Linux

An introduction to Linux
and the command line

BIOS

- Few definitions : to understand each other !
- Live Test or Hard Drive Installation ?
- Linux Fundamentals
- Ubuntu 20.04 LTS / Ubuntu 22.04 LTS
- Why use Linux ?
- The command line

Definitions

Computer

Software

Operating system

Computer ?

1 – Equipment giving access to digital content

- Desktop PC, laptop PC
- Pad, smartphone
- TV, game console

2 - Equipment connected to internet

- Internet of Things (IoT)

Software ?

« The digital tool you used to interact with a computer »

Synonymous of « software »

- Program
- Code
- Application
- ****ware

The 4 Essential Freedom of Software

1) The freedom to use a software « Execution »
2) The freedom to copy a sofware « Distribution »
3) **The freedom to study a software** « Source code »
4) The freedom to modify a software « Edition »

- Depending on the access to these « freedoms » it is possible to classify software in 2 categories …

Software categories

- Proprietary : none or **1)**
- Free : **1)**, and/or **2)** and/or **3)** and/or **4)**

… like any other product software is (or should be) protected, by what is called a user license. There are many kind of Free (Open Source) software licenses that differ based on the access to the 4 Freedoms.

Open source software licences : GPL, BSD, Apache, Creative commons

Proprietary software

- Proprietary = someone owns the software (**not you**) and sells you access to some of the 4 Freedoms, usually only **1)**

Hack proprietary software ?

- ~~That is wrong bouuuuuuhhhhh~~
- Who does (did) it among you ?
- Why ?
  - Games ?
  - Anything else ?
- How much of the software capabilities where you using ?
- What if there was something better ? ...

Open Source Software

Open Source Software

A little bit of history:

- **1983** : Creation of GNU and the GPL license by **Richard M. Stallman** (RMS)
- **1985** : Creation of the **F**ree **S**oftware **F**oundation by RMS

FREE SOFTWARE FOUNDATION
www.fsf.org

- **1991** : Linux is developed by **Linus Torvalds**

- **2004** : Open source software officially enter UNESCO world heritage

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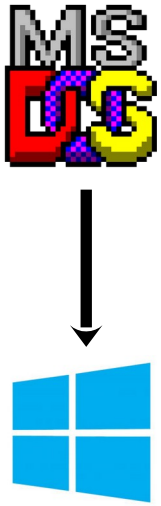
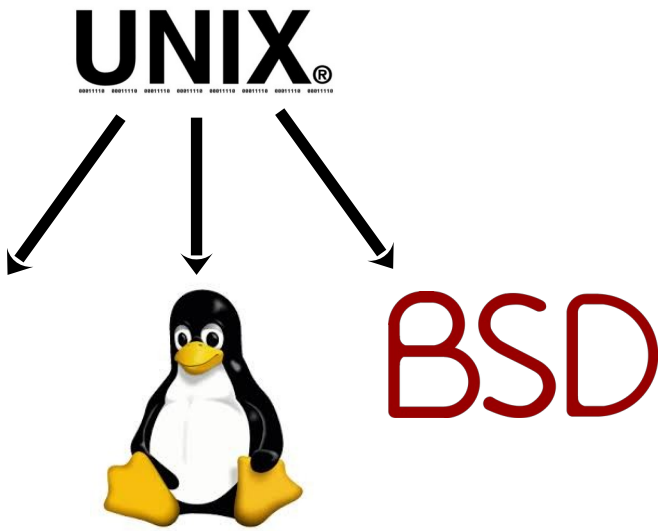
Famous Open Source Software

Operating System

« The first program that will start when you turn on your computer, without it is not possible to use other programs »

- Short name « **OS** », **S**ystème d'**E**xploitation « **SE** »





Operating Systems ?!

Android: 40.5%

Windows: 34.2%

OSX+iOS: 22.3%

Linux: 1%

Proportion of each OS **all devices** considered

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Android: 40.5%

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Proportion of each OS **all devices** considered

The Operating System !

Linux: 41.5%

Windows: 34.2%

OSX+iOS: 22.3%

Proportion of each OS **all devices** considered

Linux Distributions: GNU/Linux

- A set of open source software composed of:
  - **Linux system** (“Kernel” or “Noyau”**)**
  - **Complementary and pre-installed / pre-parametrized software**
    - A graphical user interface
    - An office suite
    - Web browsers and mail readers
    - Multimedia packages … and many more !

GNU components







Linux Distributions: GNU/Linux

- A set of open source software composed of:
  - **Linux system** (“Kernel” or “Noyau”**)**
  - **Complementary and pre-installed [illegible] arametrized software**
    - A graphical user interface
    - An office suite
    - Web browsers an[illegible]
    - Multimedia package[illegible]ny more !

Up to 20 000 !!!

GNU components







Linux Distributions

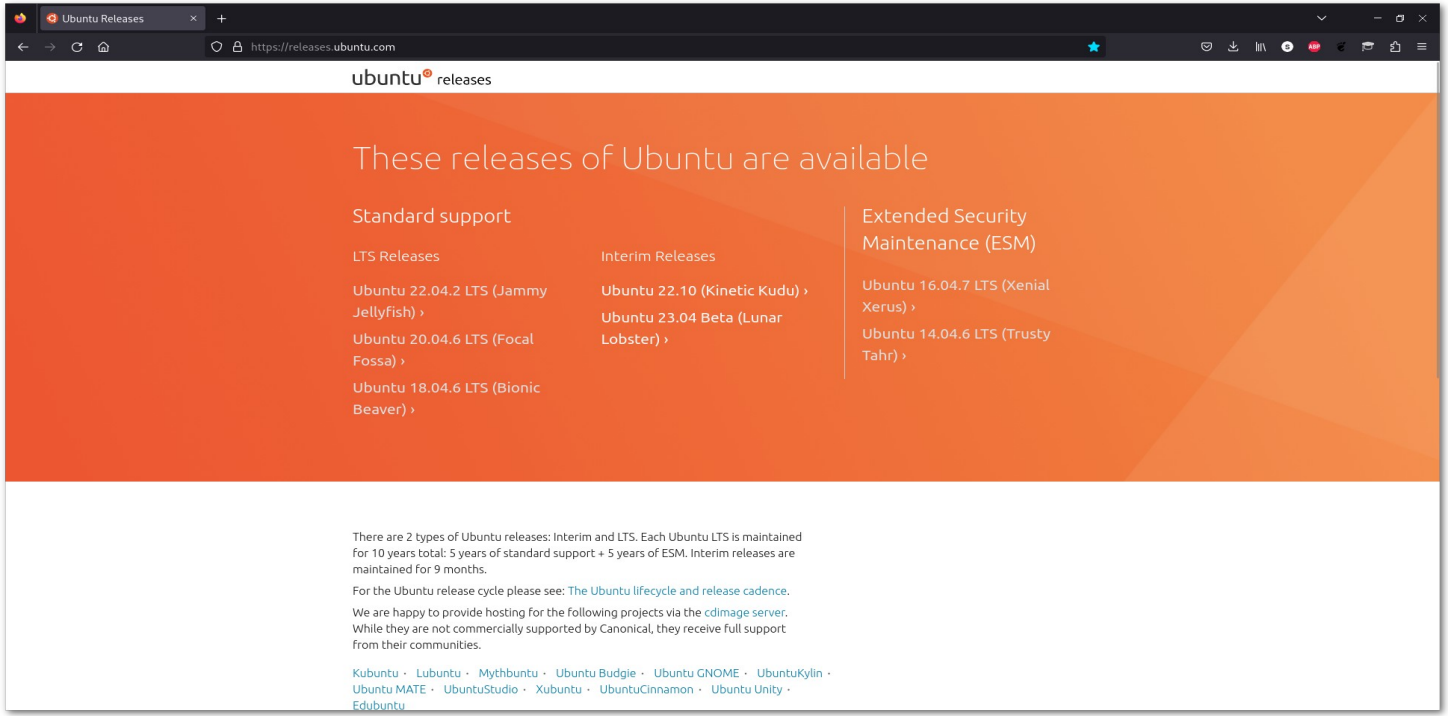
Red Hat Package Manager
".rpm"

Debian Package Manager
".deb"

Sources Codes
".tar.gz" or ".tar.bz2"

Linux Distribution: Which One ?

- Ubuntu is the best choice for beginners !



https://releases.ubuntu.com/ or https://ubuntu.com/download/desktop

Linux Distribution: Which One ?

These releases of Ubuntu are available

Ubuntu 18.04.6 LTS (Bionic Beaver) ›

Ubuntu 16.04.7 LTS (Xenial Xerus) ›

Ubuntu 20.04.3 LTS (Focal Fossa) ›

Ubuntu 21.04 (Hirsute Hippo) ›

Ubuntu 21.10 (Impish Indri) ›

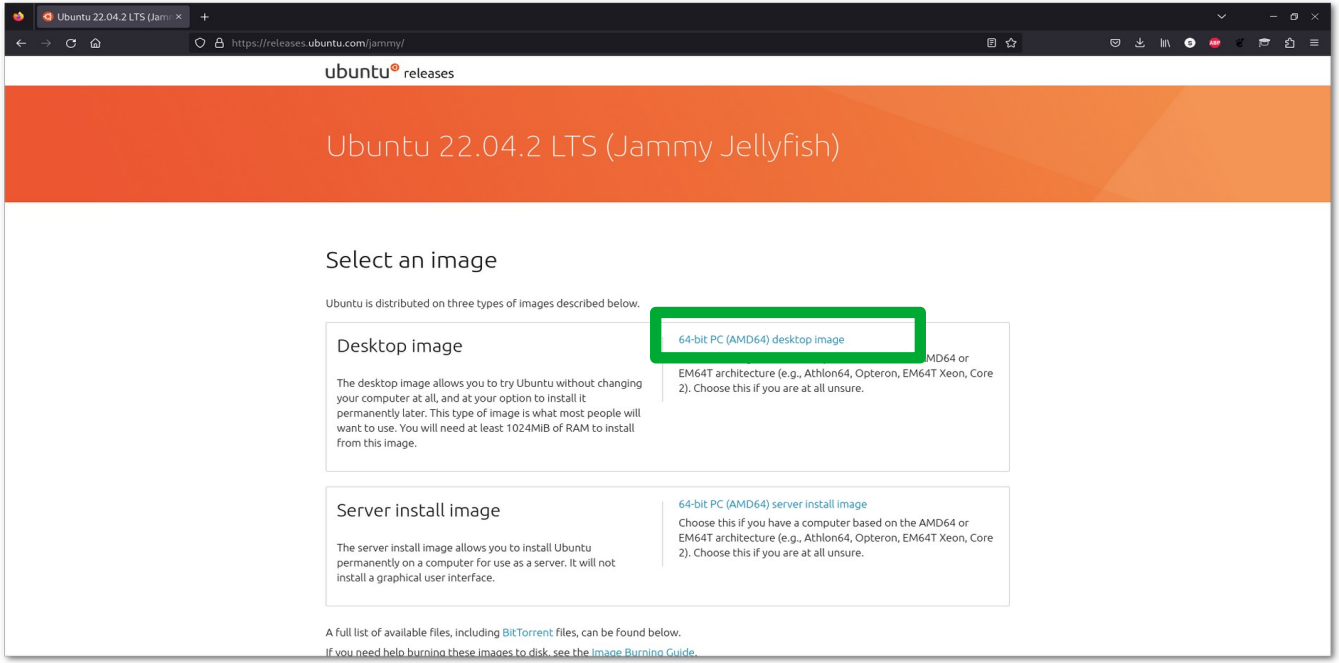
LTS = Long Term Support = 5 years support

Year

Month

Linux Distribution: Ubuntu 22.04.2 LTS

- Code name **“Jammy Jellyfish”**



https://releases.ubuntu.com/focal/ubuntu-22.04.2-desktop-amd64.iso

Linux Distribution: Ubuntu 22.04.3 LTS

Ubuntu 22.04.2 LTS

The latest LTS version of Ubuntu, for desktop PCs and laptops. LTS stands for long-term support — which means five years of free security and maintenance updates, guaranteed until April 2027.

Ubuntu 22.04 LTS release notes

Recommended system requirements:

- 2 GHz dual-core processor or better
- 4 GB system memory
- 25 GB of free hard drive space
- Internet access is helpful
- Either a DVD drive or a USB port for the installer media

Download

For other versions of Ubuntu Desktop including torrents, the network installer, a list of local mirrors and past releases see our alternative downloads.

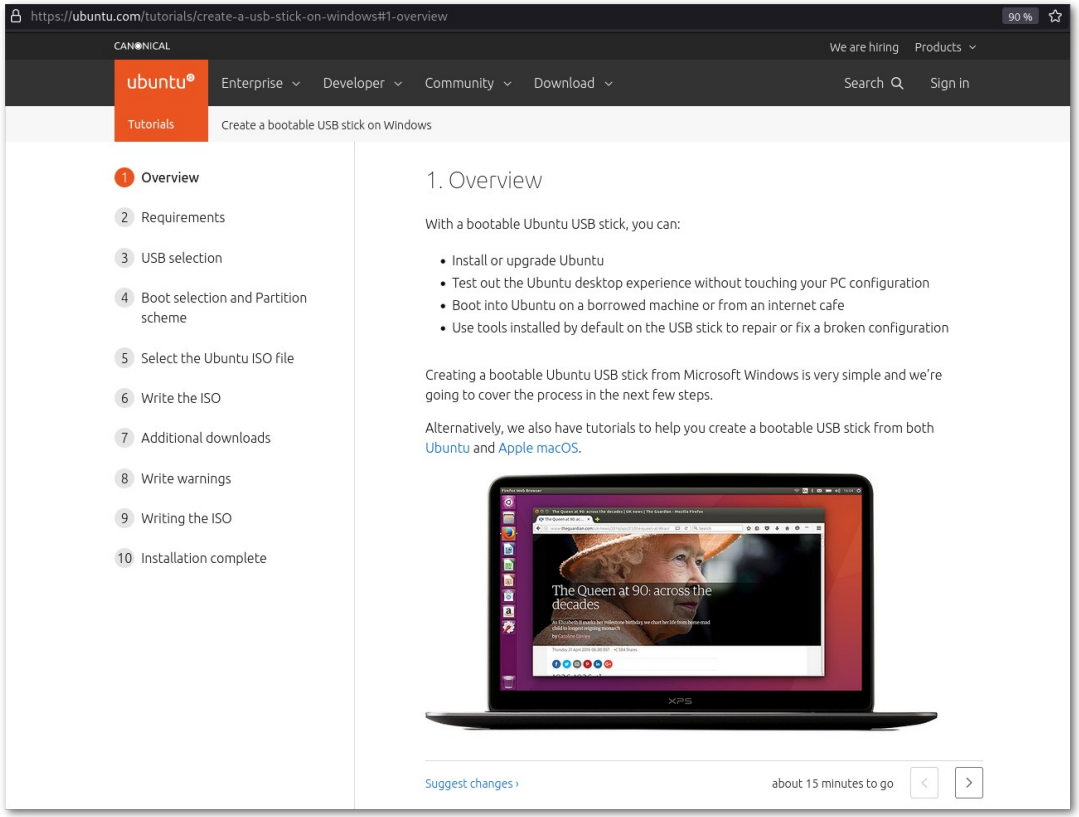
Live Test or Hard Drive Installation ?

- **Live test**: no risk for your hard drive: **that's the easy way !**

Hard drive installation:

- Be careful not to wipe out everything when you install Linux !
- Multiple boot is possible (to have multiple OS on the same computer)
  - **Linux can see MS Windows partition(s)**
  - **MS Windows can not see Linux partition(s)**
- Ask for help !

