Session 2 – Linux environment review

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Unidades Comunes Científico Técnicas – SGSAFI-ISCIII

22-26 Mayo 2023, 10ª Edición
Programa Formación Continua, ISCIII

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Linux environment review:

- Linux OS
- Linux file system
- Linux users and privileges
- Basic commands
- Command line syntax

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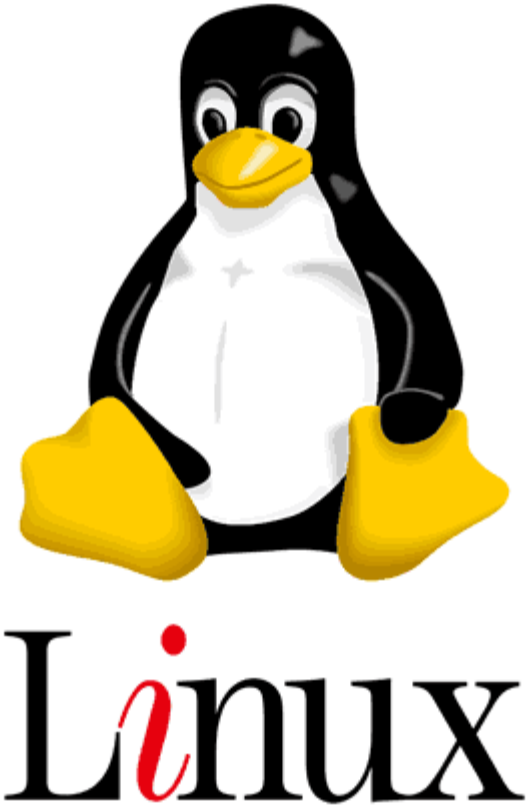
Linux OS - Introduction

Linux is:

- Operative system
- Open source
- Multi-task
- Multi-user



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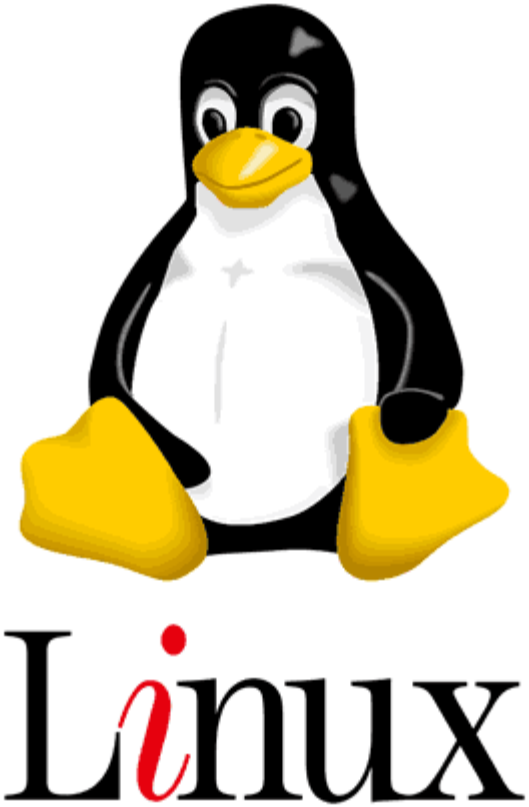
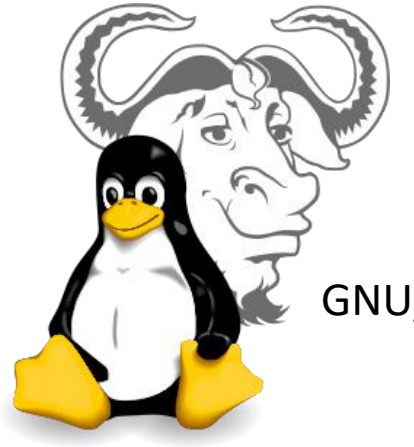


Linux OS – Operating System I

Operative System (OS):

Windows

Mac OS

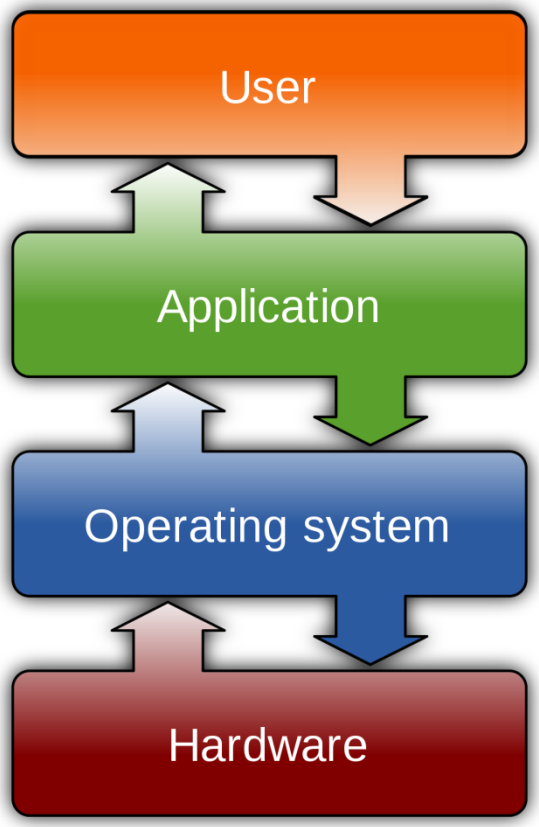


GNU/Linux

Linux OS – Operating System I

Operative System (OS):

- Software that manages computer hardware and software resources and provides common services for computer programs



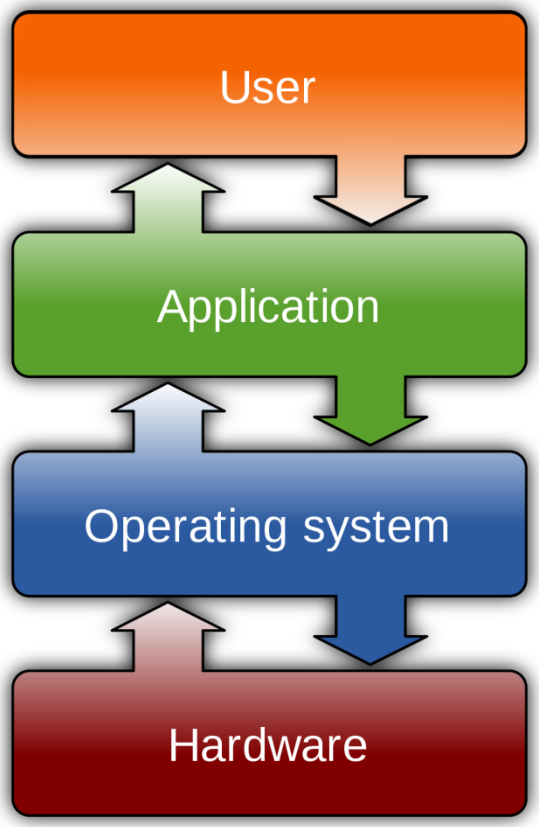
Linux OS – Operating System I

Operative System (OS):

- Software that manages computer hardware and software resources and provides common services for computer programs

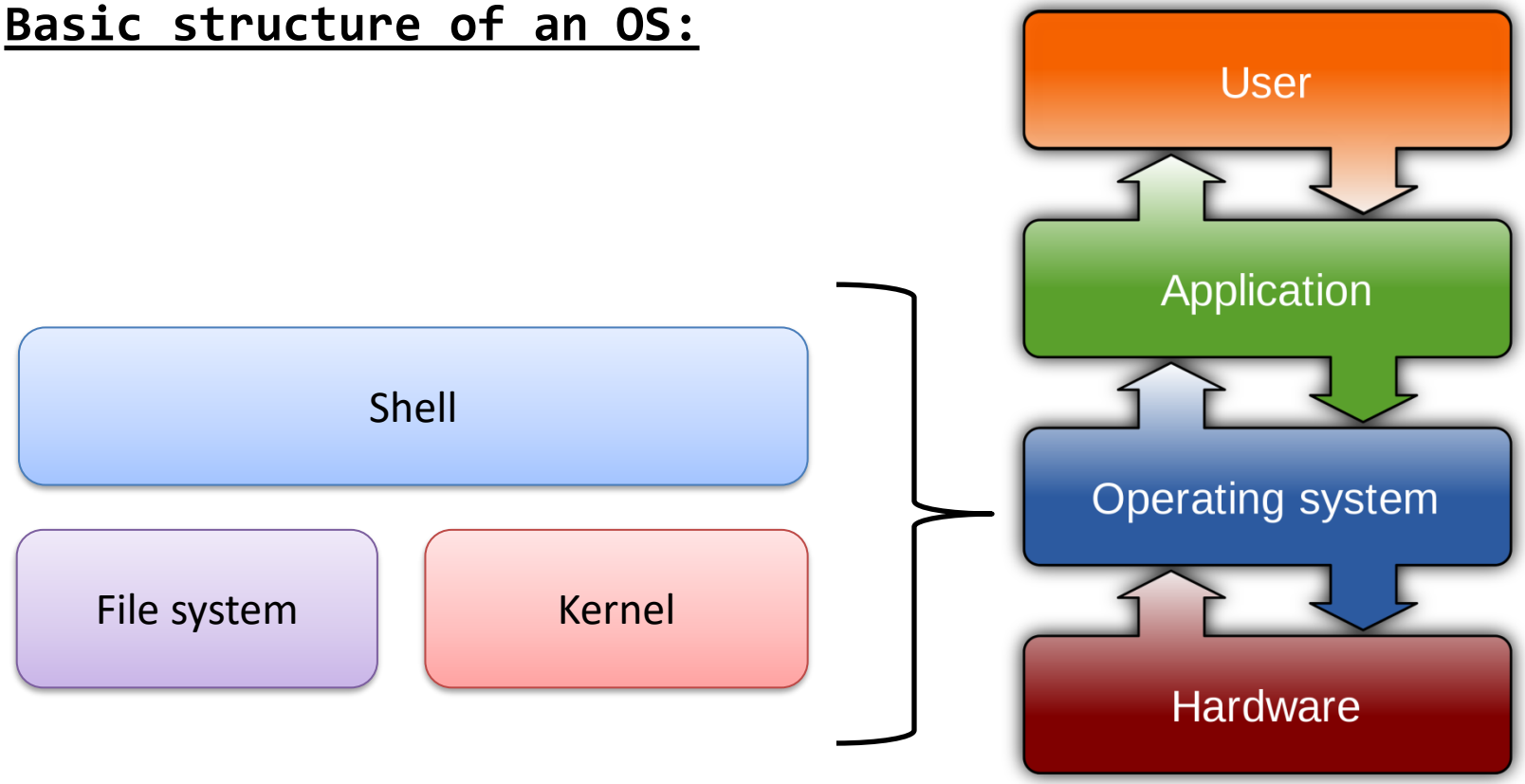
Functions:

- Program execution control and oversee
- Administrate peripherals
- User and permission management
- Error and security management



Linux OS – Operating System II

Basic structure of an OS:



Linux OS – Operating System III

Shell

Program that provides the traditional, text-only user interface.

