Numerical Methods for Astrophysics:

BASIC LINUX TUTORIAL

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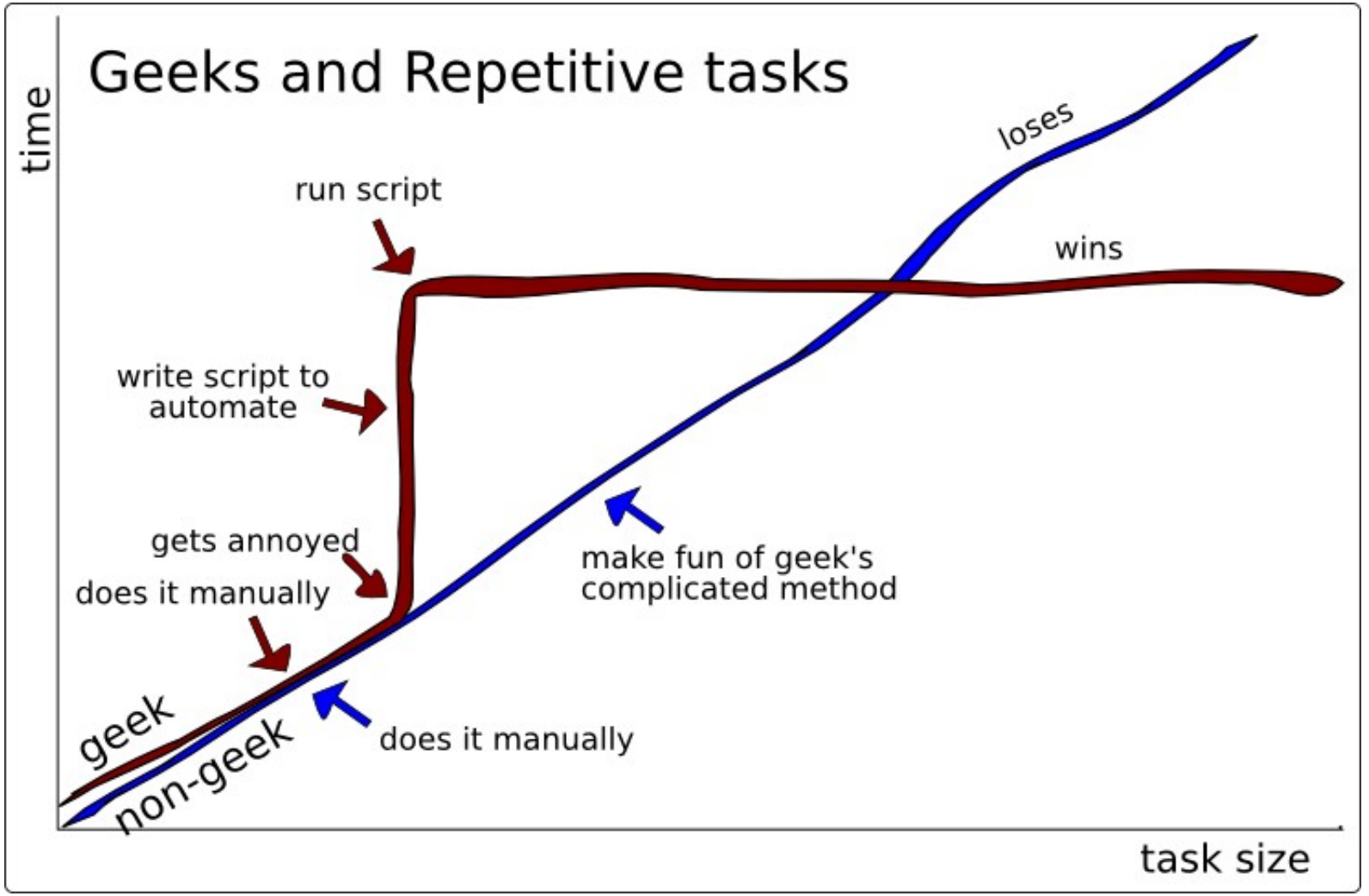
Intro. Why numerical methods?

