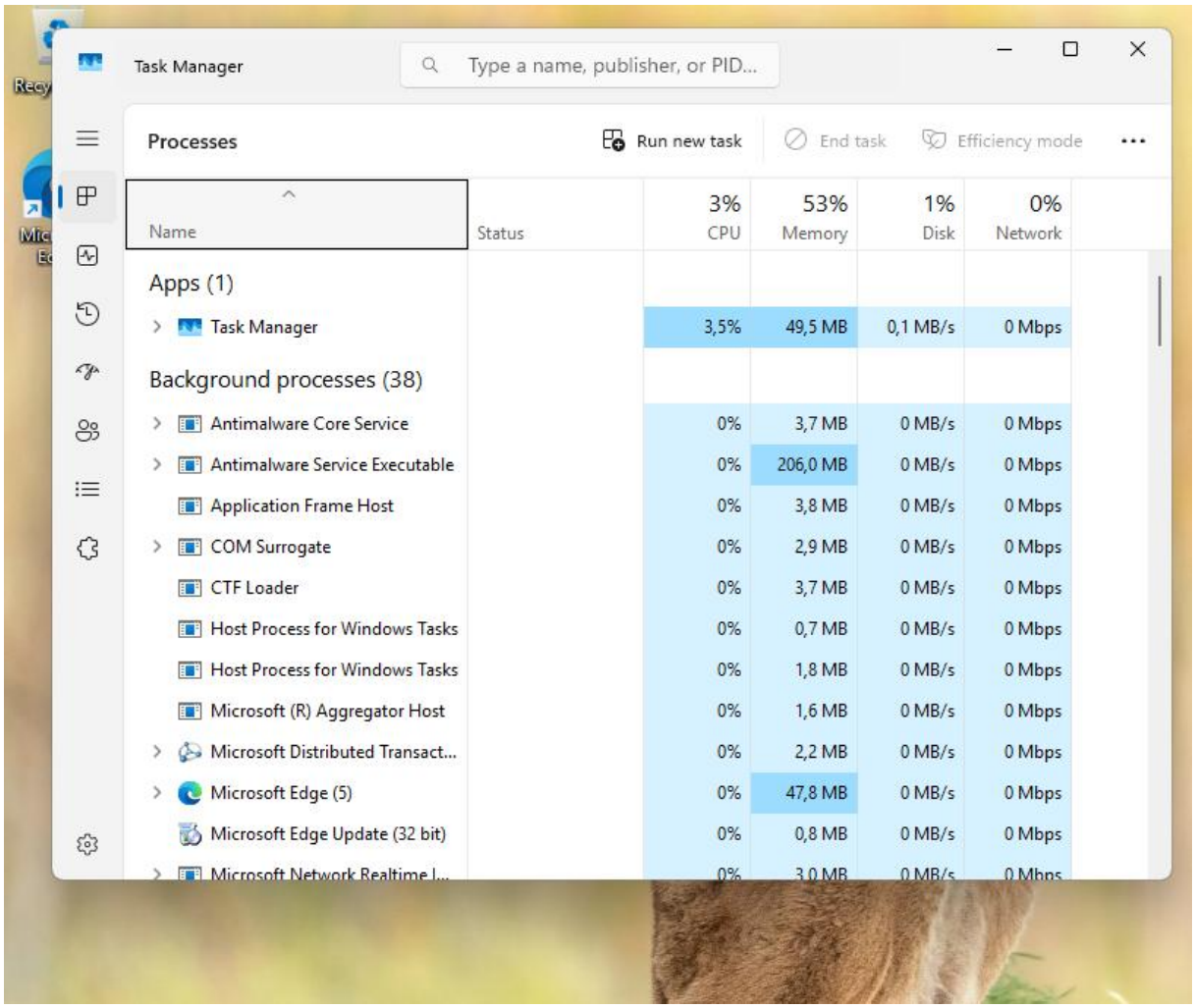
b) The file explorer can be opened with W + E, Which key combination could you also use?

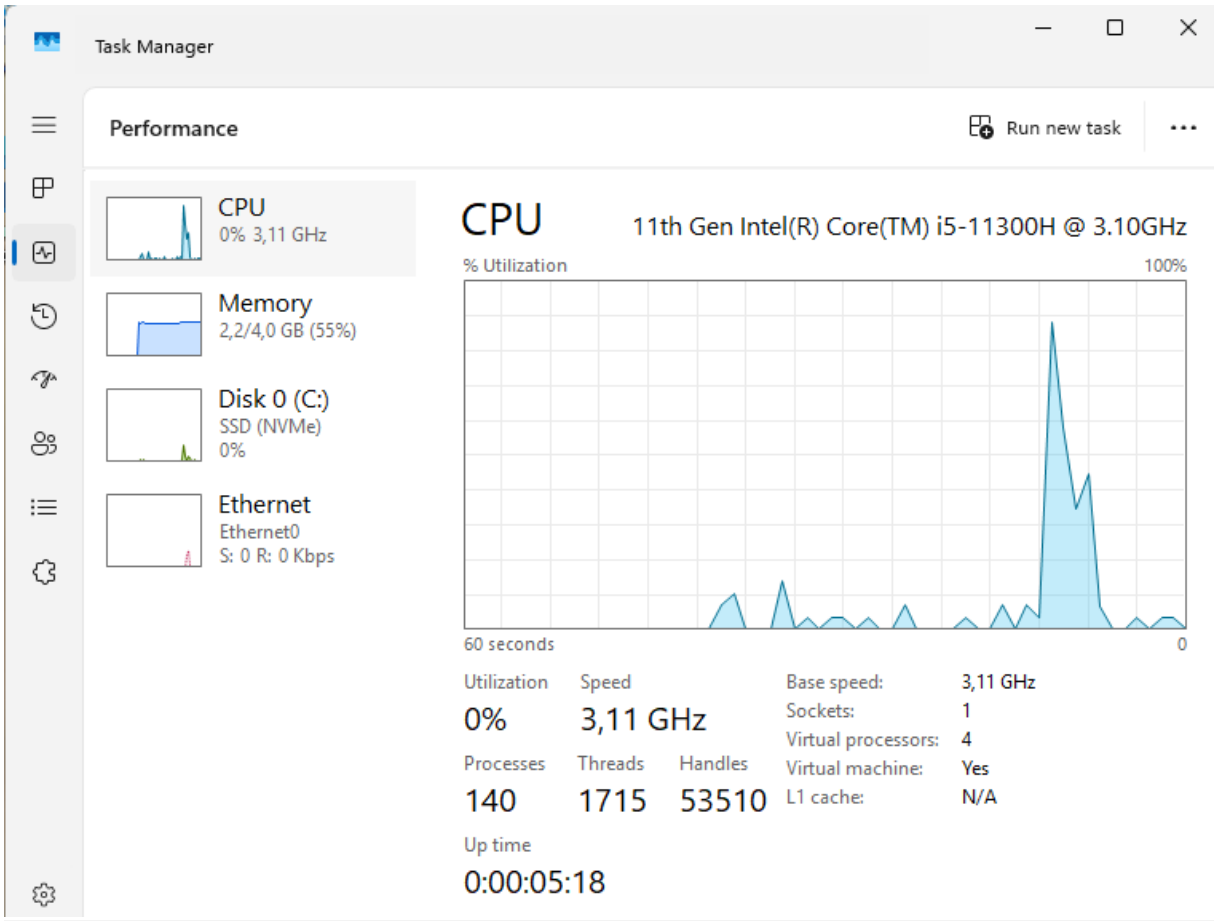
- CTRL + ESC to open the start panel and there to type “file explorer” and press Enter.

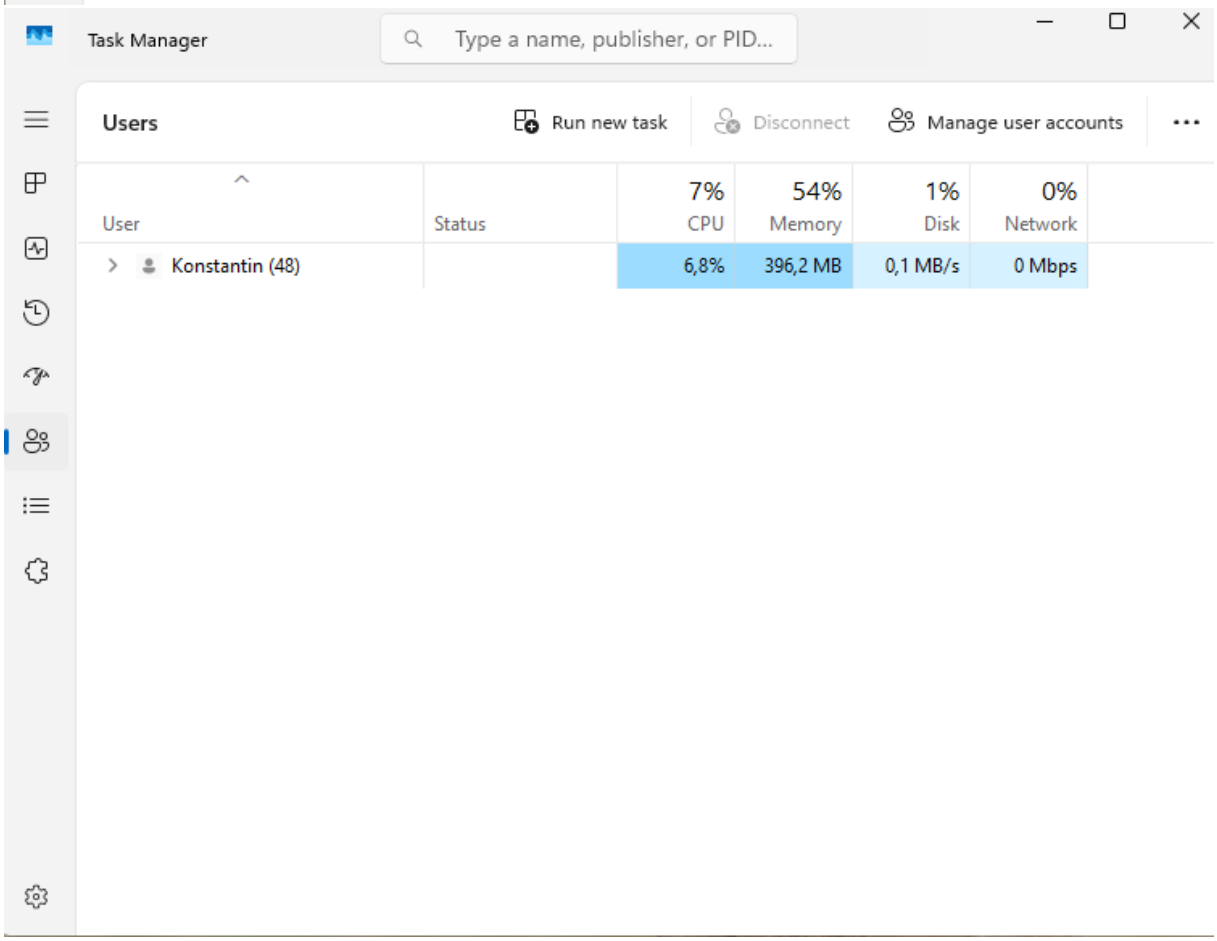
c) Open the system properties with a W key combination, take a screenshot of the open screen. Paste this screenshot into this template.

- 

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.


Task Manager
Type a name, publisher, or PID...
Processes
Run new task
End task
Efficiency mode
Name
Status
3%
CPU
53%
Memory
1%
Disk
0%
Network
Apps (1)
Task Manager
3,5%
49,5 MB
0,1 MB/s
0 Mbps
Background processes (38)
Antimalware Core Service
0%
3,7 MB
0 MB/s
0 Mbps
Antimalware Service Executable
0%
206,0 MB
0 MB/s
0 Mbps
Application Frame Host
0%
3,8 MB
0 MB/s
0 Mbps
COM Surrogate
0%
2,9 MB
0 MB/s
0 Mbps
CTF Loader
0%
3,7 MB
0 MB/s
0 Mbps
Host Process for Windows Tasks
0%
0,7 MB
0 MB/s
0 Mbps
Host Process for Windows Tasks
0%
1,8 MB
0 MB/s
0 Mbps
Microsoft (R) Aggregator Host
0%
1,6 MB
0 MB/s
0 Mbps
Microsoft Distributed Transact...
0%
2,2 MB
0 MB/s
0 Mbps
Microsoft Edge (5)
0%
47,8 MB
0 MB/s
0 Mbps
Microsoft Edge Update (32 bit)
0%
0,8 MB
0 MB/s
0 Mbps

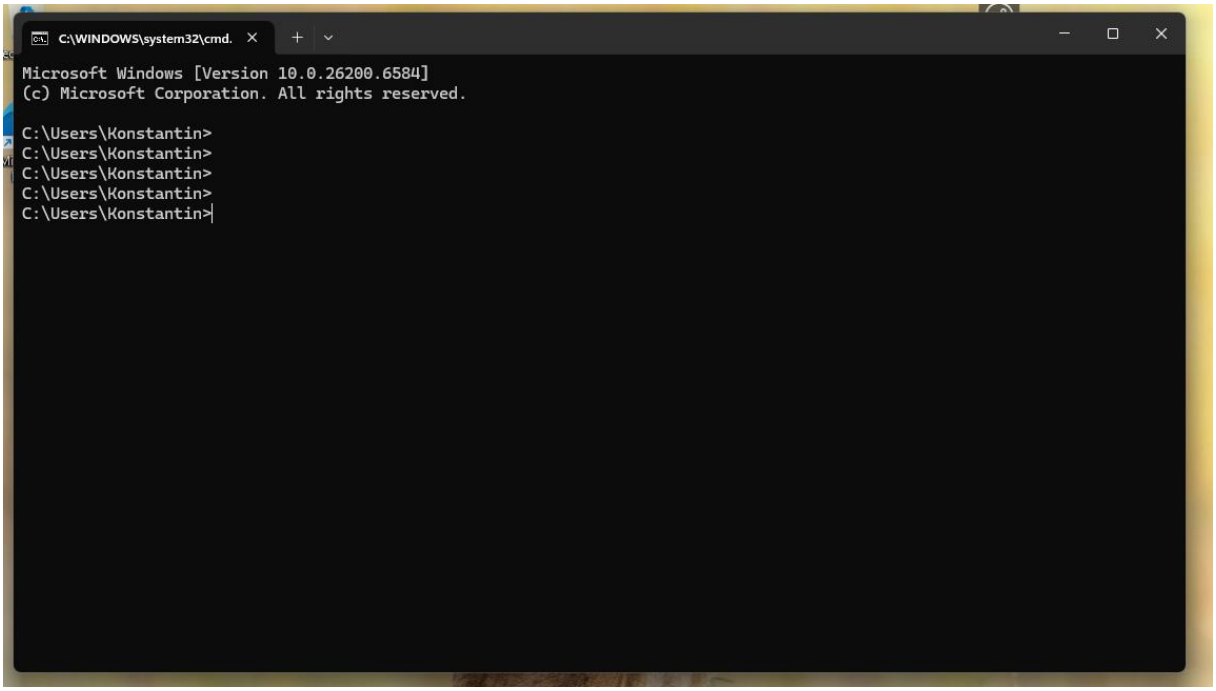

Task Manager
Performance
Run new task
CPU
0% 3,11 GHz
Memory
2,2/4,0 GB (55%)
Disk 0 (C:)
SSD (NVMe)
0%
Ethernet
Ethernet0
S: 0 R: 0 Kbps
CPU
11th Gen Intel(R) Core(TM) i5-11300H @ 3.10GHz
% Utilization
100%
60 seconds
0
Utilization
0%
Speed
3,11 GHz
Processes
140
Threads
1715
Handles
53510
Up time
0:00:05:18
Base speed: 3,11 GHz
Sockets: 1
Virtual processors: 4
Virtual machine: Yes
L1 cache: N/A


