Week 5 – Operating Systems.

Student number: 578856

Assignment 5.1: Unix-like

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

UNIX is the original operating system developed at Bell Labs and is a trademarked system. Only operating systems that have been officially certified under the Single UNIX Specification may be called UNIX (for example Solaris, AIX, HP-UX, macOS).
Unix-like systems are operating systems that behave like UNIX but are not officially certified. Some examples of them are Linux distributions and BSD systems.

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 – One of the original creators of UNIX. He designed the early UNIX kernel, the file system, and several core tools. He also developed the B programming language, which later influenced the C language.

Dennis Ritchie – Co-creator of UNIX alongside Thompson. He is also the creator of the C programming language, which became fundamental not only for UNIX but for modern software development in general.

Bill Joy played an integral role in the early development of BSD UNIX. He developed important UNIX tools such as the v*i* editor and was instrumental in the distribution of BSD. He later co-founded Sun Microsystems.

Richard Stallman launched the free software movement and created essential tools such as Emacs and GNU Compiler Collection, as well as the GPL license. Founder of the GNU Project and the Free Software Foundation.

Linus Torvalds – Creator of the Linux kernel (1991). His work made it possible to combine the GNU tools with a free, modern kernel, resulting in today's GNU/Linux systems. He also created Git.

c) What is the philosophy of the GNU movement?
The main goal is: users control the software, not the companies.

Free software means users have the four essential freedoms: (0) to run the program, (1) to study and change the program in source code form, (2) to redistribute exact copies, and (3) to distribute modified versions. (Quote from gnu.org website)

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

Ubuntu follows GNU philosophy, but only partly. Ubuntu includes lots of free software (Linux kernel, GNU tools, open-source applications) and most of the system is open-source. But Ubuntu also includes proprietary drivers (NVIDIA, Wi-Fi firmware). It encourages installing closed-source software like Spotify and Chrome. So Ubuntu is mostly aligned, but not fully follows strict GNU/FSF ideology.

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

WSL is a compatibility layer in Windows 10/11 that allows running Linux:

- You can install real Linux distributions like Ubuntu, Debian and others.
- Run Linux commands, tools, servers, and development environments directly on Windows.
- And you don't need virtual machine to use it.

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

Android belongs to the Linux operating system family because it is based on the Linux kernel. iOS belongs to the UNIX/BSD family since it is built on Darwin, which uses BSD UNIX components. ChromeOS also belongs to the Linux family because it is developed on top of the Gentoo Linux distribution.

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 extremely powerful machines used for tasks that require huge amounts of calculations. According to the Computer History Museum, they are mainly used for scientific simulations, weather and climate prediction, medical and chemical research, engineering design, and national security tasks like codebreaking. Because they can process massive datasets very quickly, supercomputers help scientists model complex systems, such as the climate, the universe, or molecular behaviour that regular computers cannot handle.

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 supercomputer made by connecting multiple PS3 consoles using their powerful Cell processors. It was used for scientific research and simulations, such as modelling black holes or analyzing large datasets.

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?

It uses Oracle Linux for ARM.

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 Raspberry Pi supercomputer would not appear in the top 500 list of the world's fastest supercomputers. The top 500 rankings list only the 500 highest-performance systems based on the LINPACK benchmark, and the lowest performance required to get on the list was on the order of petaflops. Typical Raspberry Pi clusters, even if built from many units, deliver performance in the gigaflops range at best, which is many orders of magnitude slower than even the slowest machines on the top 500 list. Because of this huge difference in performance, a Raspberry Pi cluster would be far too slow to qualify for 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?

The PlayStation 5 and Xbox Series X both use AMD's custom x86-64 CPU architecture. The PS5 runs a custom FreeBSD-based operating system, while the Xbox Series X uses a custom Windows-based OS. This shows that modern consoles are essentially specialized PCs, using similar CPU architecture and software foundations as regular computers.

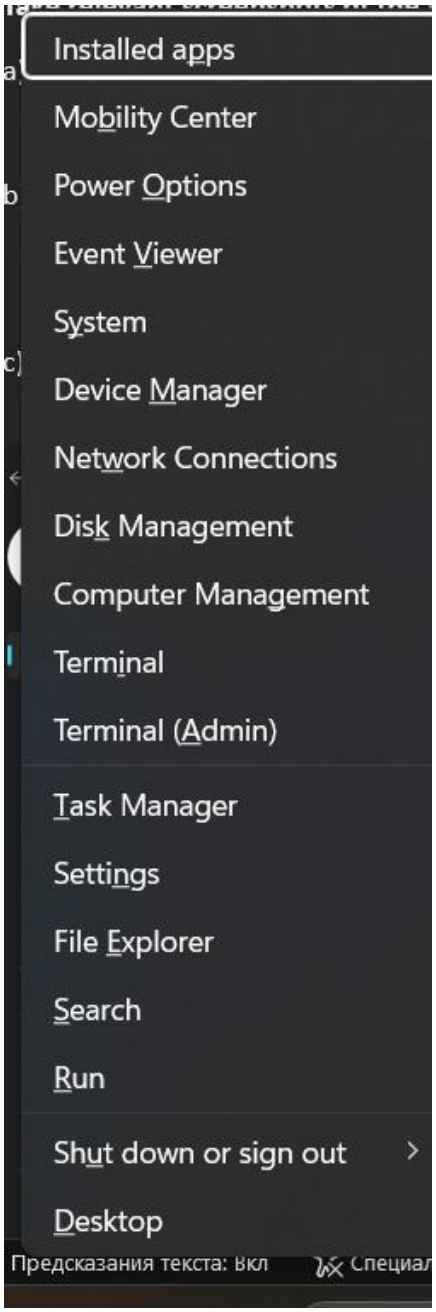
Assignment 5.3: Working with Windows

Take relevant screenshots of the assignments below

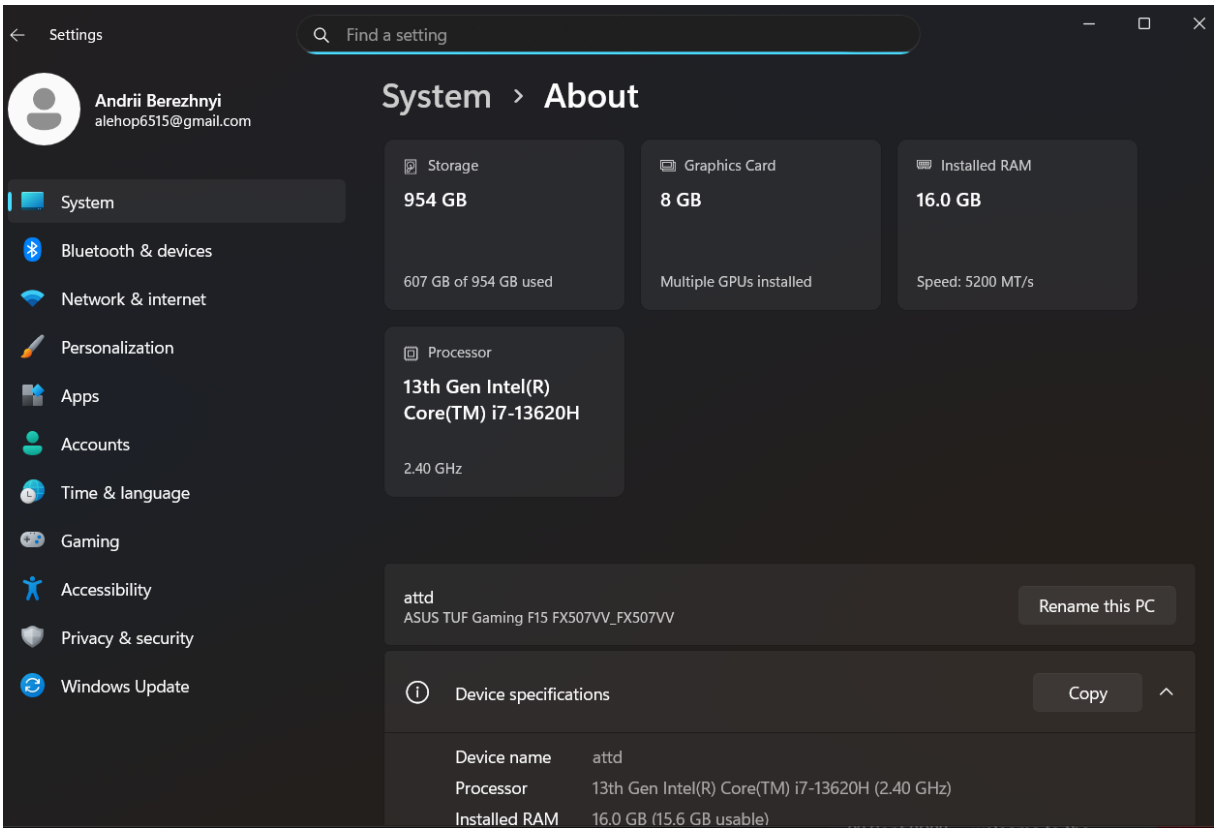
a) Practice for about 10 minutes with the ⊞ keyboard shortcuts combinations, skip the general shortcuts in this exercise. Take a look at which screens are opened.

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

It is also possible to use Win + X and pick a file explorer there, in shortcuts menu.