Preparing the USB key



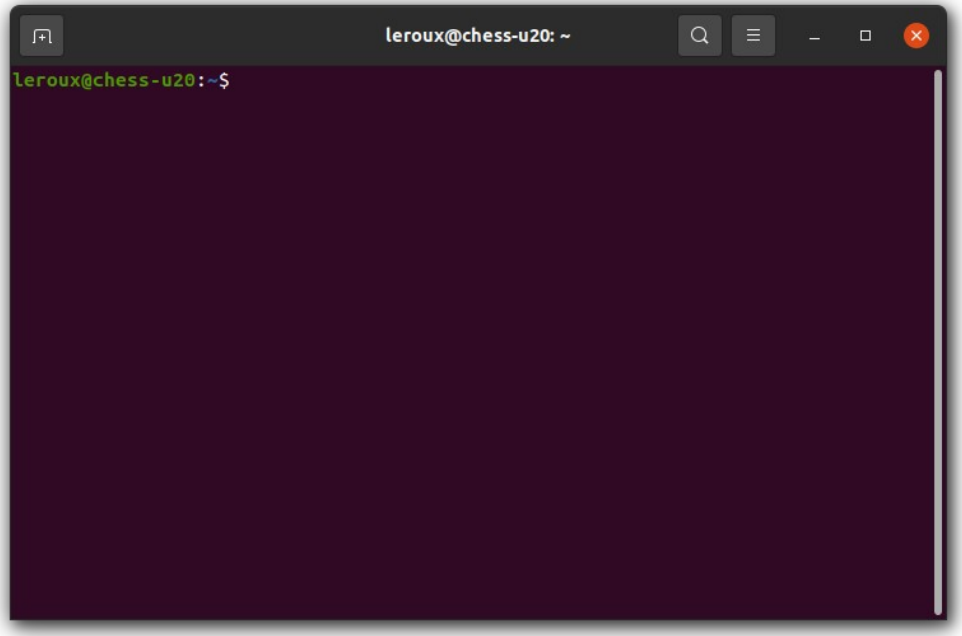
https://ubuntu.com/tutorials/create-a-usb-stick-on-windows

Linux Fundamentals

- The Terminal
- File System
- Users
- File Permissions
- Tips

Linux Fundamentals: The Terminal

- Text interface to your computer
- Often referred as
  - Shell
  - Console
  - Prompt
  - Bash ...



Linux Fundamentals: The Terminal

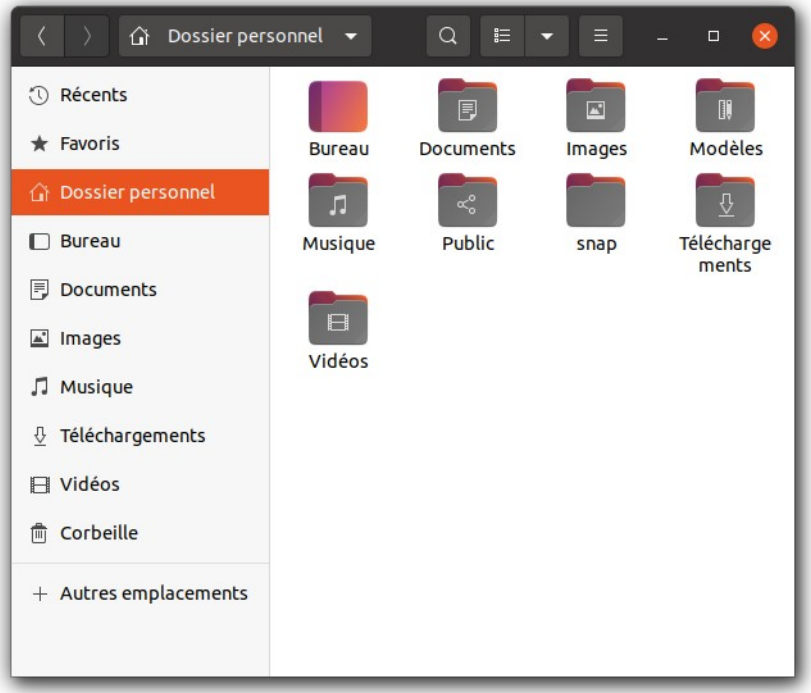
- The “**Prompt**” or “**Invite de commandes**”

```
leroux@chess-u20:~$
```

User | **Host name** | **Location**

- **User :** the name of the user that opened the terminal
- **Host name:** the name of the computer
- **Location:** where you are in the file system tree

Linux Fundamentals: The Terminal



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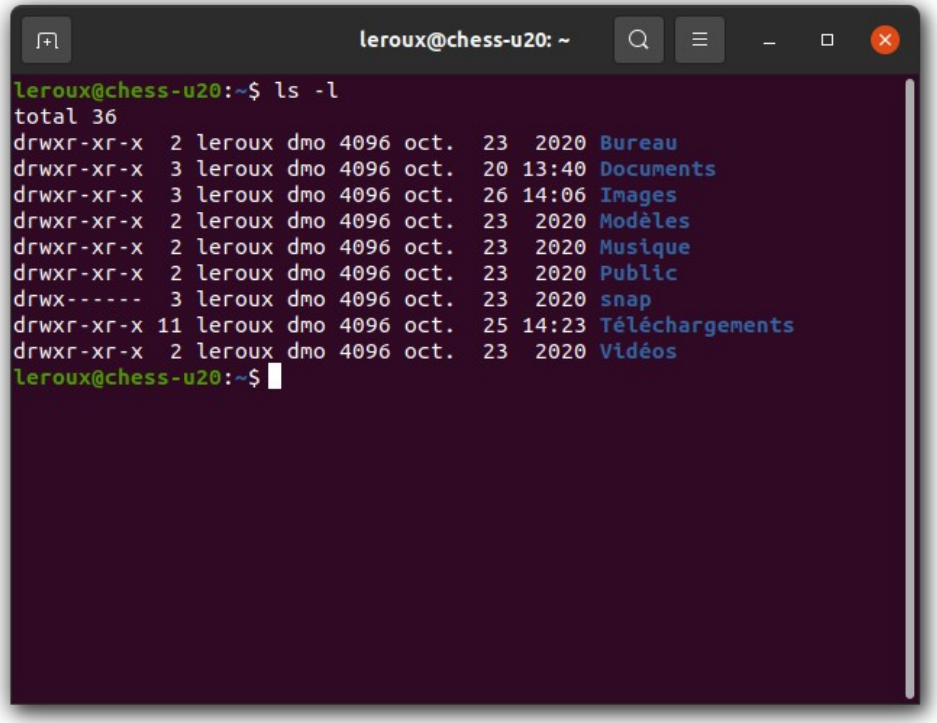
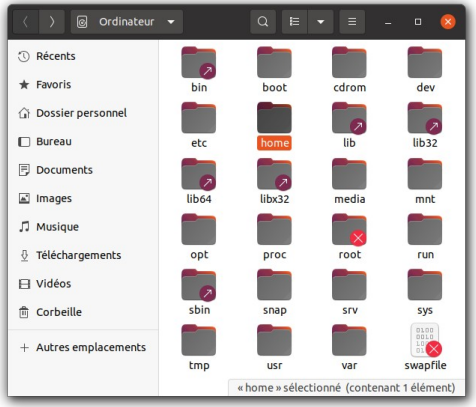
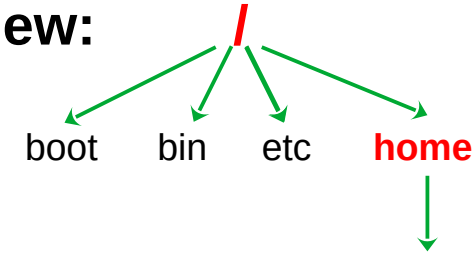


Linux Fundamentals: File System

- **Windows**
  - **Letters for the hard drive(s):** C:\, D:\, E:\ …
  - **Your 'Home' directory:** C:\Users\leroux
- **Linux**
  - **A single tree-view:**



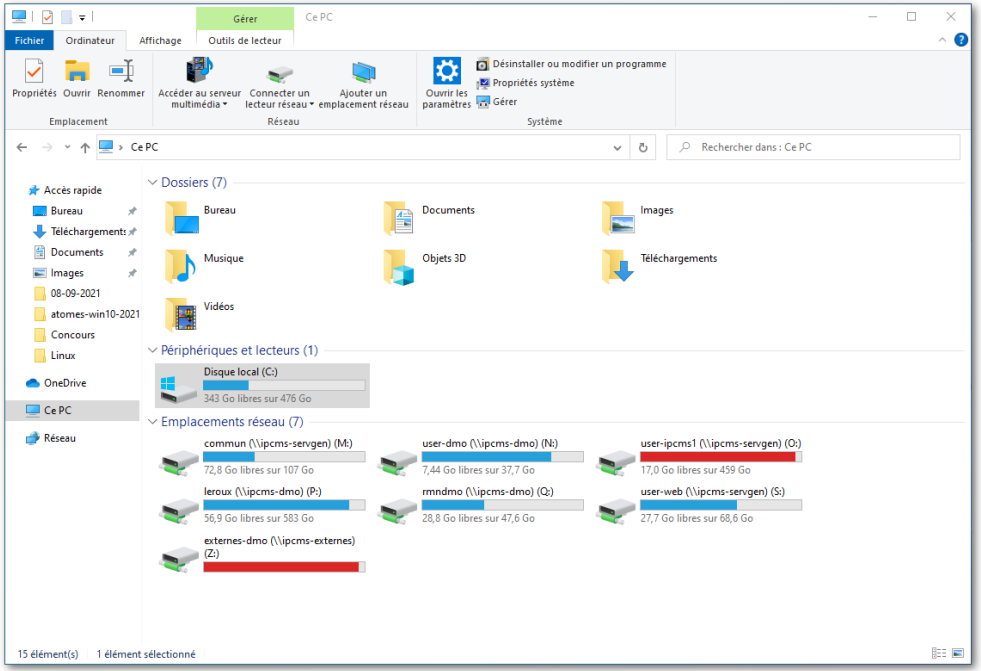


Your 'Home' directory is in there !

"Everything is a File"

All the hard drive(s), devices, component of your computer, is to be found somewhere in this tree-view

File system: windows



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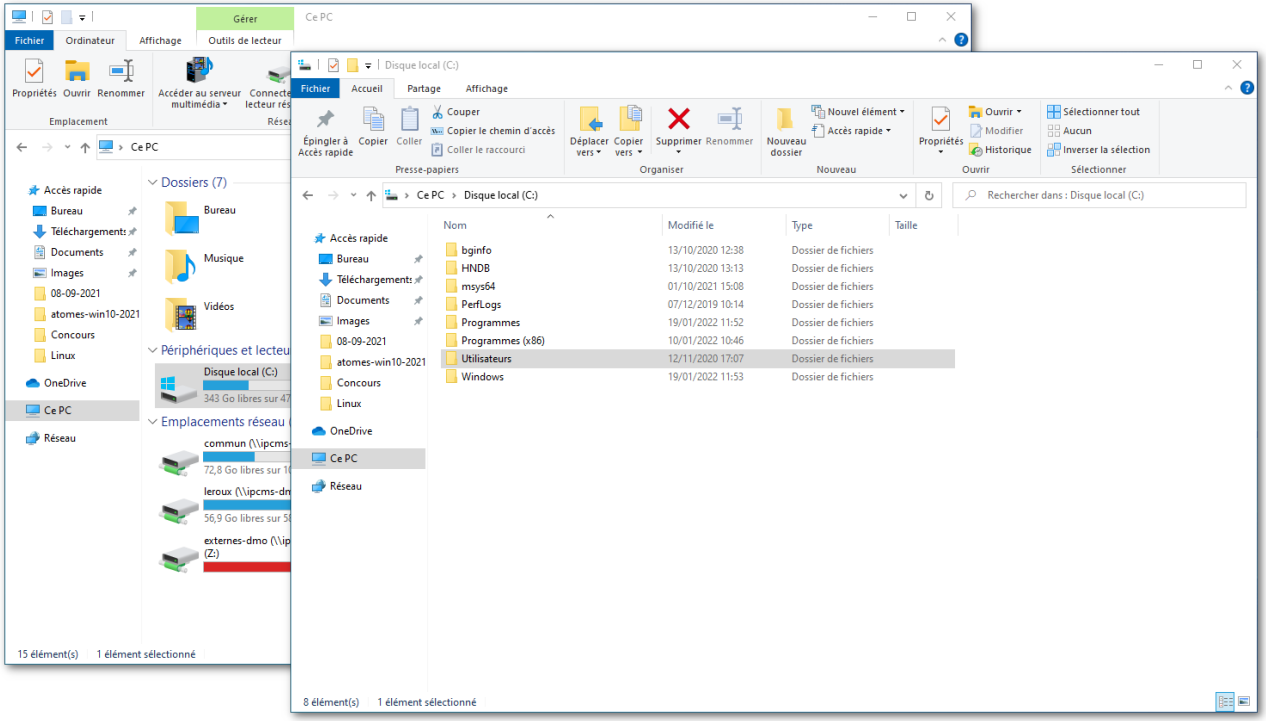

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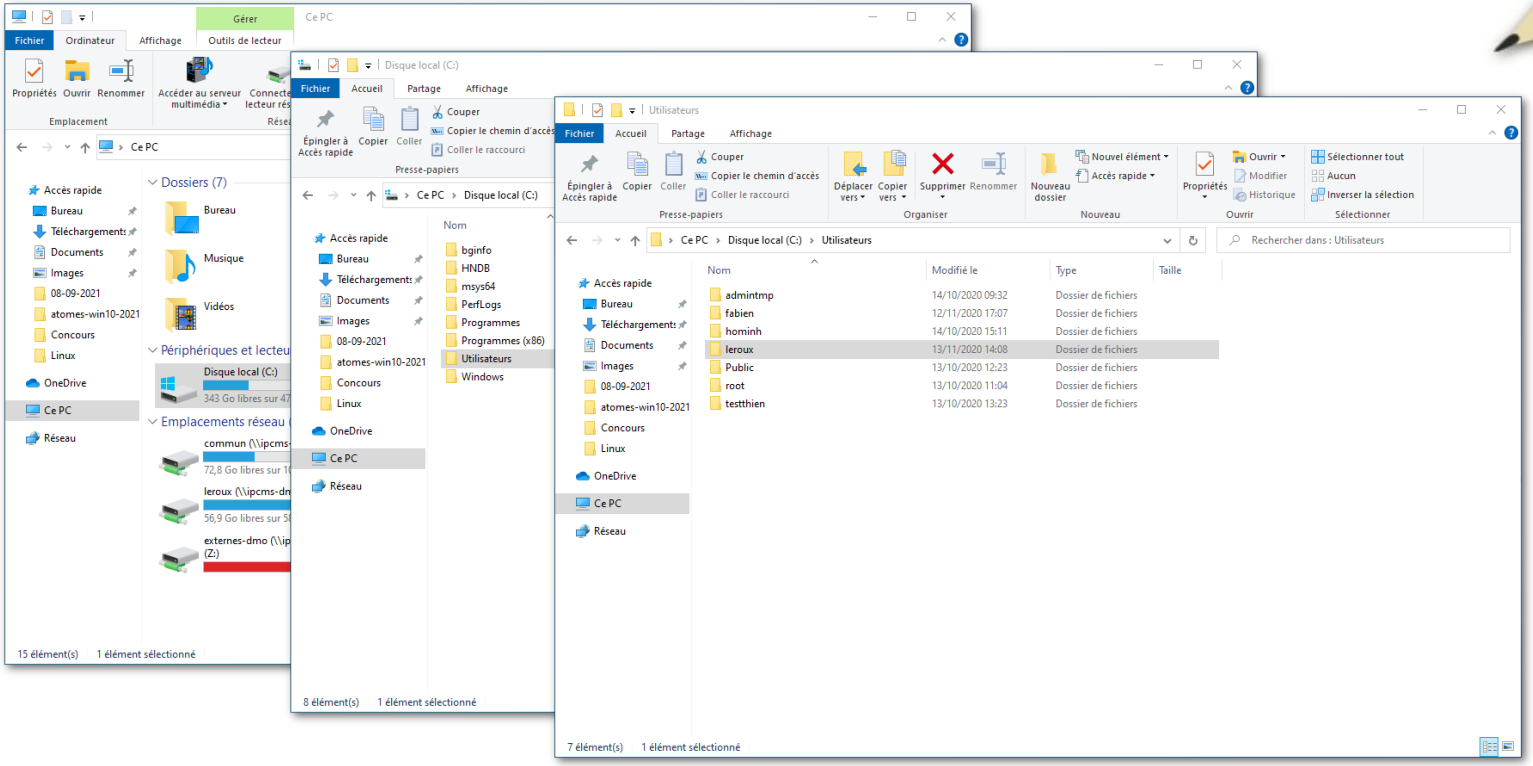