File system

It controls how data is stored, manipulated and retrieved.

Kernel

It is the foundational layer of an operating system (OS). It functions at a basic level, communicating with hardware and managing resources.

Linux OS - Introduction

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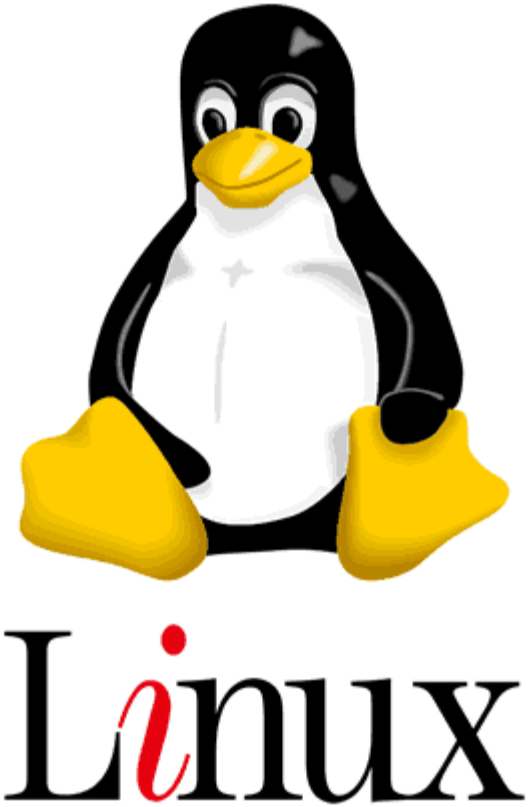

Linux OS – Open source I

The distribution terms of open-source software must comply with the following criteria:

- Free Redistribution
- Source Code
- Derived Works
- Integrity of the Author's Source Code
- No Discrimination Against Persons or Groups
- No Discrimination Against Fields of Endeavour
- Distribution of license
- License Must Not Be Specific to a Product
- License Must not Restrict Other Software
- License Must Be Technology-Neutral

Linux OS – Open source II

Linux Distributions

- A distro is a Linux kernel based operating system made from a software collection and sometimes a package management system.
- There are distros for a wide variety of platforms.
- A typical Linux distro comprises a Linux kernel, GNU tools and libraries, additional software, documentation, a window system, a window manager, and a desktop environment.
- Most of the included software is free and open-source software made available both as compiled binaries and in source code form, allowing modifications to the original software. Usually, Linux distributions optionally include some proprietary software that may not be available in source code form, such as binary blobs required for some device drivers.

Linux OS – Open source II

Linux Distributions

ubuntu

Ubuntu 20.04.6 LTS

Linux OS - Introduction

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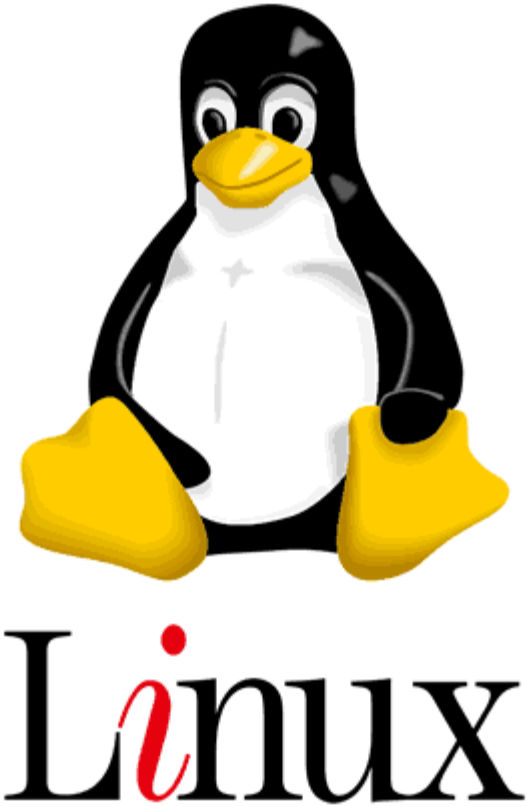
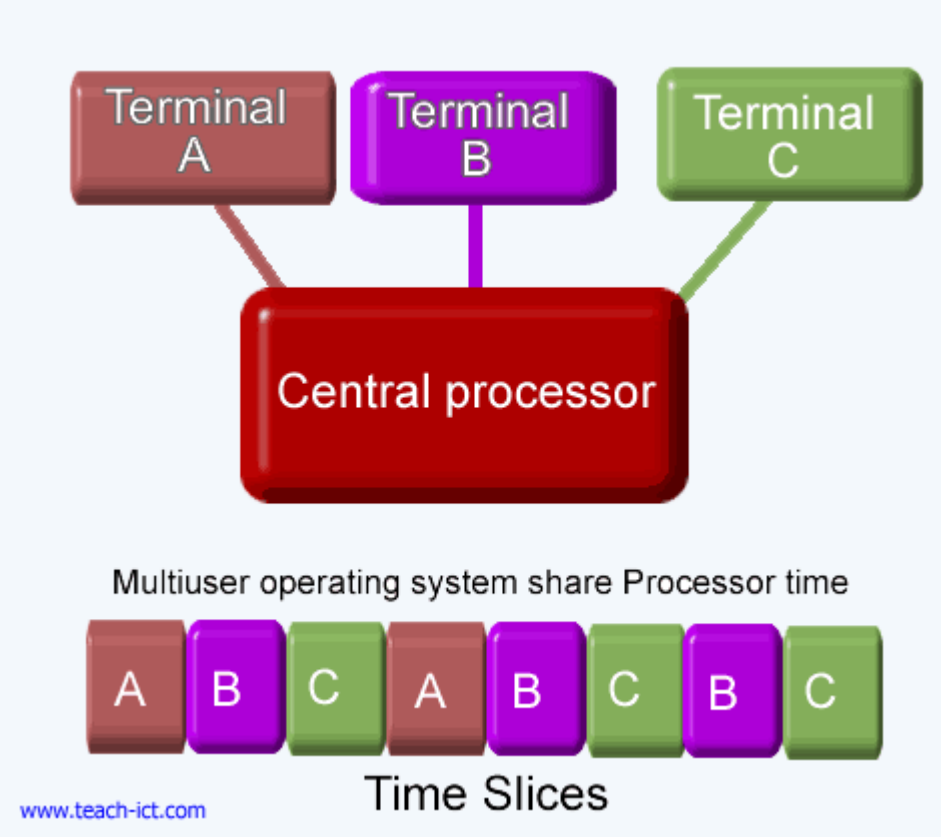


Linux OS – Multi-task

A multi-task operative systems allows a user to perform more than one computer task (such as the operation of an application program) at a time.

The operating system is able to keep track of where you are in these tasks and go from one to the other without losing information.



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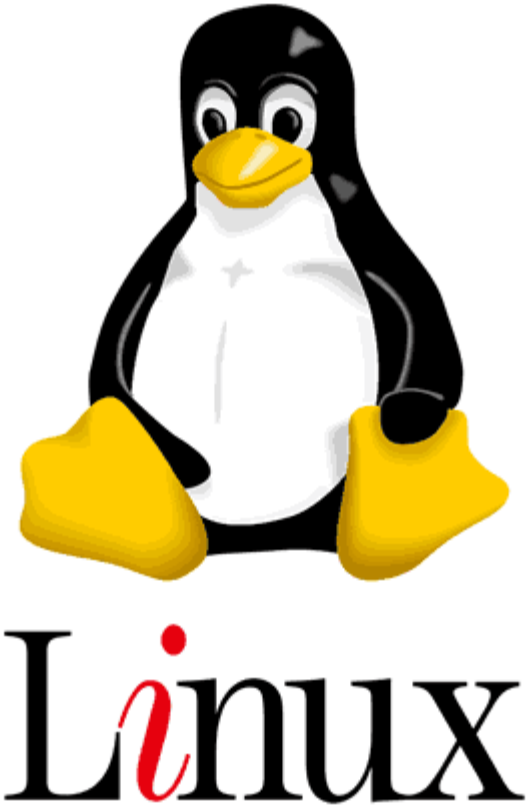


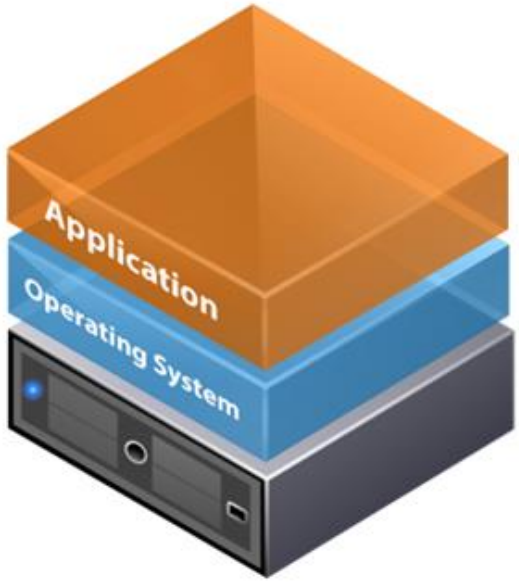
Linux OS – Multi-user I

- Multi-user software is software that allows access by multiple users of a computer.
- An example is a Unix server where multiple remote users have access (such as via a serial port or Secure Shell) to the Unix shell prompt at the same time.

Linux OS – Virtualisation

Virtualisation:

the act of creating a virtual (rather than actual) version of something, including virtual computer hardware platforms, storage devices, and computer network resources.