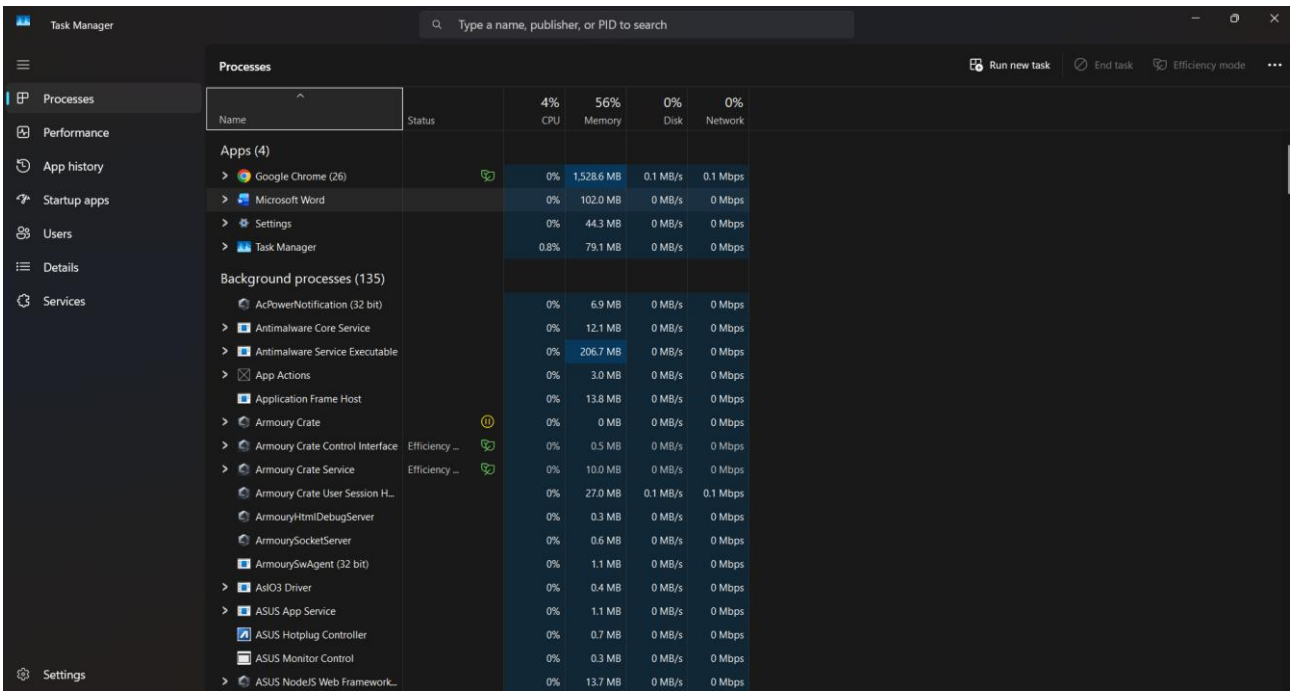


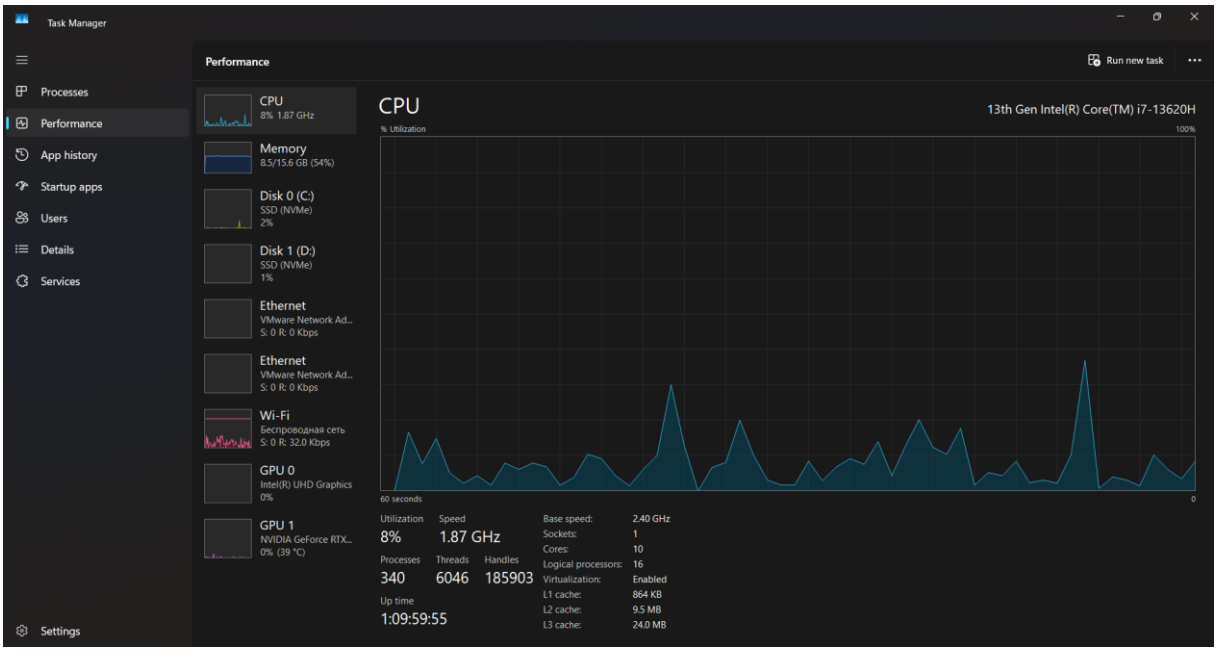
c) Open the system properties with a ⊞ key combination, take a screenshot of the open screen. Paste this screenshot into this template.

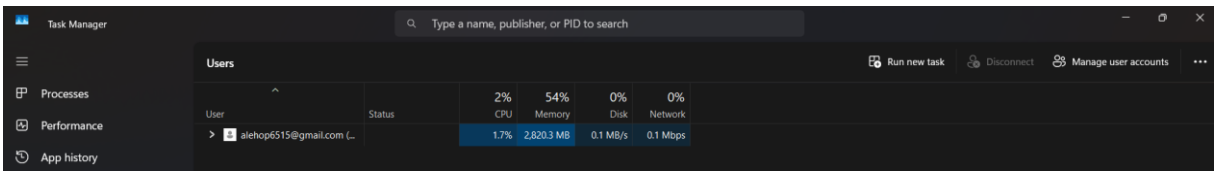


I used Win + Pause

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.

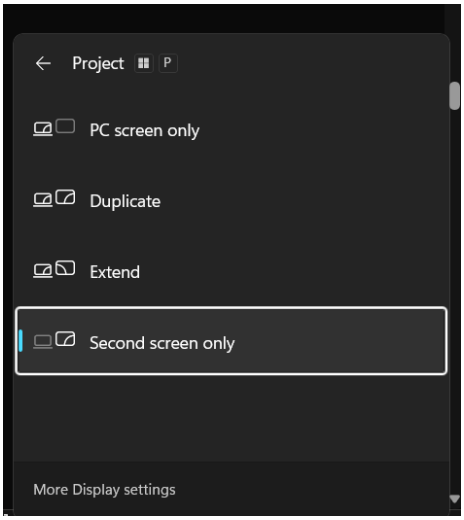






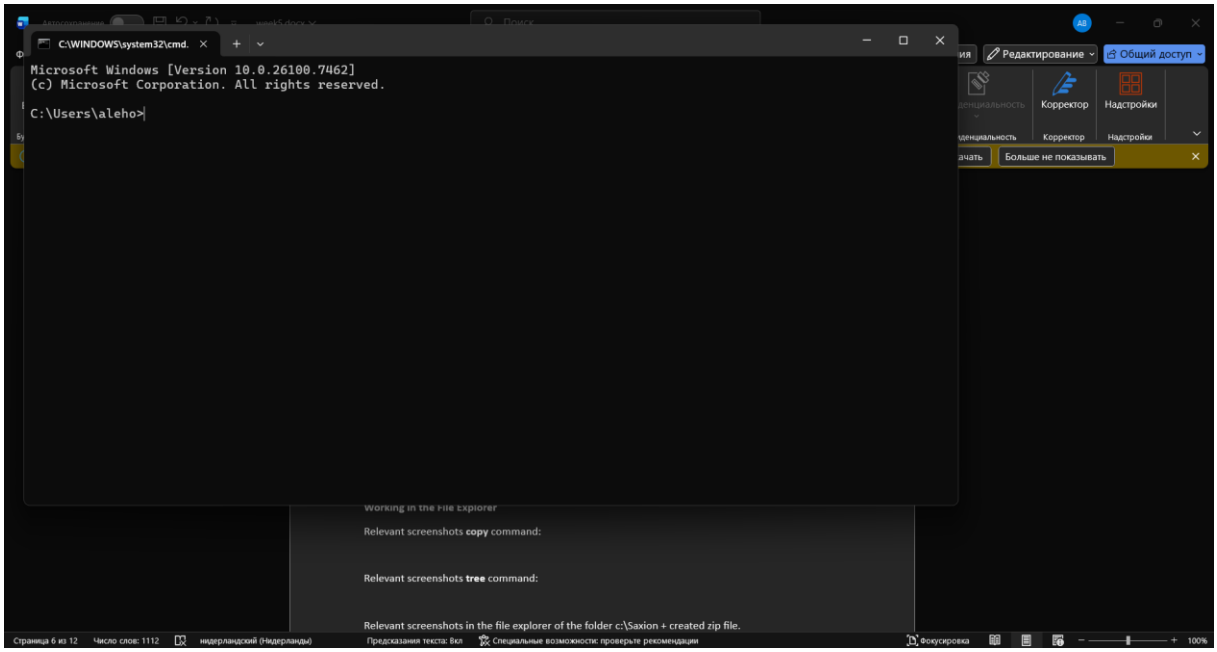
e) If you're giving a PowerPoint presentation and you connect your laptop to a projector, Windows can use the projector as a second screen. For example, you may have Outlook open on your first screen that you don't show over the projector, while the PowerPoint presentation is displayed on the projector,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