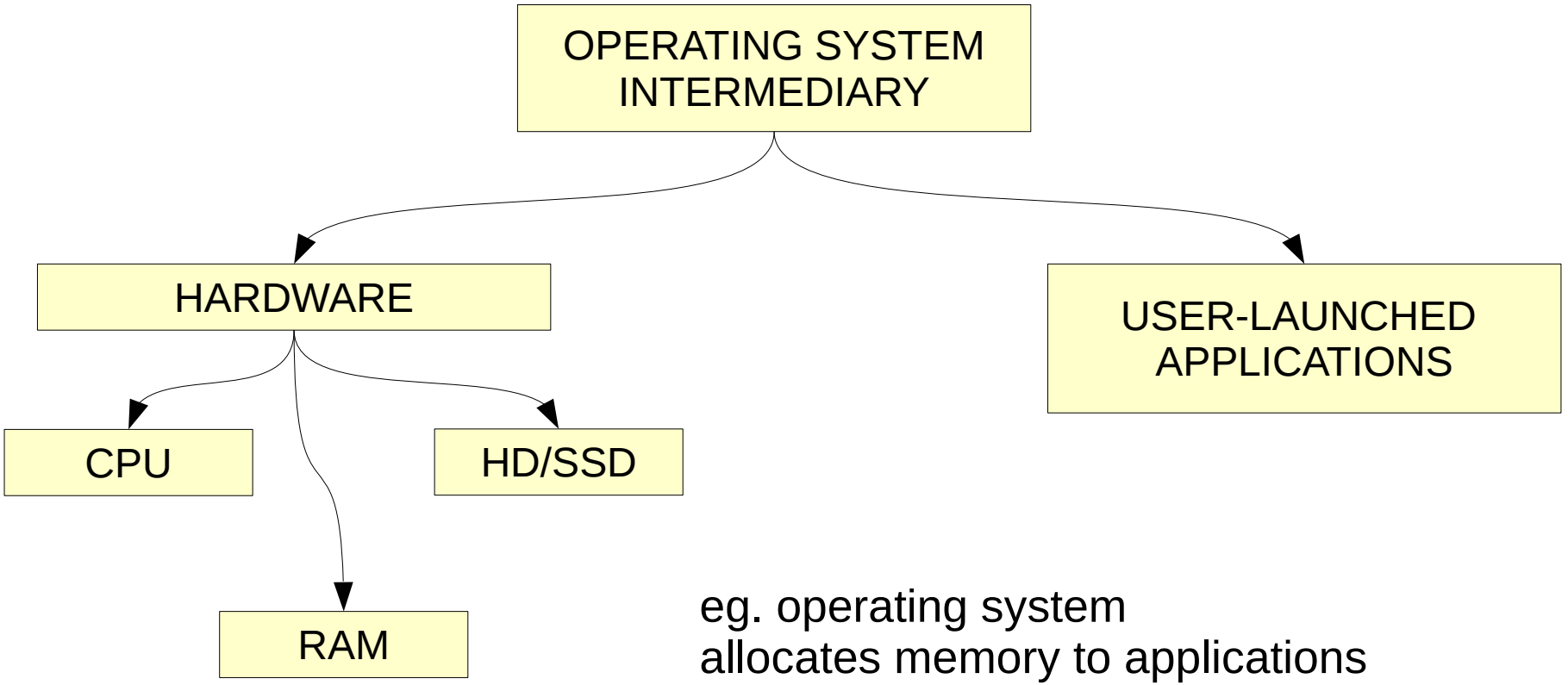


Credit: Bruno Oliveira

- a must to do research in (astro)physics and to find a job outside academia
- easy to learn / understand
- save your time

Intro. Operating system (OS)

“system software that manages computer hardware, software resources, and provides common services for computer program” - Wikipedia



eg. operating system
allocates memory to applications
optimizes the usage of the hardware by applications

Intro. Operating system (OS)