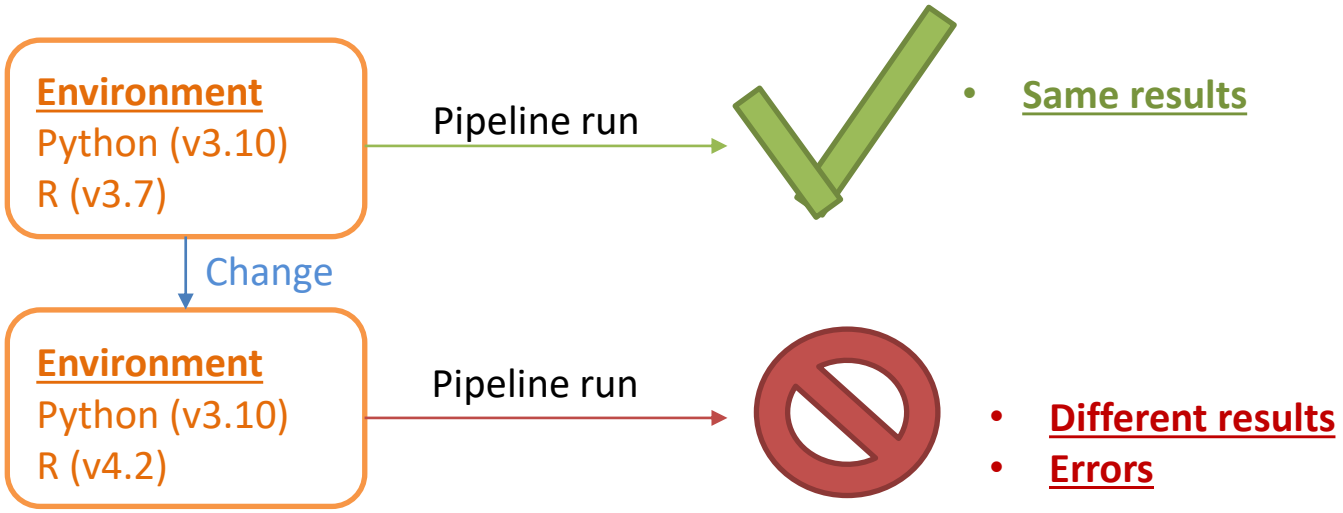
Traditional Architecture

Virtual Architecture

Linux OS – Environments

Environment:

- Files
- Resources
- Libraries
- Software packages
- Environment variables



Linux OS – Environments

Computer environment

R (v3.5)

Python (v2.7)

Conda environment 1

R (v4.2)

Conda environment 2

Python (v3.10)

Kraken2 (v2.0.8)

iVar (v1.3.1)

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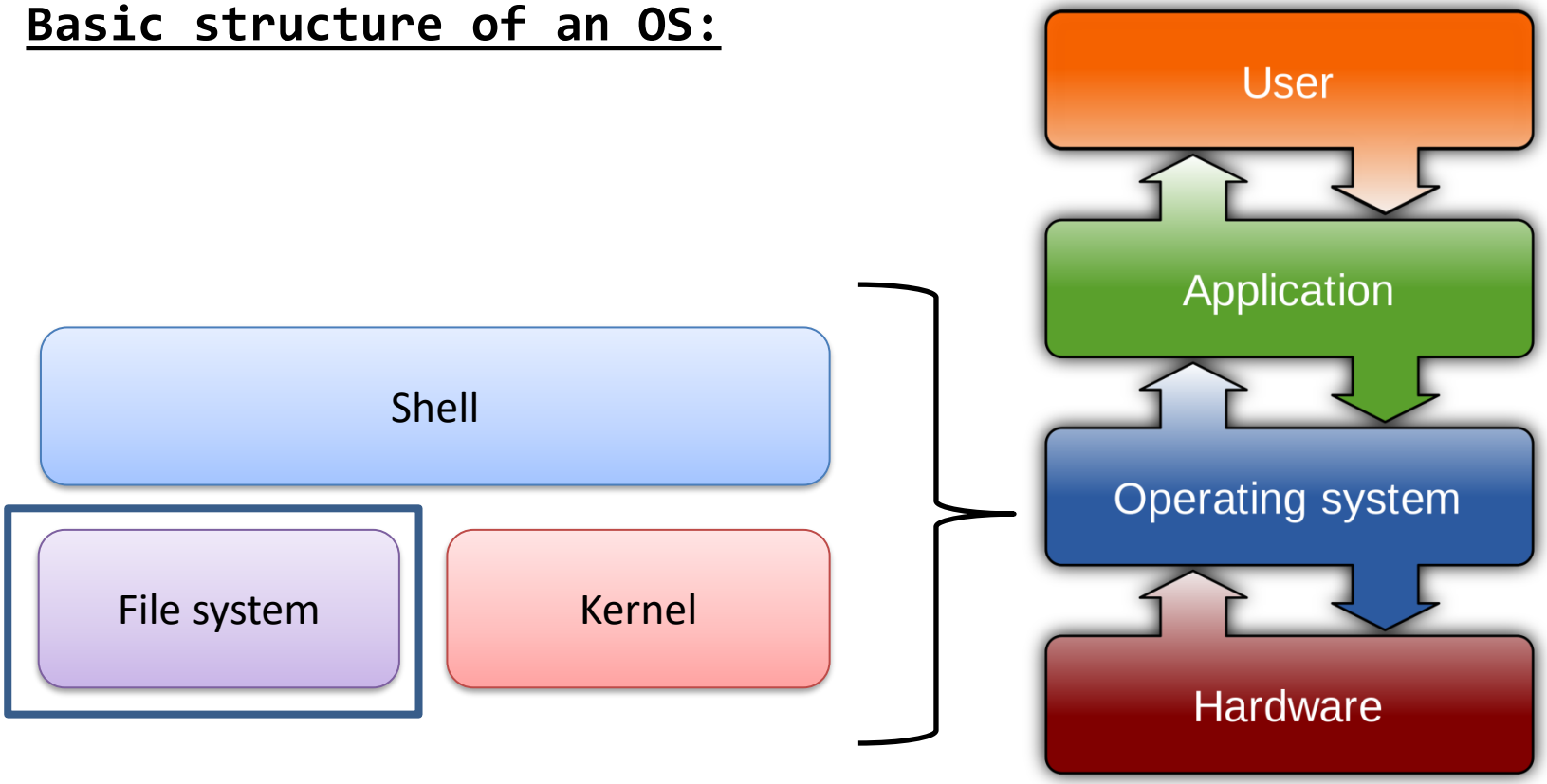
Linux OS – Operating System II

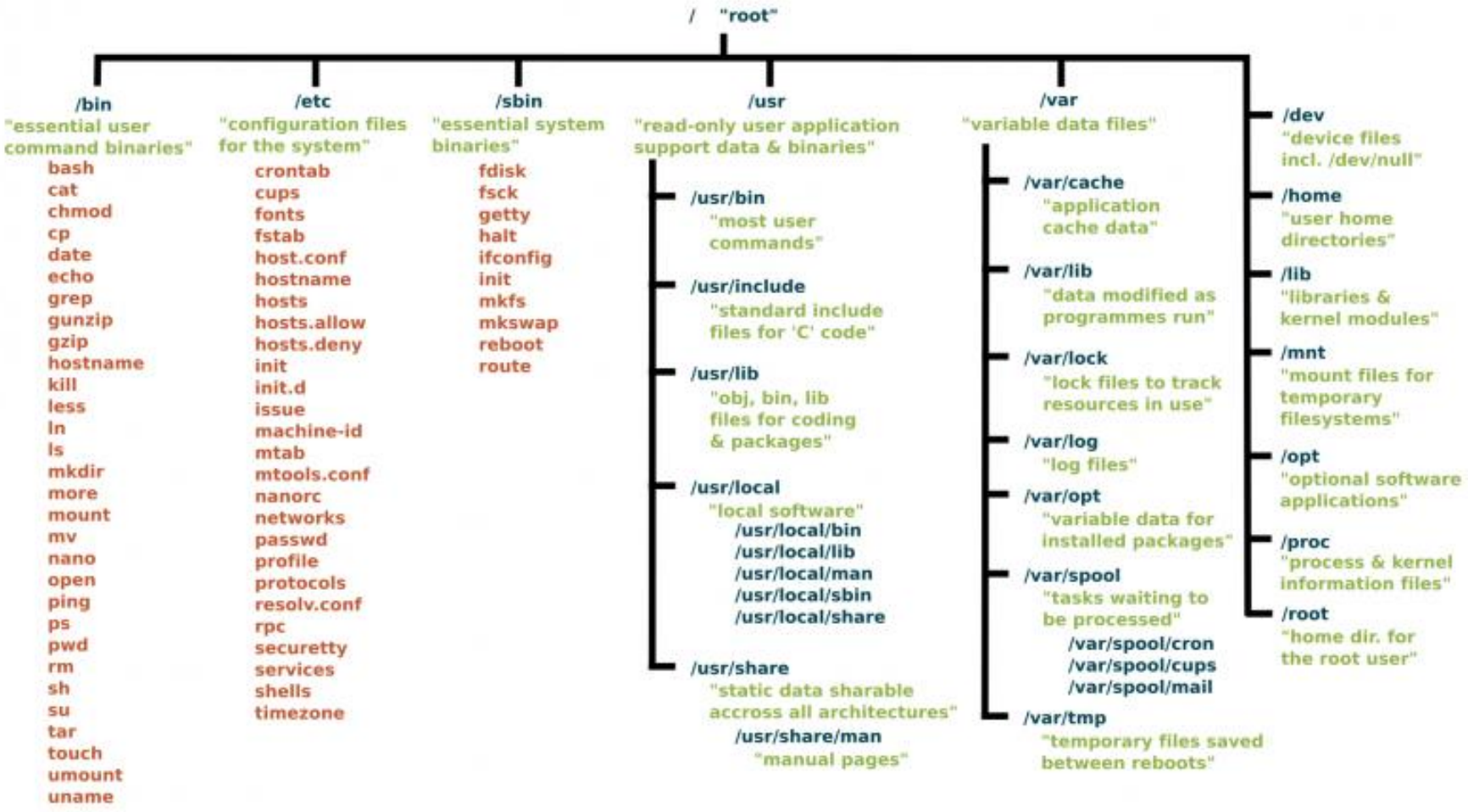
Basic structure of an OS:



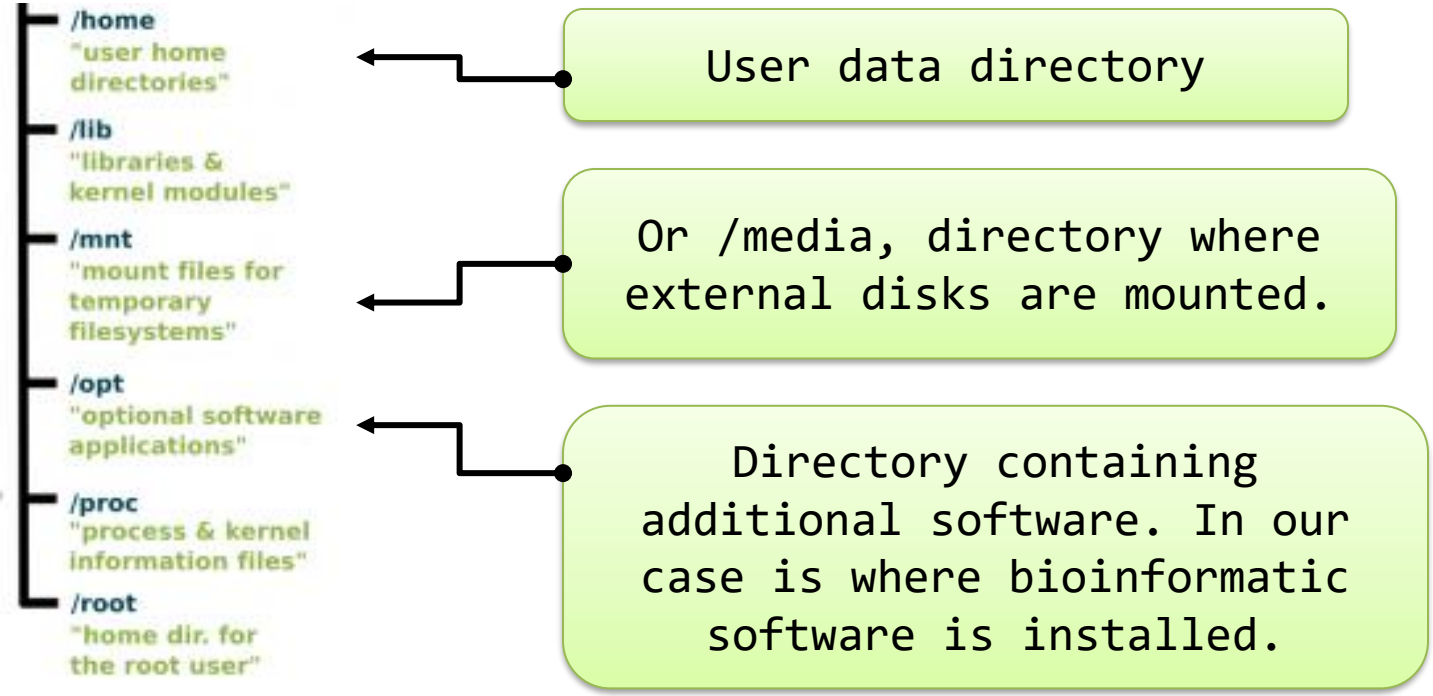
Linux File System – Key Features

- Root directory (/)
- Everything is a File
- Specifying Paths
- Case-Sensitive
- File Extensions and Hidden Files
- Permissions

Linux File System – Structure

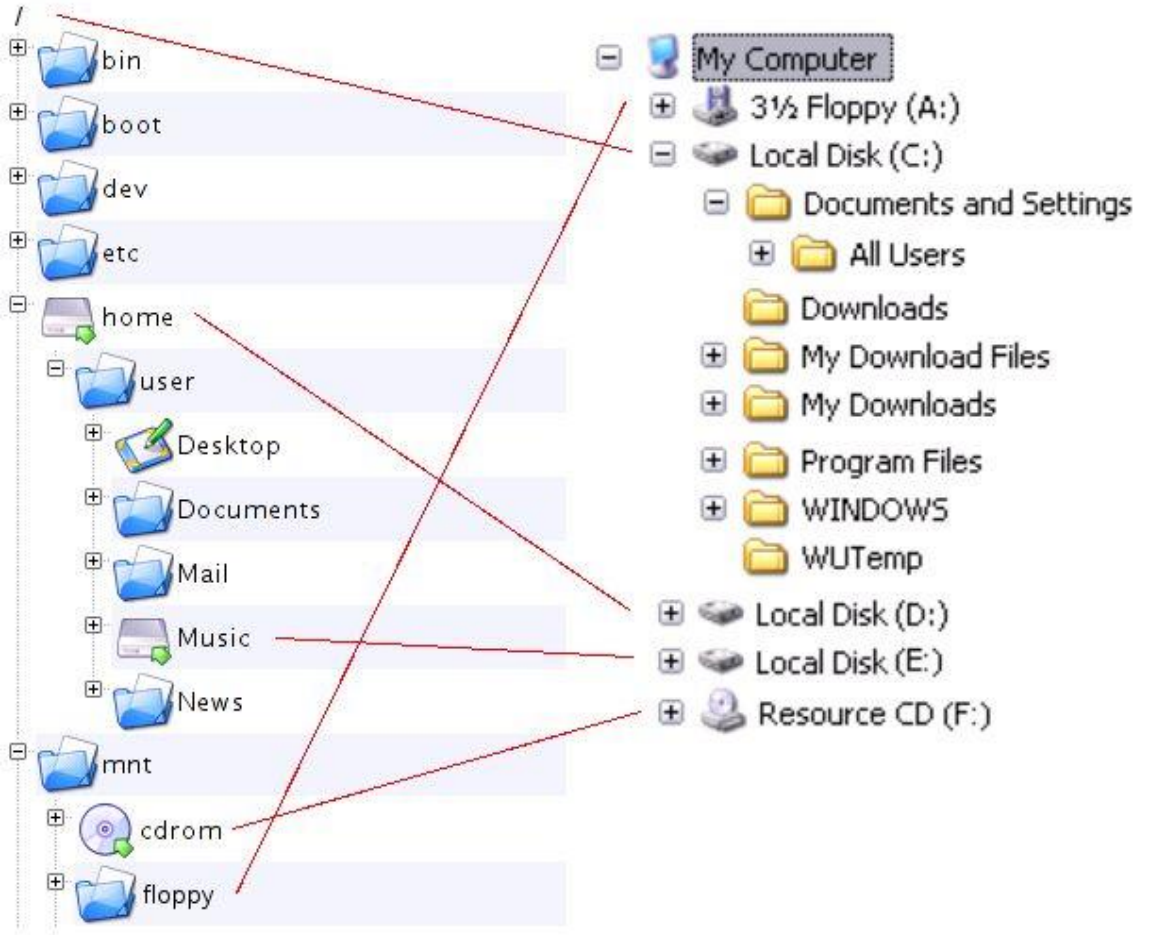


Linux File System – Structure



Linux File System - Comparison

- Everything "hangs" from root
- Files are classified by type / role instead of unit location
- Files locations in disks are invisible for users

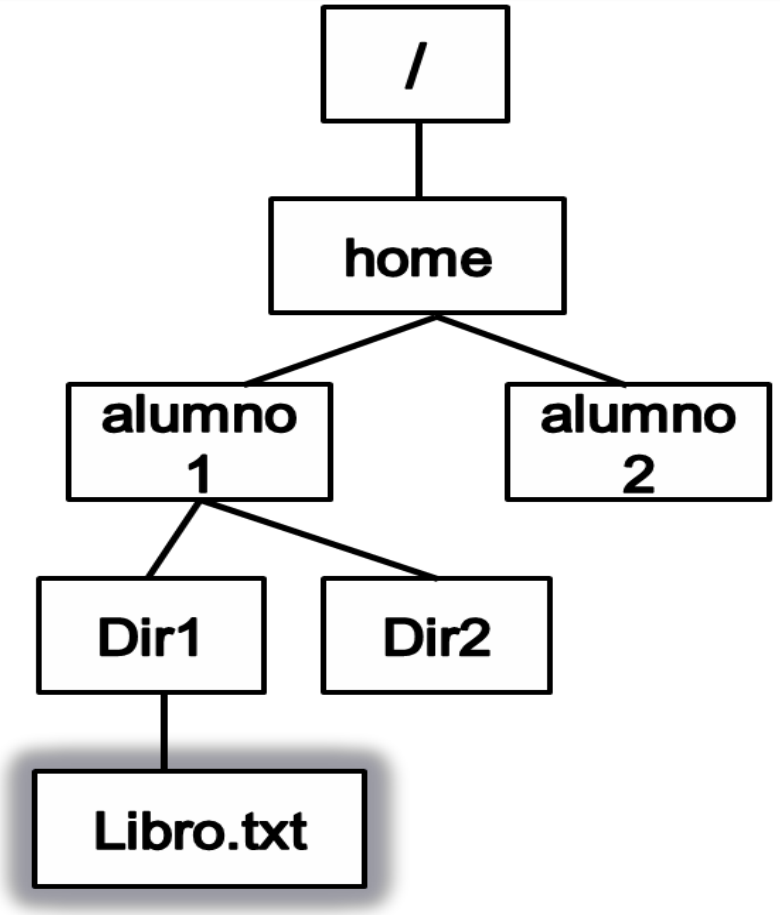


Linux File System – Paths

- PATH:
  - **Absolute path:**
    - Location of a file or directory from the root directory (/).
    - Static.
    - Ej: /home/alumno1/dir1/book.txt
  - Relative path:
    - Path related to the present working directory (pwd).
    - Variable
    - Actual pwd = “.”
    - Parent directory = “..”
    - Ej:
      - ./alumno1/dir1/book.txt (from /home)
      - dir1/book.txt (from /home/alumno1)
      - book.txt (from /home/alumno1/dir1)