You should use the Windows + P key combination. This opens the Project menu where you can choose Extend, Duplicate, or Second screen only, allowing you to use the projector as a second screen for your presentation



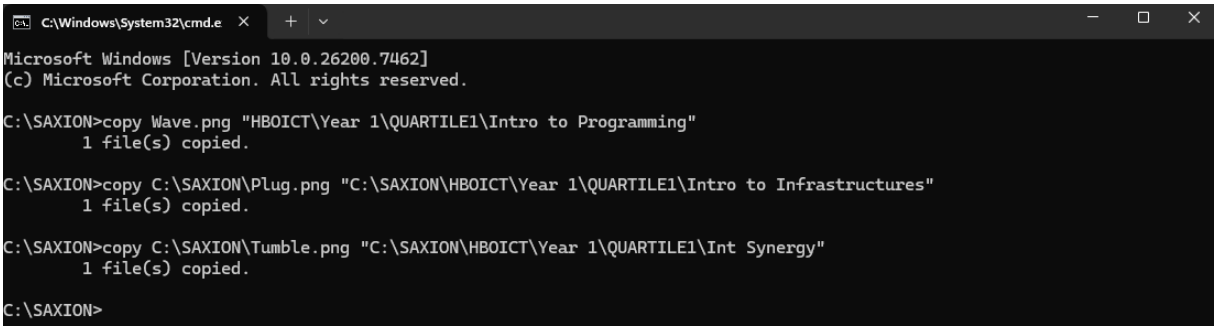
f) If you leave the classroom for a while and you leave your laptop behind, it is wise to lock the screen. Your Apps will continue to run in the background. So, for example, if you're waiting for a download that takes a while, lock the screen and get a cup of coffee. Which key combination do you use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

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.

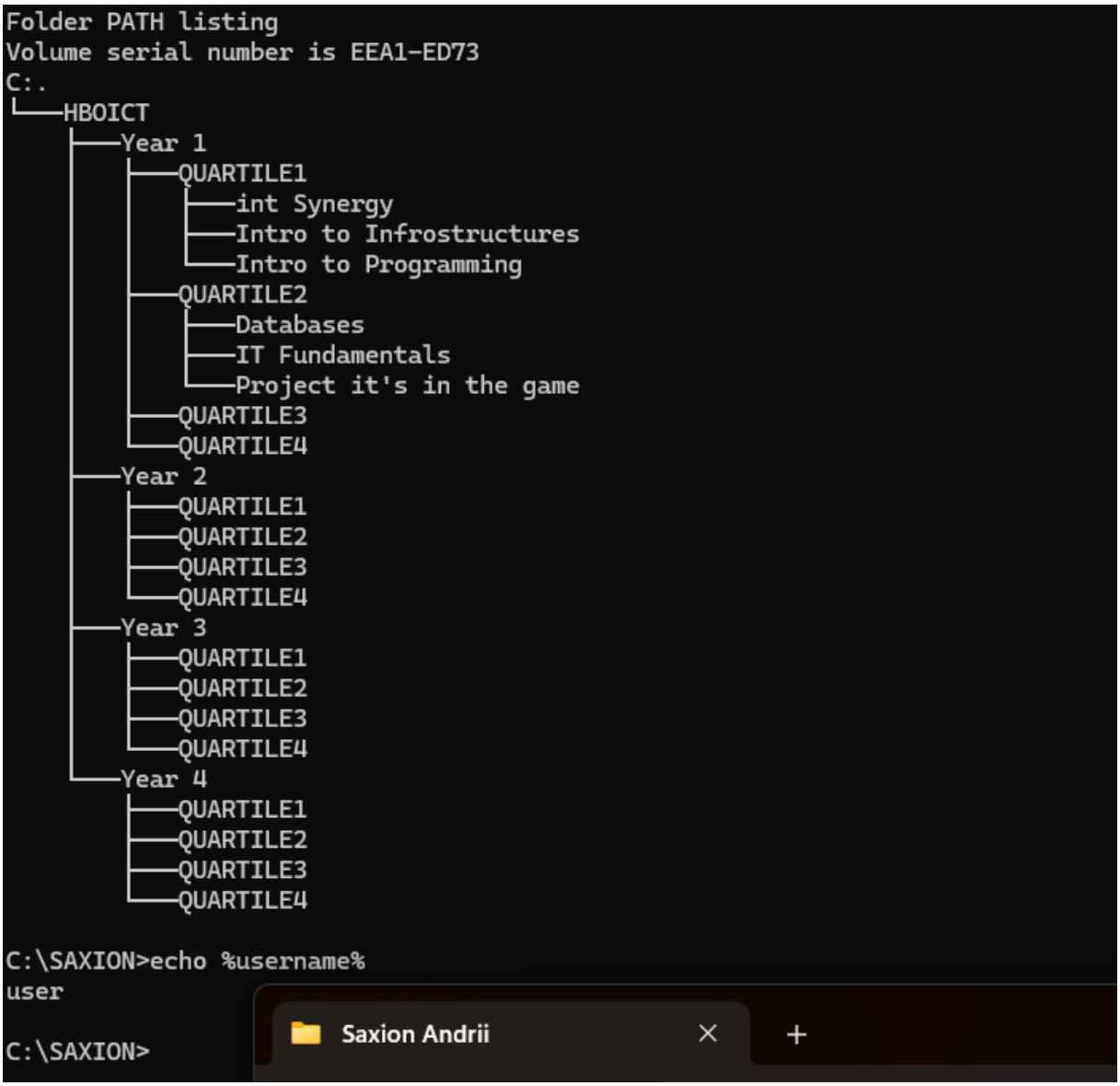


Working in the File Explorer

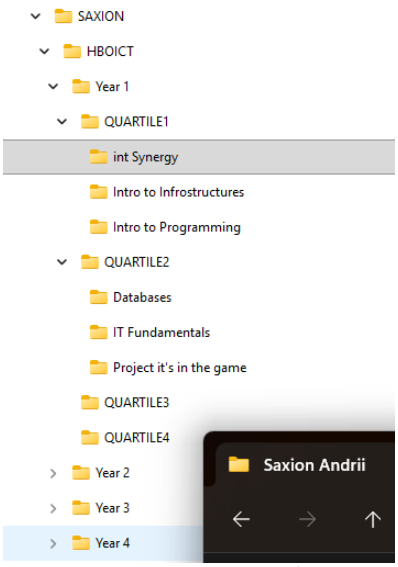
Relevant screenshots **copy** command:

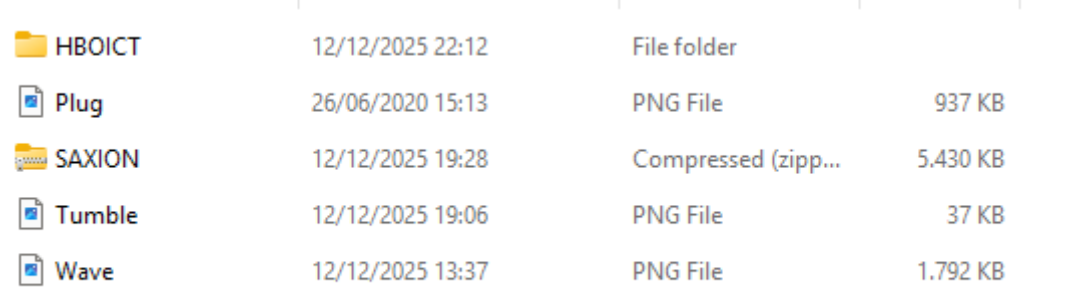


Relevant screenshots **tree** command:



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





Terminating Processes

Relevant Screenshots Task Manager Window:

Install Software

Relevant screenshots that the following software is installed with winget:

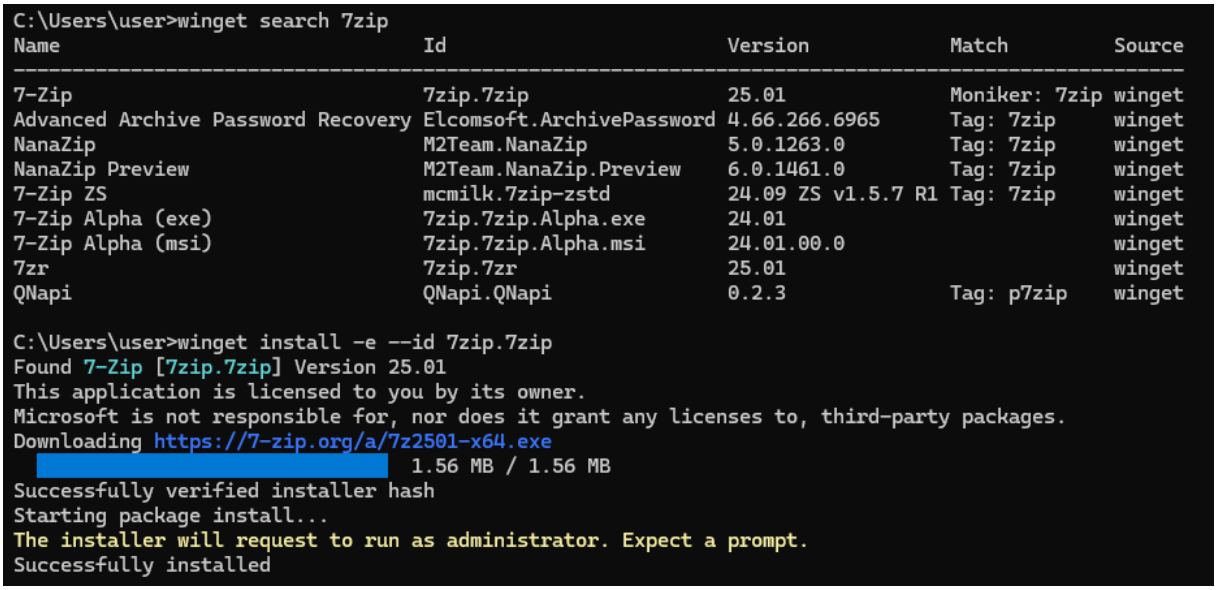
a)

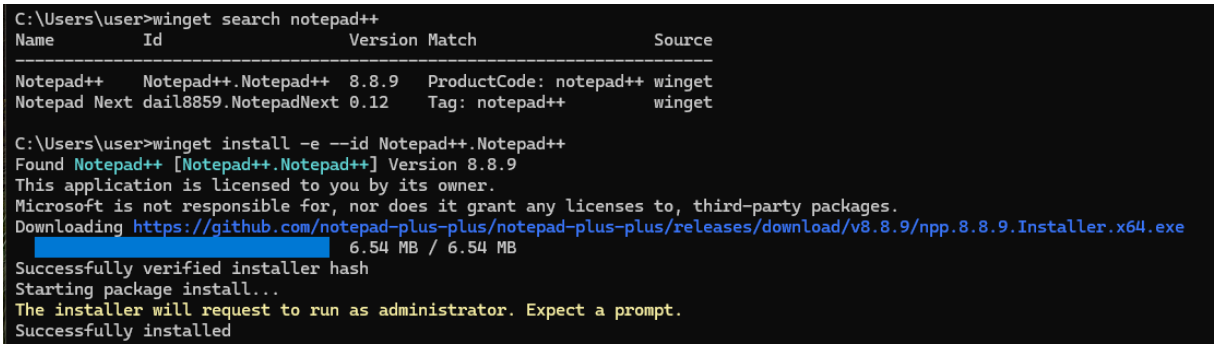
b) The command tells Winget to install the official Firefox browser. The -e option means exact match, so Winget only uses the package whose name or ID is exactly the same. The --id option specifies the

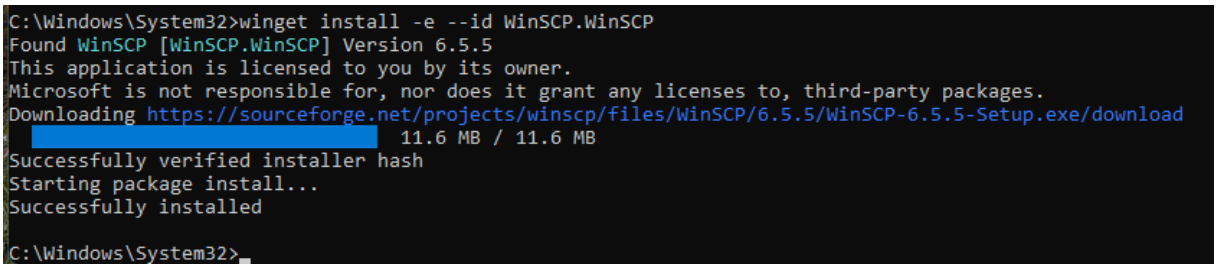
unique package identifier in the Winget database. This guarantees Winget installs the correct Firefox installer.

- WinSCP
- Notepad++
- 7zip

c)