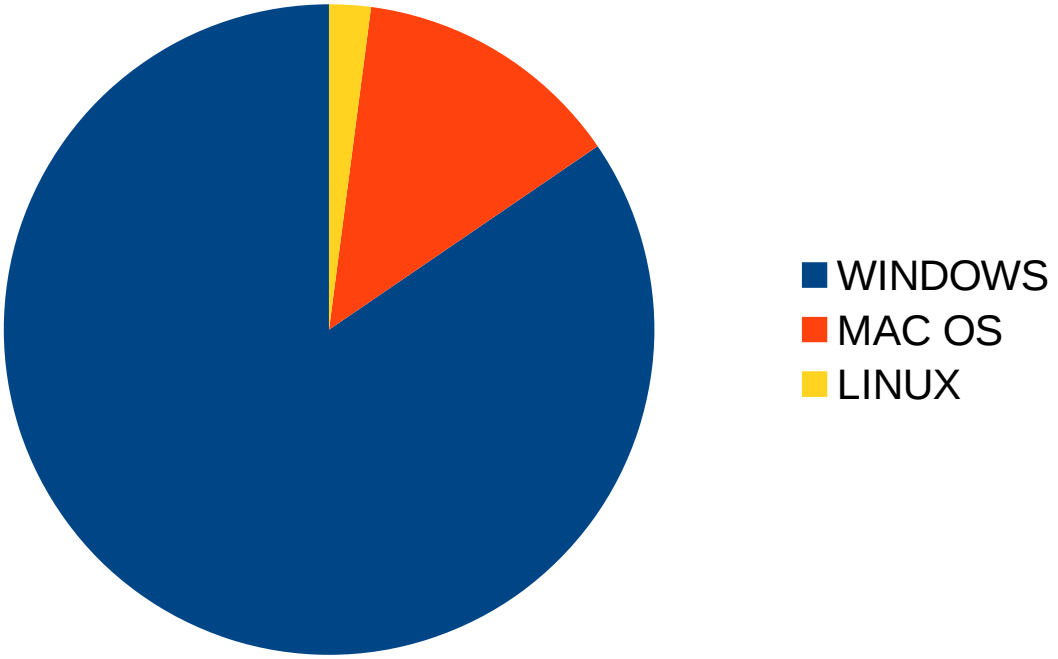
3 main OS:

WINDOWS: ~82% personal computers

Mac OS: ~13%

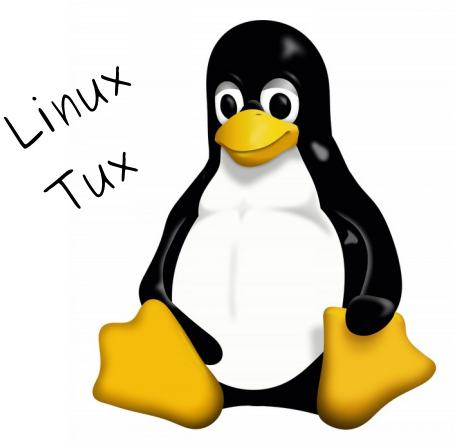
Linux: ~2%

but many linux users buy windows and then install Linux



LINUX: is the most used OS in high-performance computing (HPC) and in scientific research

Linux. What is / Why linux?

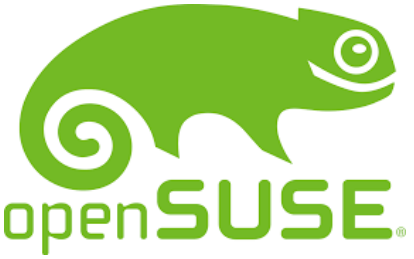


*** Open source operating system (OS)**
or better: family of open source operating systems
based on the Linux kernel

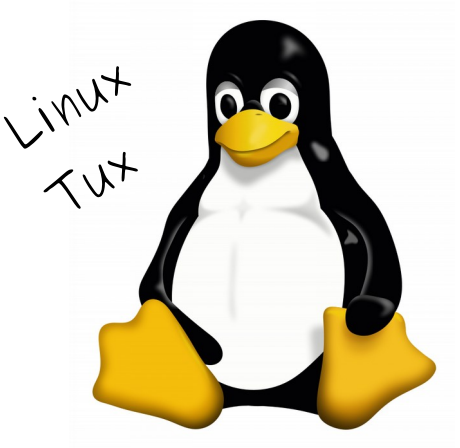
* We should call it **GNU/Linux operating system**
because the Linux operating system is a combination of Linux kernel and supporting system software and libraries, most of which are provided by the GNU project

* Different versions of the Linux software:
LINUX distributions
e.g. Ubuntu, Debian, Fedora, Open Suse

debian



Linux. What is / Why linux?