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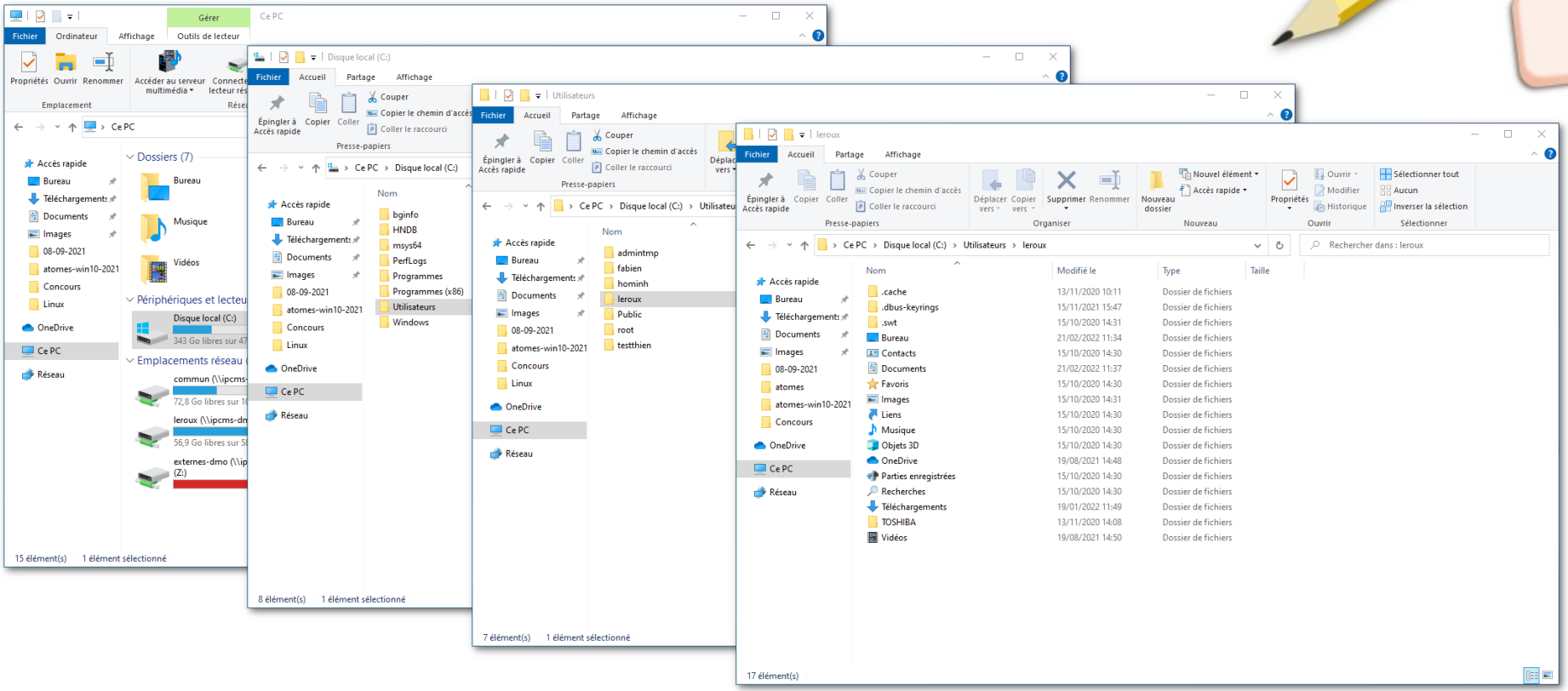
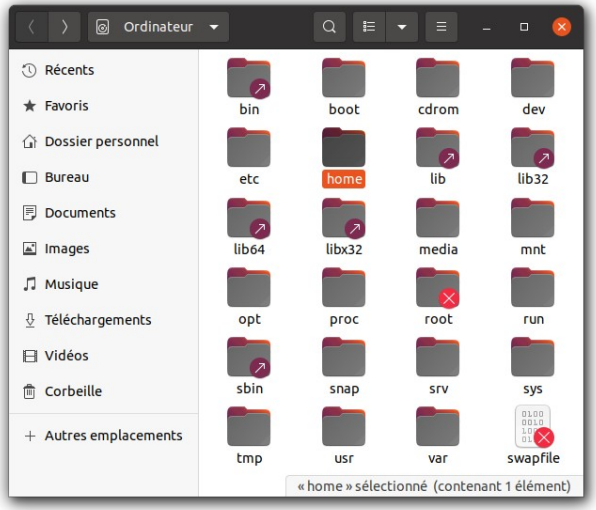


C:\Utilisateurs\leroux\

Linux Fundamentals: File System



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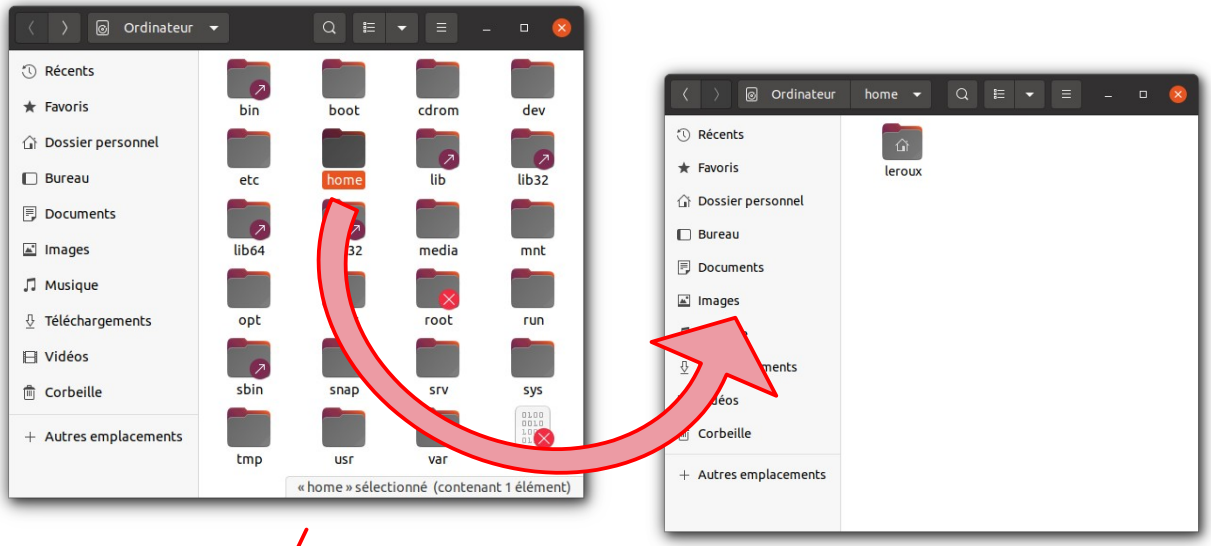

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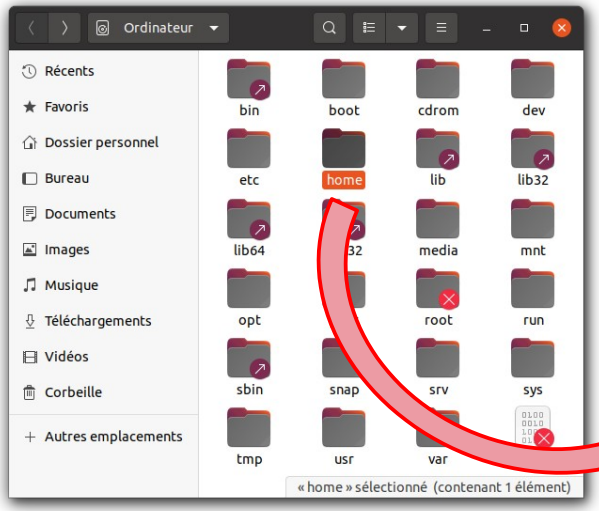
home

Linux Fundamentals: File System



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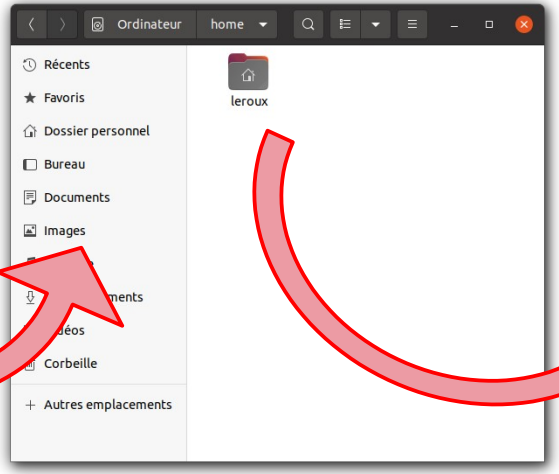
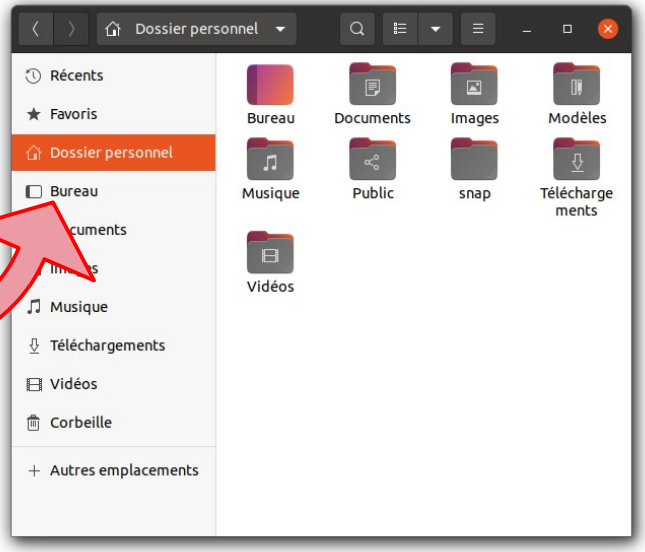


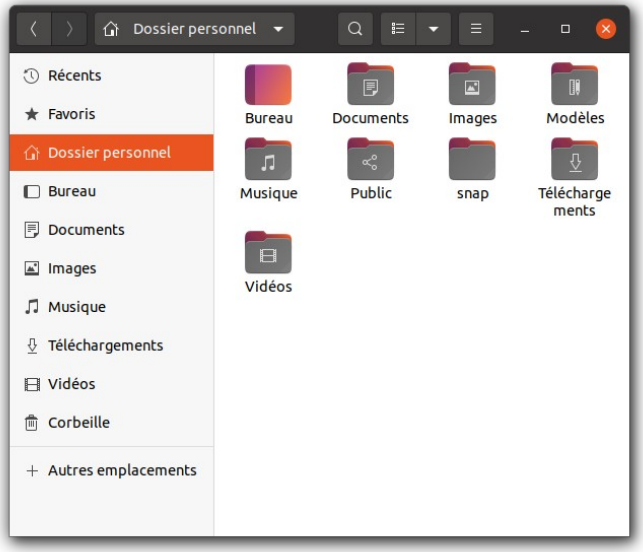
home



leroux

/home/leroux

Linux Fundamentals: File System



/home/leroux = ~

/home/leroux/Documents

~/Documents

Linux Fundamentals: Users

- The **A**dministrator (**root**) “optional”
  - All privileges !
- The “**sudo**ers” for “**super user do**”-users
  - Users that can use the **sudo** command to request admin privileges
  - When using the **sudo** command **sudoers** are required to confirm their identity by entering their user password
- The normal users

Linux Fundamentals: Users

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- The “**sudo**ers” for “**super user do**”-users
  - Users that can use the **sudo** command to request admin privileges
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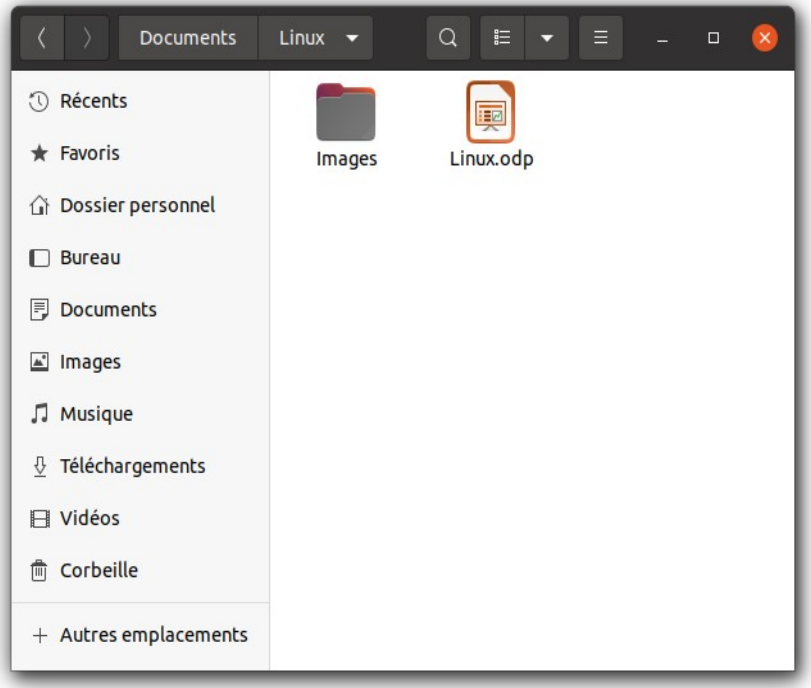
- The normal users

Linux Fundamentals: File Permissions

- The different permissions that can be granted for a **file** are:
  – **read**: to visualize its content
  – **write**: to modify its content (ex: editing)
  – **execute**: to execute its content (ex: program)

- The different permissions that can be granted for a **directory** are:
  – **read**: to visualize its content
  – **write**: to modify its content (ex: adding new files)
  – **execute**: to go inside this directory (ex: changing directory)

Linux Fundamentals: File Permissions



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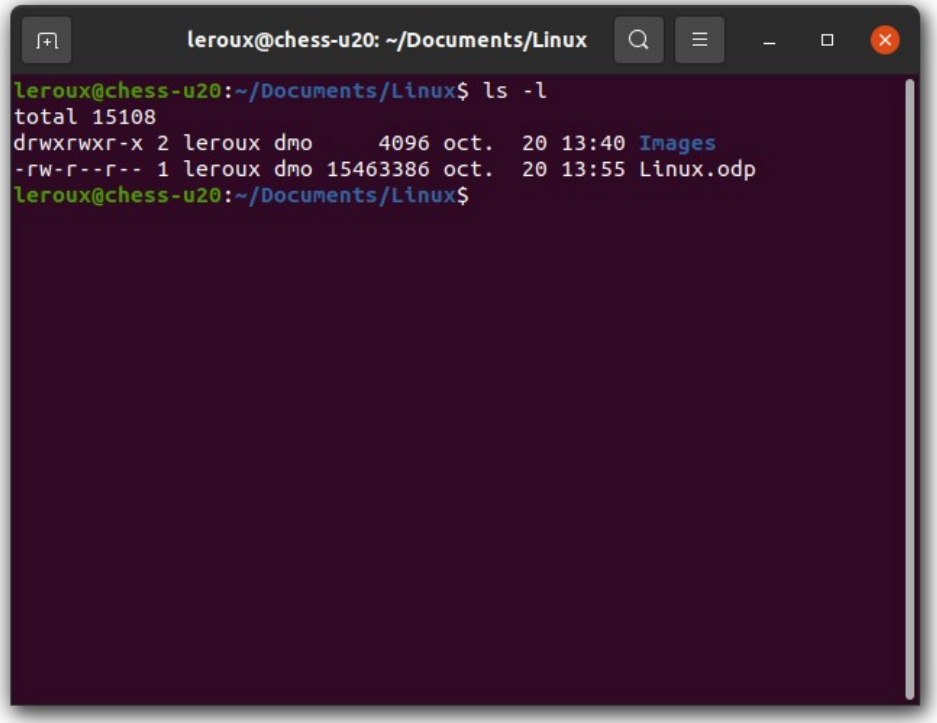
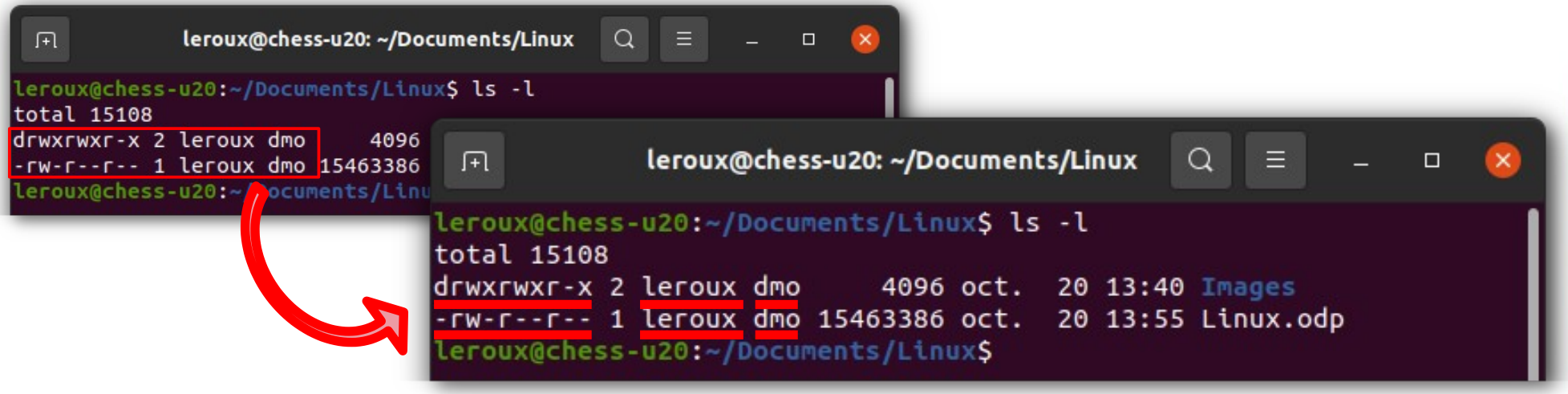