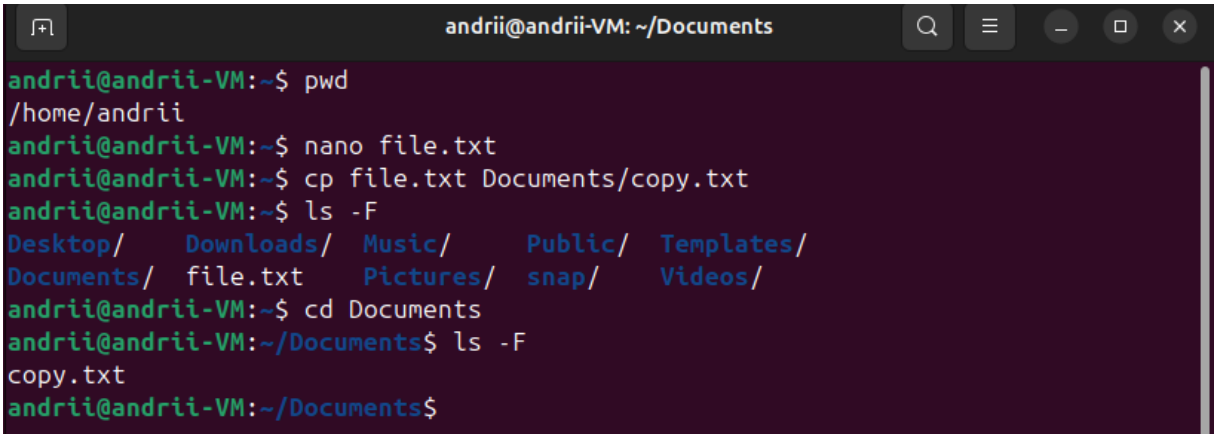




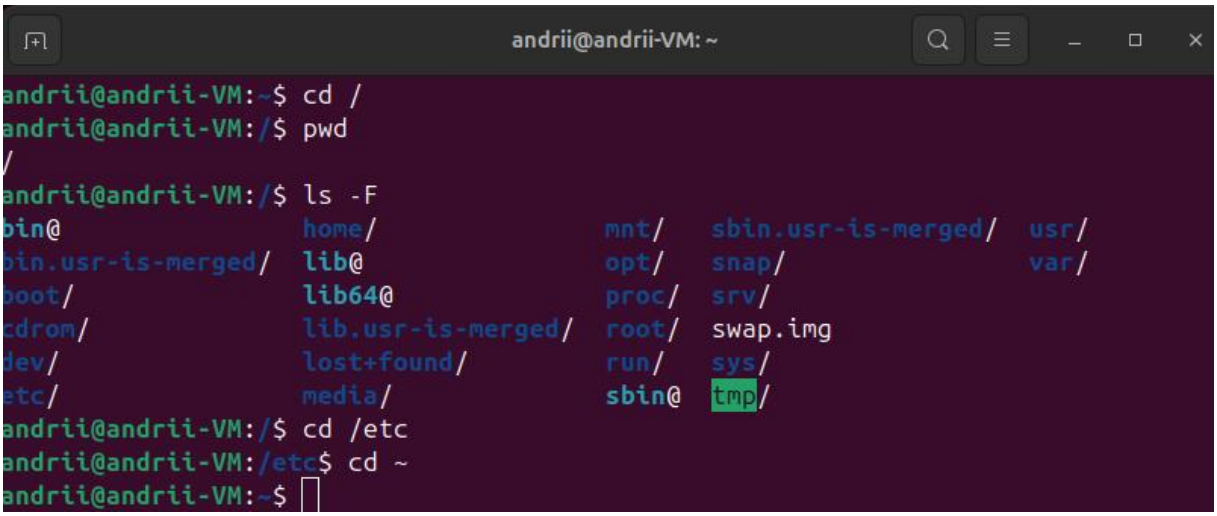
Assignment 5.4: Working with Linux

Relevant screenshots + motivation

- Copying files



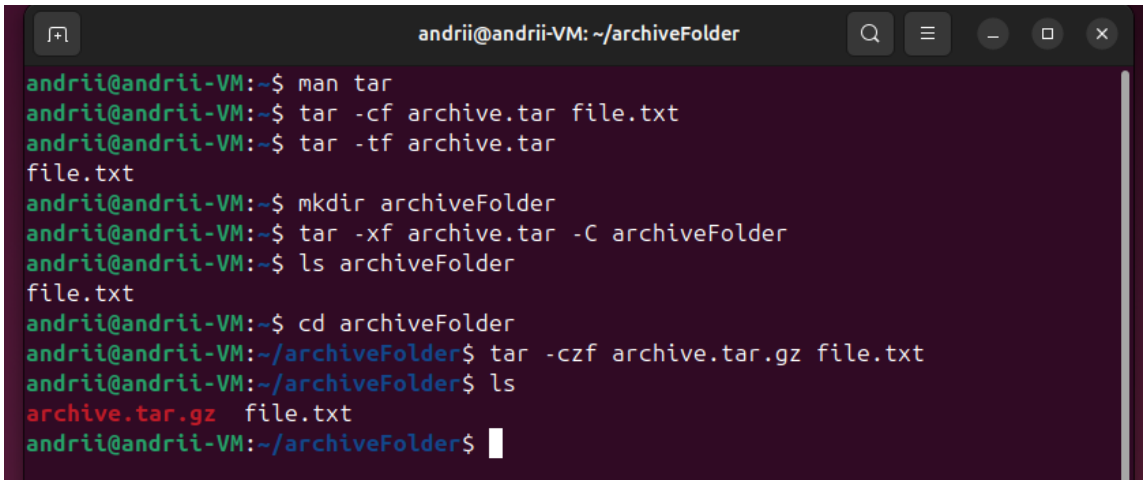
- Navigating the file structure



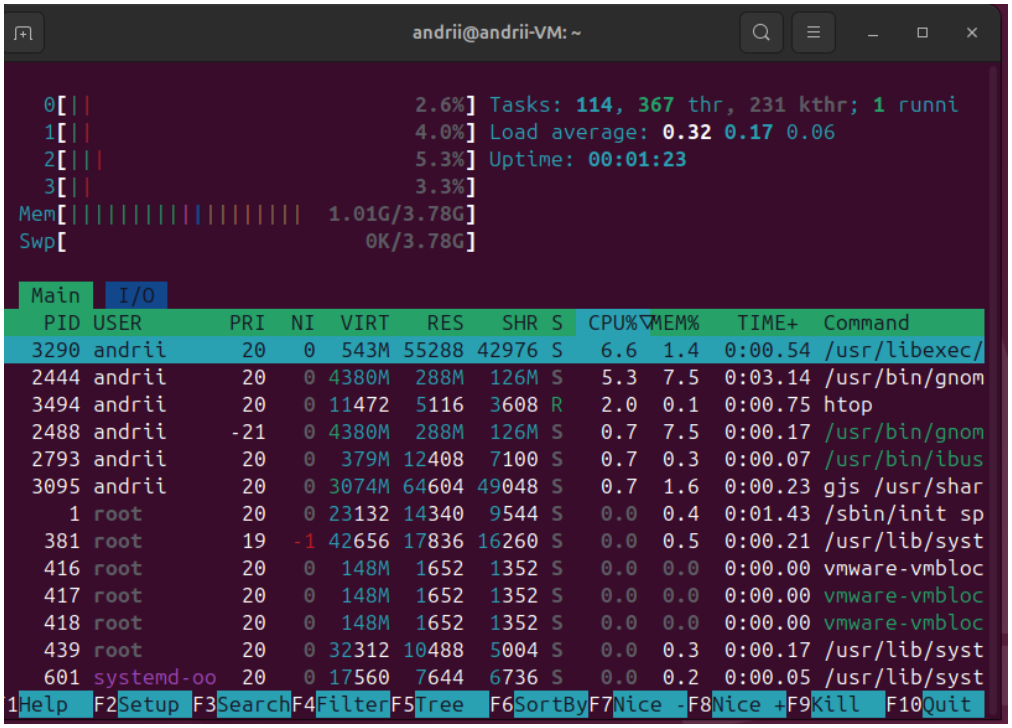
In Linux everything starts from a single root directory /, whereas in Windows everything starts form drives like C:\ or D:\.

/etc is a folder where Linux store system configuration files.

- Compress files

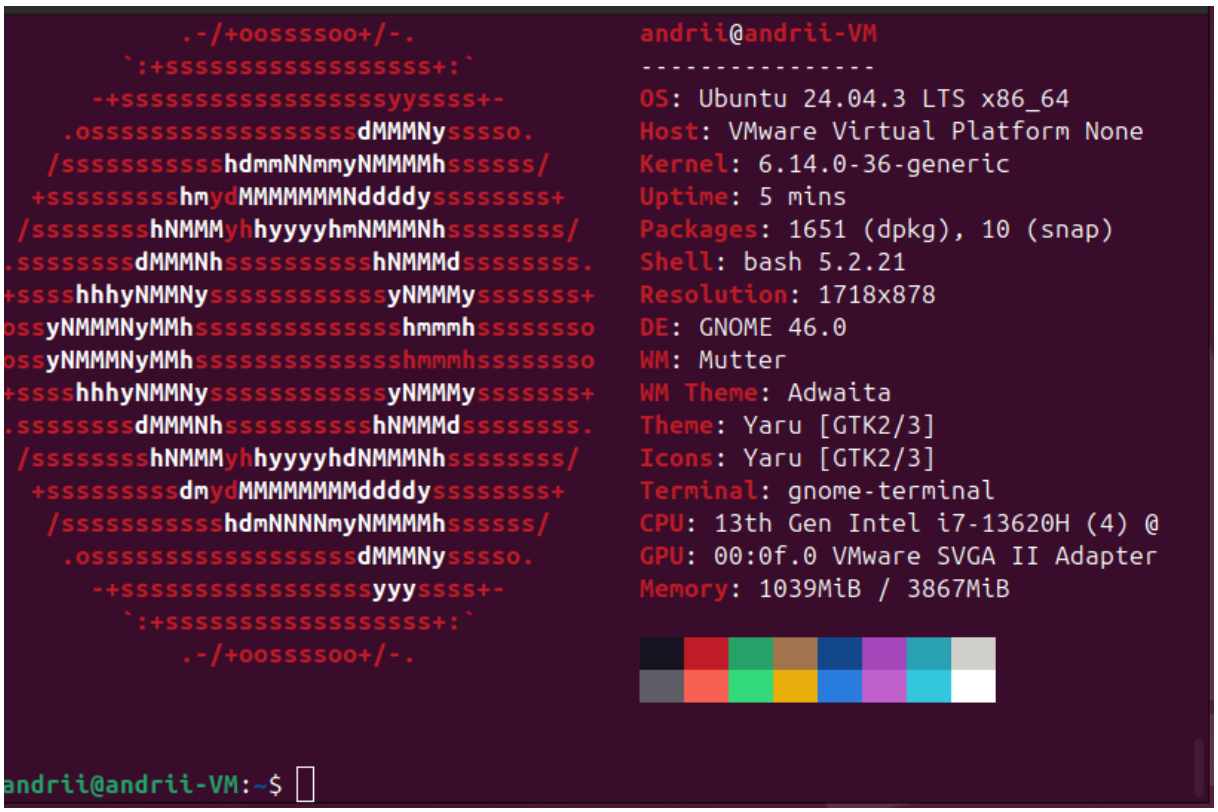


- View processes



htop that shows real-time CPU, memory, and process usage. It lets you see which programs are using the most resources and manage processes.

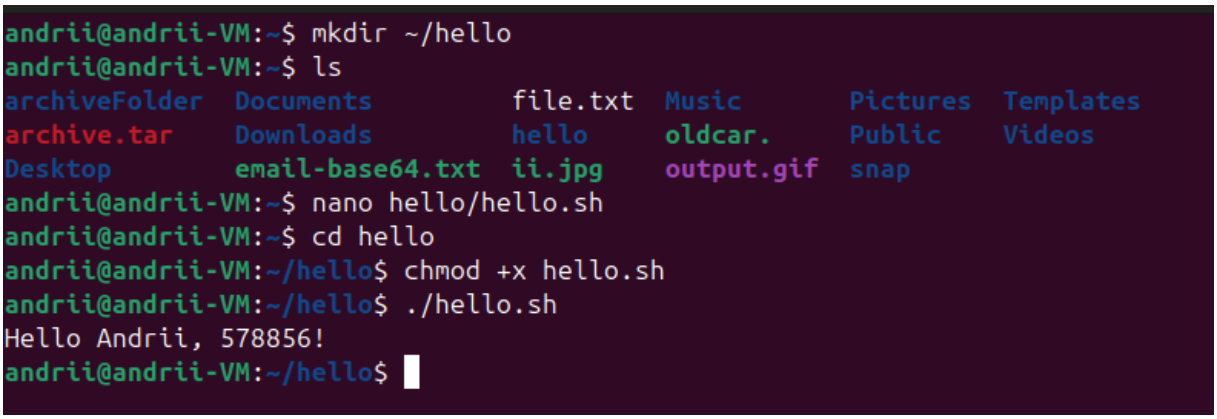
- Install Software

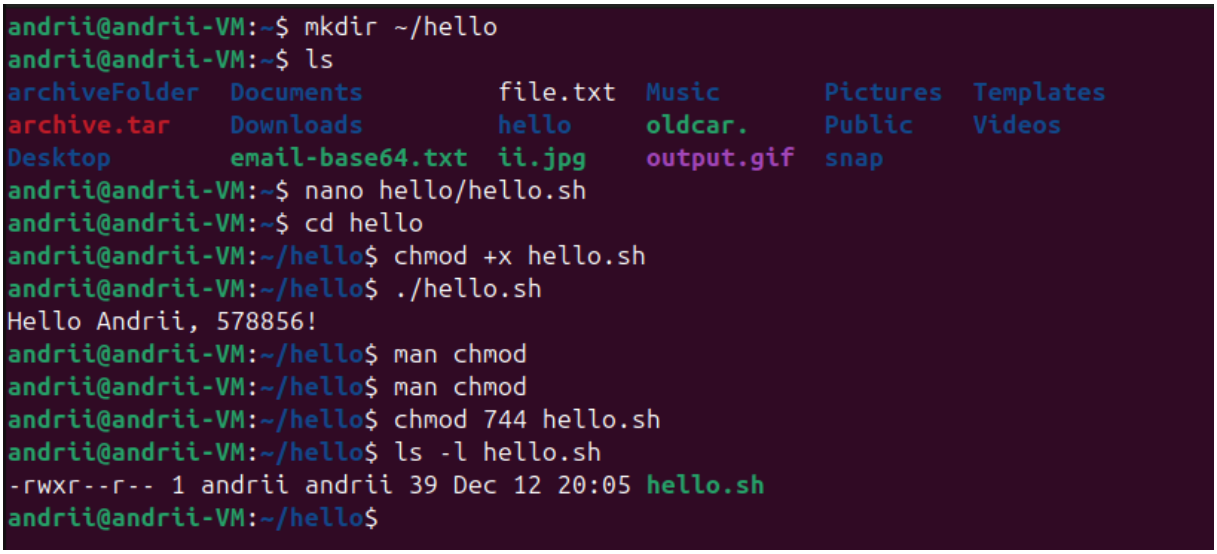


Neofetch shows a summary of your system's hardware, OS, and resource information in the terminal.