Task Manager
Type a name, publisher, or PID...
Users
Run new task
Disconnect
Manage user accounts
User
Status
7%
CPU
54%
Memory
1%
Disk
0%
Network
Konstantin (48)
6,8%
396,2 MB
0,1 MB/s
0 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 -> Select the option “Extend”

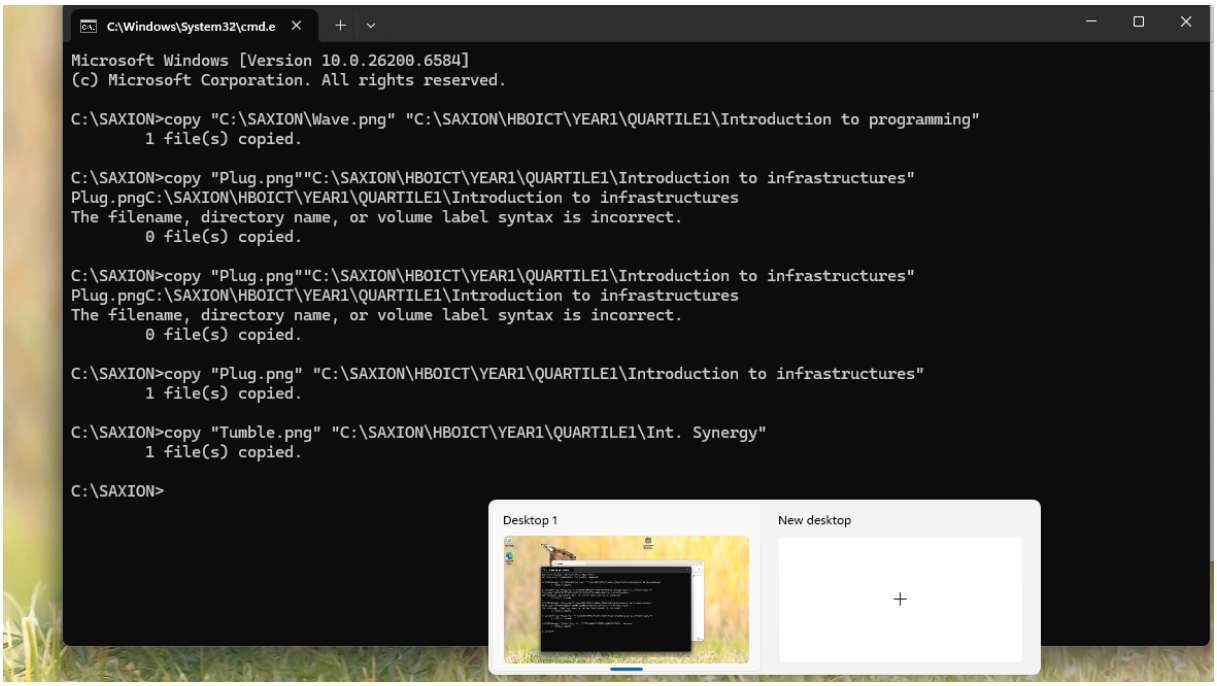
f) If you leave the classroom for a while and you leave your laptop behind, it is wise to lock the screen. Your Apps will continue to run in the background. So, for example, if you're waiting for a download that takes a while, lock the screen and get a cup of coffee. Which key combination do you use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

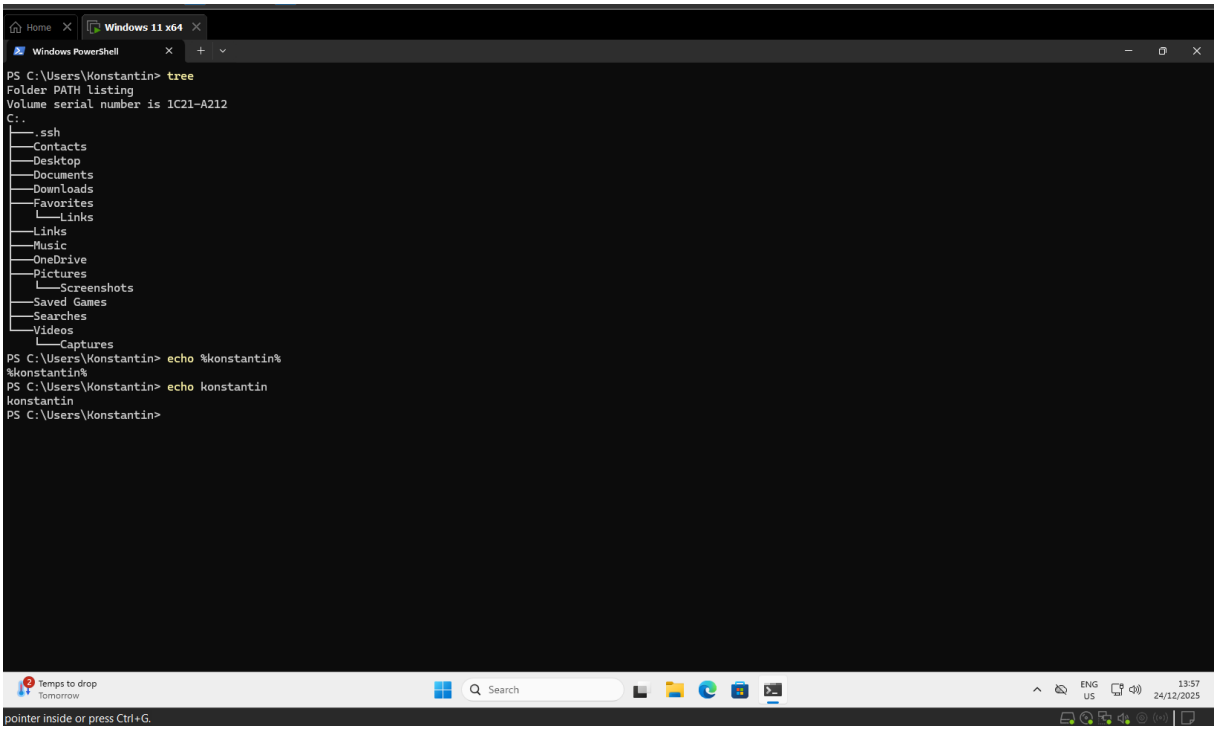


Working in the File Explorer

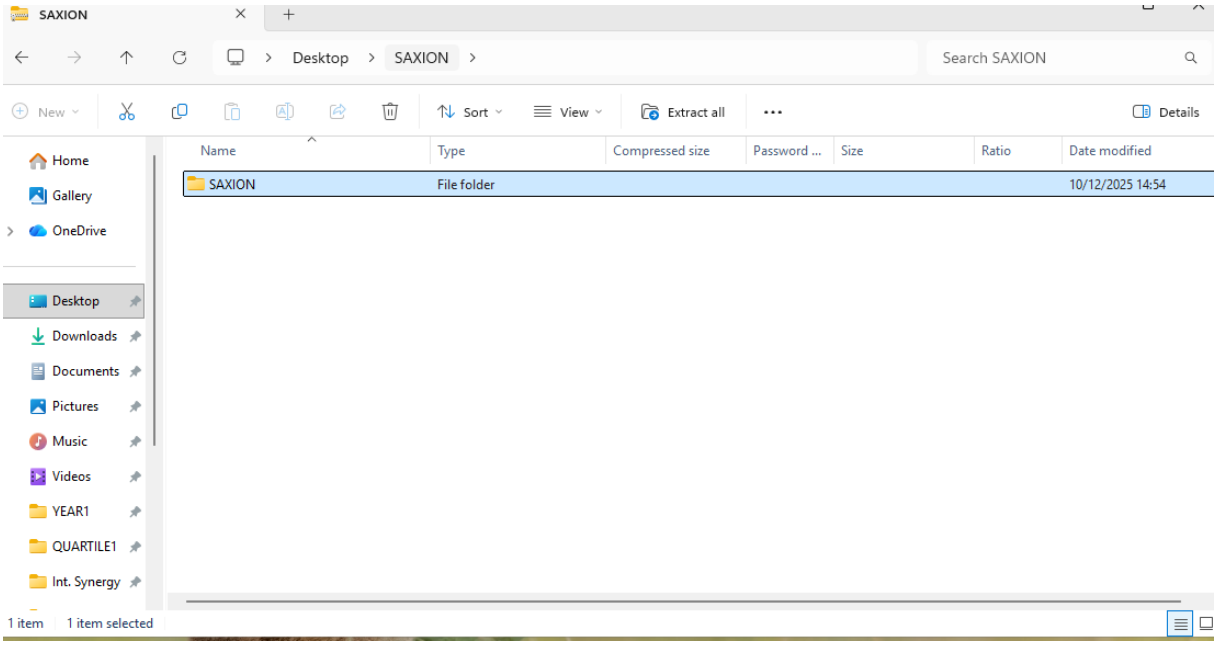
Relevant screenshots **copy** command:

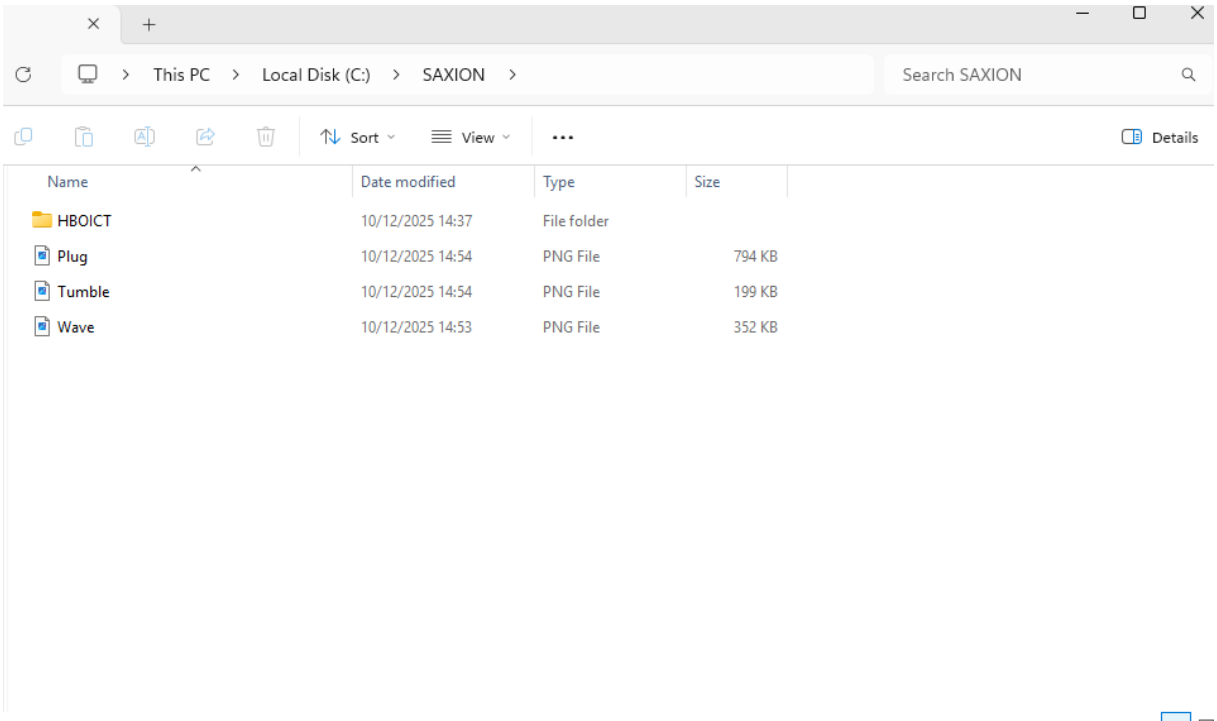


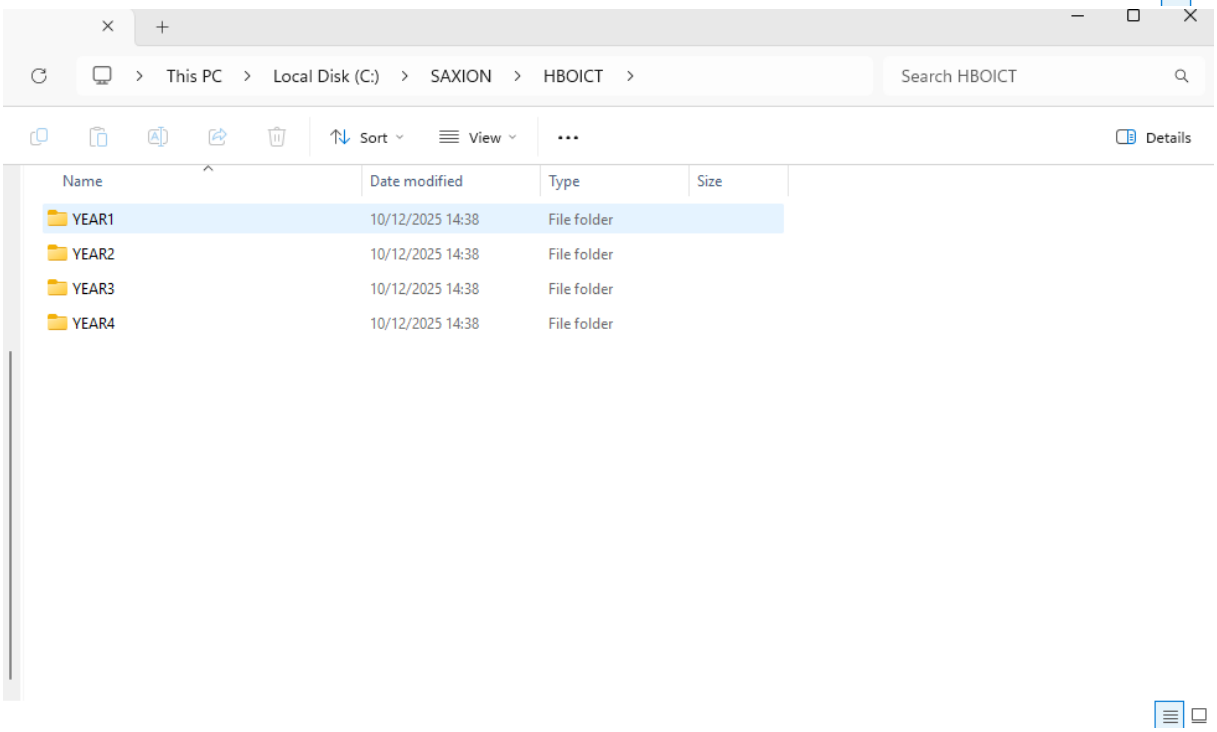
Relevant screenshots **tree** command:

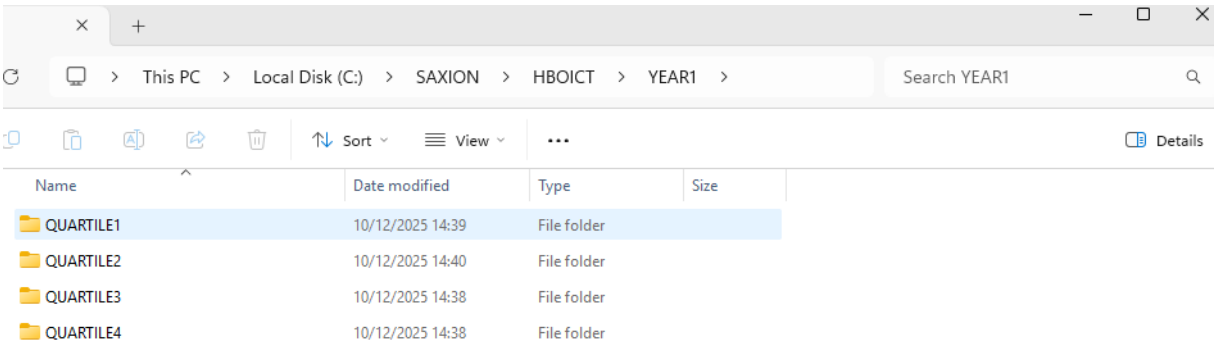


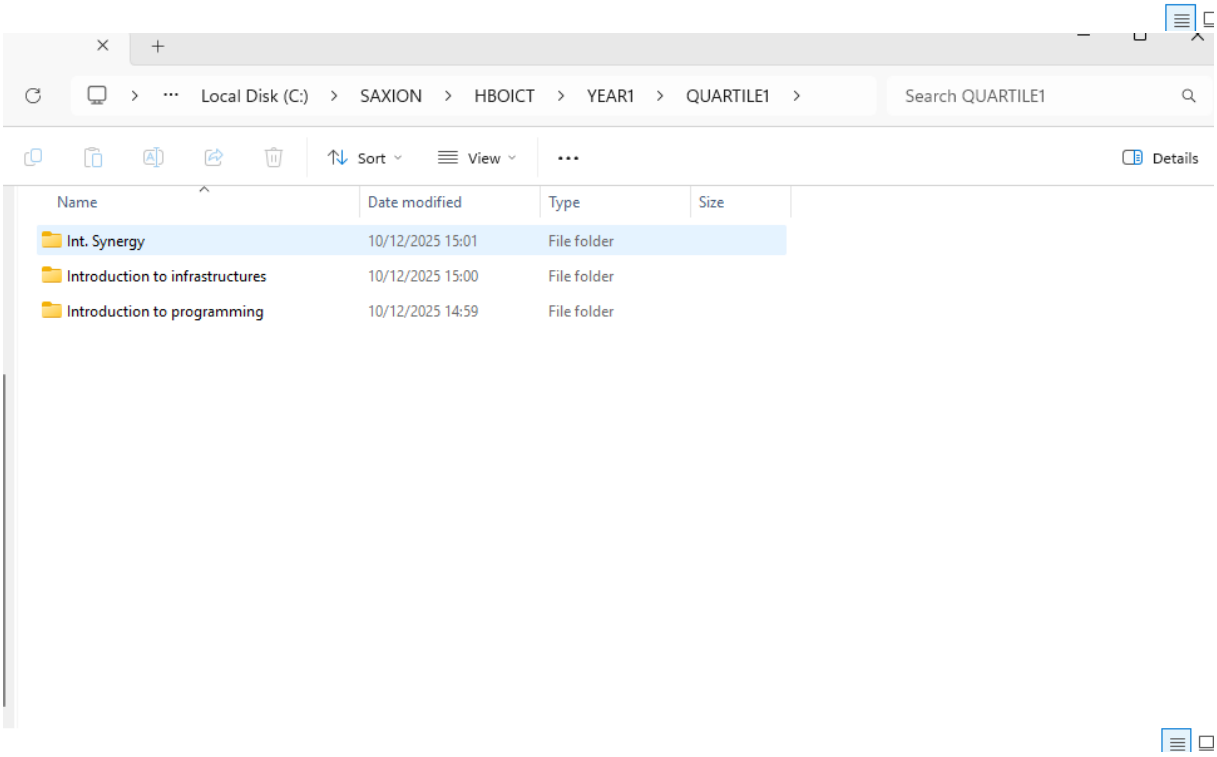
Relevant screenshots in the file explorer of the folder c:\Saxion + created zip file.

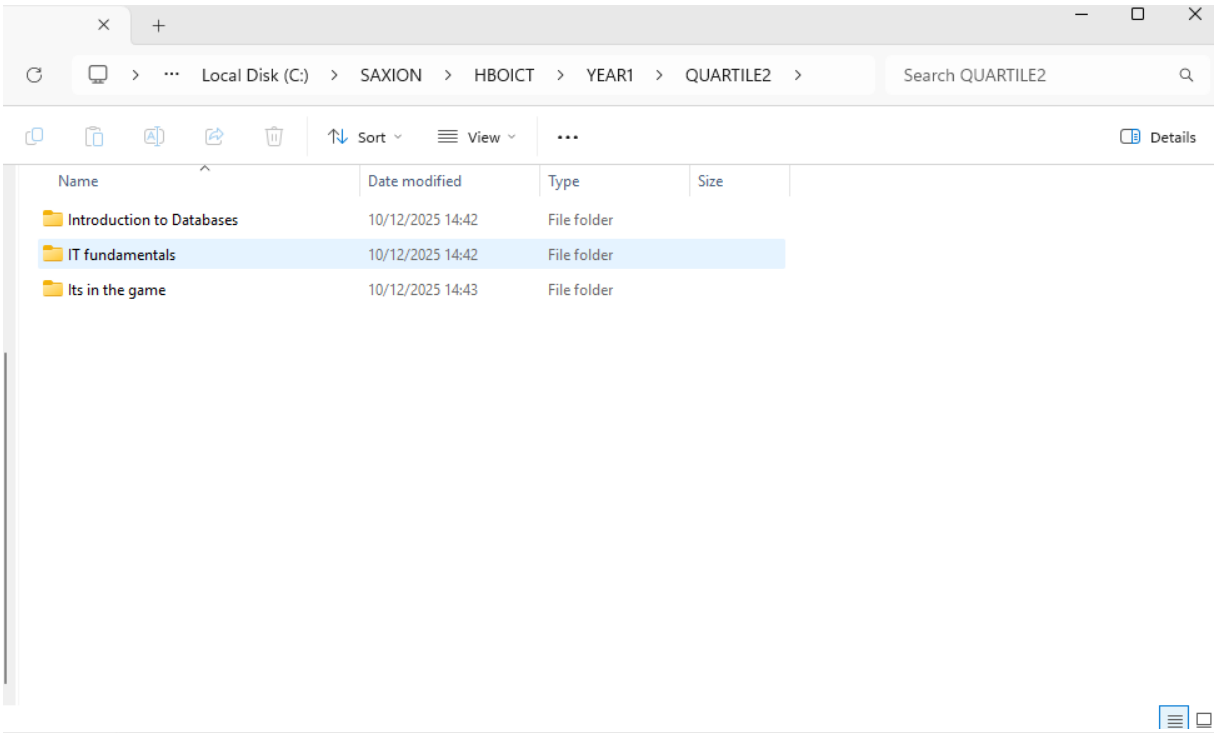

SAXION
Desktop
SAXION
Search SAXION
New
Sort
View
Extract all
Details
Home
Gallery
OneDrive
Desktop
Downloads
Documents
Pictures
Music
Videos
YEAR1
QUARTILE1
Int. Synergy
Name
Type
Compressed size
Password ...
Size
Ratio
Date modified
SAXION
File folder
10/12/2025 14:54
1 item
1 item selected

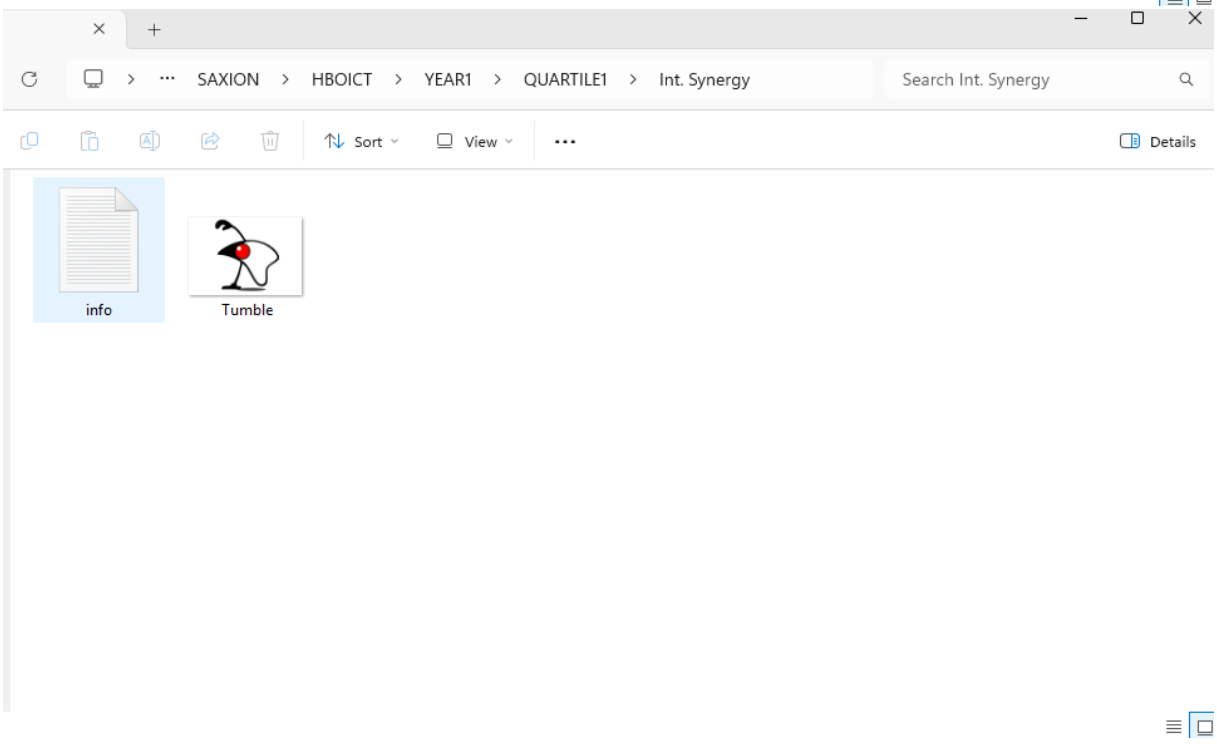

This PC
Local Disk (C:)
SAXION
Search SAXION
Sort
View
Details
Name
Date modified
Type
Size
HBOICT
10/12/2025 14:37
File folder
Plug
10/12/2025 14:54
PNG File
794 KB
Tumble
10/12/2025 14:54
PNG File
199 KB
Wave
10/12/2025 14:53
PNG File
352 KB


This PC
Local Disk (C:)
SAXION
HBOICT
Search HBOICT
Sort
View
Details
Name
Date modified
Type
Size
YEAR1
10/12/2025 14:38
File folder
YEAR2
10/12/2025 14:38
File folder
YEAR3
10/12/2025 14:38
File folder
YEAR4
10/12/2025 14:38
File folder


This PC
Local Disk (C:)
SAXION
HBOICT
YEAR1
Search YEAR1
Sort
View
Details
Name
Date modified
Type
Size
QUARTILE1 10/12/2025 14:39 File folder
QUARTILE2 10/12/2025 14:40 File folder
QUARTILE3 10/12/2025 14:38 File folder
QUARTILE4 10/12/2025 14:38 File folder