* **Open source**: = all the lines of the code are public, they can be seen and edited by everyone legally

  Not necessarily free

* **Free software**: = open source code that is also for free

  Some linux distributions (e.g. Red Hat, Suse) are not for free

* **Kernel** : = the core of the operating system
  Program at the core of the operating system which controls the system itself

Strictly speaking Linux is a just a KERNEL
→ it needs GNU software to obtain a complete operating system

Linux. What is GNU?

*** GNU is a free software initiative** and an extensive collection of utility programs completely **free software**

*** licensed under the GNU GPL (General Public License) license**

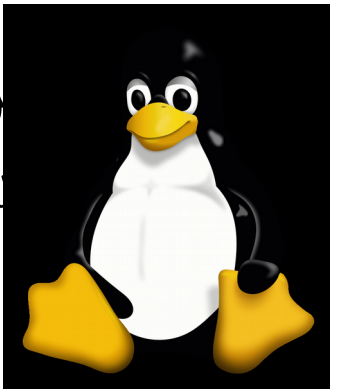
* was intended to use the Hurd kernel, but this remains at a state of development that is not ready for daily use

* September 1983: **Richard Stallman** (MIT Artificial Intelligence Laboratory) founded the GNU project. Then quit is job at the MIT Lab, to avoid that they could claim ownership of the GNU project

* Main idea of Stallman:
create a completely free software initiative that can
"create **community and social justice**".

Richard Stallman

Linux. What is / Why linux?



*** September 1991: First release of Linux kernel**

Linus Torvalds

* Developed by **Linus Torvalds** (back then University student)

* Original structure from **Unix**: born as open source then became proprietary in 1984
(user not legally allowed to modify software)

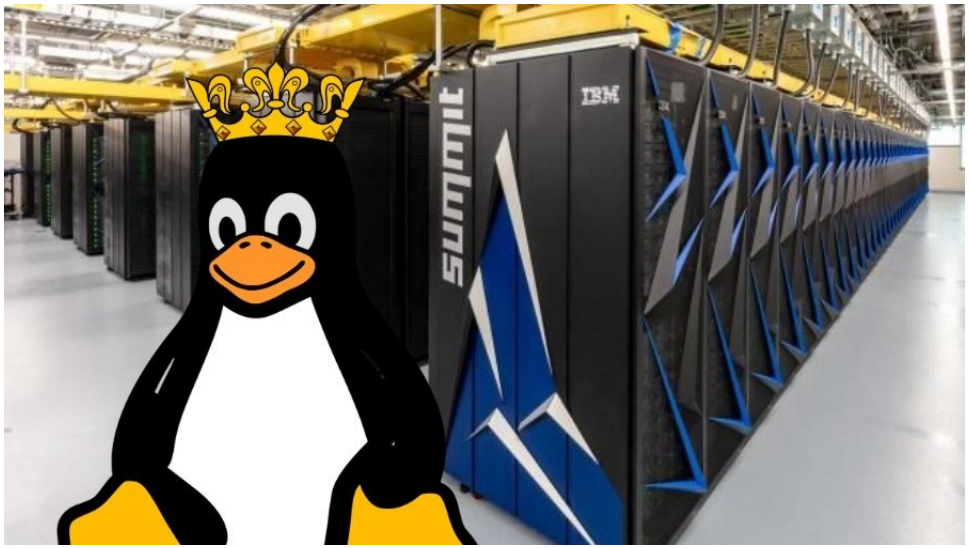
* Torvalds wanted to build its own kernel open source and compatible with Unix

* Many **developers liked the project** and participated to the Linux kernel:
Many developers contributed to modify Linux since its early stages, only the best modifications were accepted by the community, contributing to a **natural selection** of the software.

* Became popular when **NASA** and other big agencies/companies (in the ‘90s) started replacing expensive supercomputers with cheaper and efficient linux-based clusters of “normal” computers

Linux. What is / Why linux?

* Nowadays LEADING OS for big super-computers: all the **Top500 clusters use linux**



* Only ~2% of desktop computers (but this might be underestimated because many buy Windows and then install linux..)