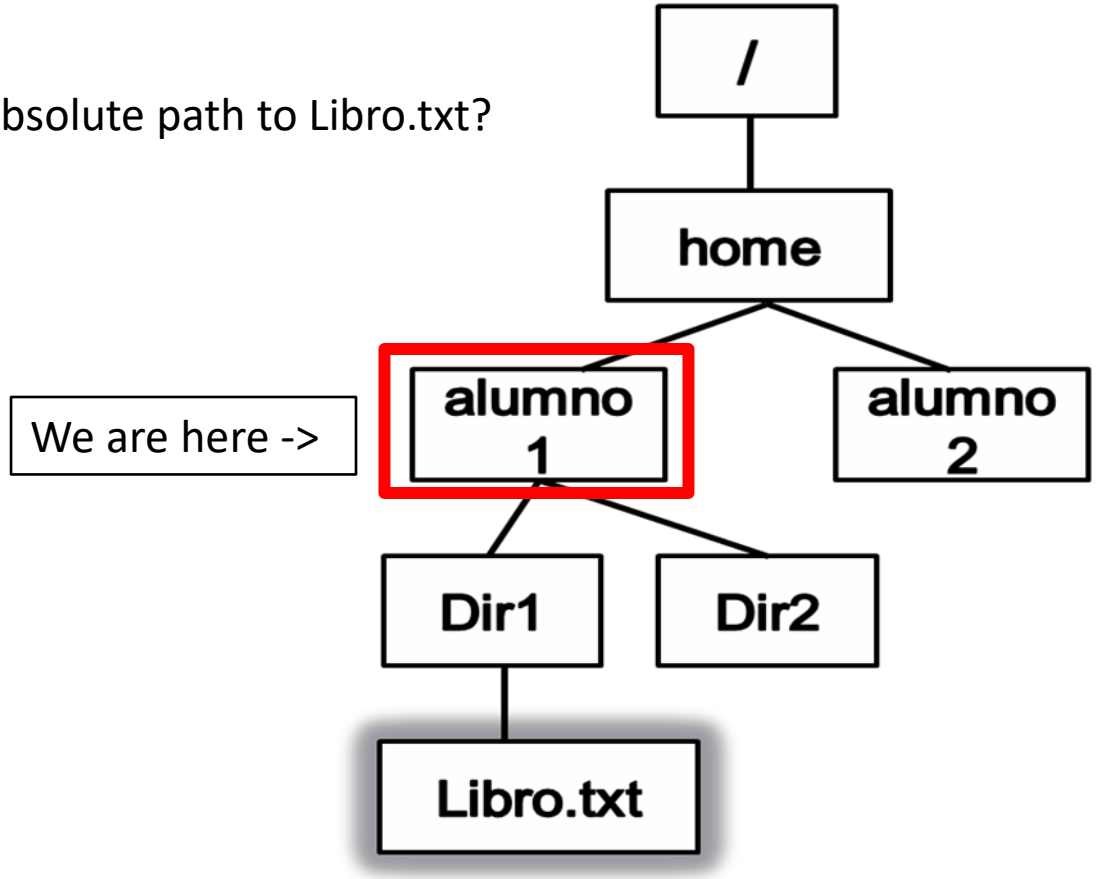
Linux File System – Paths

- Example
  - `../../` To go *home* from *Dir1* or *Dir2*
  - `../../alumno2` To go *alumno2* from *Dir1* o *Dir2*.
  - `../Dir2` To go from *Dir1* to *Dir2*.



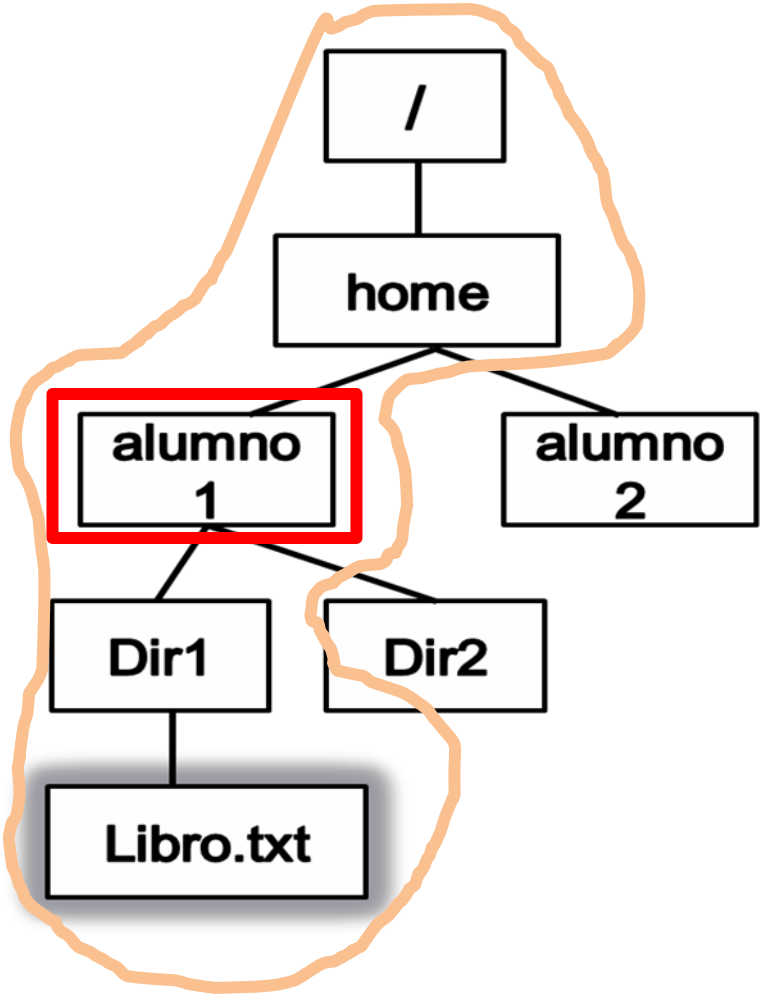
Linux File System – Paths

Which is the absolute path to Libro.txt?



Linux File System – Paths

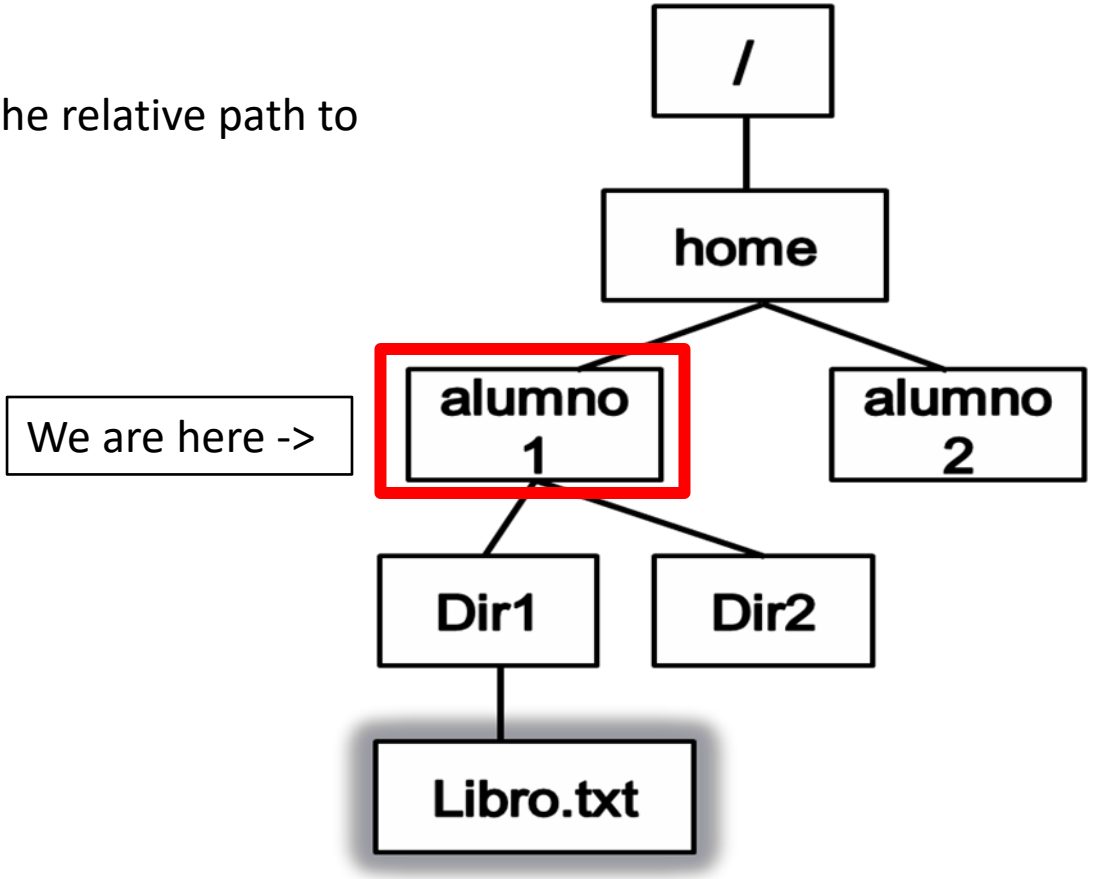
No matter were we are



Absolute path
/home/alumno1/Dir1/Libro.txt

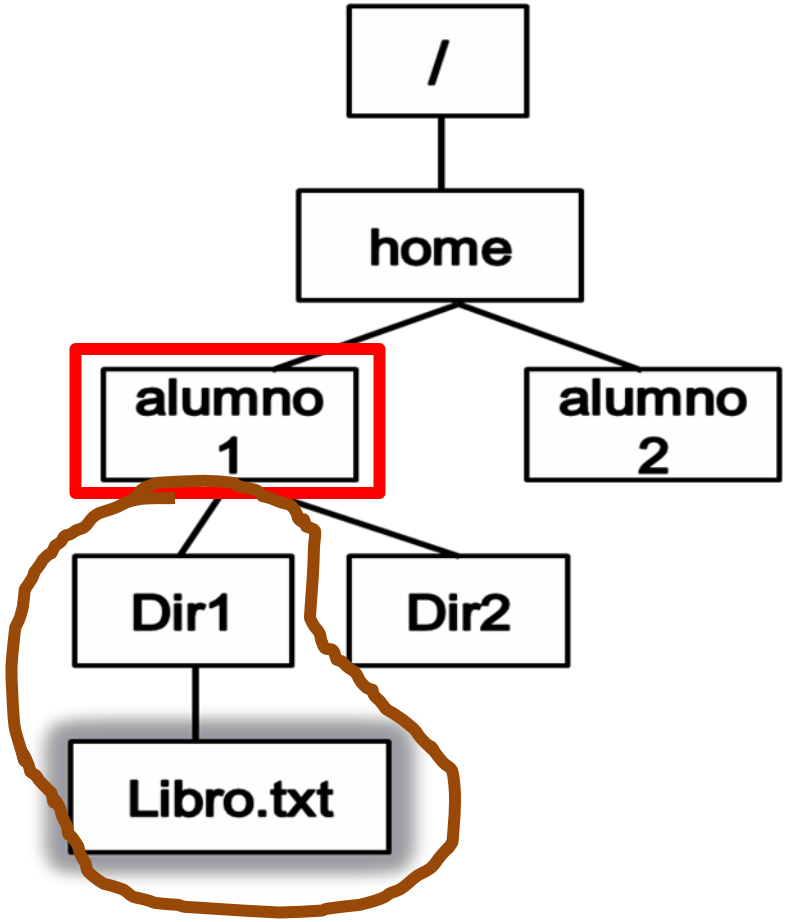
Linux File System – Paths

Which is the the relative path to Libro.txt? ?



