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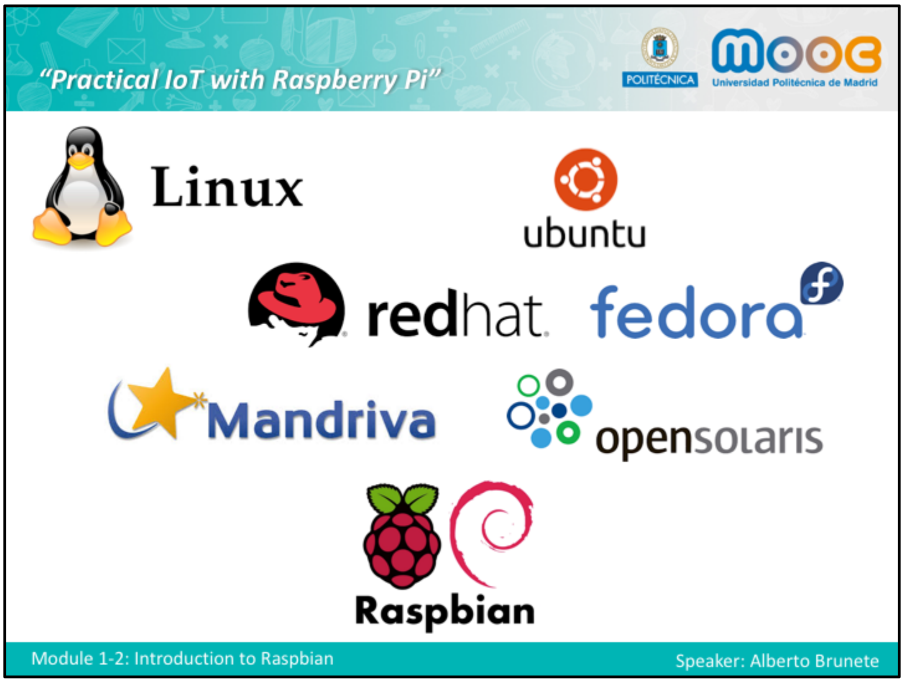
Universidad Politécnica de Madrid

“Practical IoT with Raspberry Pi”

Module 1-2: Introduction to Raspbian

Hello and welcome to the Module 1, second video, Introduction to Raspbian. In the fist video we introduced the hardware, and now we’re going to talk about the software, the operating system inside the Raspberry.



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Linux
ubuntu
redhat
fedora
Mandriva
opensolaris
Raspbian

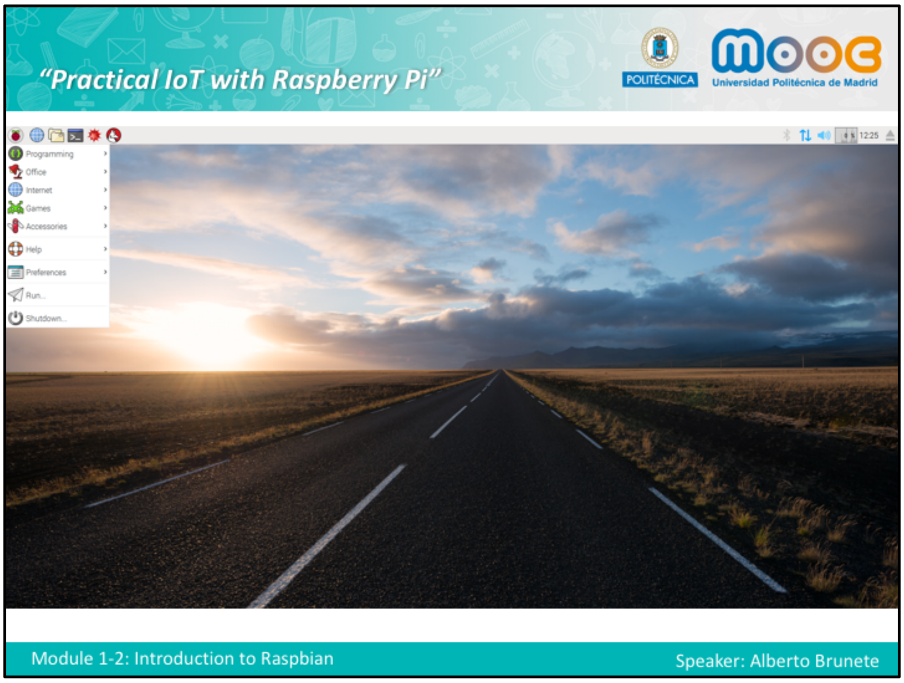
Module 1-2: Introduction to Raspbian

Speaker: Alberto Brunete

Linux is a Unix-like computer operating system assembled under the model of free and open-source software development and distribution.

There are many linux versions like Ubuntu, redhat, fedora and many others. The raspberry Pi can work with several Linux-based operating systems, including Ubuntu Mate and Windows IoT. The most used and the one we’ll be using is Raspbian.

In this video we will show the basics of Raspbian.