* Many “objects” of your every-day life run linux – for example, Android is linux based

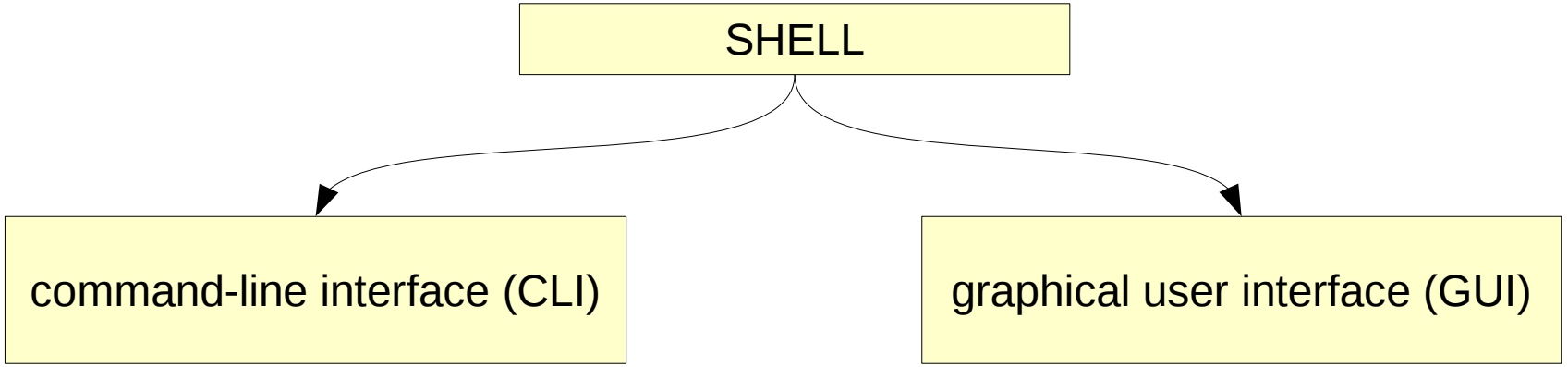
* Several possible linux distribution: Fedora, CentOs, Debian, Ubuntu

* Workstations at P104 lab and my laptop have UBUNTU

Linux. What is / Why linux?

* **user interface of a OS** (i.e. the way the user communicates with the OS):
  the **SHELL**

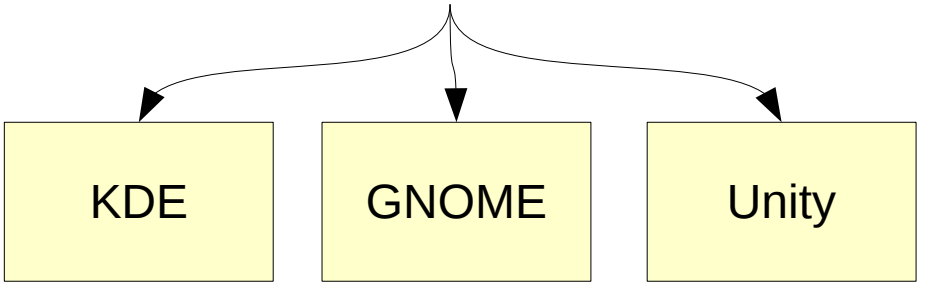
*** for linux:** most common shell is the
BASH : = Bourne Again Shell
originally developed for the GNU project