Assignment 5.5: Users and permissions on Linux

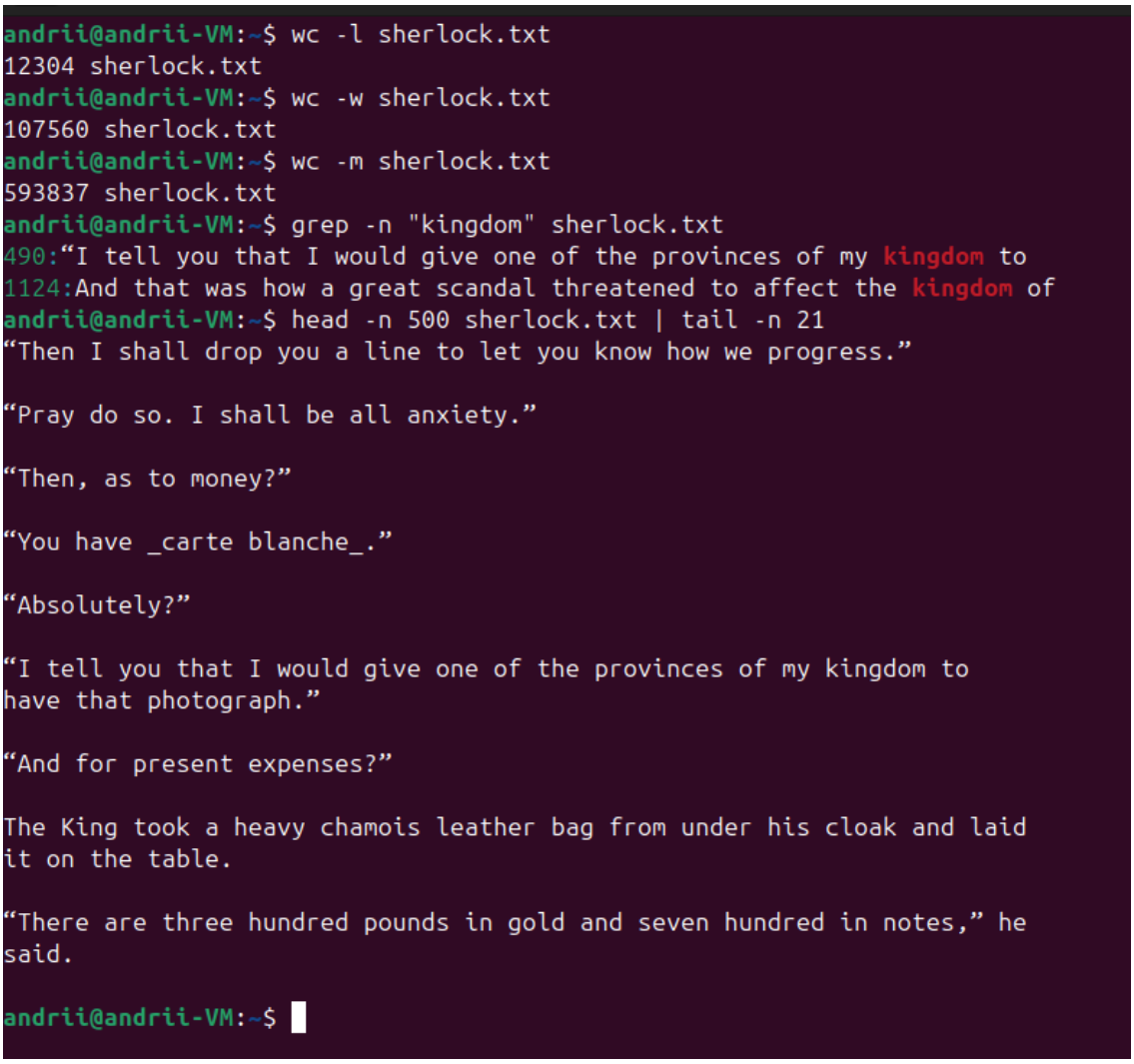
Relevant screenshots + motivation





Assignment 5.6: View the contents of files

Relevant screenshots + motivation



Assignment 5.7: Digital forensics

Relevant screenshots + motivation

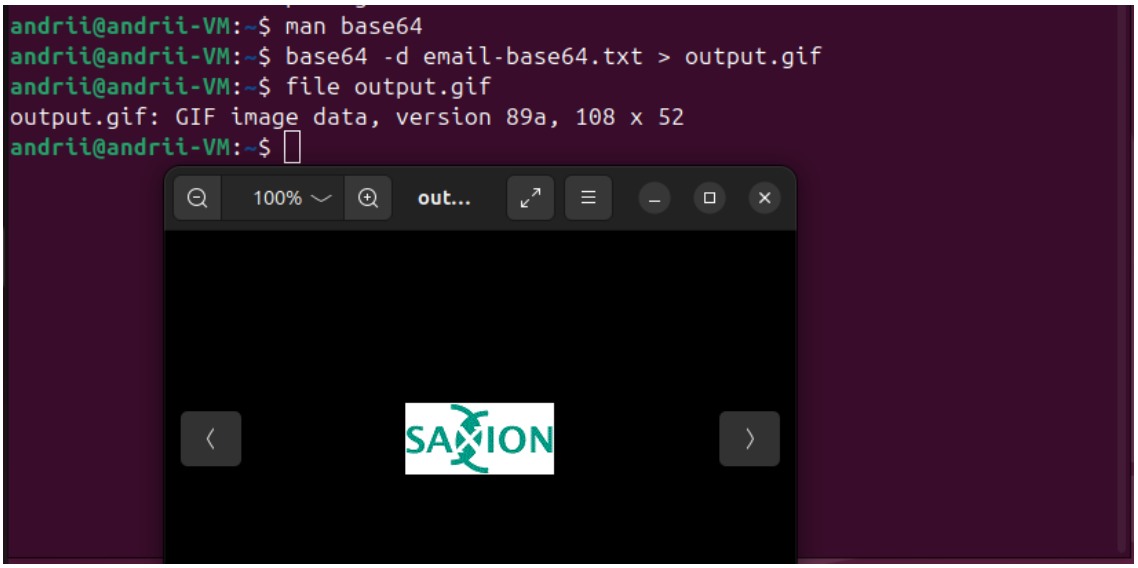
```
      --usage                    Display brief usage message
andrii@andrii-VM:~$ exif oldcar.jpg
EXIF tags in 'oldcar.jpg' ('Motorola' byte order):
--------------------+------------------------------------------------------
Tag                 |Value
--------------------+------------------------------------------------------
Manufacturer        |motorola
Model               |moto g(6) play
X-Resolution        |72
Y-Resolution        |72
Resolution Unit     |Inch
Software            |aljeter-user 9 PPPS29.55-35-18-7 6a0d0 release-keys
Date and Time       |2020:11:07 15:08:57
YCbCr Positioning   |Centered
Compression         |JPEG compression
X-Resolution        |72
Y-Resolution        |72
Resolution Unit     |Inch
Exposure Time       |1/33 sec.
F-Number            |f/2.0
Exposure Program    |Normal program
ISO Speed Ratings   |64
Exif Version        |Exif Version 2.2
F-Number            |f/2.0
Exposure Program    |Normal program
ISO Speed Ratings   |64
Exif Version        |Exif Version 2.2
Date and Time (Origi|2020:11:07 15:08:57
Date and Time (Digit|2020:11:07 15:08:57
Components Configura|Y Cb Cr -
Shutter Speed       |5.05 EV (1/33 sec.)
Aperture            |2.00 EV (f/2.0)
Brightness          |-1.00 EV (1.71 cd/m^2)
Exposure Bias       |0.00 EV
Maximum Aperture Val|2.00 EV (f/2.0)
Metering Mode       |Center-weighted average
```

Phone: moto g(6) play.

Location: the photo was made in Groningen.