Linux Fundamentals: File Permissions

- The permissions are decomposed in **3** series of **3** letters

r (for read), w (for write) and x (for execute)

the symbol "-" means that the permission is denied

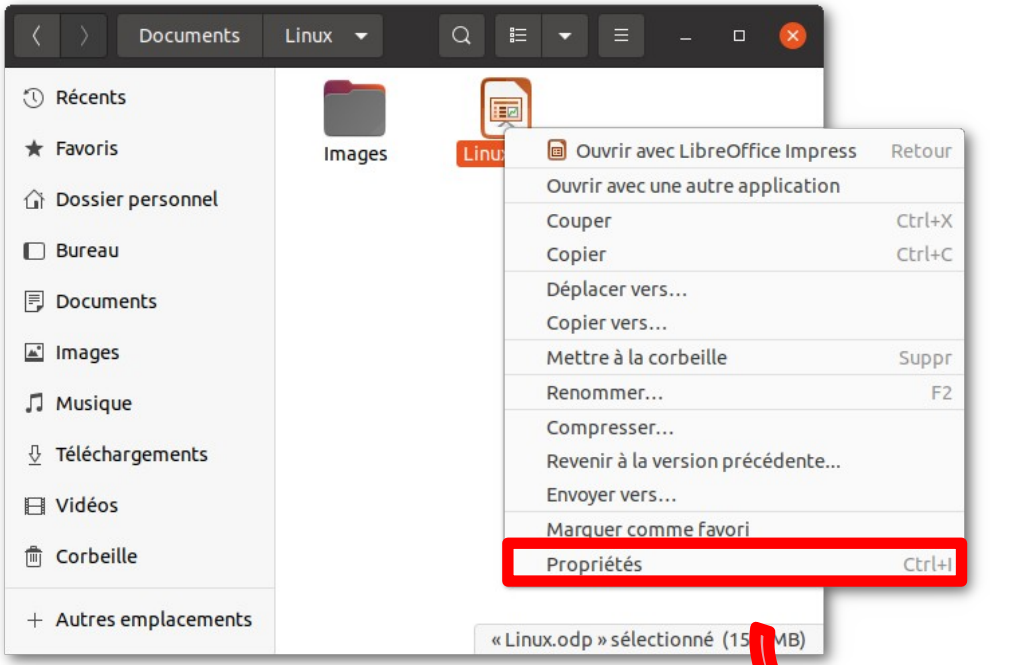


Linux Fundamentals: File Permissions

```
leroux@chess-u20: ~/Documents/Linux
leroux@chess-u20:~/Documents/Linux$ ls -l
total 15108
drwxrwxr-x 2 leroux dmo     4096 oct.  20 13:40 Images
-rw-r--r-- 1 leroux dmo 15463386 oct.  20 13:55 Linux.odp
leroux@chess-u20:~/Documents/Linux$
```

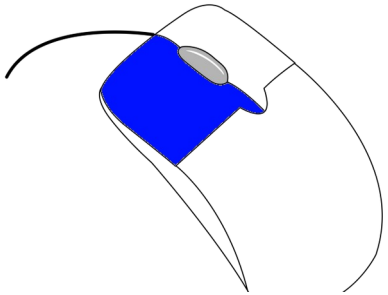
drwxrwxr-x	d	rwx	rwx	r-x
-rw-r--r--	-	rw-	r--	r--
	Object	Owner	Group	The other user(s)

Linux Fundamentals: File Permissions

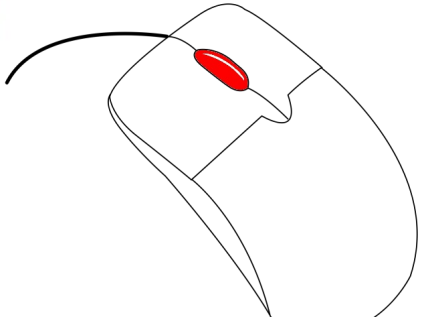


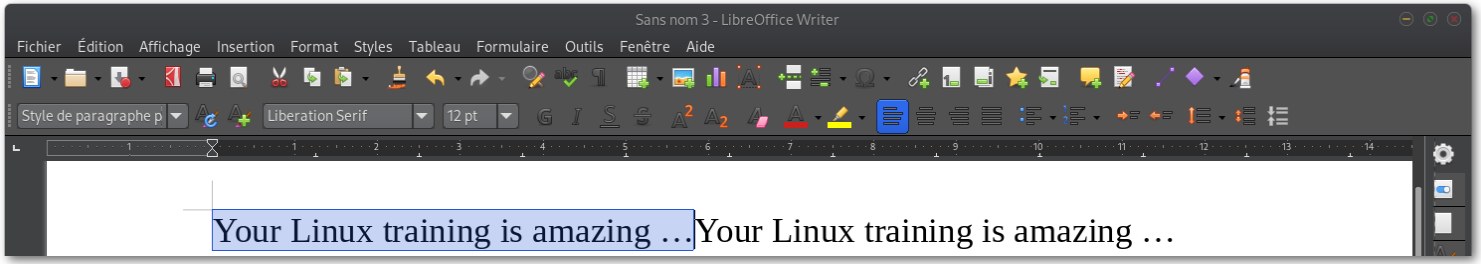
Linux Fundamentals: Mouse

- Text selected using the left click…

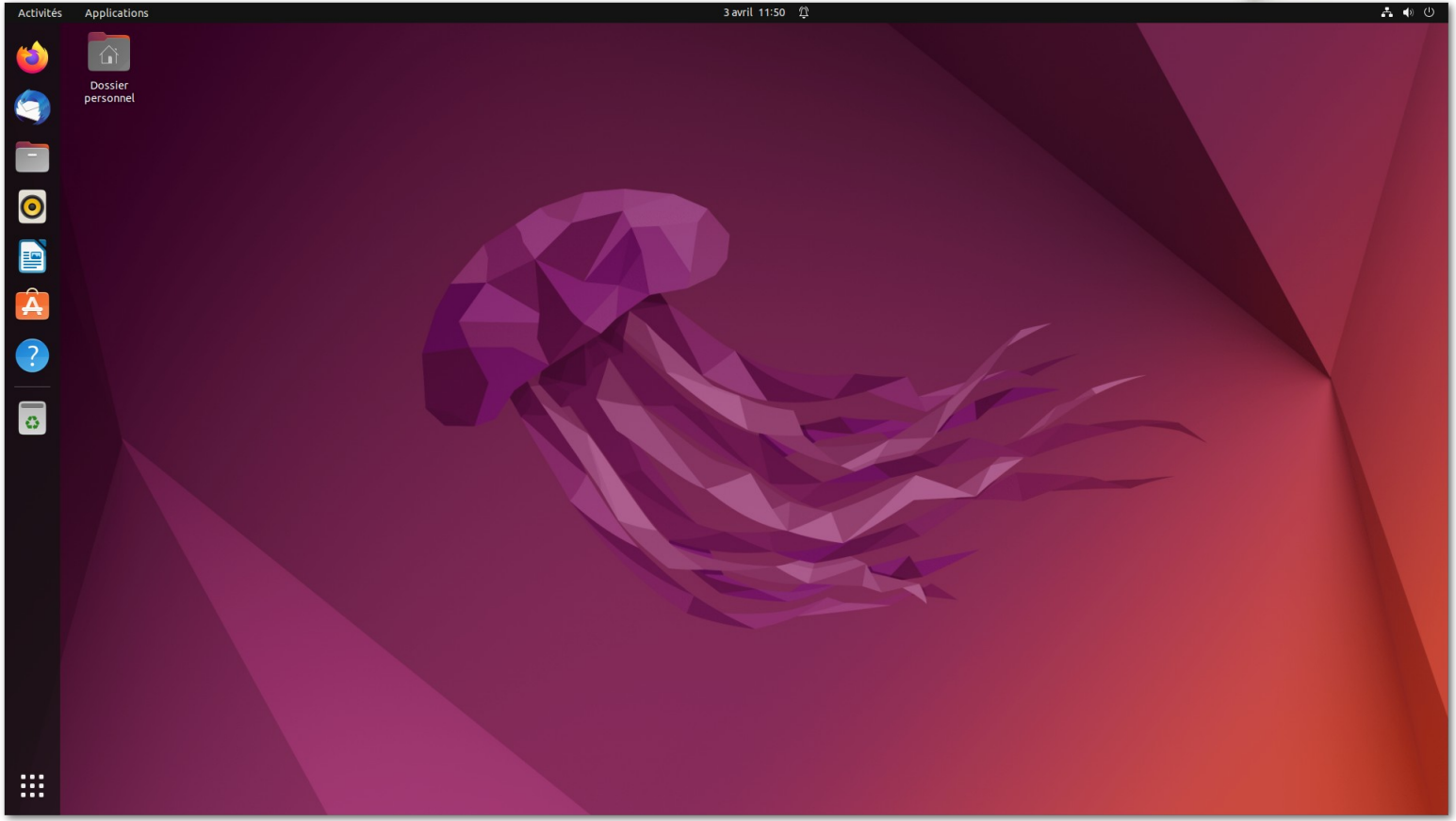


- Is copied, and can be pasted back pressing the 2nd button:





Ubuntu 2[0-2].04 LTS



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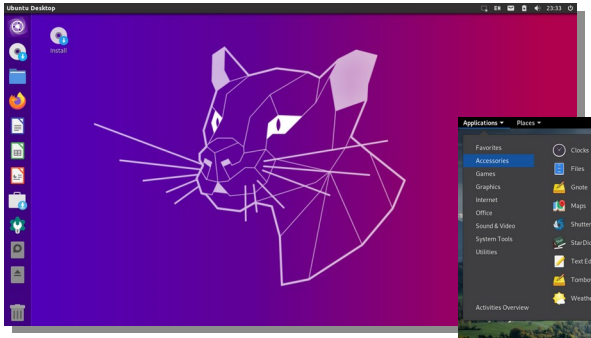

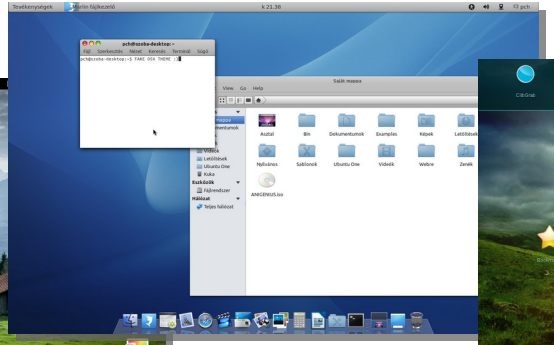

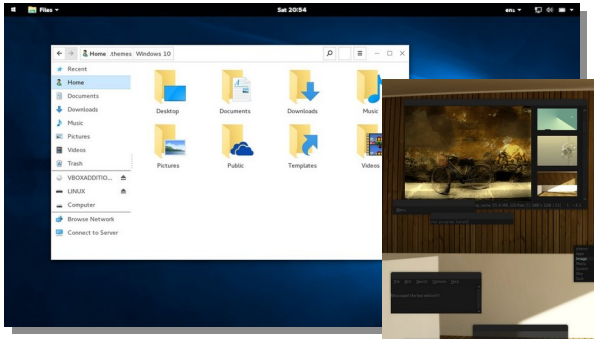

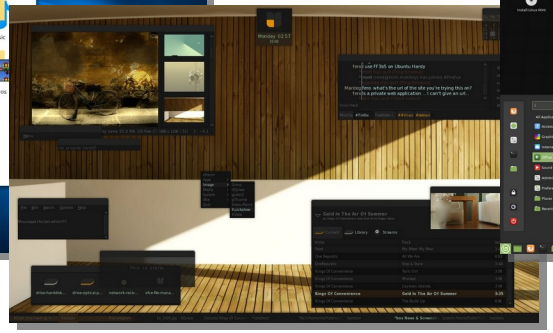

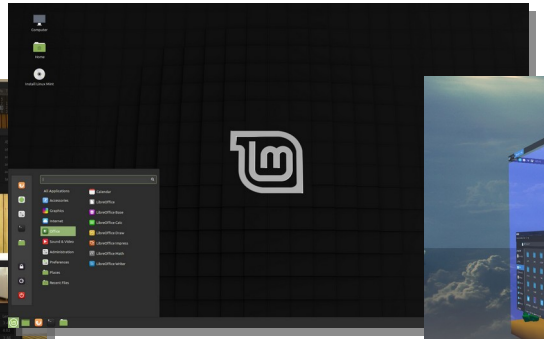

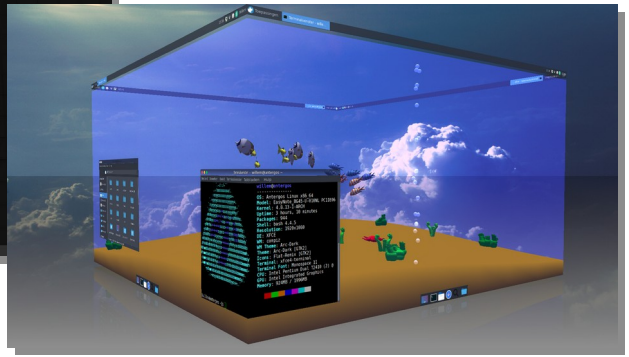

Ubuntu 2[0-2].04 LTS: Desktop Environments

Gnome	https://www.gnome.org/	
KDE	https://kde.org/	
Cinnamon	https://projects.linuxmint.com/cinnamon/	
Xfce	http://www.xfce.org/	
MATE	http://mate-desktop.com/	
LXQt	https://lxqt-project.org/	
Enlightenment	https://www.enlightenment.org/	
Deepin	https://www.deepin.org/	
Pantheon	https://elementary.io/	