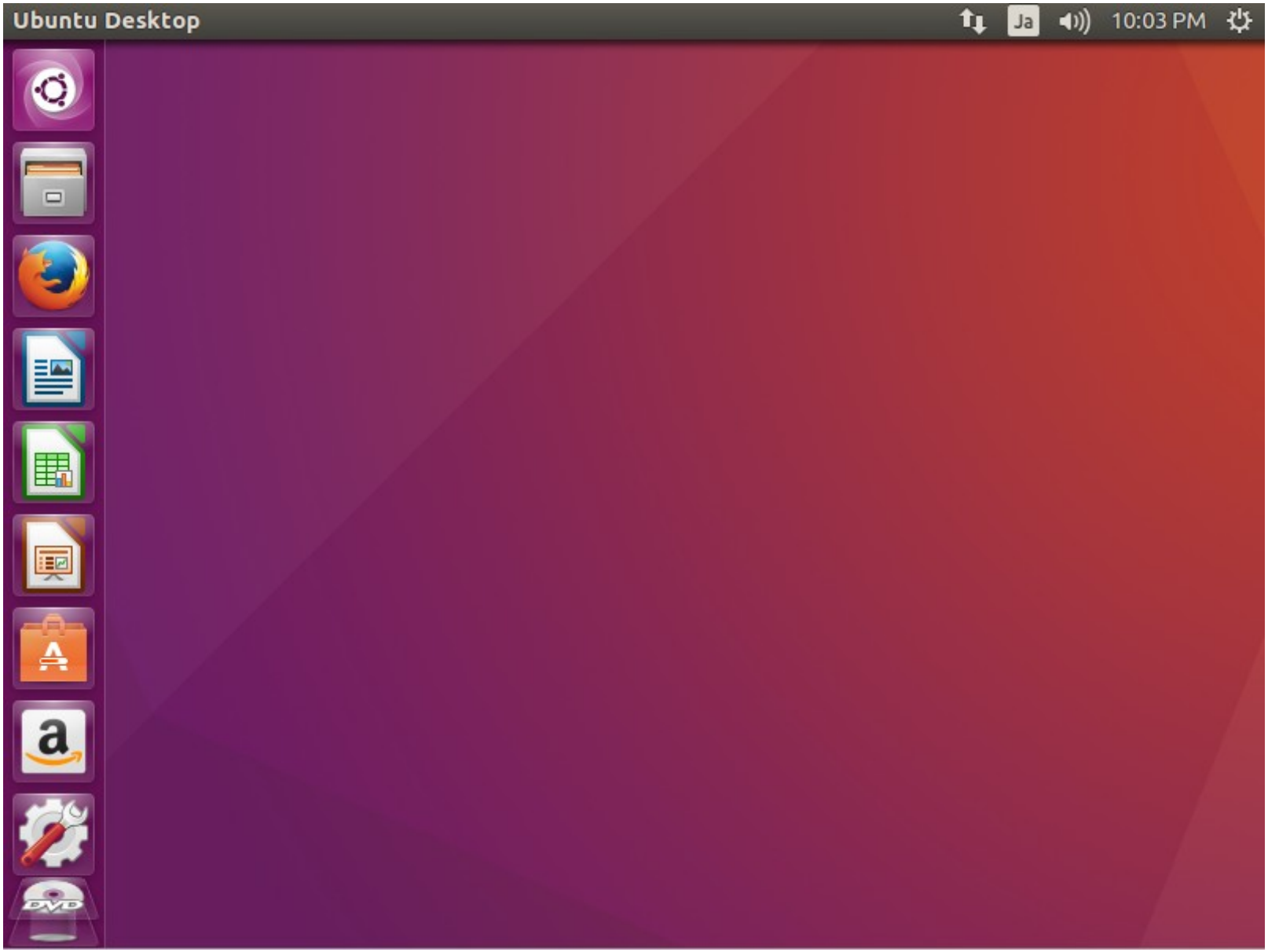
For example, if you have a linux machine, try CTRL ALT F1

Then, resume your GUI session with CTRL ALT F7 (or similar)