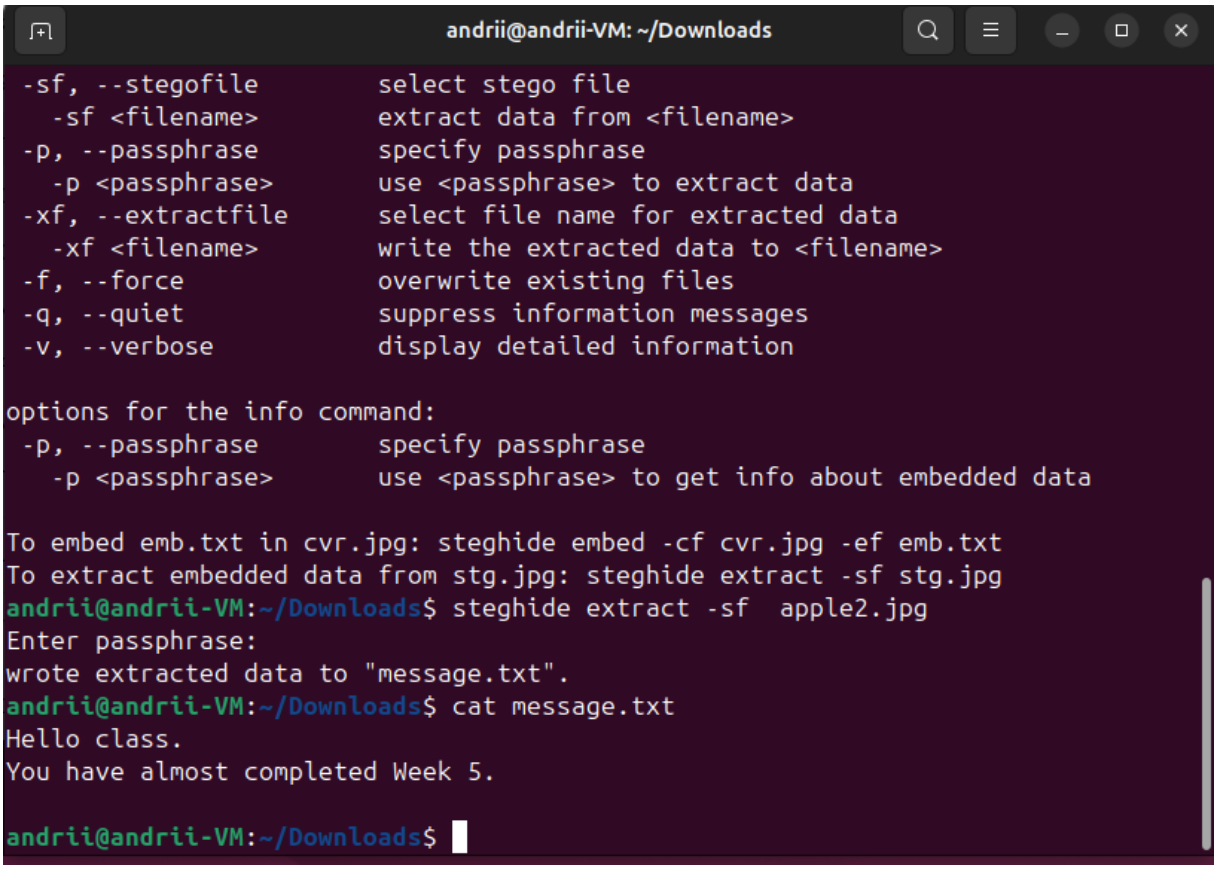
```
andrii@andrii-VM:~$ file oldcar.
oldcar.: JPEG image data, JFIF standard 1.01, aspect ratio, density 1x1, segment length 16, Exif Standard: [TIFF image data, big-endian, direntries=10, manufacture
r=motorola, model=moto g(6) play, xresolution=160, yresolution=168, resolutionunit=2, software=aljeter-user 9 PPPS29.55-35-18-7 6a0d0 release-keys, datetime=2020:1
1:07 15:08:57, GPS-Data], baseline, precision 8, 4160x3120, components 3
```

It still recognises it as a jpeg file.



Assignment 5.8: Steganography

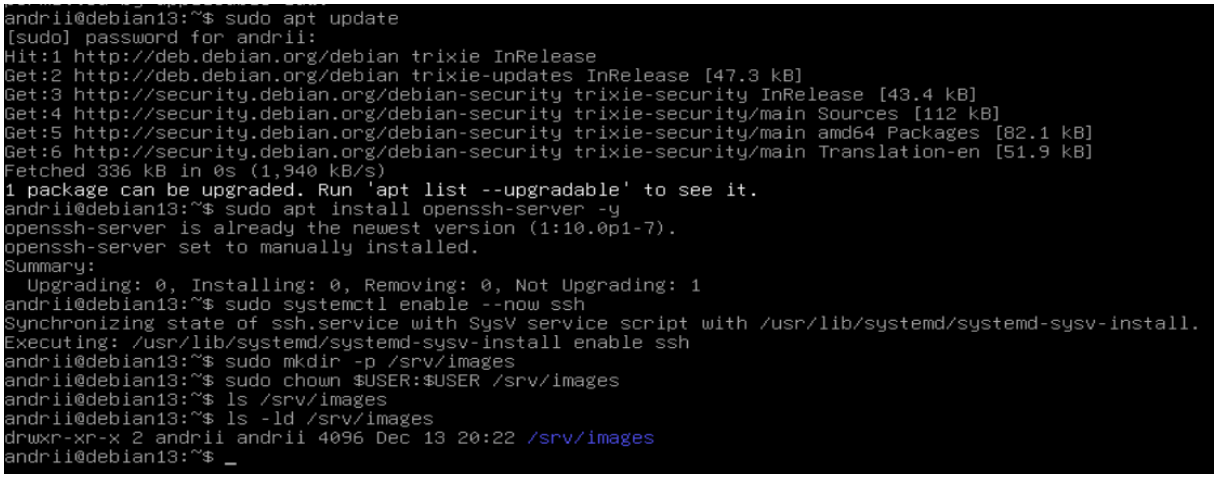
Relevant screenshots + motivation

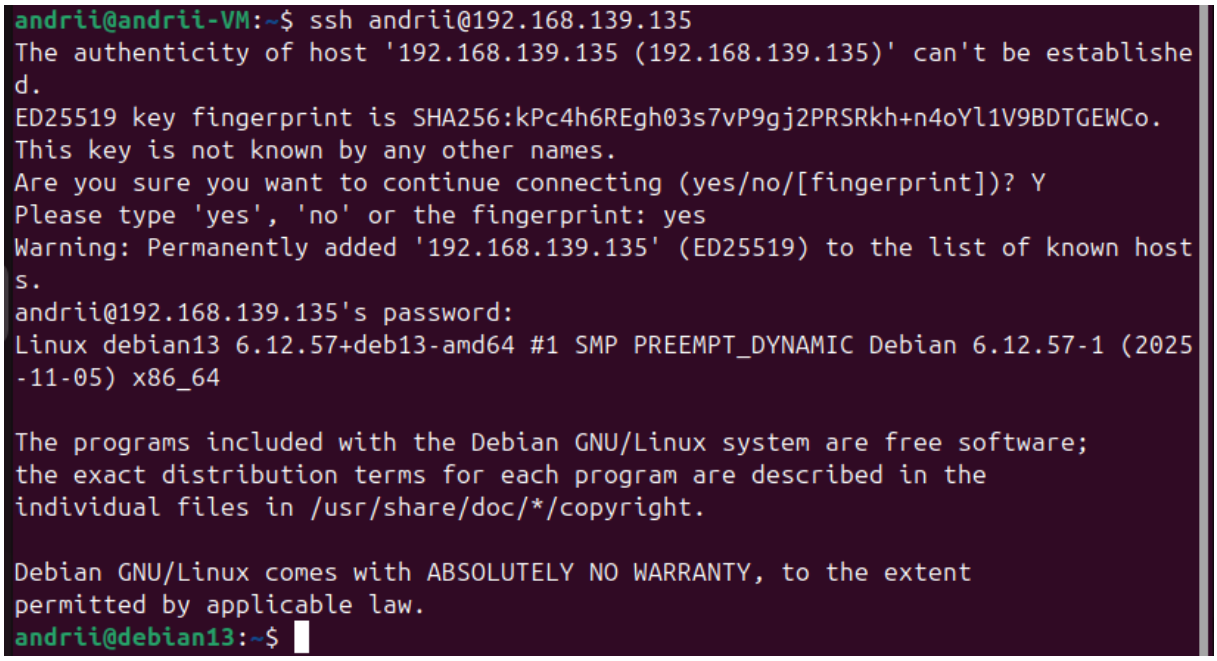


Assignment 5.9: Capture disk images

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.