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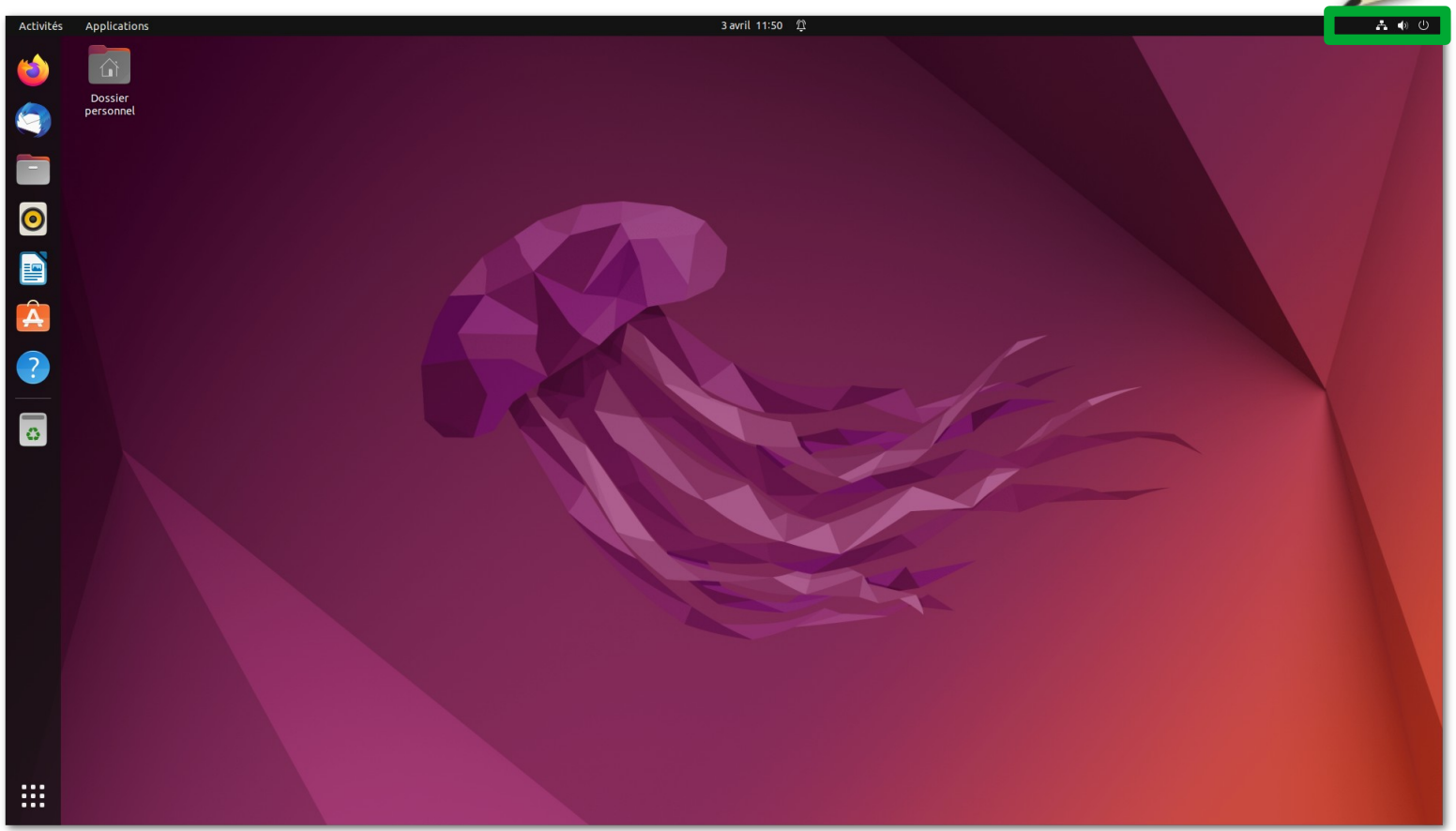
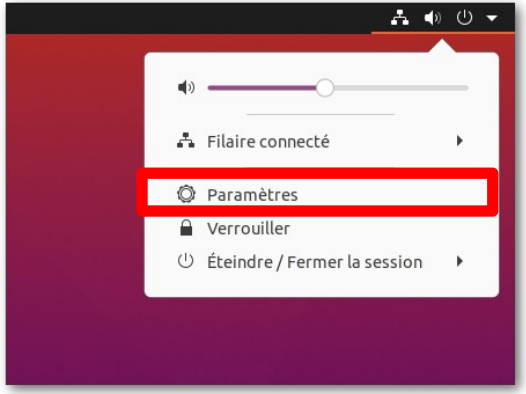
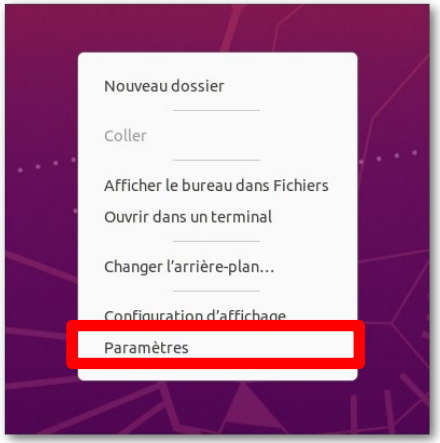
Ubuntu 22.04 LTS