Linux File System – Paths

Important pwd or “.”



Relative paths:
./Dir1/Libro.txt
or Dir1/Libro.txt

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Linux Users and Privileges - Users

- Users can be linked to a person or computer process
- Every user may belong to one ore more groups
- Every user may has a home folder inside /home
- Users own the files they create, directly or indirectly
- Users can change permissions on files they own
- Users also own processes they execute
- Root rules over them all
- Root home folder is in /root

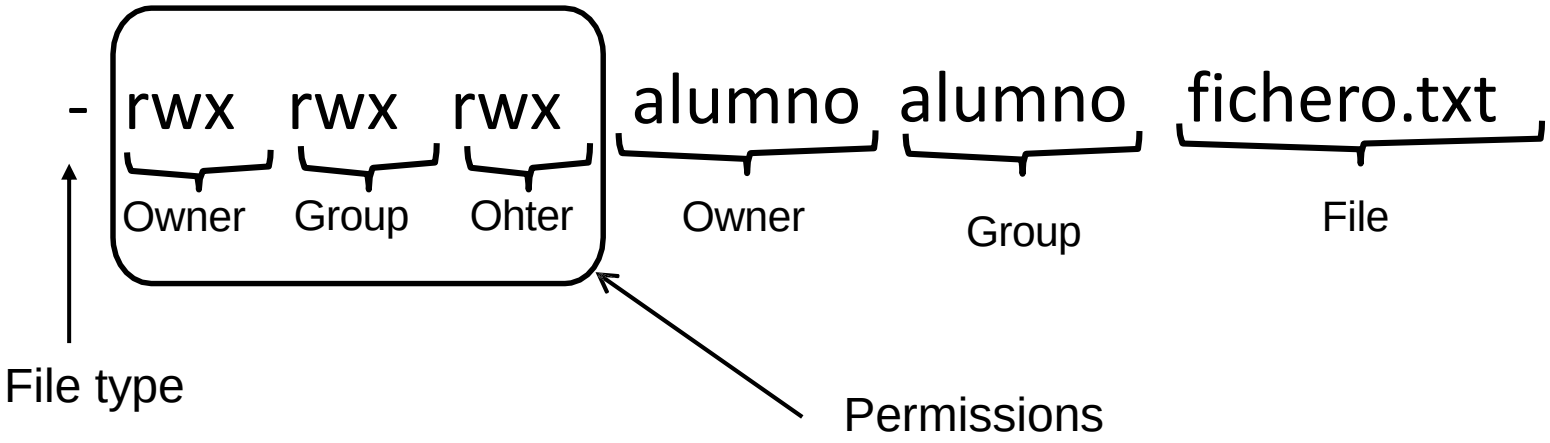
Linux Users and Privileges - Permissions

Permissions are the “rights” to act on a file or directory. The are only 3 basic permissions:

- **Read (r)** - allows the contents of the file to be viewed. A read permission on a directory allows you to list the contents of a directory.
- **Write (w)** - allows you to modify the contents of that file. For a directory, the write permission allows you to edit the contents of a directory.
- **Execute (x)** - for a file, the executable permission allows you to run the file and execute a program or script. For a directory, the execute permission allows you to change to a different directory and make it your current working directory (pwd or “.”).

Linux Users and Privileges - Permissions

- A file's rights can only be modified by the owner of the file, the group owning the file and the root
- The system stores this right information in a 9 bits sequence.
- This sequence has a sequence of 3 elements for each 3 groups:



Linux Users and Privileges - Permissions

- Examples:
  - Example 1: /opt directory

Linux File System – Structure

Directorio que contiene software adicional. En nuestro caso aquí se realiza la instalación de software bioinformático

Linux Users and Privileges - Permissions

- Examples:
  - Example 1: /opt directory:

```
drwxr-xr-x   root   root   opt
```

    - Owner (root) can read, write and execute
    - Group (root) and rest can only read and execute

Linux Users and Privileges - Permissions

- Examples:
  - Example 2: personal directory : /home/alumno

```
drwx------  alumno  clase  alumno
```

  - Owner (alumno) can read, modify and access the directory
  - Group (clase) and rest can’t do anything

Linux Users and Privileges - Permissions

- Examples:
  - Example 3: /tmp :

```
drwxrwxrwx    root    root    tmp
```

    - ???

Linux Users and Privileges - Permissions

- Examples:
  - Example 3: tmp :

```
drwxrwxrwx    root    root    tmp
```

    - Everybody has permissions for everything

Linux Users and Privileges – Check Permissions I

To view file permissions and ownership on files and directories, use the **ls -al** command. For example:

```
drwxr-xr-x 2 user user 4096 Jan  9 10:11 documents
```

`drwxr-xr-x` are the permissions
`2` is the number of files or directories
`user` is the owner
`user` is the group
`4096` is the size in bytes
`Jan  9 10:11` is the date/time of last access
`documents` is the directory

Linux Users and Privileges – Check Permissions II

Following previous example:

```
drwxrw-r-- 2 user user 4096 Jan  9 10:11 documents
```

?????

Linux Users and Privileges – Check Permissions II

Following previous example:

```
drwxrw-r-- 2 user user 4096 Jan  9 10:11 documents
```

Permissions are listed in the first 10 characters-dash section. The section can be read as follows:

`d` is a directory (`-` for files)
`rwx` the user has read, write, and execute permissions
`rw-` the group has read and write permissions
`r--` all others have read only permissions

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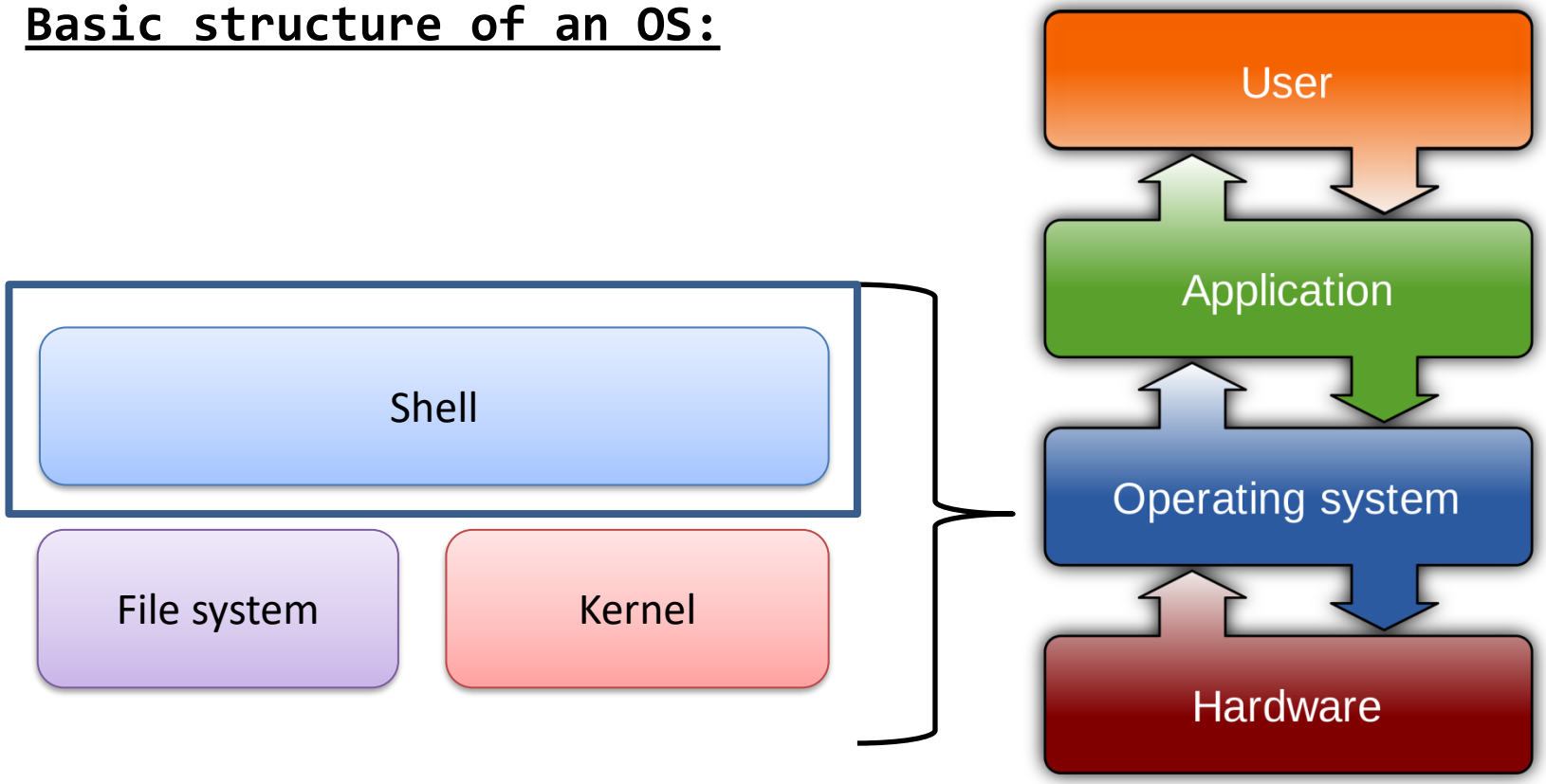
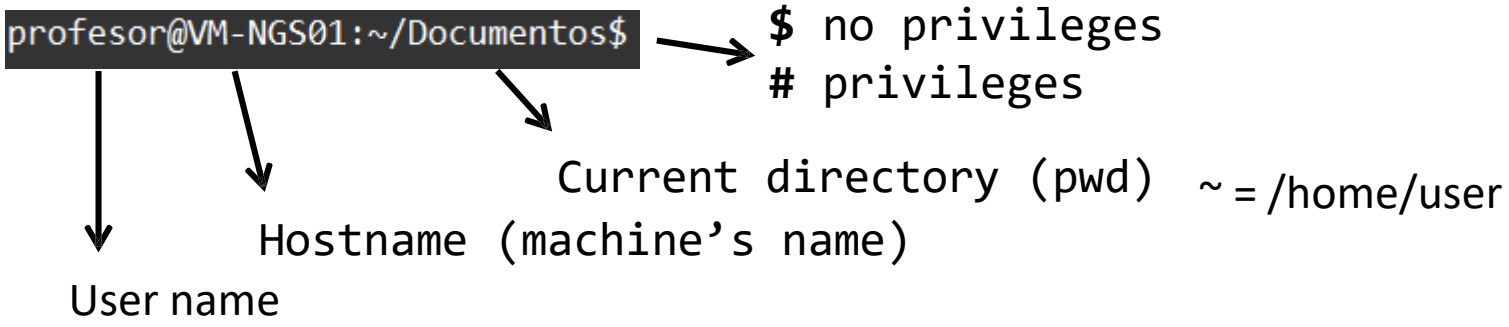