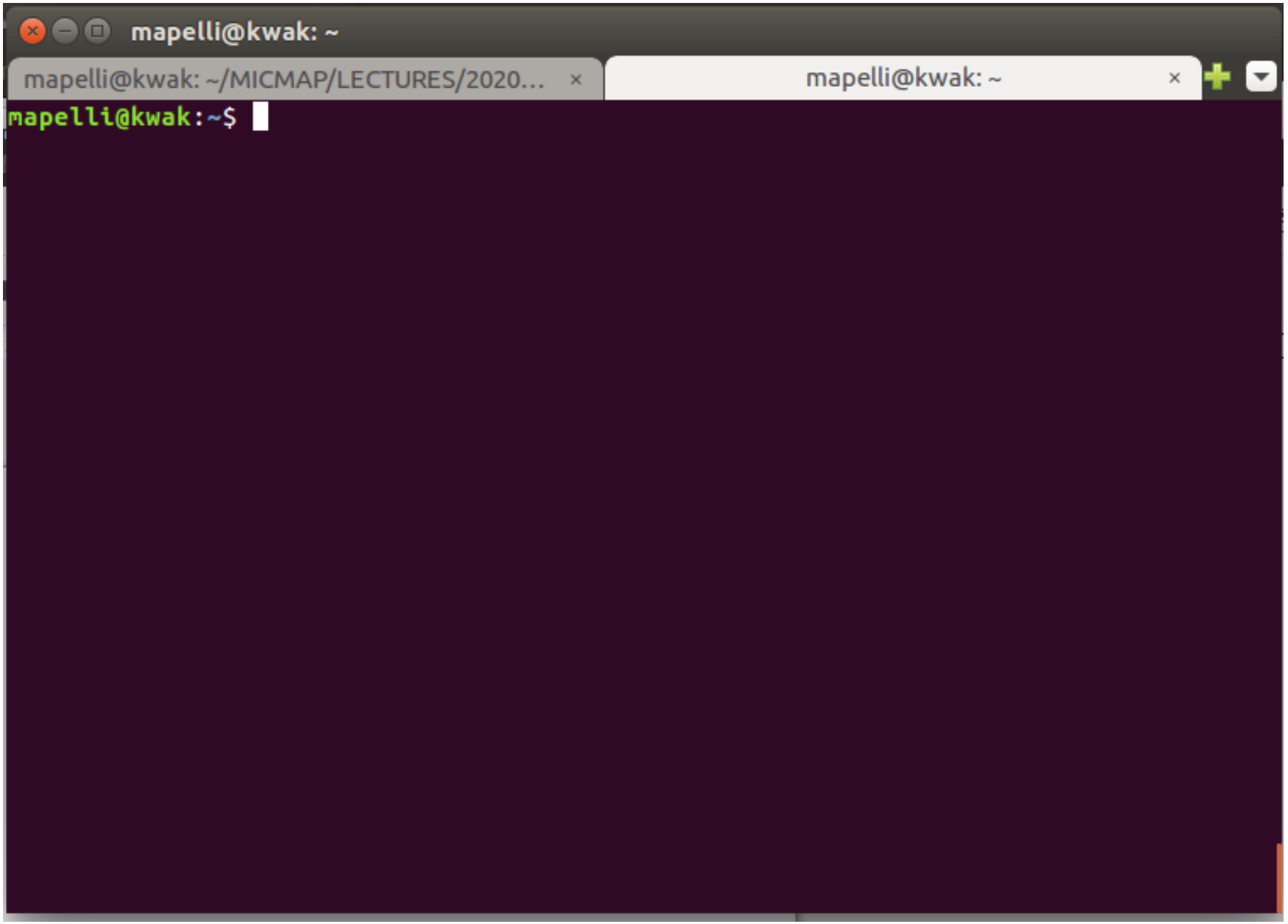
On desktops, GUI packaged with DESKTOP ENVIRONMENT



Linux. Ubuntu Desktop (with Unity)