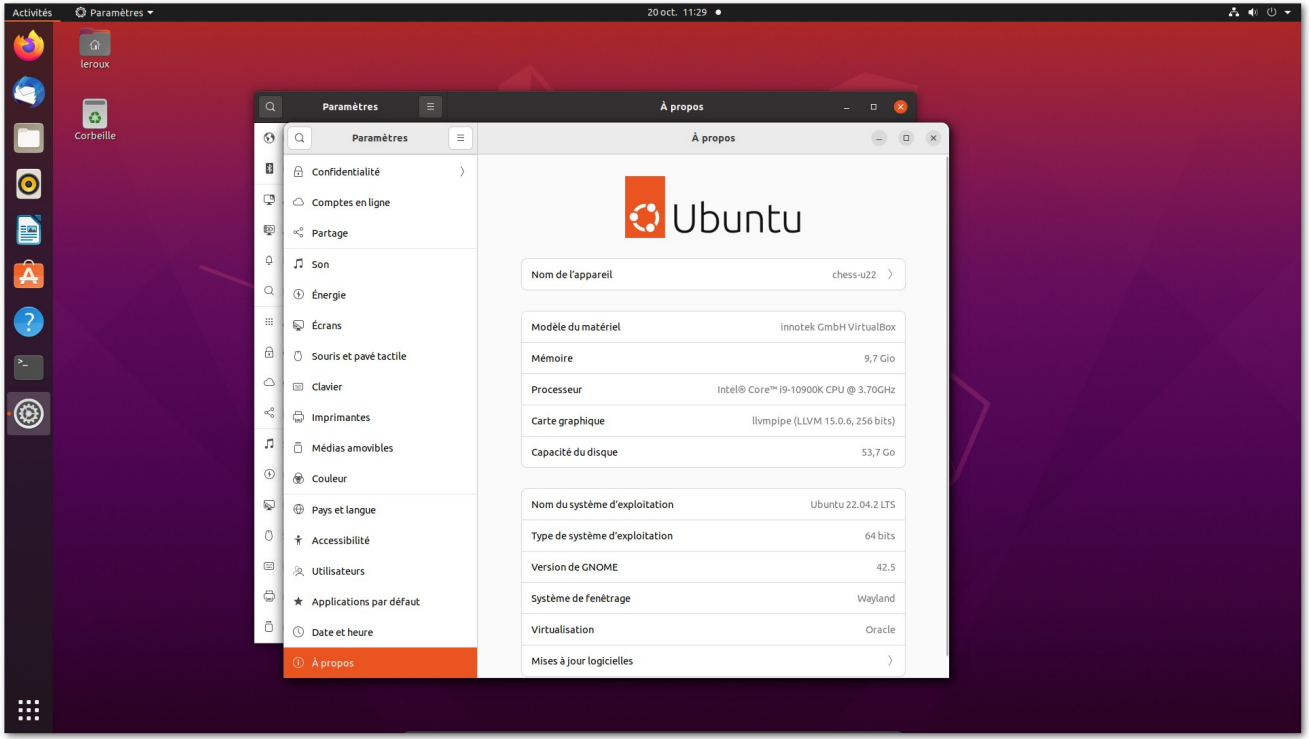


GNOME™

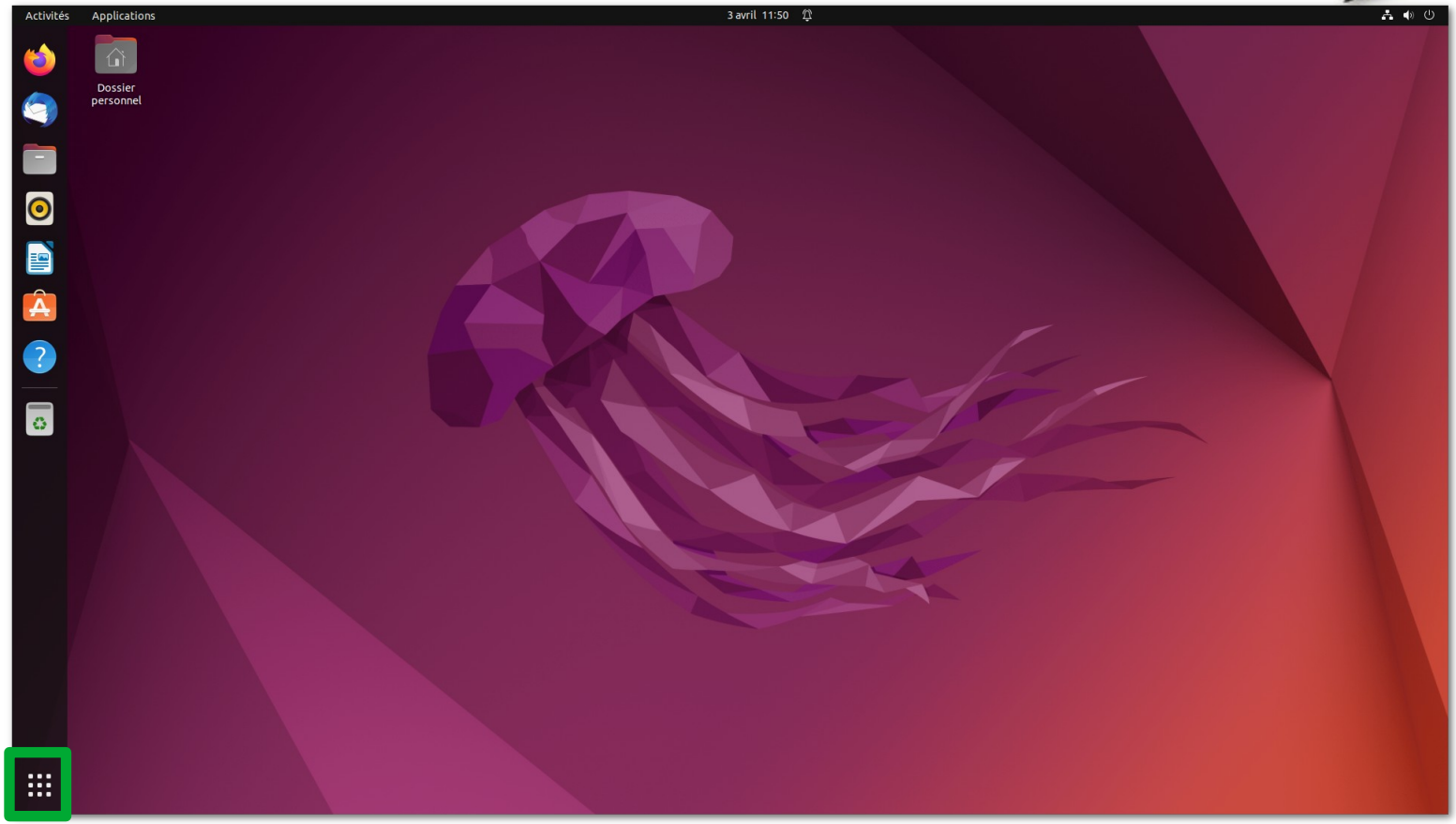
Ubuntu 2[0-2].04 LTS: Control Panel







Ubuntu 22.04 LTS

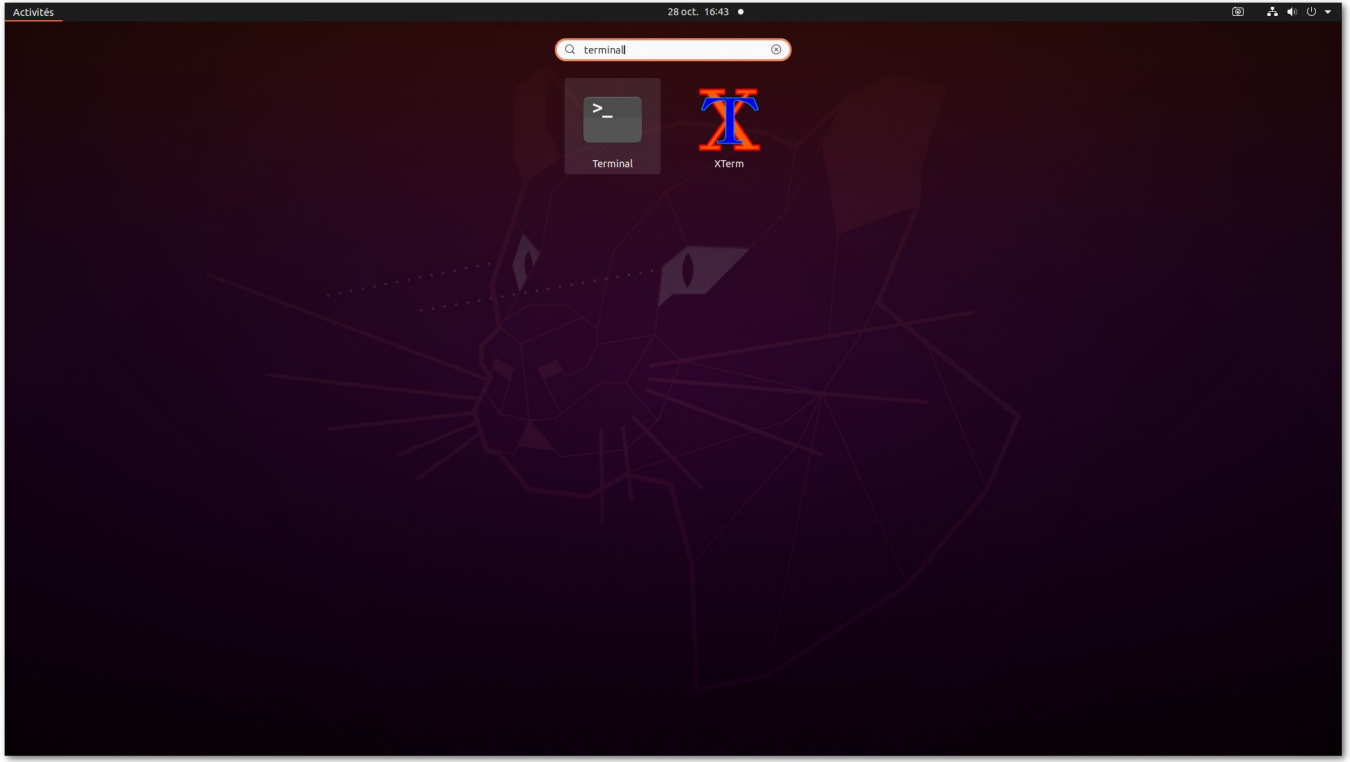


GNOME™

U. 2[0-2].04 LTS: Applications

U. 2[0-2].04 LTS: Open the Terminal

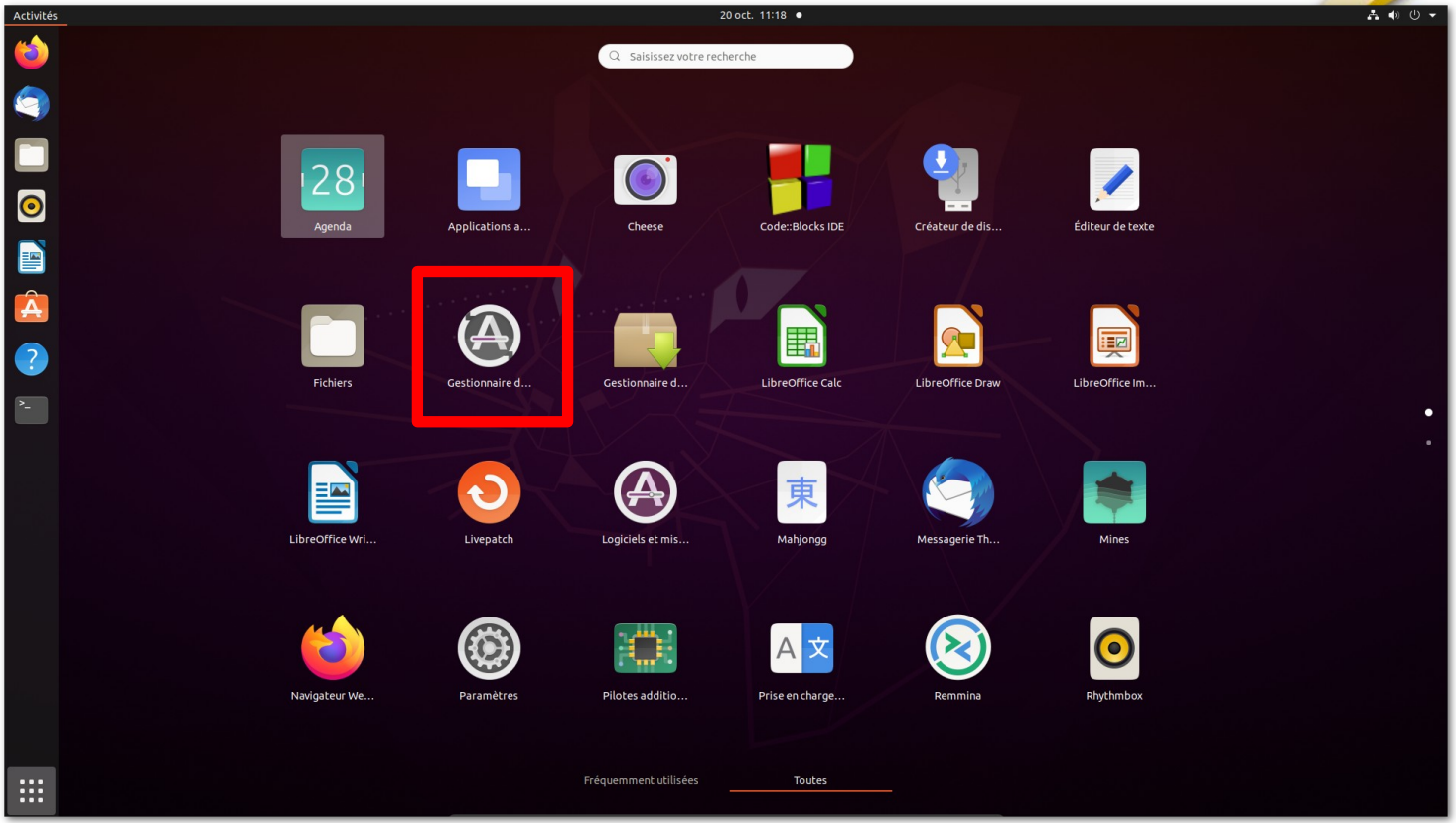
Ctrl + Alt + t



Things to do after installation

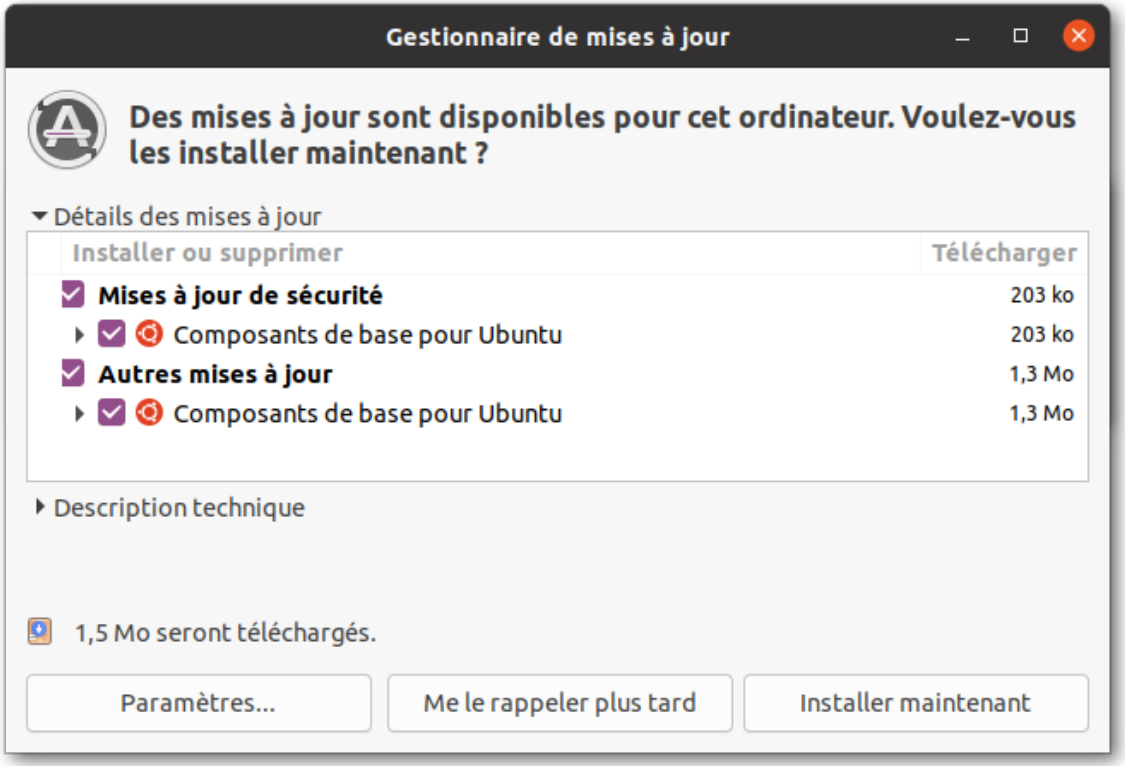
- Check for Updates (if not done during installation)
- Enable Partner Repositories
- Install Possibly Missing Graphics Drivers
- Install Extra Multimedia Codecs

U. 2[0-2].04 LTS: Check for Updates

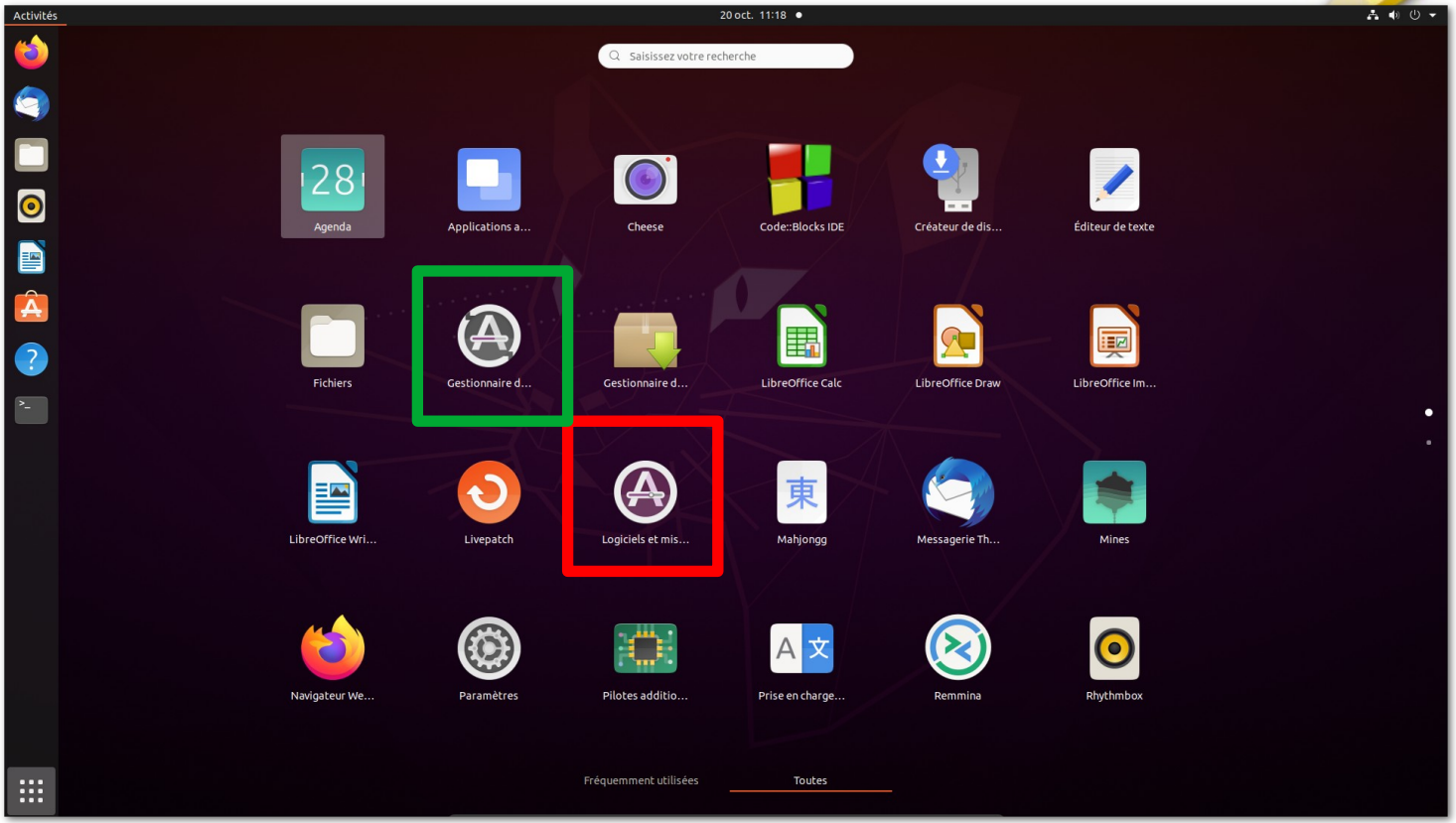


Terminal command: `update-manager`

U. 2[0-2].04 LTS: Updates



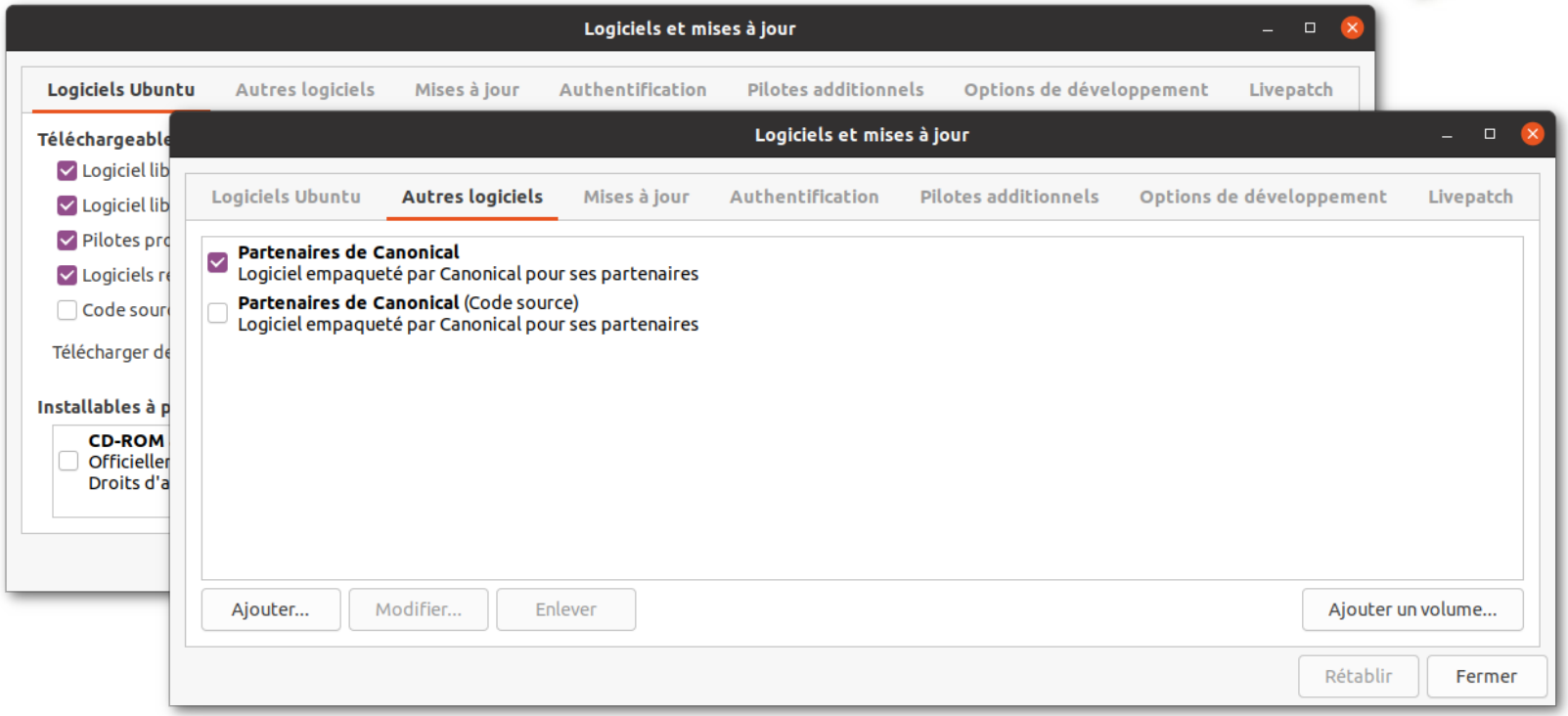
U. 2[0-2].04 LTS: Enable Repo.



Terminal command: `software-properties-gtk`

U. 2[0-2].04 LTS: Repo. and more

U. 2[0-2].04 LTS: Repo. and more



U. 2[0-2].04 LTS: Repo. and more

U. 2[0-2].04 LTS: Install software(s)

- Using the command line (the terminal)

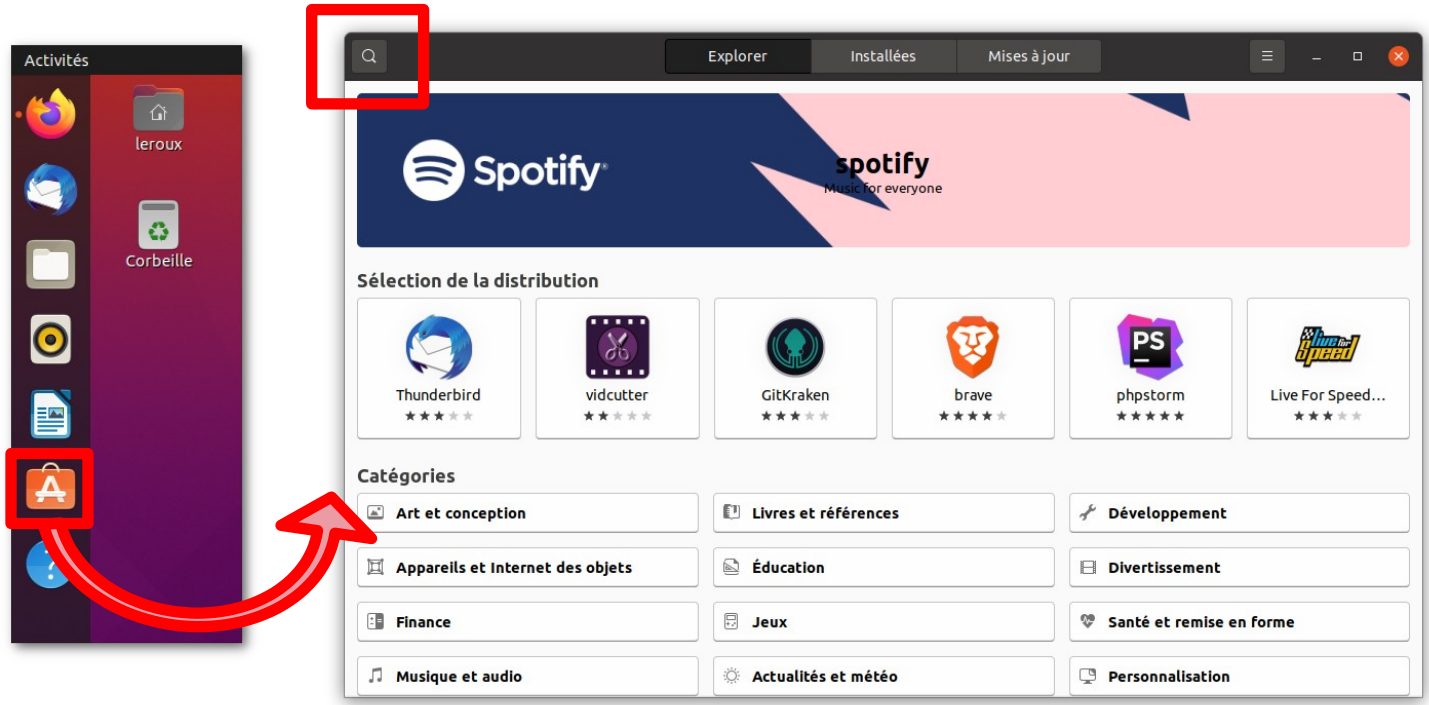
```
$ sudo apt install package-name
```

- Example:

```
$ sudo apt install synaptic
```

U. 2[0-2].04 LTS: Install software(s)

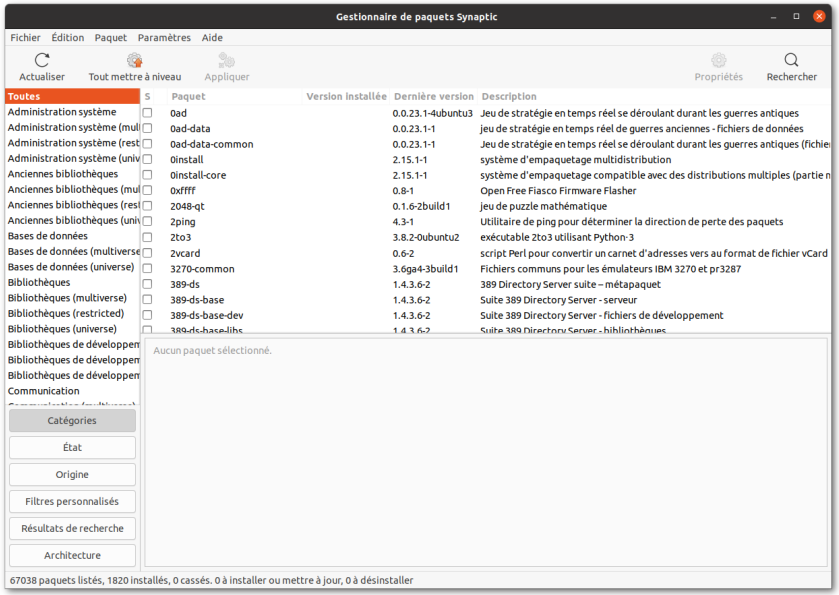
Using “**Ubuntu Software**”



Terminal command: `snap-store`

U. 2[0-2].04 LTS: Install software(s)

- Using “**Synaptic**”



Prerequisite: Install “Synaptic” using “Ubuntu Software”

Terminal command: `synaptic`

U. 2[0-2].04 LTS: Install software(s)

- **No matter the method, you need to have admin privileges to install a software and/or the updates !**

  For Ubuntu 2[0-2].04 LTS you need to be in the “**sudo**ers” group

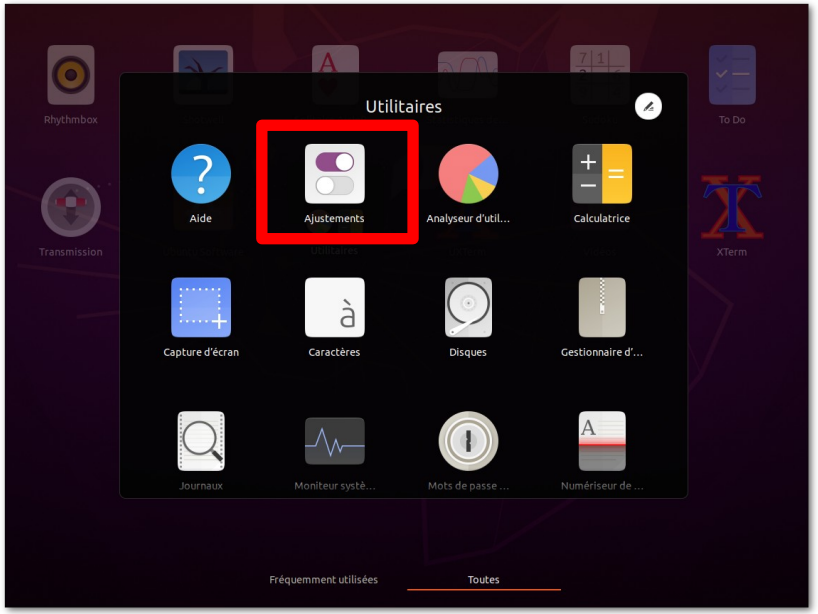
- What if you can not find what you are looking for ?