Basic Commands – Shell's prompt

- Shell waits for the user to write commands in a line called prompt.
- Prompt line gives some important information that can be easily understood:

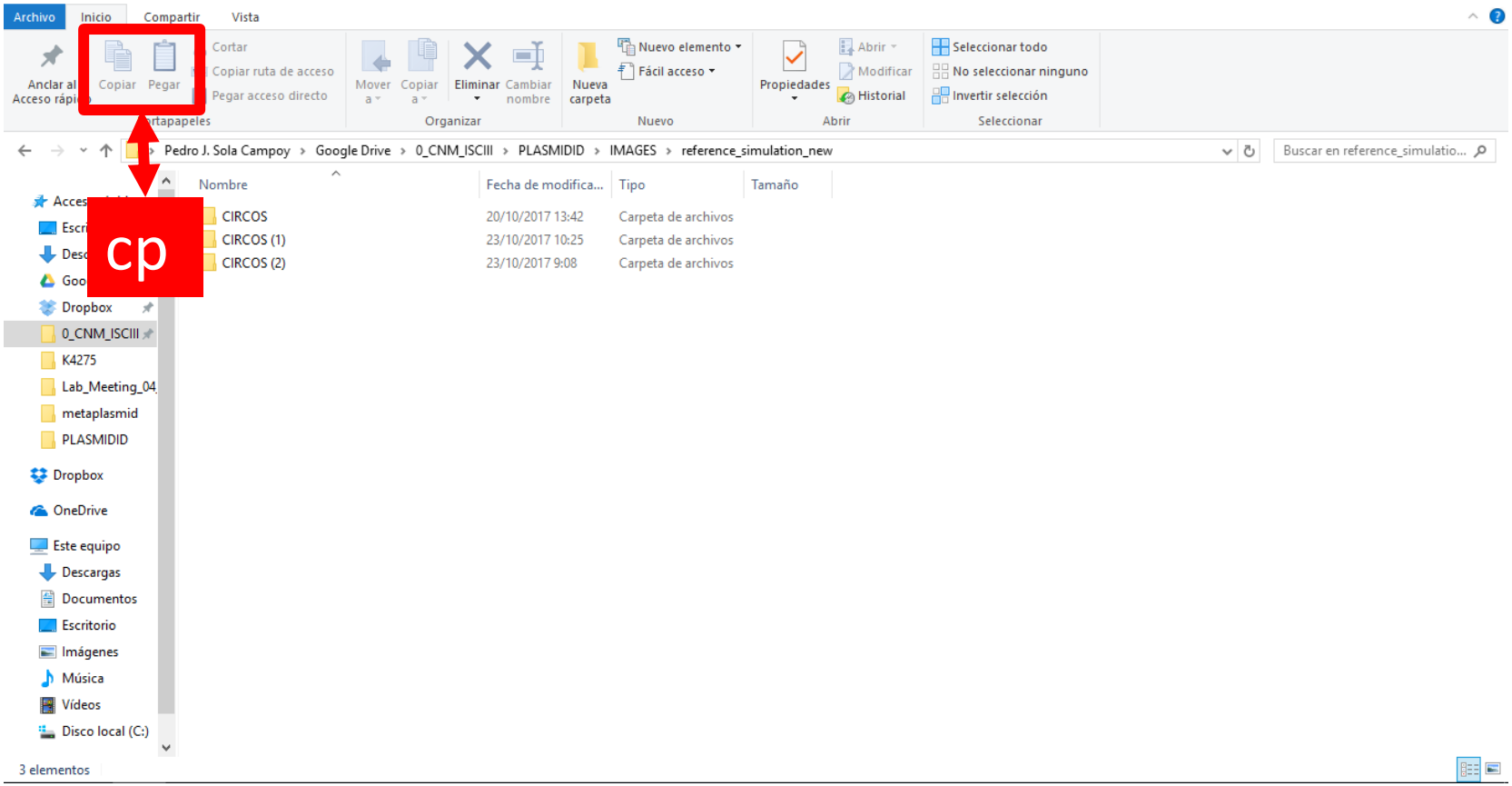


- This example prompt gives the information that the user is profesor, which has no admin privileges, which is connected to VM-NGS01 machine, and whose directory where the user is located is the folder Documentos.

Basic Commands

- `**pwd**` - display your present working directory
- `**ls**`- list contents
- `**cd**` - change directory
- `**mkdir**` - make directory
- `**rm**` - remove file
- `**rmdir**` - remove directory
- `**less**` - display contents of file
- `**nano**` - text editor on the terminal
- `**man**` - displays the manual of a command

Basic Commands



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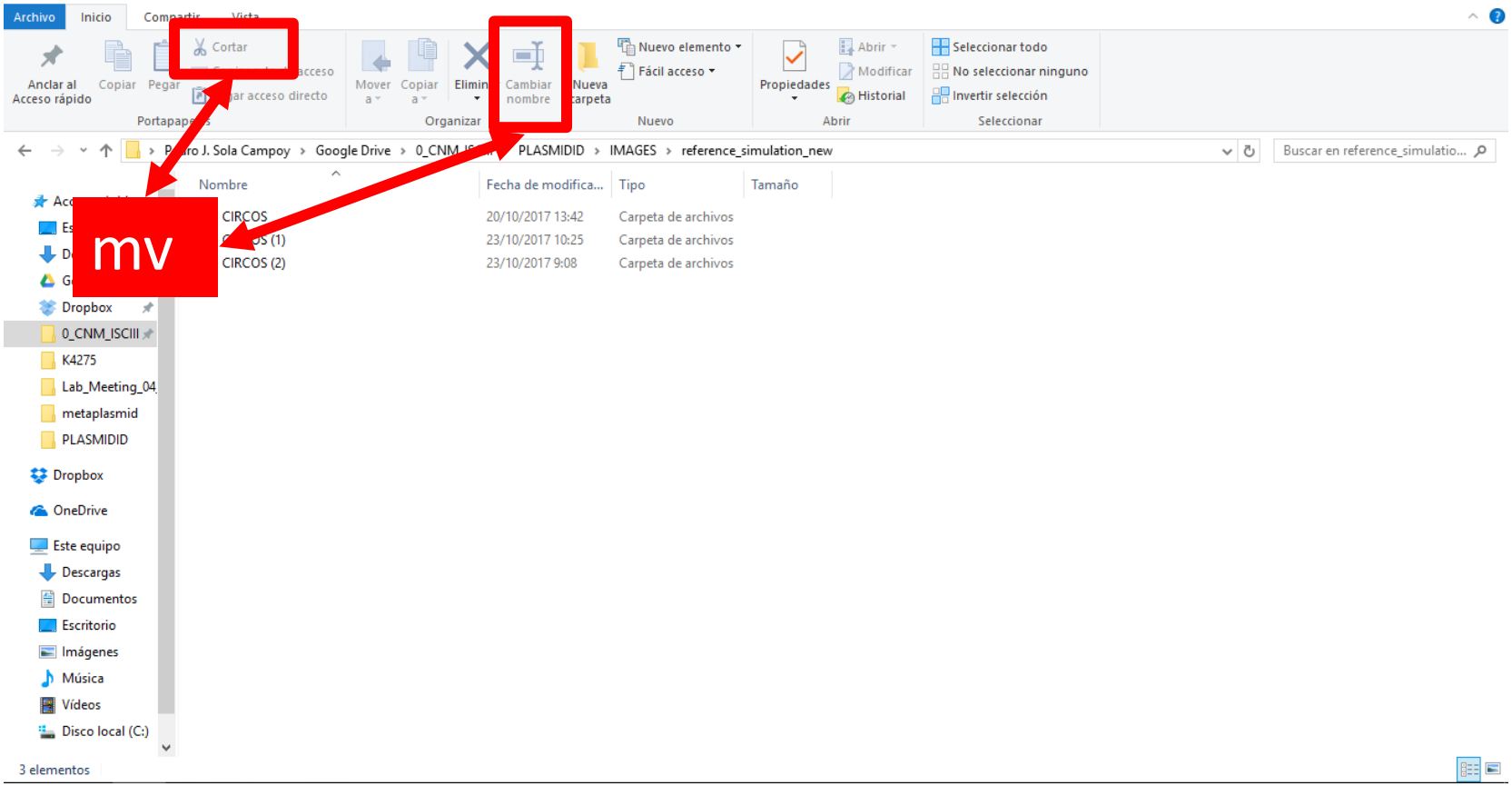