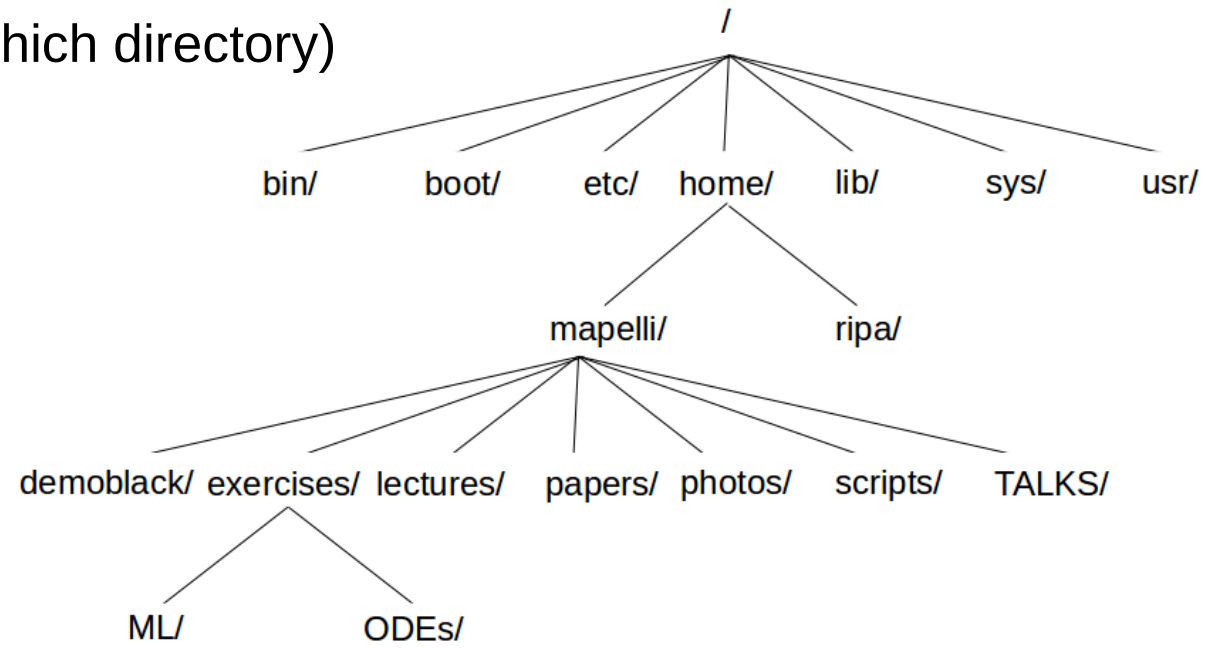
Linux. Ubuntu Terminal



Linux. Some basic commands

*** First open the TERMINAL.**
For ubuntu, click on the "search your computer" application on the top left of the screen and type "terminal"
Select the terminal icon with the mouse and click to open it

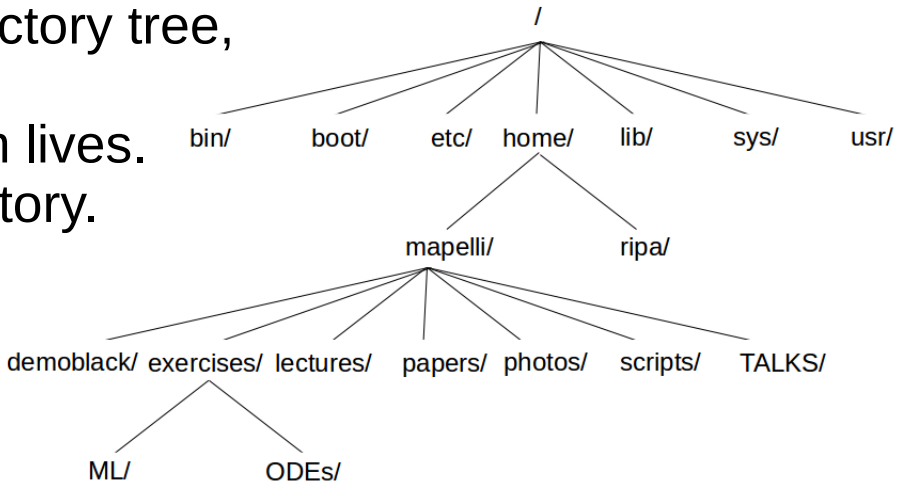
pwd (print which directory)



Directories in a computer are organized like a tree,
with a common root (the / directory) and
many sub-directories which are the branches and the leaves of the tree

Linux. Some basic commands

The / directory, the one on top of the directory tree,
is usually the system directory,
i.e. the place where the operating system lives.
Be careful: don't mess up with the / directory.



ls

ls -lrt

man ls

man followed by name of the command gives me information on every possible linux command

mkdir directoryname (make directory)

Linux. Some basic commands

cd directory

rm filename rm -i filename rm -r directory rm -ri directory (remove)

cp something somethingelse (cp -r, cp -i, cp -ri)

diff filename1 filename2

ssh username@computername.domain -X

scp username@computername.domain:filepath/filename filename

scp filename username@computername.domain:pathtosendfile/filename

rsync -a something somethingelse

mv file1 file 2 → move file1 into file2 (mv -i)

du -sh or **du -sk**

df -h

Linux. Some basic commands

top

ps aux prints processes

kill identifier **(kill -KILL identifier)**

find -name namefile

grep something filename (searches something into filename)

wc -l filename (gives number of lines of filename)

nl filename (prints file lines numbered)

more filename (shows filename without editing)

less filename (similar to more, but more interactive)

You can combine whatever command with | (pipe key)

e.g. ps aux | grep python | nl