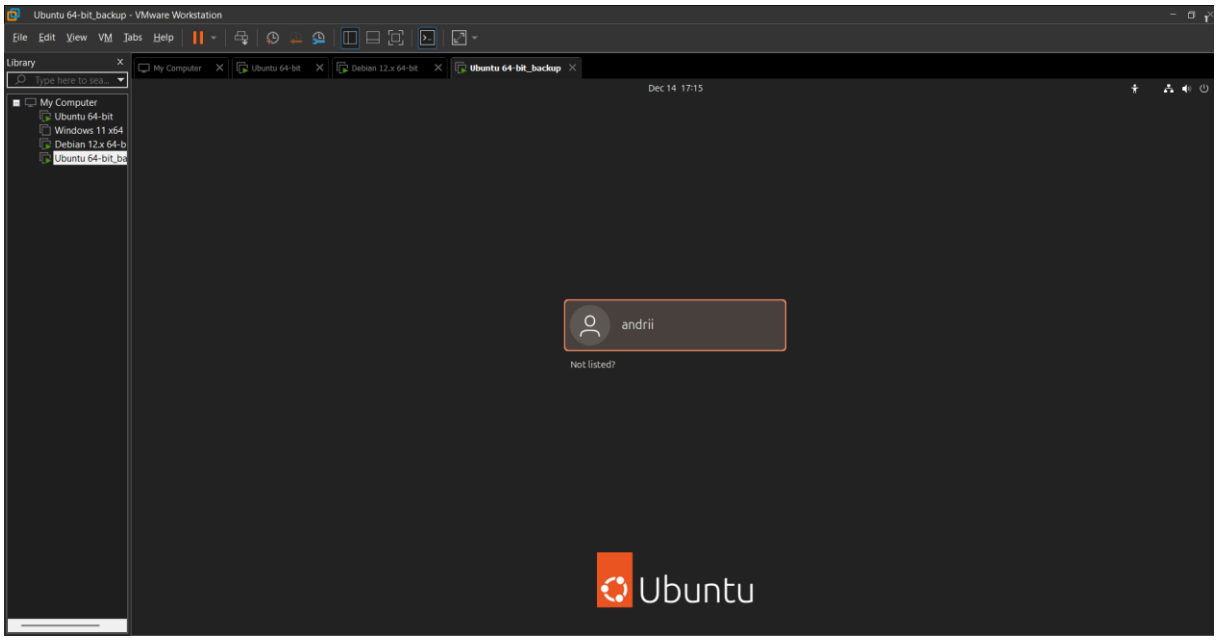


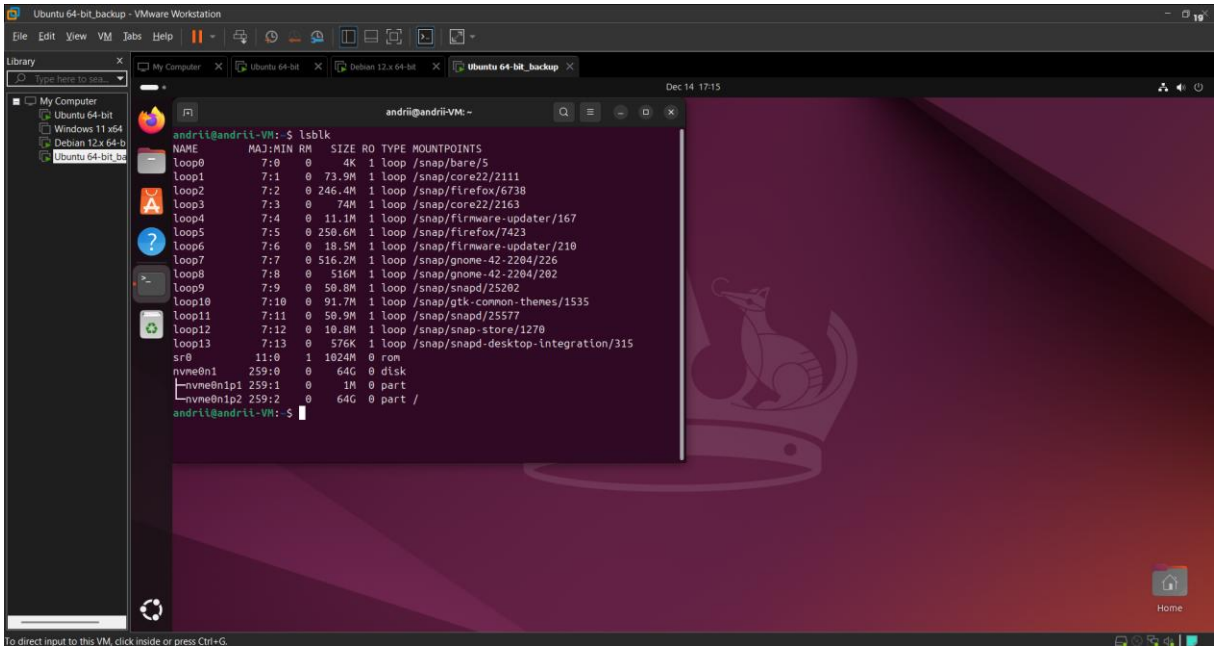
```
ubuntu@ubuntu:~$ lsblk
NAME        MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
loop0         7:0    0   1.7G  1 loop /rofs
loop1         7:1    0 535.4M  1 loop
loop2         7:2    0   926M  1 loop
loop3         7:3    0     4K  1 loop /snap/bare/5
loop4         7:4    0  73.9M  1 loop /snap/core22/2111
loop5         7:5    0 246.4M  1 loop /snap/firefox/6738
loop6         7:6    0  11.1M  1 loop /snap/firmware-updater/167
loop7         7:7    0   516M  1 loop /snap/gnome-42-2204/202
loop8         7:8    0  10.8M  1 loop /snap/snap-store/1270
loop9         7:9    0  91.7M  1 loop /snap/gtk-common-themes/1535
loop10        7:10   0   226M  1 loop /snap/thunderbird/796
loop11        7:11   0  50.8M  1 loop /snap/snapd/25202
loop12        7:12   0   576K  1 loop /snap/snapd-desktop-integration/315
loop13        7:13   0 112.6M  1 loop /snap/ubuntu-desktop-bootstrap/413
sr0           11:0    1   5.9G  0 rom  /cdrom
nvme0n1      259:0    0    64G  0 disk
├─nvme0n1p1  259:1    0     1M  0 part
└─nvme0n1p2  259:2    0    64G  0 part
ubuntu@ubuntu:~$
```

```
ubuntu@ubuntu:~$ sudo dd if=/dev/nvme0n1 bs=4M status=progress | gzip | ssh andrii@192.168.139.135 "cat > /srv/images/ub
untu2404_vm.img.gz"
The authenticity of host '192.168.139.135 (192.168.139.135)' can't be established.
ED25519 key fingerprint is SHA256:kPc4h6REgh03s7vP9gj2PRSRkh+n4oYl1V9BDTGEWCo.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.139.135' (ED25519) to the list of known hosts.
andrii@192.168.139.135's password:
Permission denied, please try again.
andrii@192.168.139.135's password:
68484595712 bytes (68 GB, 64 GiB) copied, 559 s, 123 MB/s
16384+0 records in
16384+0 records out
68719476736 bytes (69 GB, 64 GiB) copied, 560.012 s, 123 MB/s
ubuntu@ubuntu:~$
```

```
andrii@debian13:/$ ls /srv/images
ubuntu2404_vm.img.gz
andrii@debian13:/$ _
```

I forgot to take a screenshot after doing sudo dd if=/dev/sda bs=4M status=progress | gzip | ssh @ "cat > /srv/images/ubuntu2404_vm.img.gz", but I attached screenshots from restored VM.


Ubuntu 64-bit_backup - VMware Workstation
File Edit View VM Tabs Help
Library
My Computer
Ubuntu 64-bit
Windows 11 x64
Debian 12.x 64-b
Ubuntu 64-bit_ba
My Computer
Ubuntu 64-bit
Debian 12.x 64-bit
Ubuntu 64-bit_backup
Dec 14 17:15
andrii
Not listed?
Ubuntu


Ubuntu 64-bit_backup - VMware Workstation
File Edit View VM Tabs Help
Library
My Computer
Ubuntu 64-bit
Windows 11 x64
Debian 12.x 64-b
Ubuntu 64-bit_ba
My Computer
Ubuntu 64-bit
Debian 12.x 64-bit
Ubuntu 64-bit_backup
Dec 14 17:15
andrii@andrii-VM: ~
andrii@andrii-VM:~$ lsblk
NAME MAJ:MIN RM SIZE RO TYPE MOUNTPOINTS
loop0 7:0 0 4K 1 loop /snap/bare/5
loop1 7:1 0 73.9M 1 loop /snap/core22/2111
loop2 7:2 0 246.4M 1 loop /snap/firefox/6738
loop3 7:3 0 74M 1 loop /snap/core22/2163
loop4 7:4 0 11.1M 1 loop /snap/firmware-updater/167
loop5 7:5 0 250.6M 1 loop /snap/firefox/7423
loop6 7:6 0 18.5M 1 loop /snap/firmware-updater/210
loop7 7:7 0 516.2M 1 loop /snap/gnome-42-2204/226
loop8 7:8 0 516M 1 loop /snap/gnome-42-2204/202
loop9 7:9 0 50.8M 1 loop /snap/snapd/25202
loop10 7:10 0 91.7M 1 loop /snap/gtk-common-themes/1535
loop11 7:11 0 50.9M 1 loop /snap/snapd/25577
loop12 7:12 0 10.8M 1 loop /snap/snap-store/1270
loop13 7:13 0 576K 1 loop /snap/snapd-desktop-integration/315
sr0 11:0 1 1024M 0 rom
nvme0n1 259:0 0 64G 0 disk
├─nvme0n1p1 259:1 0 1M 0 part
└─nvme0n1p2 259:2 0 64G 0 part /
andrii@andrii-VM:~$
Home
To direct input to this VM, click inside or press Ctrl+G.