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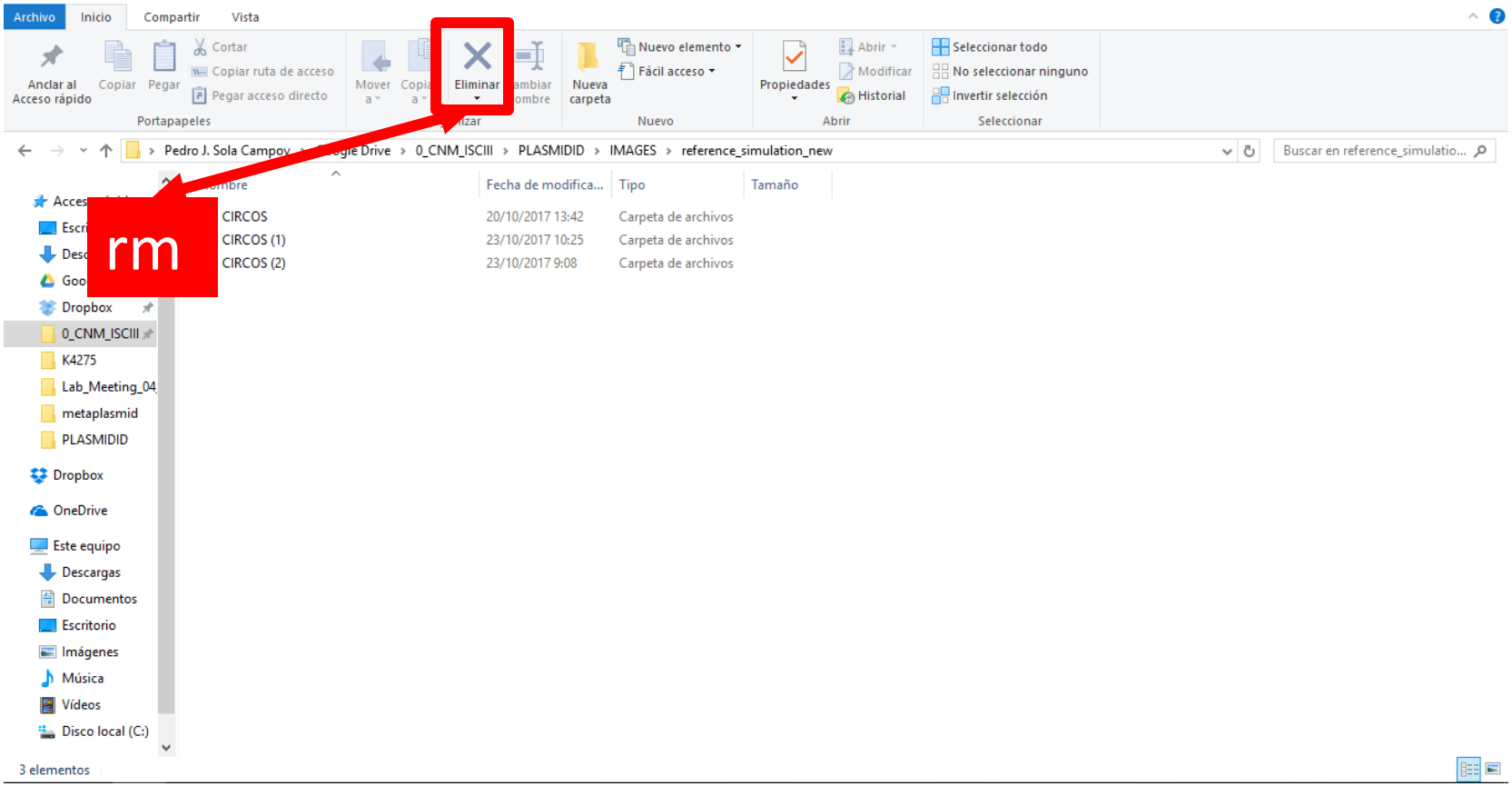

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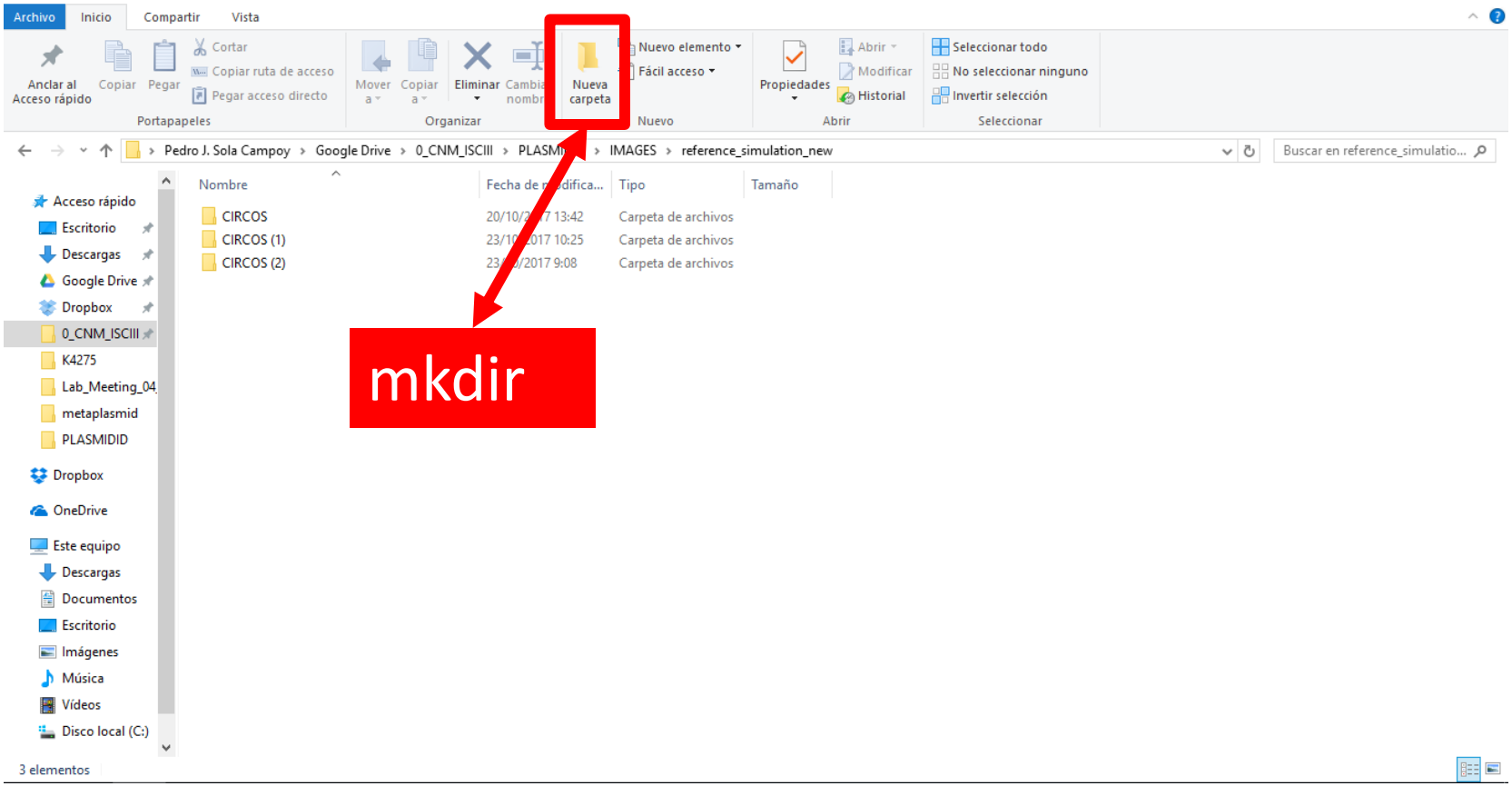

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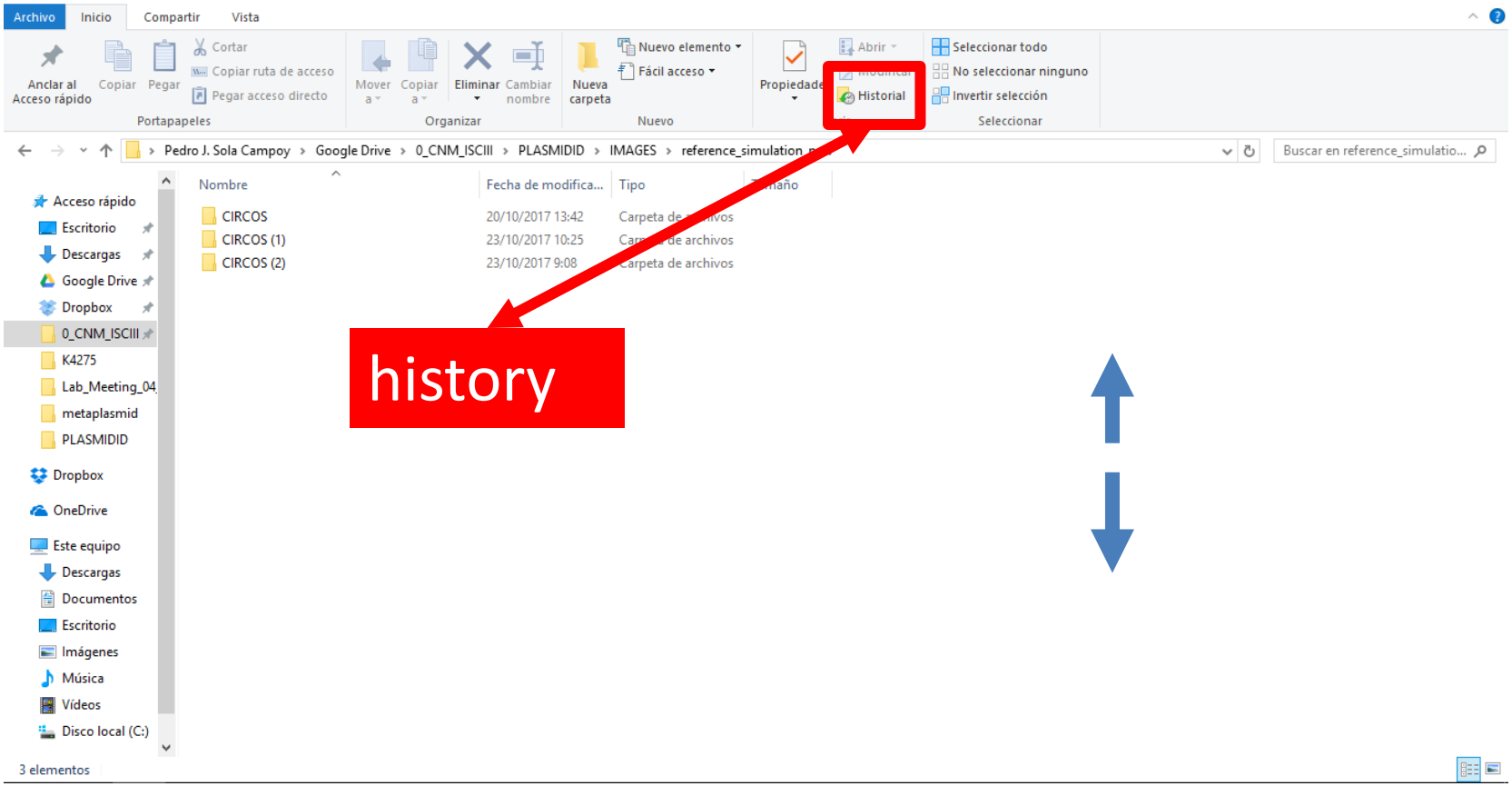

Basic Commands

REMEMBER:

TAB is your friend!

Hit it to autocomplete a command, file, path or get suggestion to do it

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Command Line Syntax

Linux command line follows a simple syntax common to every command and program you can execute on it:

Command [options] [attributes]

- Options are characters or words preceded by a dash (`ls -la`). They change the way a program works by default.
- Attributes are other parameters that the program may need to run. The most common ones usually are the input files.
- REMEMBER: most programs have a –h or --help option which displays a short description and usage guide.

Thanks for your attention!