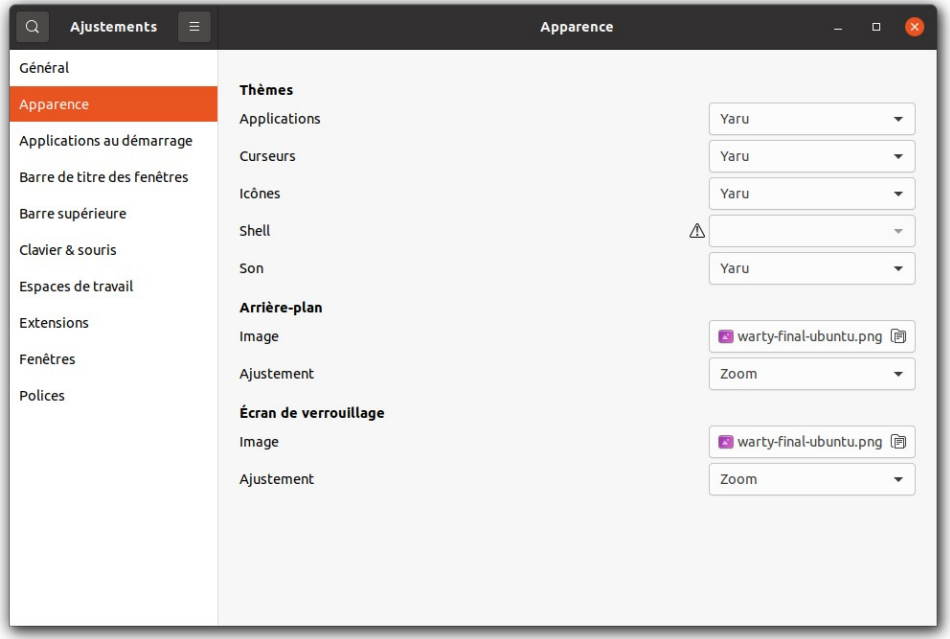
  Add extra package repository: https://doc.ubuntu-fr.org/depots_focal

U. 2[0-2].04 LTS: GNOME Extras

- Tweaks “Ajustements” (gnome-tweaks)

```
$ sudo apt install gnome-tweaks
```

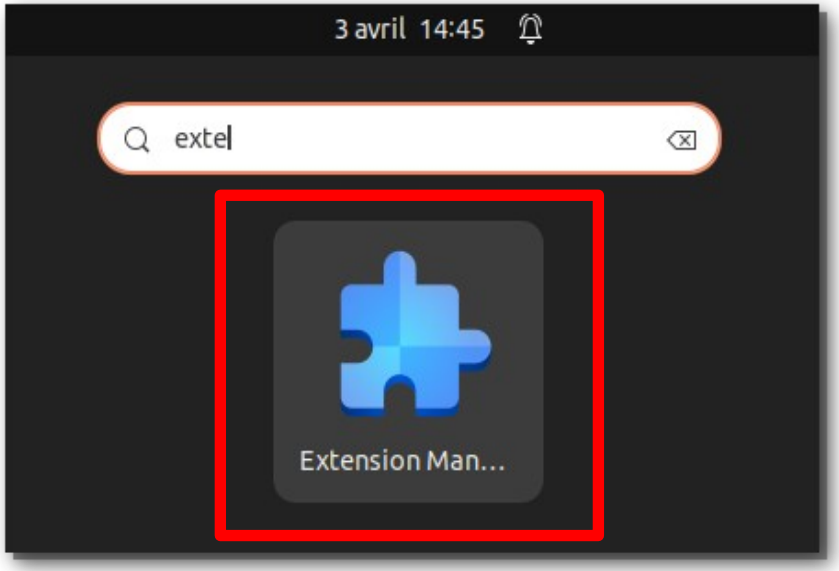


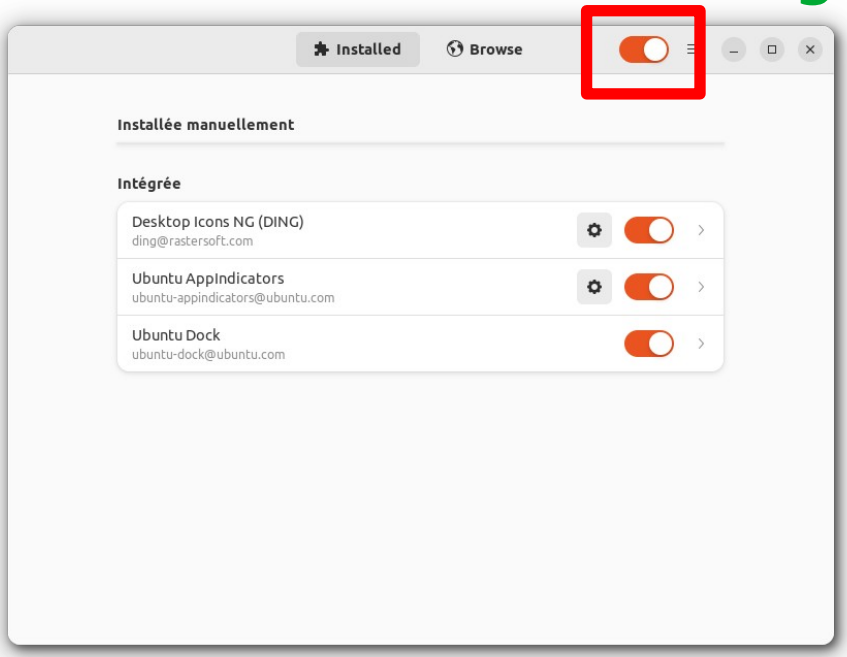


U. 22.04 LTS: GNOME Extras

- **Extension manager (gnome-shell-extension-manager)**

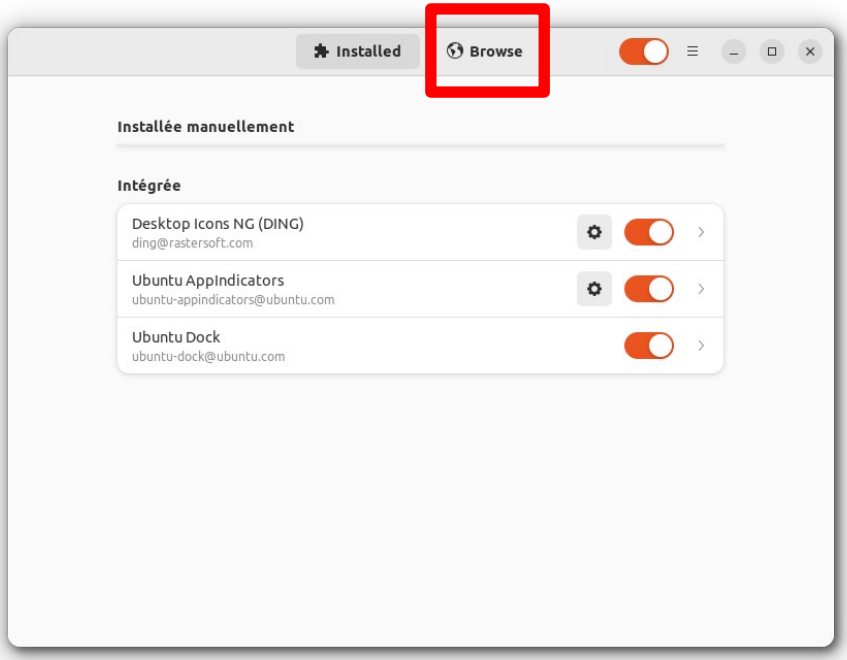
```
$ sudo apt install gnome-shell-extension-manager
```





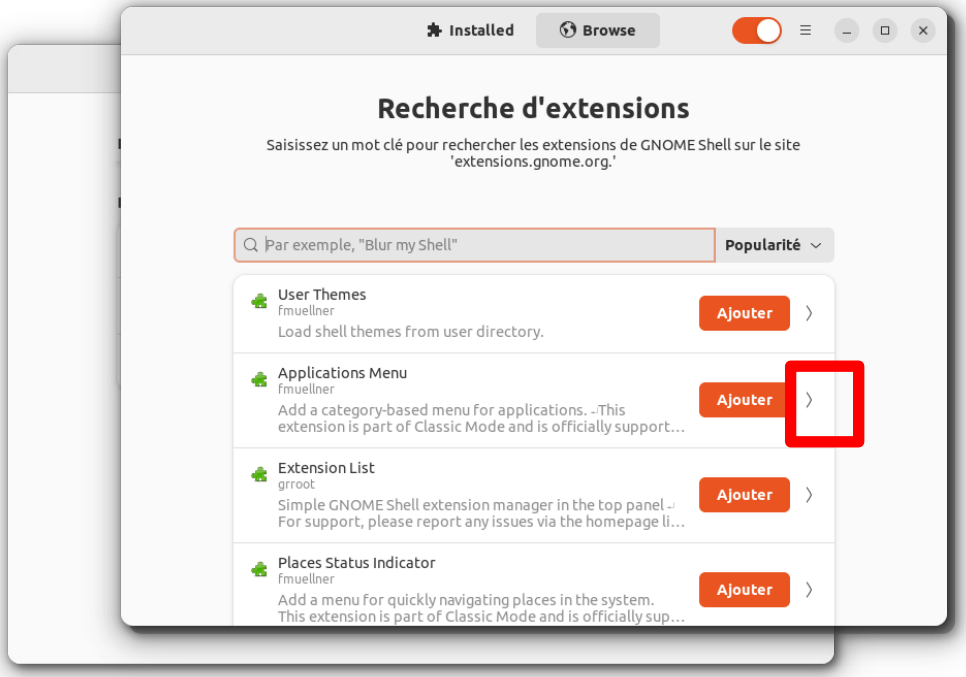
U. 22.04 LTS: GNOME Extras

- Extension manager ($ `extension-manager`)



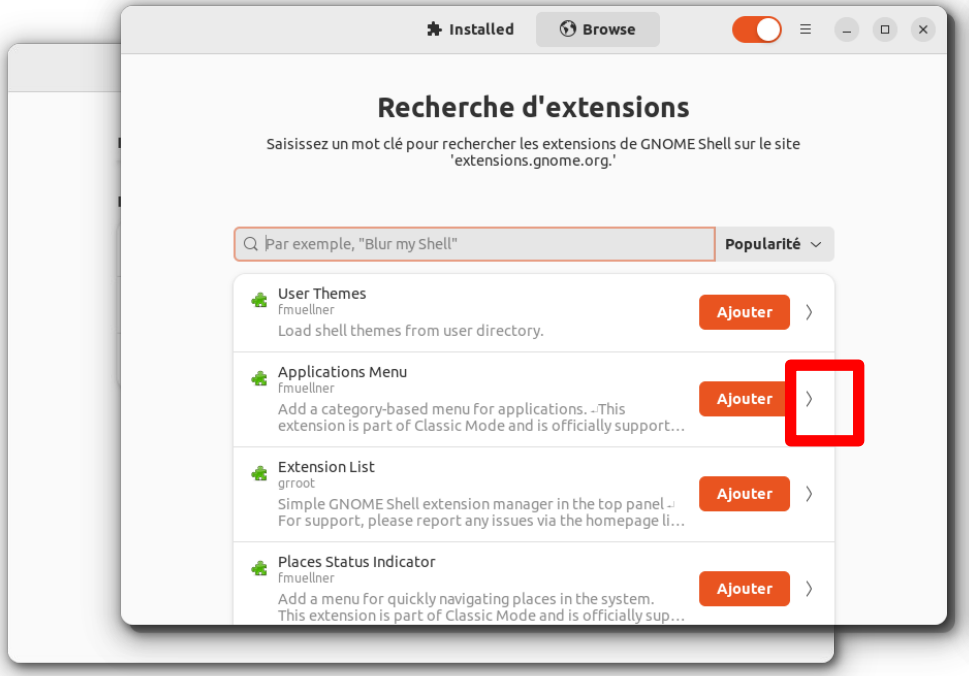
U. 22.04 LTS: GNOME Extras

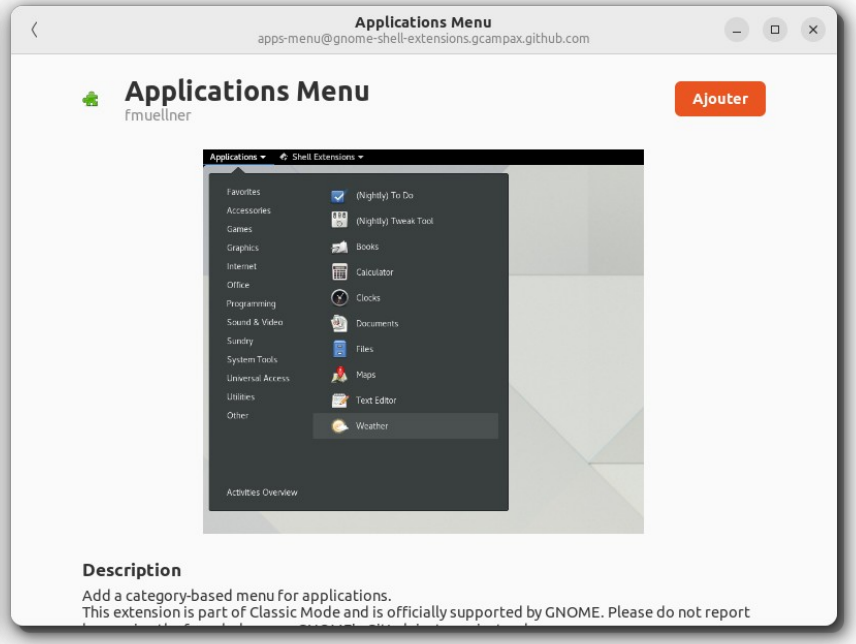
- Extension manager ($ `extension-manager`)



U. 22.04 LTS: GNOME Extras

- Extension manager ($ `extension-manager`)





Why use Linux ?

- It's free !
- No need to change your computer to use the newest Linux !

  How long should you use your computer so that the CO_2 footprint of its usage becomes as large of the CO_2 footprint of its production ?

- High security: **no viruses ... no viruses at all !**
- High stability: **the world best servers use Linux !**
- Ease of use: **you are already using it on your smartphone !**
- **Its Free ! = Open Source: the code source is available !!!**

Why use Linux ?

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139 years !!!