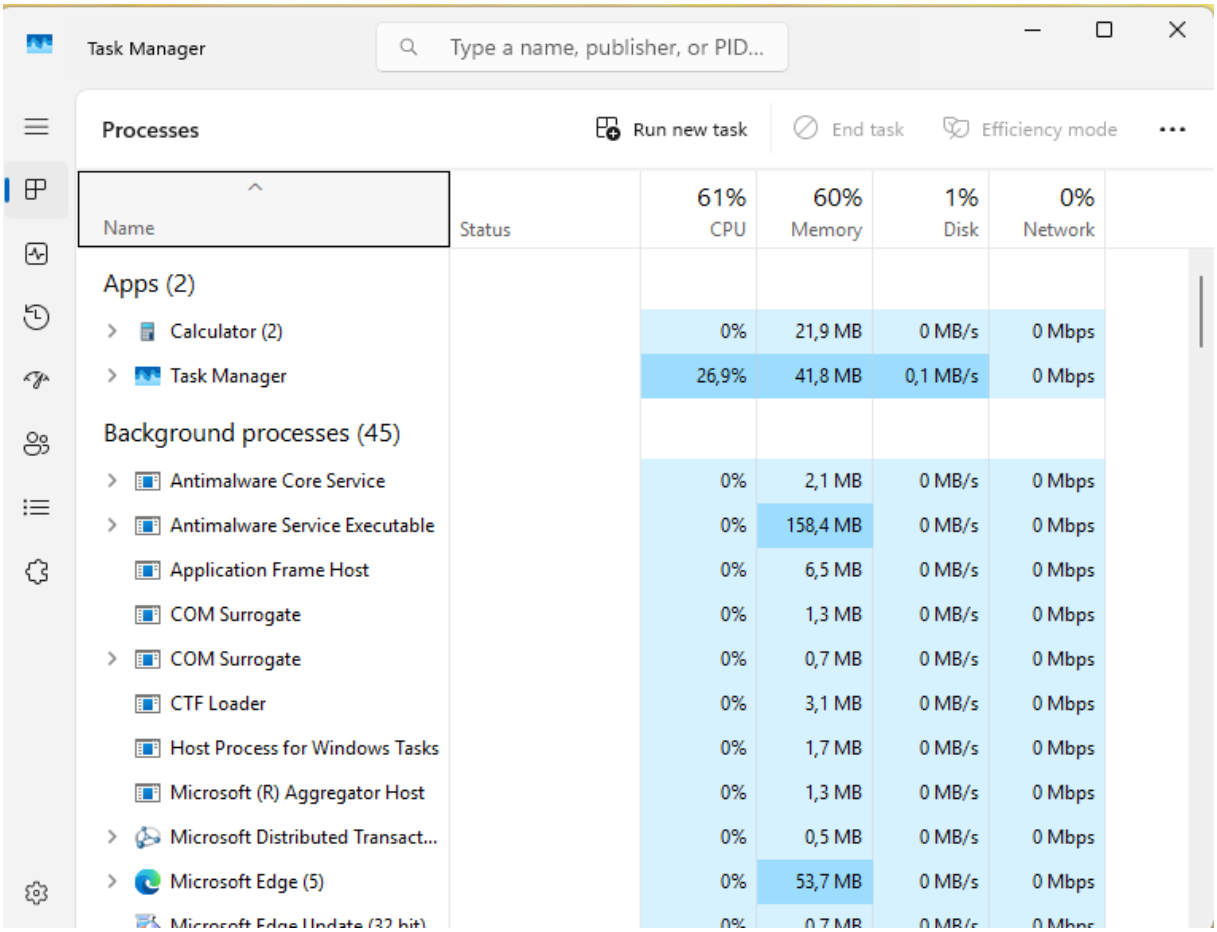

Local Disk (C:)
SAXION
HBOICT
YEAR1
QUARTILE1
Search QUARTILE1
Sort
View
Details
Name
Date modified
Type
Size
Int. Synergy 10/12/2025 15:01 File folder
Introduction to infrastructures 10/12/2025 15:00 File folder
Introduction to programming 10/12/2025 14:59 File folder

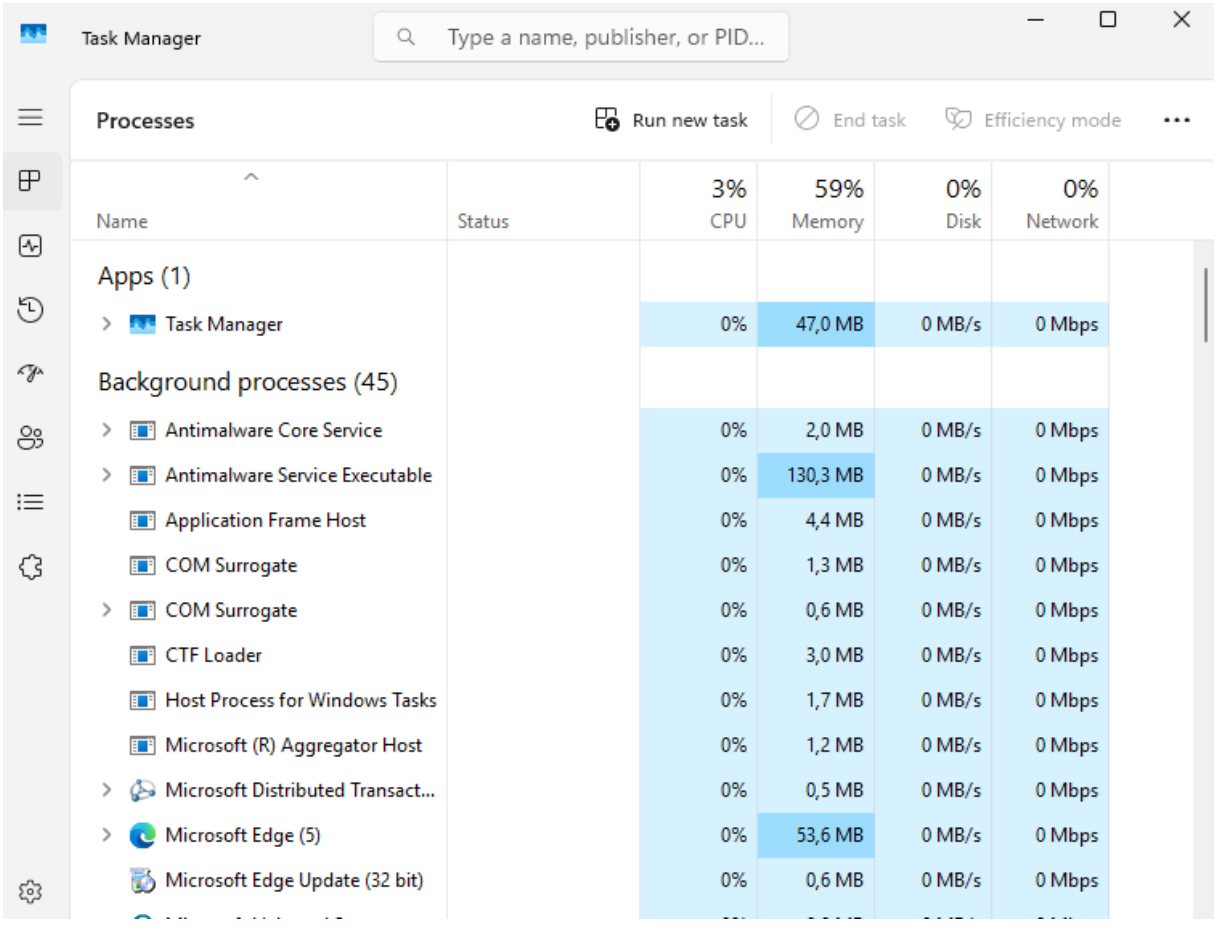




Terminating Processes

Relevant Screenshots Task Manager Window:

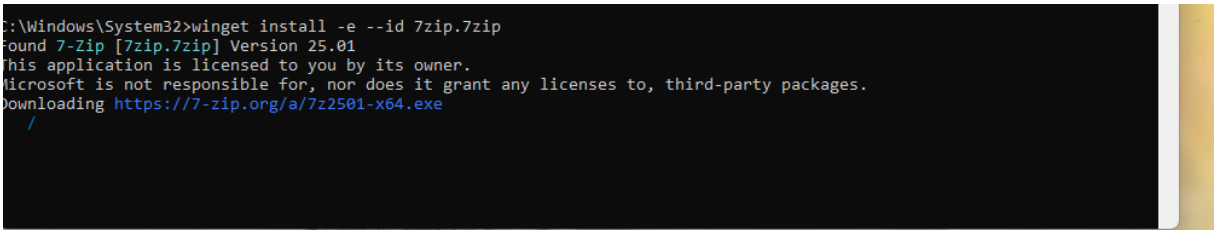

Task Manager
Type a name, publisher, or PID...
Processes
Run new task
End task
Efficiency mode
Name
Status
61%
CPU
60%
Memory
1%
Disk
0%
Network
Apps (2)
Calculator (2) 0% 21,9 MB 0 MB/s 0 Mbps
Task Manager 26,9% 41,8 MB 0,1 MB/s 0 Mbps
Background processes (45)
Antimalware Core Service 0% 2,1 MB 0 MB/s 0 Mbps
Antimalware Service Executable 0% 158,4 MB 0 MB/s 0 Mbps
Application Frame Host 0% 6,5 MB 0 MB/s 0 Mbps
COM Surrogate 0% 1,3 MB 0 MB/s 0 Mbps
COM Surrogate 0% 0,7 MB 0 MB/s 0 Mbps
CTF Loader 0% 3,1 MB 0 MB/s 0 Mbps
Host Process for Windows Tasks 0% 1,7 MB 0 MB/s 0 Mbps
Microsoft (R) Aggregator Host 0% 1,3 MB 0 MB/s 0 Mbps
Microsoft Distributed Transact... 0% 0,5 MB 0 MB/s 0 Mbps
Microsoft Edge (5) 0% 53,7 MB 0 MB/s 0 Mbps

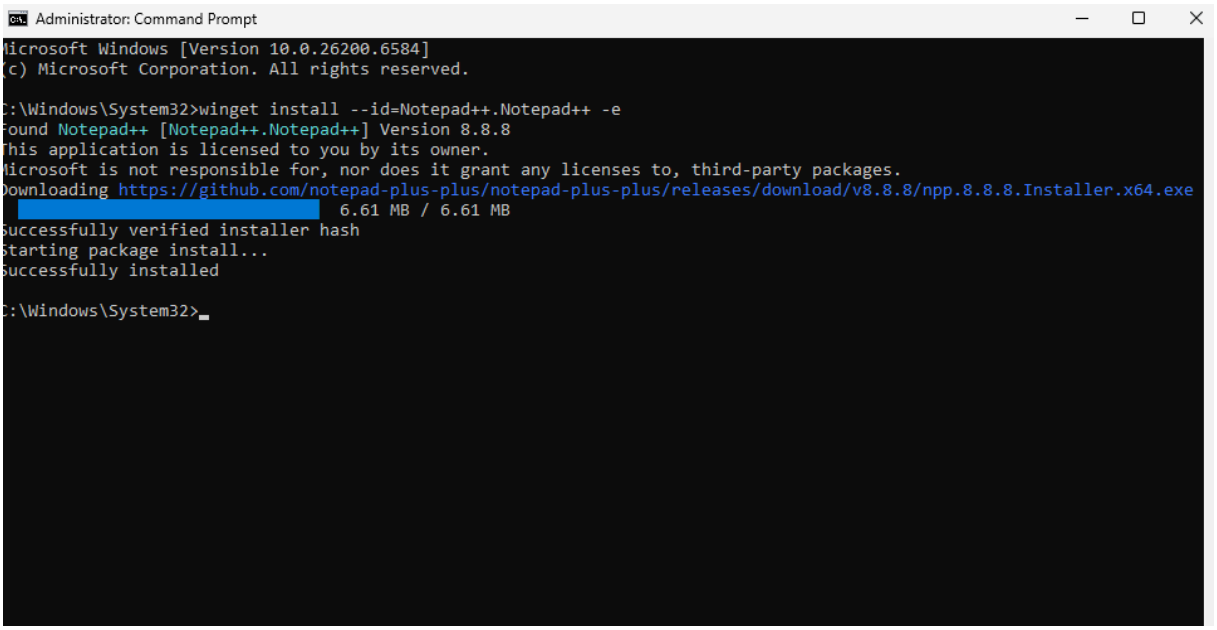

Task Manager
Type a name, publisher, or PID...
Processes
Run new task
End task
Efficiency mode
Name
Status
3%
CPU
59%
Memory
0%
Disk
0%
Network
Apps (1)
Task Manager 0% 47,0 MB 0 MB/s 0 Mbps
Background processes (45)
Antimalware Core Service 0% 2,0 MB 0 MB/s 0 Mbps
Antimalware Service Executable 0% 130,3 MB 0 MB/s 0 Mbps
Application Frame Host 0% 4,4 MB 0 MB/s 0 Mbps
COM Surrogate 0% 1,3 MB 0 MB/s 0 Mbps
COM Surrogate 0% 0,6 MB 0 MB/s 0 Mbps
CTF Loader 0% 3,0 MB 0 MB/s 0 Mbps
Host Process for Windows Tasks 0% 1,7 MB 0 MB/s 0 Mbps
Microsoft (R) Aggregator Host 0% 1,2 MB 0 MB/s 0 Mbps
Microsoft Distributed Transact... 0% 0,5 MB 0 MB/s 0 Mbps
Microsoft Edge (5) 0% 53,6 MB 0 MB/s 0 Mbps
Microsoft Edge Update (32 bit) 0% 0,6 MB 0 MB/s 0 Mbps

Install Software

Relevant screenshots that the following software is installed with winget:

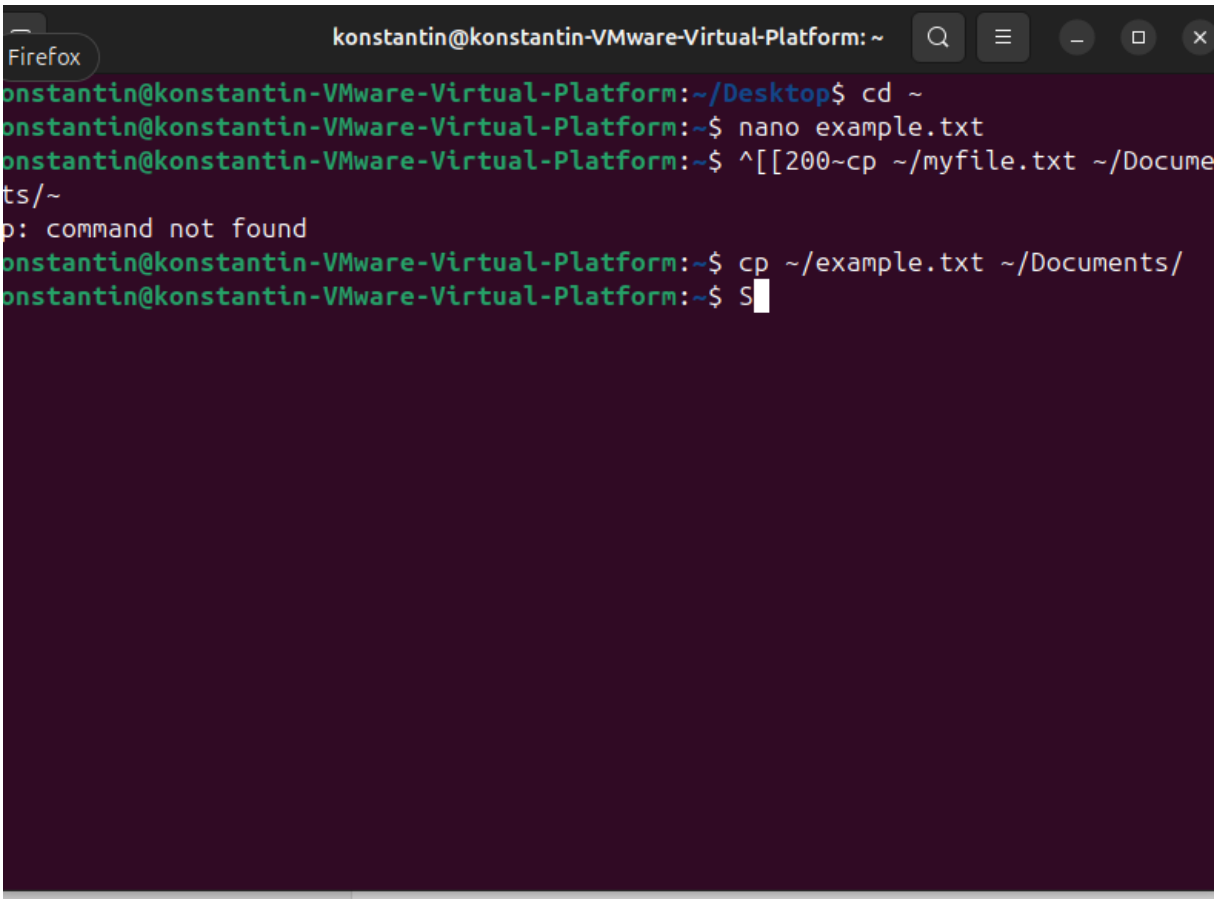
- WinSCP
- Notepad++
- 7zip

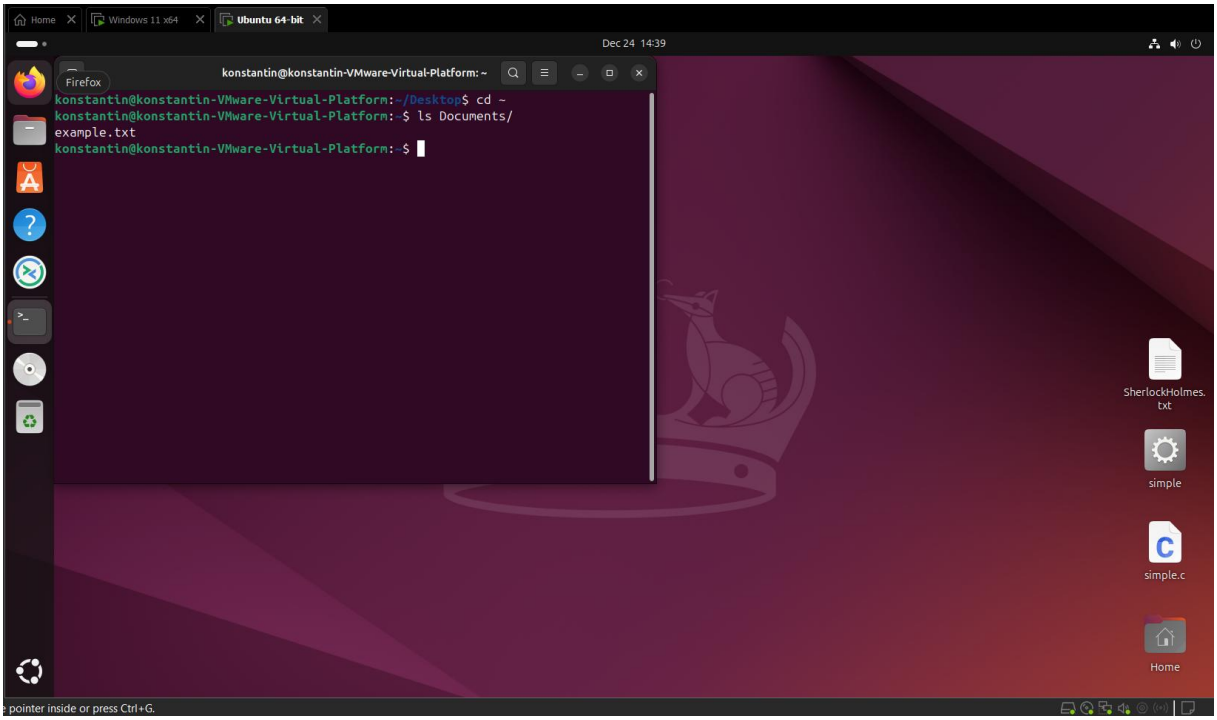


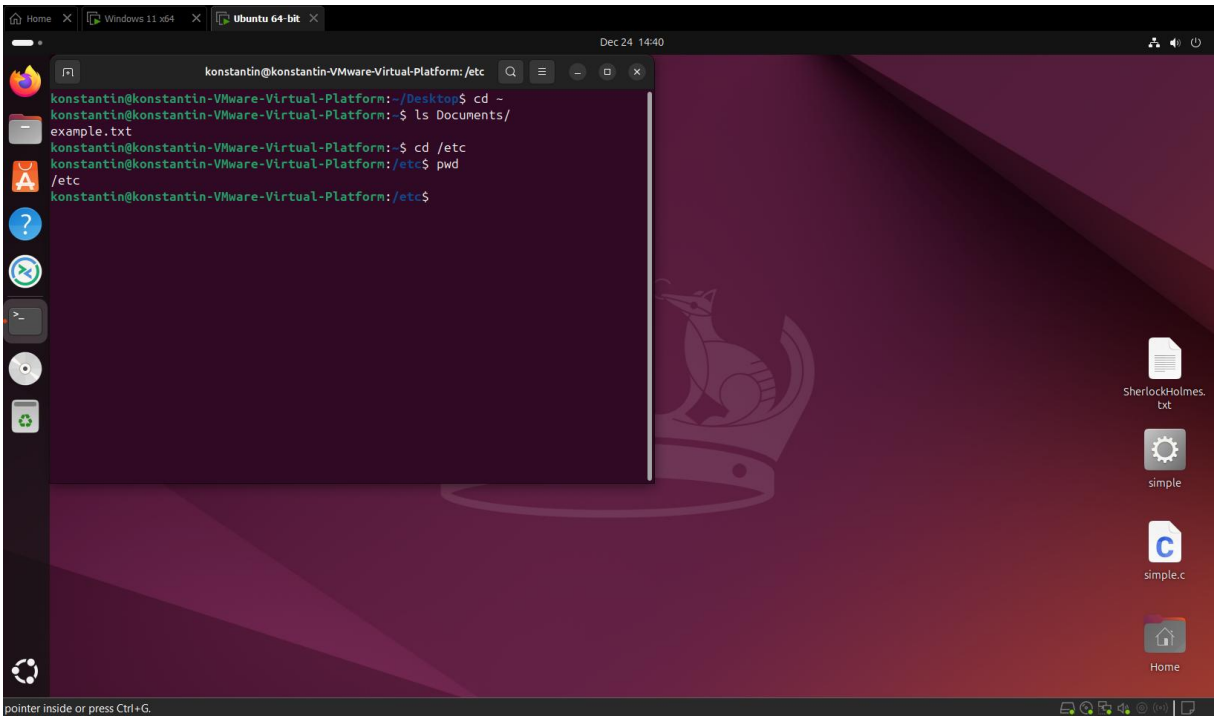


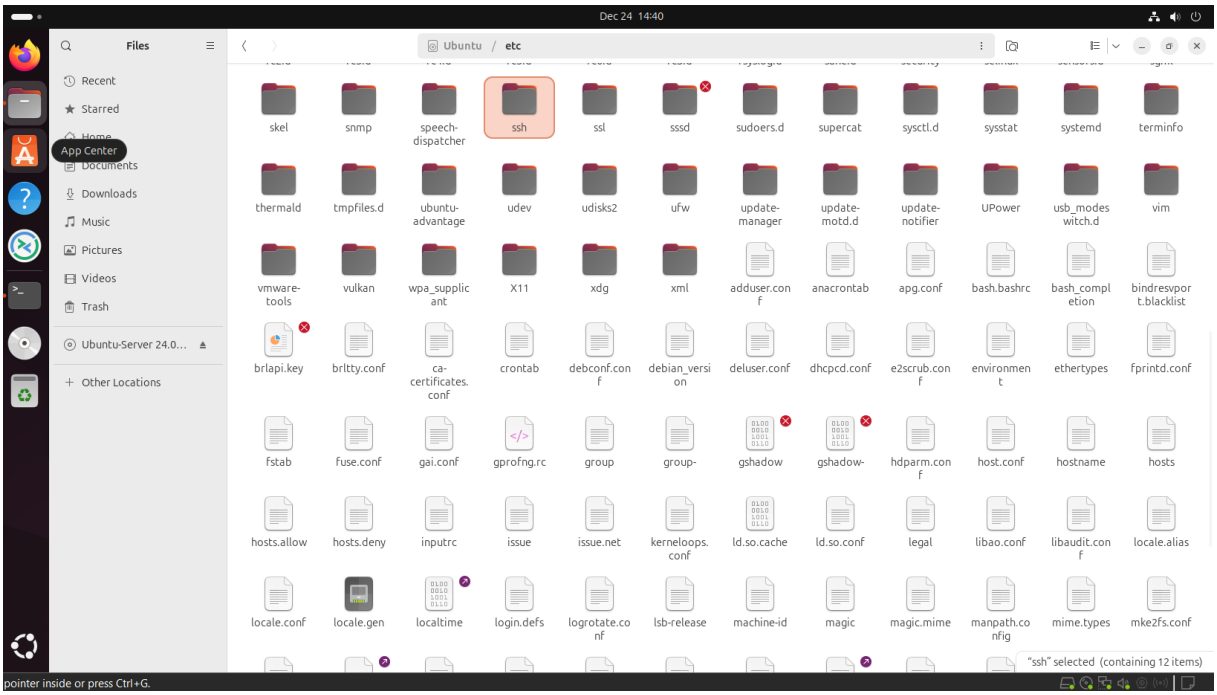
Assignment 5.4: Working with Linux

Relevant screenshots + motivation


Firefox
konstantin@konstantin-VMware-Virtual-Platform: ~
onstantin@konstantin-VMware-Virtual-Platform:~/Desktop$ cd ~
onstantin@konstantin-VMware-Virtual-Platform:~$ nano example.txt
onstantin@konstantin-VMware-Virtual-Platform:~$ ^[[200~cp ~/myfile.txt ~/Docume
ts/~
p: command not found
onstantin@konstantin-VMware-Virtual-Platform:~$ cp ~/example.txt ~/Documents/
onstantin@konstantin-VMware-Virtual-Platform:~$ S

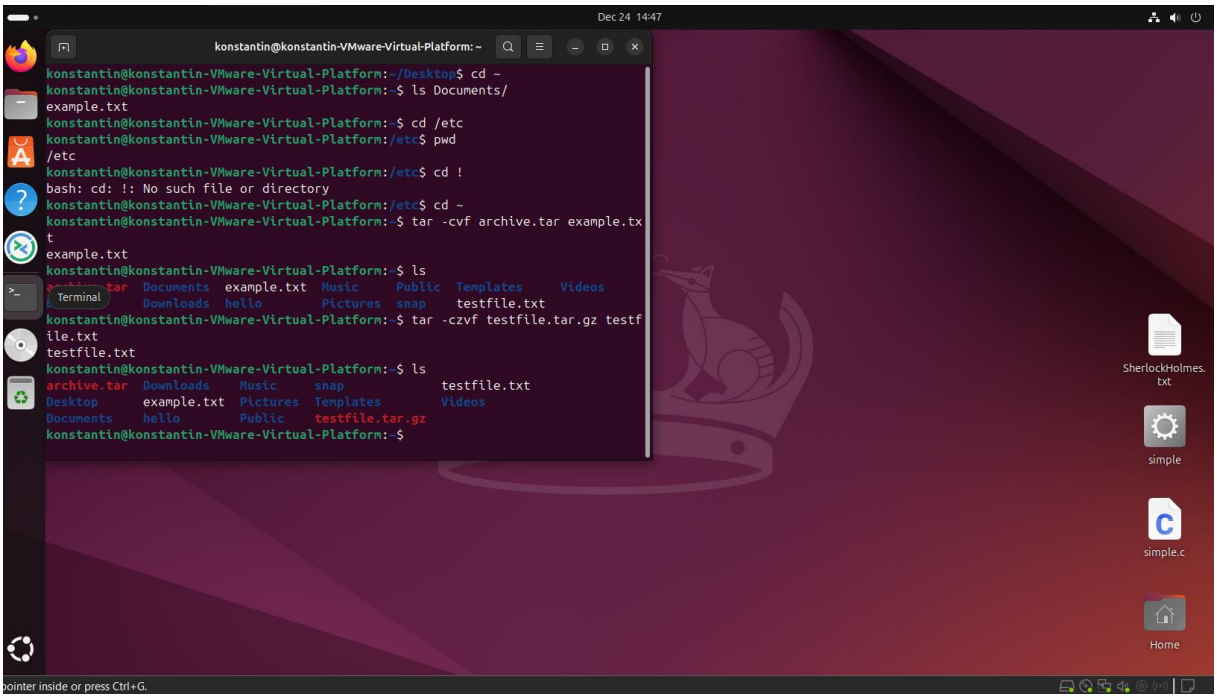

Home
Windows 11 x64
Ubuntu 64-bit
Dec 24 14:39
Firefox
konstantin@konstantin-VMware-Virtual-Platform: ~
konstantin@konstantin-VMware-Virtual-Platform:~/Desktop$ cd ~
konstantin@konstantin-VMware-Virtual-Platform:~$ ls Documents/
example.txt
konstantin@konstantin-VMware-Virtual-Platform:~$
SherlockHolmes.txt
simple
simple.c
Home
pointer inside or press Ctrl+G.

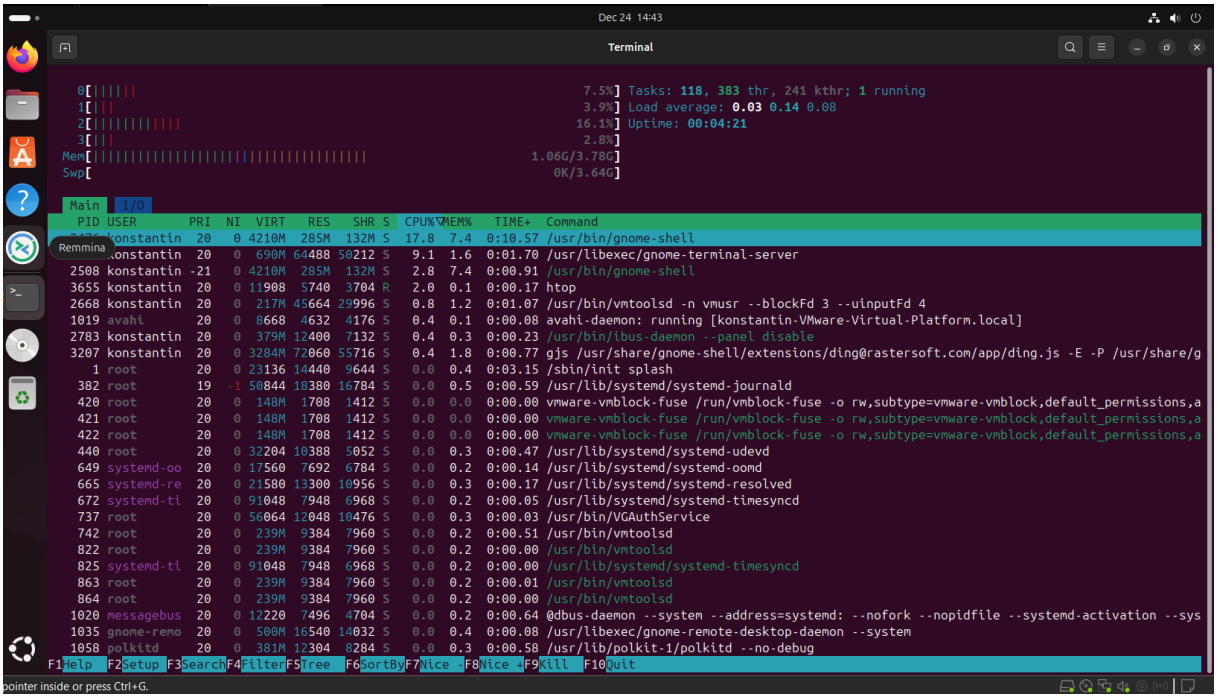


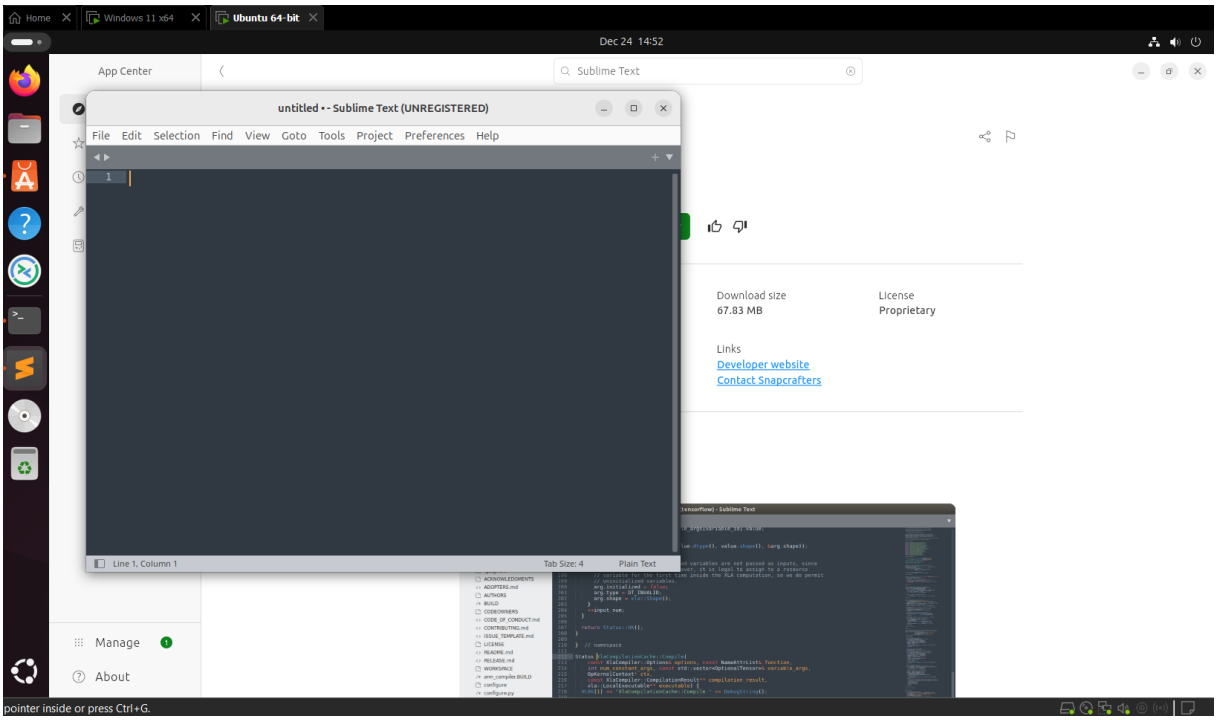


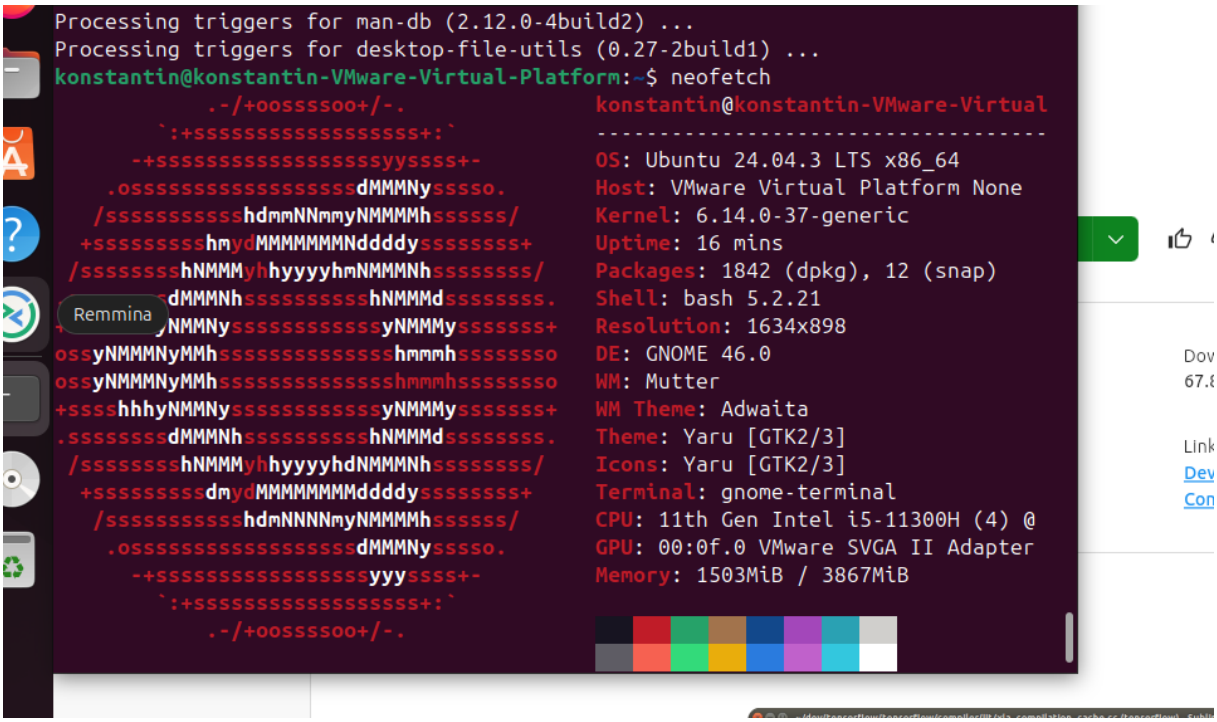
Linux uses a single root directory /, while Windows uses drive letters like C:\.

The /etc directory contains system-wide configuration files.


Dec 24 14:47
konstantin@konstantin-VMware-Virtual-Platform: ~
konstantin@konstantin-VMware-Virtual-Platform:~/Desktop$ cd ~
konstantin@konstantin-VMware-Virtual-Platform:~$ ls Documents/
example.txt
konstantin@konstantin-VMware-Virtual-Platform:~$ cd /etc
konstantin@konstantin-VMware-Virtual-Platform:/etc$ pwd
/etc
konstantin@konstantin-VMware-Virtual-Platform:/etc$ cd !
bash: cd: !: No such file or directory
konstantin@konstantin-VMware-Virtual-Platform:/etc$ cd ~
konstantin@konstantin-VMware-Virtual-Platform:~$ tar -cvf archive.tar example.tx
t
example.txt
konstantin@konstantin-VMware-Virtual-Platform:~$ ls
archive.tar Documents example.txt Music Public Templates Videos
Desktop Downloads hello Pictures snap testfile.txt
konstantin@konstantin-VMware-Virtual-Platform:~$ tar -czvf testfile.tar.gz testf
ile.txt
testfile.txt
konstantin@konstantin-VMware-Virtual-Platform:~$ ls
archive.tar Downloads Music snap testfile.txt
Desktop example.txt Pictures Templates Videos
Documents hello Public testfile.tar.gz
konstantin@konstantin-VMware-Virtual-Platform:~$
Terminal
SherlockHolmes.txt
simple
simple.c
Home
pointer inside or press Ctrl+G.

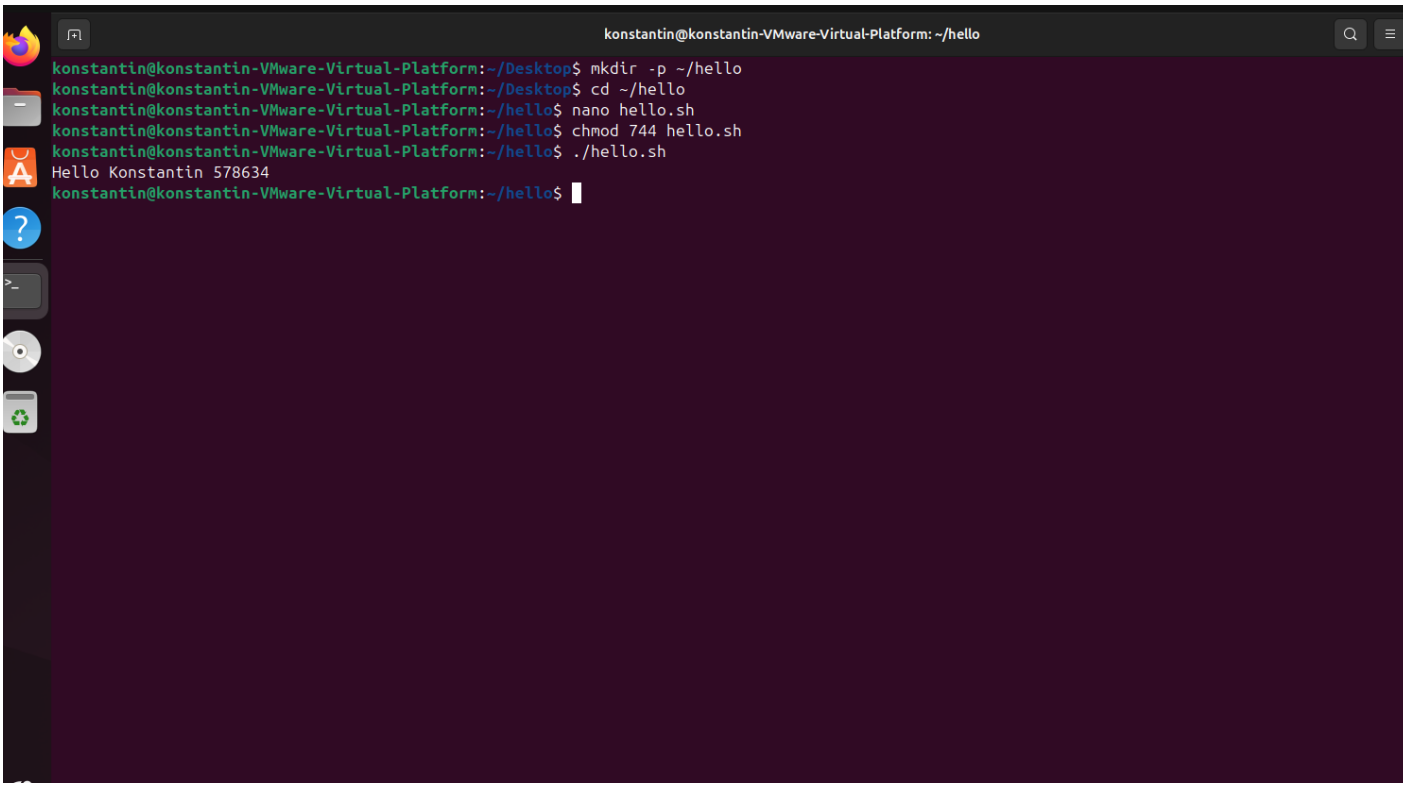

Dec 24 14:43
Terminal
0[|||||| 7.5%] Tasks: 118, 383 thr, 241 kthr; 1 running
1[||| 3.9%] Load average: 0.03 0.14 0.08
2[|||||||||||| 16.1%] Uptime: 00:04:21
3[||| 2.8%]
Mem[|||||||||||||||||||||||||||||||| 1.06G/3.78G]
Swp[0K/3.64G]
Main I/O
PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
konstantin 20 0 4210M 285M 132M S 17.8 7.4 0:10.57 /usr/bin/gnome-shell
konstantin 20 0 690M 64488 50212 S 9.1 1.6 0:01.70 /usr/libexec/gnome-terminal-server
2508 konstantin -21 0 4210M 285M 132M S 2.8 7.4 0:00.91 /usr/bin/gnome-shell
3655 konstantin 20 0 11908 5740 3704 R 2.0 0.1 0:00.17 htop
2668 konstantin 20 0 217M 45664 29996 S 0.8 1.2 0:01.07 /usr/bin/vmtoolsd -n vmusr --blockFd 3 --uinputFd 4
1019 avahi 20 0 8668 4632 4176 S 0.4 0.1 0:00.08 avahi-daemon: running [konstantin-VMware-Virtual-Platform.local]
2783 konstantin 20 0 379M 12400 7132 S 0.4 0.3 0:00.23 /usr/bin/ibus-daemon --panel disable
3207 konstantin 20 0 3284M 72060 55716 S 0.4 1.8 0:00.77 gjs /usr/share/gnome-shell/extensions/ding@rastersoft.com/app/ding.js -E -P /usr/share/g
1 root 20 0 23136 14440 9644 S 0.0 0.4 0:03.15 /sbin/init splash
382 root 19 -1 50844 18380 16784 S 0.0 0.5 0:00.59 /usr/lib/systemd/systemd-journald
420 root 20 0 148M 1708 1412 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default_permissions,a
421 root 20 0 148M 1708 1412 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default_permissions,a
422 root 20 0 148M 1708 1412 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default_permissions,a
440 root 20 0 32204 10388 5052 S 0.0 0.3 0:00.47 /usr/lib/systemd/systemd-udevd
649 systemd-oo 20 0 17560 7692 6784 S 0.0 0.2 0:00.14 /usr/lib/systemd/systemd-oomd
665 systemd-re 20 0 21580 13300 10956 S 0.0 0.3 0:00.17 /usr/lib/systemd/systemd-resolved
672 systemd-ti 20 0 91048 7948 6968 S 0.0 0.2 0:00.05 /usr/lib/systemd/systemd-timesyncd
737 root 20 0 56064 12048 10476 S 0.0 0.3 0:00.03 /usr/bin/VGAuthService
742 root 20 0 239M 9384 7960 S 0.0 0.2 0:00.51 /usr/bin/vmtoolsd
822 root 20 0 239M 9384 7960 S 0.0 0.2 0:00.00 /usr/bin/vmtoolsd
825 systemd-ti 20 0 91048 7948 6968 S 0.0 0.2 0:00.00 /usr/lib/systemd/systemd-timesyncd
863 root 20 0 239M 9384 7960 S 0.0 0.2 0:00.01 /usr/bin/vmtoolsd
864 root 20 0 239M 9384 7960 S 0.0 0.2 0:00.00 /usr/bin/vmtoolsd
1020 messagebus 20 0 12220 7496 4704 S 0.0 0.2 0:00.64 @dbus-daemon --system --address=systemd: --nofork --nopidfile --systemd-activation --sys
1035 gnome-remo 20 0 500M 16540 14032 S 0.0 0.4 0:00.08 /usr/libexec/gnome-remote-desktop-daemon --system
1058 polkitd 20 0 381M 12304 8284 S 0.0 0.3 0:00.58 /usr/lib/polkit-1/polkitd --no-debug
F1Help F2Setup F3SearchF4FilterF5Tree F6SortByF7Nice -F8Nice +F9Kill F10Quit
Remmina
pointer inside or press Ctrl+G.