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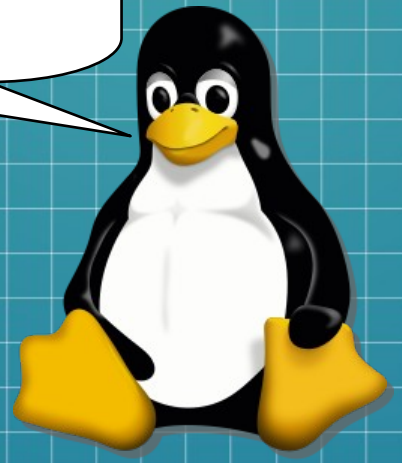
- Ease of use: **you are already using it on your smartphone !**
- **Its Free ! = Open Source: the code source is available !!!**

“Astronauts use Linux …
… because you cant open windows in space”

Questions ?



The command line ?

- What is a command interpreter ?
- What is a command ?
- Where to find command(s) ?
- How to execute a command ?
- How to use a command ?
- How to get help ?
- What are the basic commands ?
- What are the filters ?
- What is a redirection ?
- What is scripting ?

Command interpreter ?

- A command interpreter, or **Sh**ell, is a program that allows users to interact with the system using the command line.
- Many shells are available: BA**SH**, K**SH**, TC**SH**, Z**SH**
- **BASH** “Bourne-Again Shell”

BASH

- BASH native (built-in) commands: `echo`, `pwd`, `export` ...
- Special characters

" " (space)	
`$`	what follow is a variable.
`*`	stands for any number of any character(s) = everything.
`?`	any single character.
`{} () []`	used to encompass expressions.
`/`	to define file and directory path(s).
`` ```	to substitute enclosed command(s).
`''`	to enclose command(s).
`""`	to enclose command(s) with variable(s) expansion.
`#`	to start a comment in BASH.
`| & < >`	redirections.
`.` and `..`	navigation in the directory tree.
`\`	to “protect” the other special characters

Linux: files and terminology

- On a computer you can have **2** types of files:
  - **Text files**
  - Other types of files = files that are not text files = **binary files**

  Easy to work of text files !

- Not matter the type of file, on a Linux system you have:
  - Standard files and repositories.
  - Hidden files and repositories which names, by convention, start by a "**.**" dot symbol.

Example: "`~/.bashrc`"

Exercise: Compare the results of the commands: `ls` and "`ls -a`"

What is a command ?

A file that has the execute permission ! …

… A file that you can execute.

Linux Fundamentals: File Permissions

- The different permissions that can be granted for a **file** are:
  - **read**: to visualize its content
  - **write**: to modify its content (ex: editing)
  - **execute**: to execute its content (ex: program)

- The different permissions that can be granted for a **directory** are:
  - **read**: to visualize its content
  - **write**: to modify its content (ex: adding new files)
  - **execute**: to go inside this directory (ex: changing directory)

Linux Fundamentals: File Permissions

```
leroux@chess-u20: ~/Documents/Linux
leroux@chess-u20:~/Documents/Linux$ ls -l
total 15108
drwxrwxr-x 2 leroux dmo     4096 oct.  20 13:40 Images
-rw-r--r-- 1 leroux dmo 15463386 oct.  20 13:55 Linux.odp
leroux@chess-u20:~/Documents/Linux$
```

drwxrwxr-x	d	rwx	rwx	r-x
-rw-r--r--	-	rw-	r--	r--
	Object	Owner	Group	The other user(s)

Command = Executable

- Command = “**a file that has the execute permission**”

```
leroux@chess-u24: ~/Documents
leroux@chess-u24:~/Documents$ ls -l
total 4
-rwx------ 1 leroux leroux 26 avril  3 15:23 test.sh
```

Where to find commands ?

- In the **PATH**

- Anywhere you need ...

  … because you can create command(s) yourself

PATH

- **Environment variable(s) [EV]**:

  “Set of dynamic named values used to create the operating environment in which a process runs”

- To access the **EV** list use the **env** command:

```
user@localhost:~$ env
```

- To display the value of a variable:

```
user@localhost:~$ echo $PATH
```

Locating a command

- To locate a command use the **`which`** command:

```
user@localhost:~$ which ls
/usr/bin/ls
user@localhost:~$
```

How to execute a command ?

- Use it name directly:

```
user@localhost:~$ ls
```

The command MUST be in the PATH

- Use the direct path + name of the executable:

```
user@localhost:~$ /usr/bin/ls
```

- Change directory to the folder of the executable and use “`./`”

```
user@localhost:~$ cd /usr/bin
user@localhost:/usr/bin$ ./ls $HOME
```

How to use a command ?

- A **command** can receive **argument(s)**:

```
user@localhost:~$ cd ~/Documents
```

- A **command** can receive **option(s)**:

```
user@localhost:~$ ls -l -h
user@localhost:~$ ls -lh
user@localhost:~$ ls -l --human-readable
```

How to get help

- The `-h` or `--help` option(s):

  *Accepted by most commands, **to get basic help**.*

```
user@localhost:~$ ls --help
```

- The `man` command:

  To access the manual pages

```
user@localhost:~$ man ls
```

Basic commands (1/6)

- File system management: `ls`, `pwd`, `cd`, `touch`, `mkdir`
  `mv`, `cp`, `rmdir`, `rm`
- File printing: `wc`, `cat`, `tac`, `more`, `tail`, `cut`
- File management: `chown`, `chmod`, `diff`, `ln`

Basic commands (2/6)

```
user@localhost:~$ ls
Bureau     Images   Musique  snap             vidéo
Documents  Modèles  Public   Téléchargements
user@localhost:~$ ls -l
total 36
drwxr-xr-x. 2 user ipcms 4096 avril 12 11:04 Bureau
drwxr-xr-x. 2 user ipcms 4096 avril 12 11:04 Documents
drwxr-xr-x. 2 user ipcms 4096 avril 12 11:04 Images
drwxr-xr-x. 2 user ipcms 4096 avril 12 11:04 Modèles
drwxr-xr-x. 2 user ipcms 4096 avril 12 11:04 Musique
drwxr-xr-x. 2 user ipcms 4096 avril 12 11:04 Public
drwx------. 2 user ipcms 4096 avril 12 11:04 snap
drwxr-xr-x. 2 user ipcms 4096 avril 12 11:04 Téléchargements
drwxr-xr-x. 2 user ipcms 4096 avril 12 11:04 Vidéos
user@localhost:~$
```

Basic commands (3/6)

```
user@localhost:~$ cd Images
user@localhost:~/Images$ ls
user@localhost:~/Images$ cd ..
user@localhost:~$ cd ../..
user@localhost:/$ cd
user@localhost:~$ cd Documents
user@localhost:~/Documents$
```

```
user@localhost:~/Documents$ touch file
user@localhost:~/Documents$ ls
file
user@localhost:~/Documents$
```

Basic commands (4/6)

- The `rm` command, important option: `-i`

```
user@localhost:~/Documents$ rm file
user@localhost:~/Documents$ ls
user@localhost:~/Documents$ touch nfile
user@localhost:~/Documents$ ls
nfile
user@localhost:~/Documents$ rm -i nfile
rm : supprimer ‘nfile’ du type fichier ? n
user@localhost:~/Documents$ ls
nfile
```

Basic commands (5/6)

- The **cat**, **tac** and **wc** commands

```
user@localhost:~/Documents$ cat Ethanol.xyz
         9

C       1.0111998889     -0.0452918889     -0.0626048889
C      -0.4620761111      0.0306281111      0.2946991111
H       1.6265438889     -0.0376928889      0.8456121111
H       1.3252608889      0.8030881111     -0.6846978889
H       1.2501238889     -0.9611748889     -0.6188868889
H      -0.7580021111     -0.8263228889      0.9315601111
H      -0.6822251111      0.9536901111      0.8665561111
H      -2.1126961111      0.0649821111     -0.6649928889
O      -1.1981291111      0.0180941111     -0.9072448889
user@localhost:~/Documents$ wc -l Ethanol.xyz
11 Ethanol.xyz
user@localhost:~/Documents$
```

Basic commands (6/6)

- The **chmod** command “to change file permissions”

-rw-r--r--

Object	Owner	Group	The other user(s)

Using **3** series (**owner**, **group**, **others**) of **3** numbers as well as their combinations:

(0 = nothing = **---**)

1	= execute (**x**)	= **--x**
2	= write (**w**)	= **-w-**
4	= read (**r**)	= **r--**
3 = **1** + **2**	= **x** + **r**	= **r-x**
5 = **1** + **4**	= **x** + **w**	= **-wx**
6 = **2** + **4**	= **w** + **r**	= **-wr**
7 = **1** + **2** + **4**	= **x** + **w** + **r**	= **rw**

Basic commands (6/6)

- The **chmod** command “to change file permissions”

-rw-r--r--

Object	Owner	Group	The other user(s)

Using **3** series (**owner**, **group**, **others**) of **3** numbers as well as their combinations:

```
user@localhost:~/Documents$ ls -l Ethanol.xyz
-rw-r--r--. 1 user ipcms 525 avril 14 11:22 Ethanol.xyz
user@localhost:~/Documents$ chmod 600 Ethanol.xyz
user@localhost:~/Documents$ ls -l Ethanol.xyz
-rw-------. 1 user ipcms 525 avril 14 11:22 Ethanol.xyz
user@localhost:~/Documents$
```

What are the filters ?

- Filters are a type of command line utility designed to manipulate and process text data.
- The most common filters are **awk**, **sed** and **grep**

```
user@localhost:~$ filter option(s) ‘regular expression’ file

user@localhost:~$ filter option(s) “regular expression” file
```

- Filter use regular expressions or **regexp**

  “Set of rules and patterns to match and manipulate text data”

grep

- To find line(s) with pattern(s) in text files

```
user@localhost:~$ grep --color=always 'C' Ethanol.xyz
C        1.0111998889      -0.0452918889      -0.0626048889
C       -0.4620761111       0.0306281111       0.2946991111
user@localhost:~$ grep -n --color=always 'O' Ethanol.xyz
11:O       -1.1981291111       0.0180941111      -0.9072448889
user@localhost:~$
```

sed

- To find, substitute and delete pattern(s) in text files

```
user@localhost:~$ sed 's/0/?/g' Ethanol.xyz
9

C       1.?111998889     -?.?452918889     -?.?626?48889
C      -?.462?761111      ?.?3?6281111      ?.2946991111
H       1.6265438889     -?.?376928889      ?.8456121111
H       1.32526?8889      ?.8?3?881111     -?.6846978889
H       1.25?1238889     -?.9611748889     -?.6188868889
H      -?.758??21111     -?.8263228889      ?.93156?1111
H      -?.6822251111      ?.95369?1111      ?.8665561111
H      -2.1126961111      ?.?649821111     -?.6649928889
O      -1.1981291111      ?.?18?941111     -?.9?72448889
user@localhost:~$
```

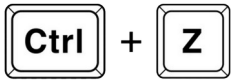
awk

- To find pattern(s) and process line(s) in text files

```
user@localhost:~$ awk '{print $1}' Ethanol.xyz
9

C
C
H
H
H
H
H
H
O
user@localhost:~$
```

What is a redirection ?

- Sending a command to the background:
  - Foreground job to the background:



Followed by:

```
user@localhost:~$ bg
```

  - Job directly to the background, using: **&**

```
user@localhost:~$ gedit &
```

- Sending the output of a command to a file:

```
user@localhost:~$ cat Ethanol.xyz > Eth.xyz
user@localhost:~$ cat Ethanol.xyz >> Eth.xyz
```

- **Sending the output of a command in another command: the pipe |**

The pipe (pipeline) |

- Redirecting a command in another command, using: |

```
user@localhost:~$ cat Ethanol.xyz | wc -l
11
user@localhost:~$
```

```
user@localhost:~$ ls -l E* | grep '^-'
-rw-r--r--. 1 user ipcms 525 avril 14 11:22 Ethanol.xyz
-rw-r--r--. 1 user ipcms 525 avril 14 11:23 Eth.xyz
user@localhost:~$
```

```
user@localhost:~$ ls -l E* | grep '^-' | awk '{printf $NF" "}'
Ethanol.xyz Eth.xyz user@localhost:~$
```

What is scripting ?

- To program a list of command(s) and action(s) in a file

```
#!/bin/bash

# This little example to say “Hello” in BASH
echo “Hello”
```

  - The first line tells the system which program use to run the script.
  - The other lines describe the commands to be performed.

- To execute the script:

```
user@localhost:~$ bash MyScript
```

or

```
user@localhost:~$ chmod 755 MyScript
user@localhost:~$ ./MyScript
```

–

The file ~/.bashrc

- Configuration file that BASH reads every time a shell starts
- BASH then executes the commands in ~/.bashrc

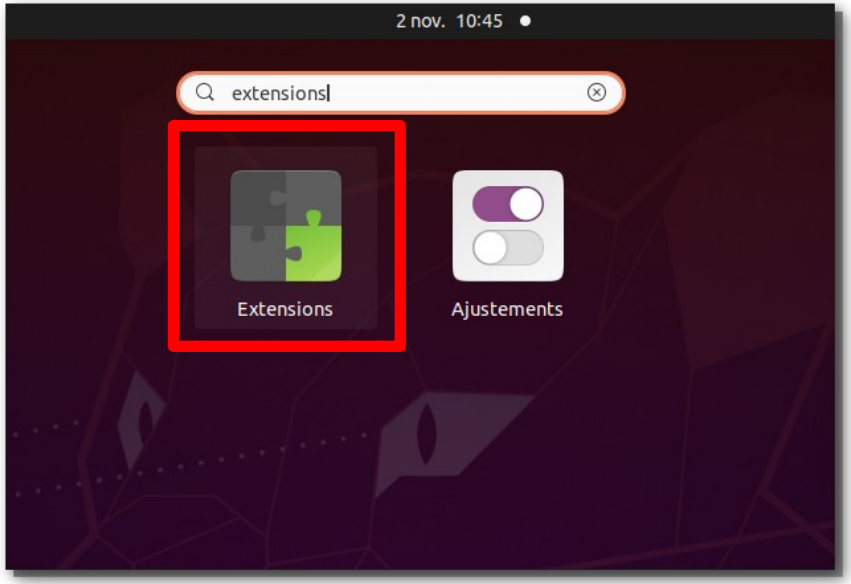
```
# Modifying the PATH environment variable:
PATH=$PATH:~/bin

# Creating aliases, using: alias name='what to do'

alias ll='ls -lh'
alias lla='ls -lha'

alias rm='rm -i'

alias grep='grep --color=always'
```

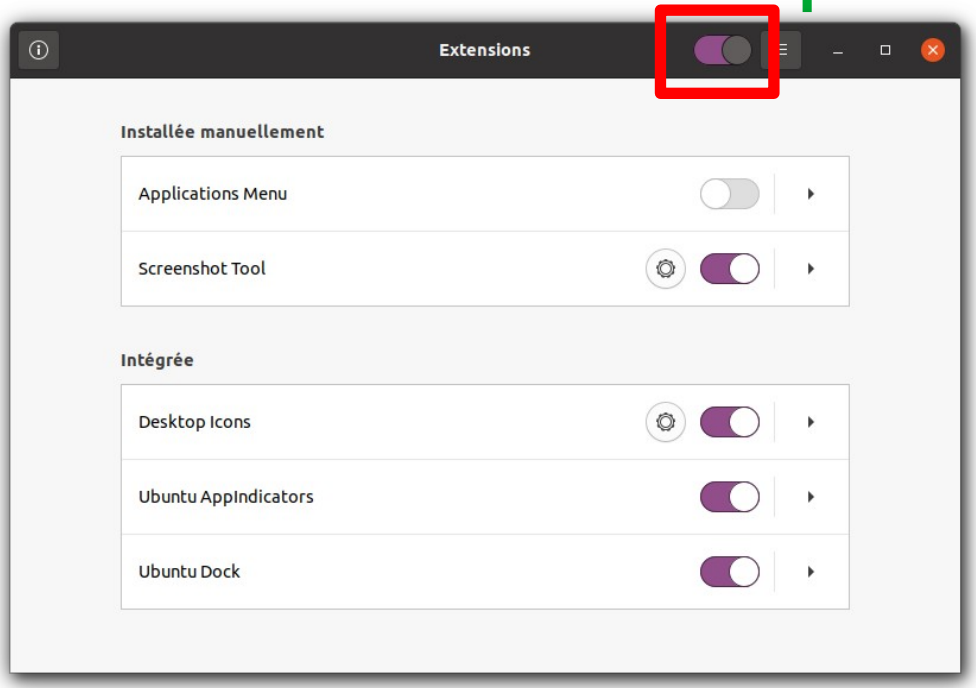
```
#!/bin/bash

echo “Questions ?”
```

U. 20.04 LTS: GNOME Extras

- **Extension preferences (gnome-shell-extension-prefs)**

```
$ sudo apt install gnome-shell-extension-prefs
```





U. 20.04 LTS: GNOME Extras

- **Gnome-shell extensions:** https://extensions.gnome.org/