Assignment 5.5: Users and permissions on Linux

Relevant screenshots + motivation

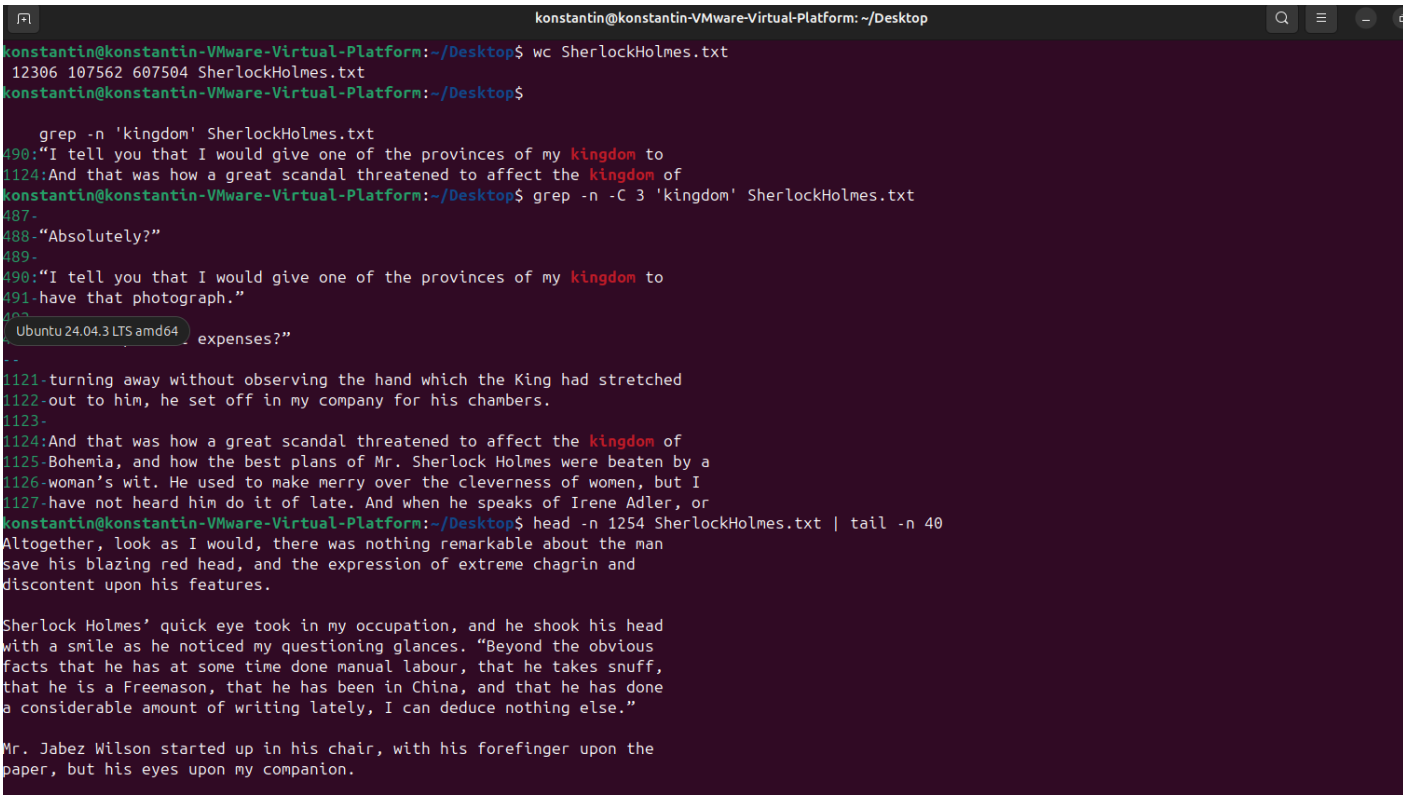


Assignment 5.6: View the contents of files

Relevant screenshots + motivation

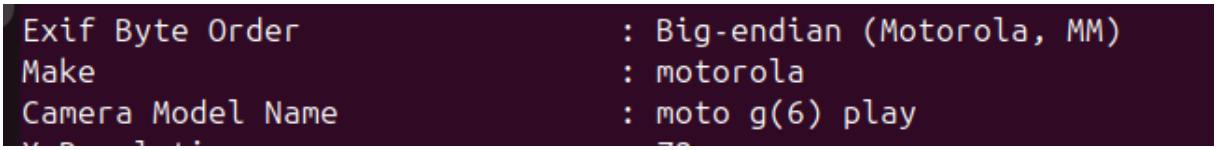
Commands' usage:

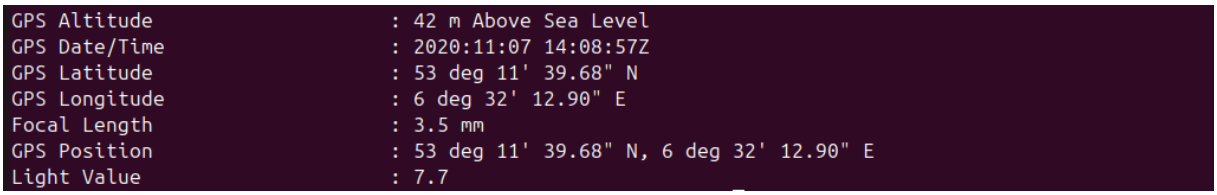
- **cat**: used for displaying the contents of files, combine multiple files into one, and create new files directly from the terminal.
- **wc**: counts the number of lines, words, characters, and bytes in a file or input.
- **less**: allows users to view the contents of a file one page at a time, enabling both forward and backward navigation without loading the entire file into memory.
- **tail**: display the last part of a file, typically showing the last 10 lines by default.
- **head**: display the first few lines of a text file or piped data, with the default being the first 10 lines.
- **grep**: search for specific words, phrases, or patterns inside text files, and shows the matching lines



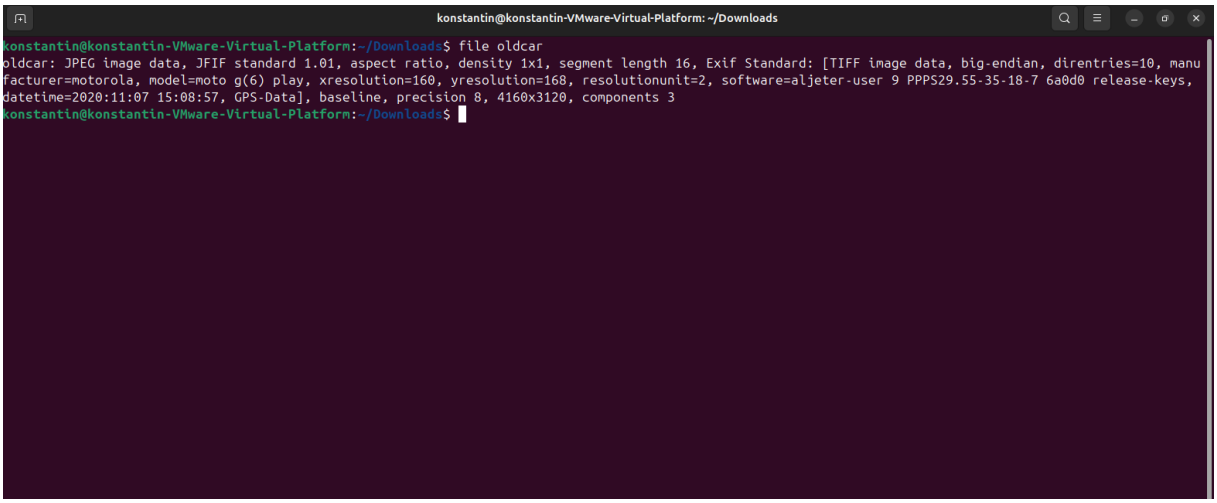
Assignment 5.7: Digital forensics

Relevant screenshots + motivation

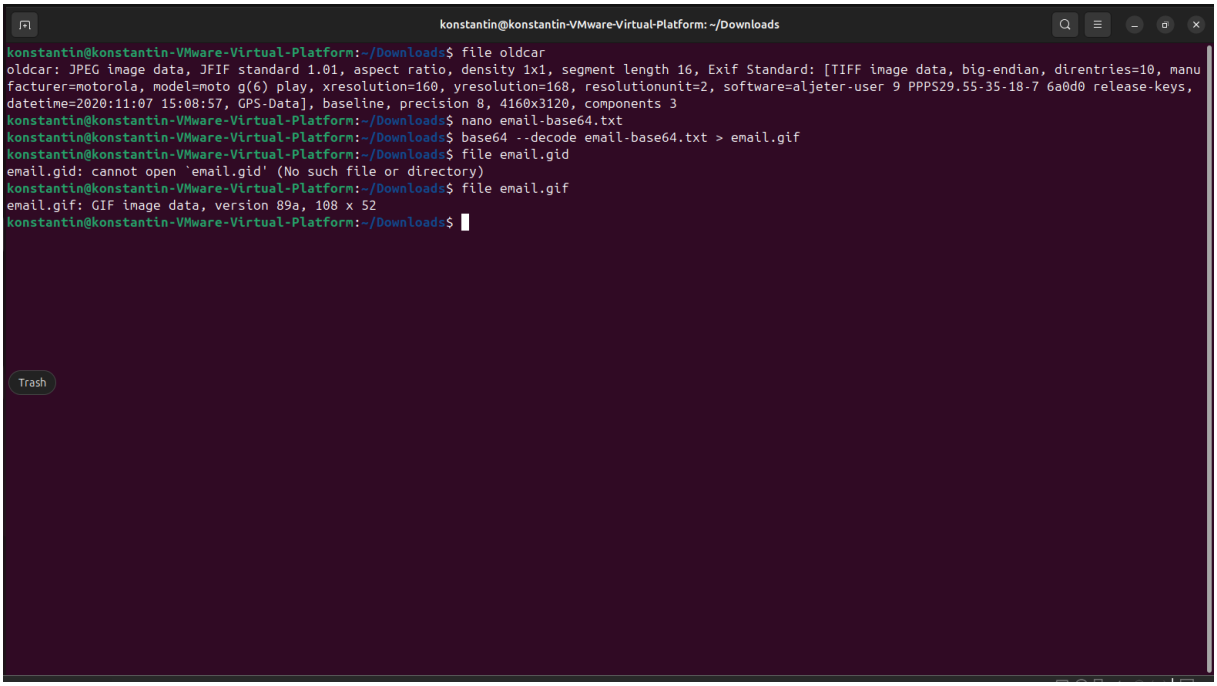




The address is: D G van der Keesselstraat 42, 7412 ZR Deventer, Netherlands

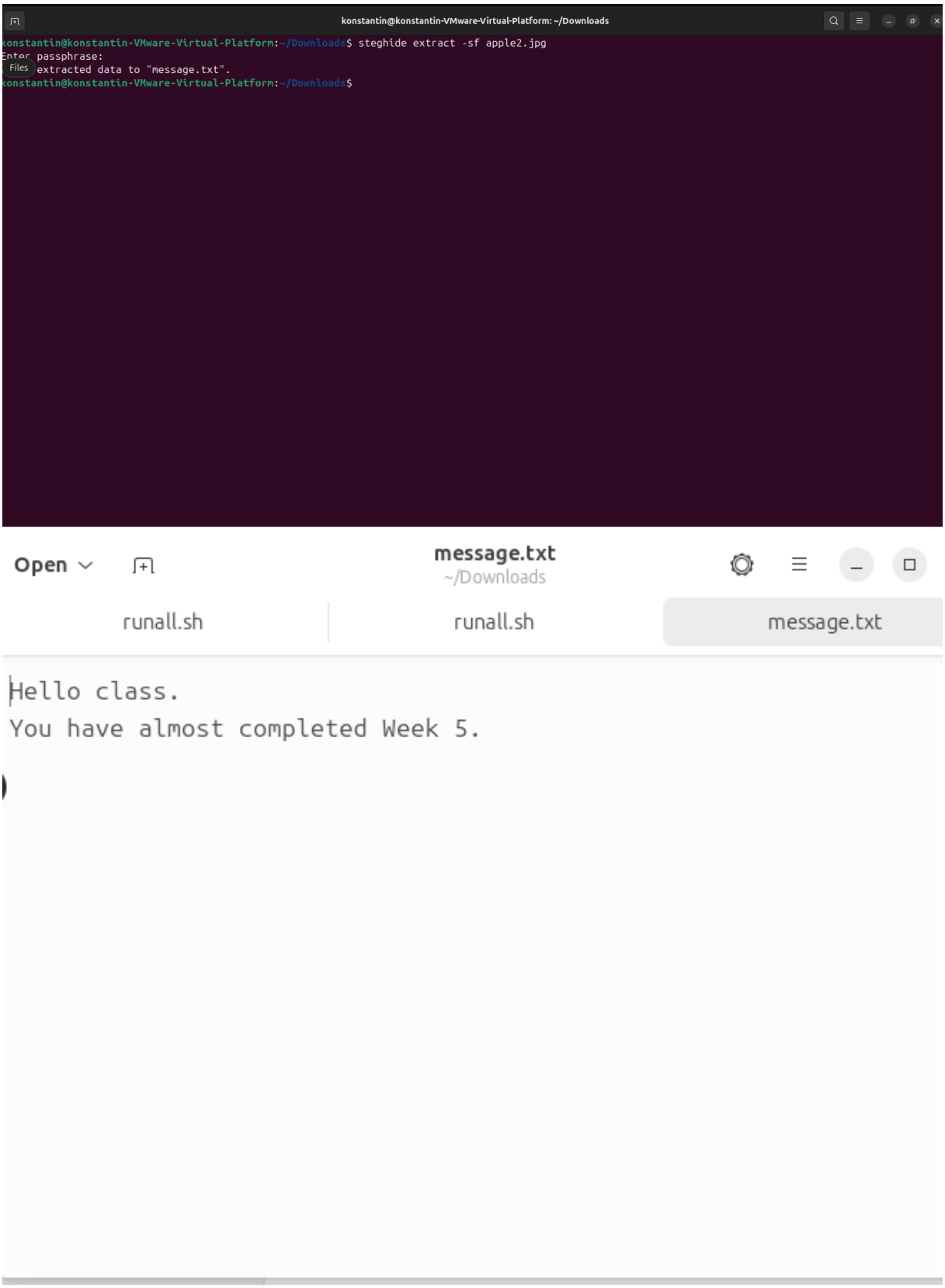


It is still considered an image file.



Assignment 5.8: Steganography

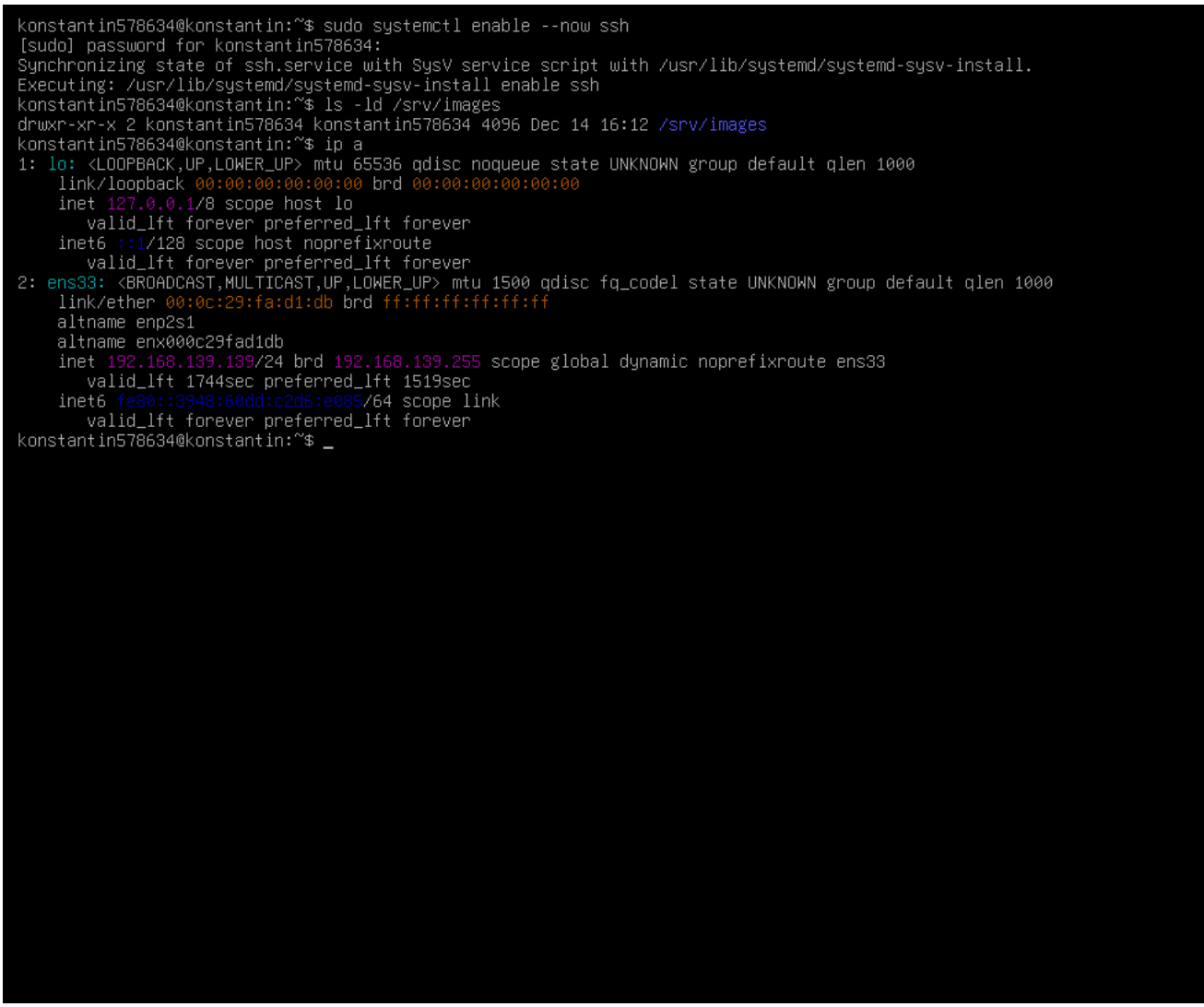
Relevant screenshots + motivation

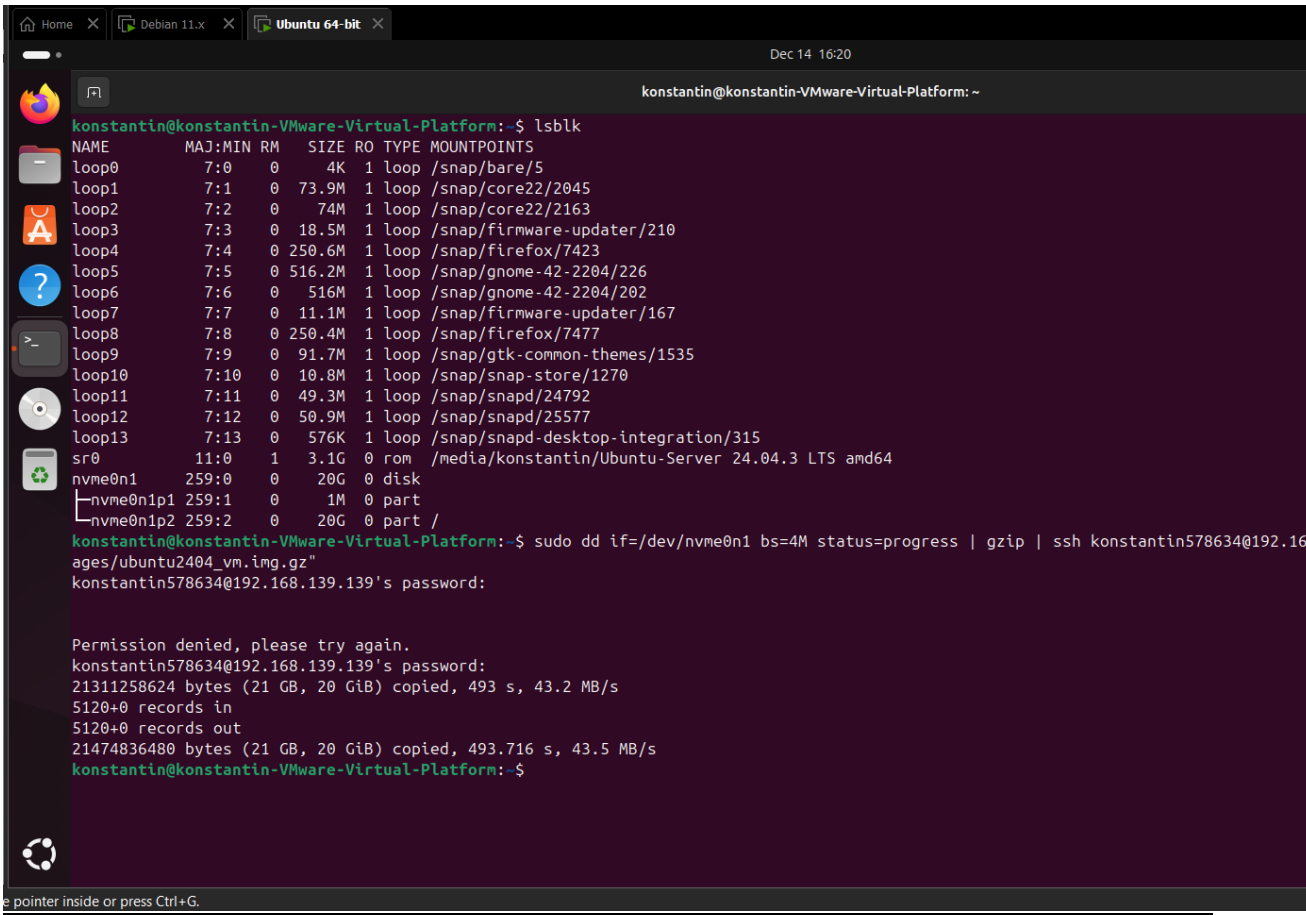


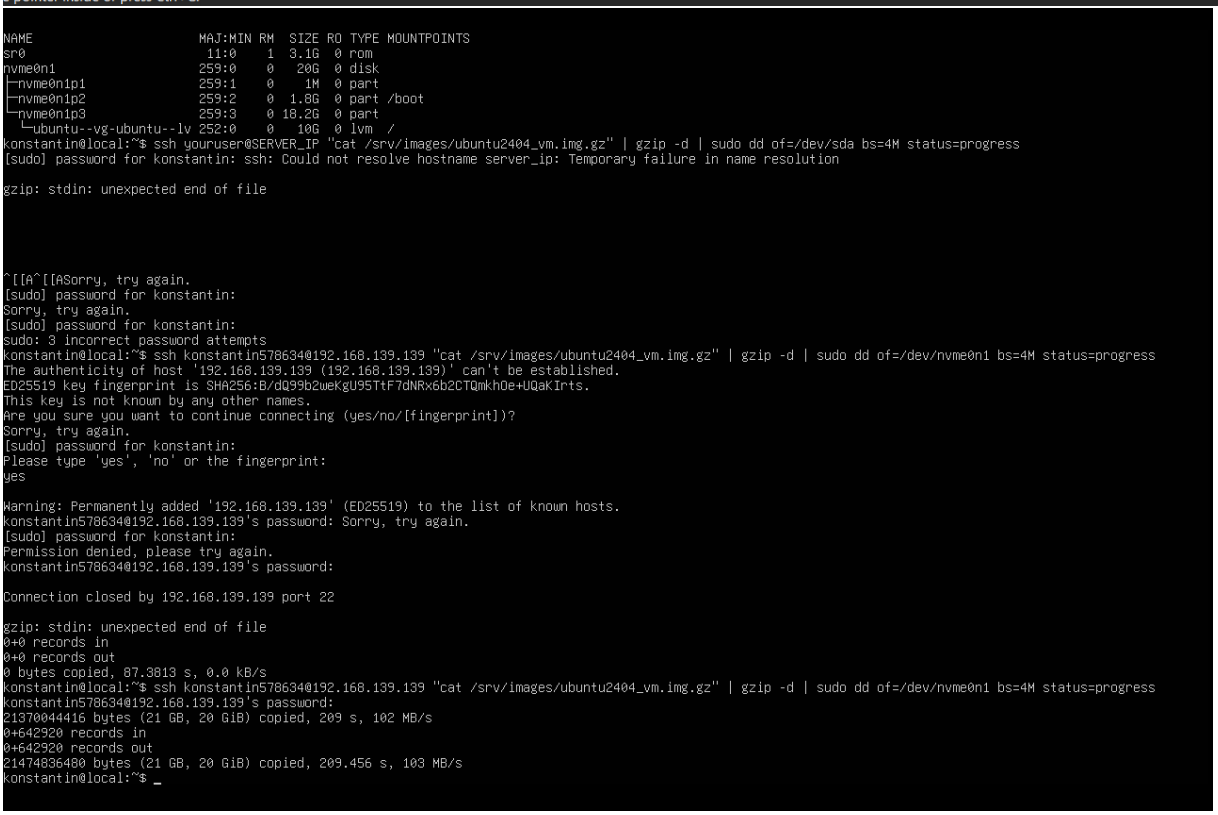
Assignment 5.9: Capture disk images

Make relevant screenshots + motivation:

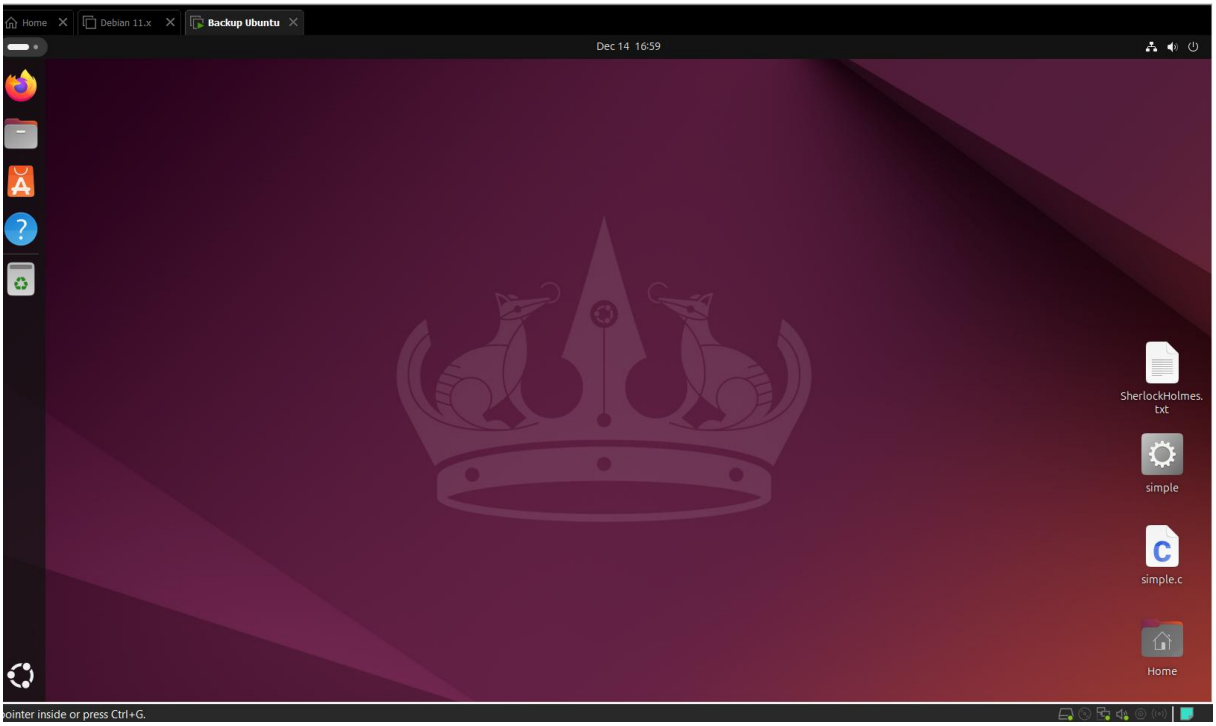
- Proof that the Debian 13 server stored a back-up image of the Ubuntu 24.04 Desktop VM.



- 

- 

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

- 

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