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Module 1-2: Introduction to Raspbian

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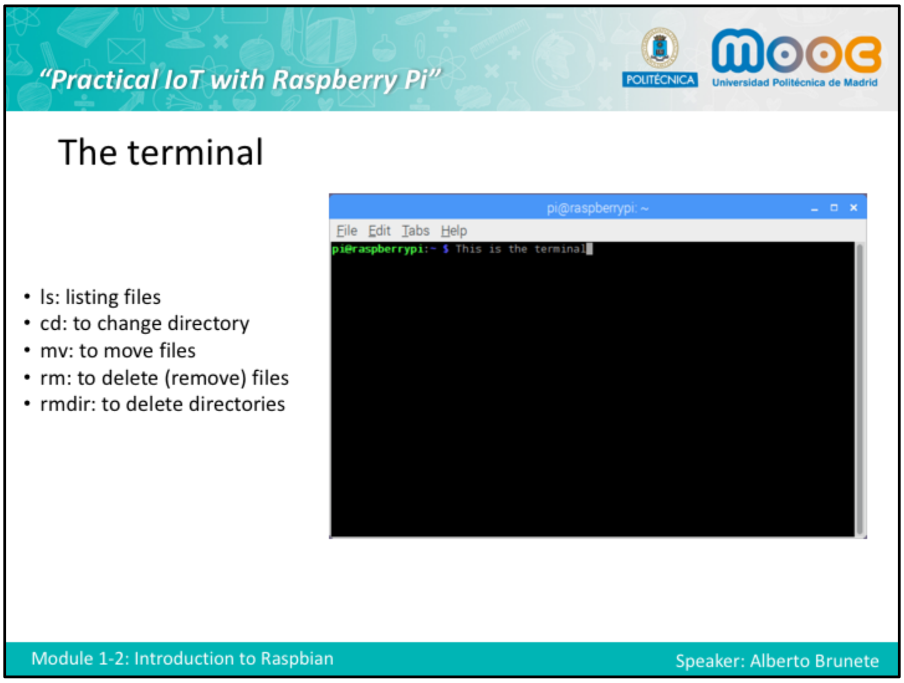
When the Raspberry boots up, a desktop environment is loaded by default. This is the GUI, Graphical User Inteface. We can work with windows and files as we do in Windows OS, Mac OS or other Linux based OS.

As in OS X and Windows, there are typically two main ways to execute applications in Linux: through the graphical user interface (GUI) and through the command line (known in Linux as the console or the terminal).

We can run the text editor from the taskbar,

or from the command line.

ej. leafpad



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The terminal

- ls: listing files
- cd: to change directory
- mv: to move files
- rm: to delete (remove) files
- rmdir: to delete directories

```
pi@raspberrypi:~ $ This is the terminal
```

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It is important to be able to use the terminal, because there are some tasks that can only be performed in the terminal, and some other are easy to perform in the terminal.

The basic command are:

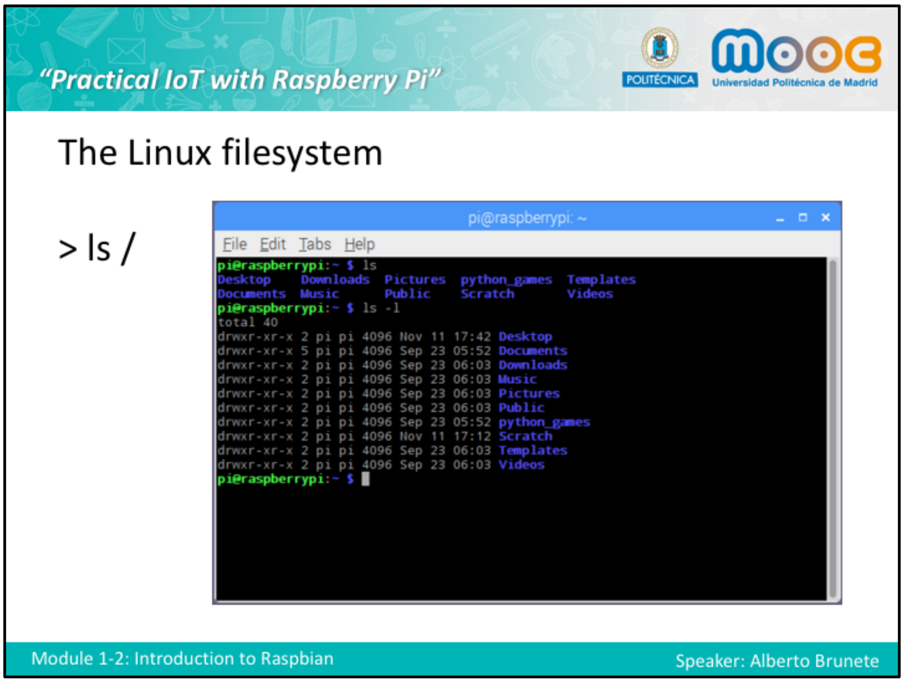
- ls: listing files
- cd: to change directory
- mv: to move files
- rm: to delete (remove) files
- rmdir: to delete directories

To execute files it is important to specify the path,

for example python /python_games/ -> ./launcher

Some commands need special permission and must be executed with root privileges. In that case the command “sudo” must be used, followed by the root password.

For example sudo leafpad



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The Linux filesystem

> ls /

```
pi@raspberrypi:~ $ ls
Desktop    Downloads  Pictures  python_games  Templates
Documents  Music      Public    Scratch       Videos
pi@raspberrypi:~ $ ls -l
total 40
drwxr-xr-x 2 pi pi 4096 Nov 11 17:42 Desktop
drwxr-xr-x 5 pi pi 4096 Sep 23 05:52 Documents
drwxr-xr-x 2 pi pi 4096 Sep 23 06:03 Downloads
drwxr-xr-x 2 pi pi 4096 Sep 23 06:03 Music
drwxr-xr-x 2 pi pi 4096 Sep 23 06:03 Pictures
drwxr-xr-x 2 pi pi 4096 Sep 23 06:03 Public
drwxr-xr-x 2 pi pi 4096 Sep 23 05:52 python_games
drwxr-xr-x 2 pi pi 4096 Nov 11 17:12 Scratch
drwxr-xr-x 2 pi pi 4096 Sep 23 06:03 Templates
drwxr-xr-x 2 pi pi 4096 Sep 23 06:03 Videos
pi@raspberrypi:~ $
```

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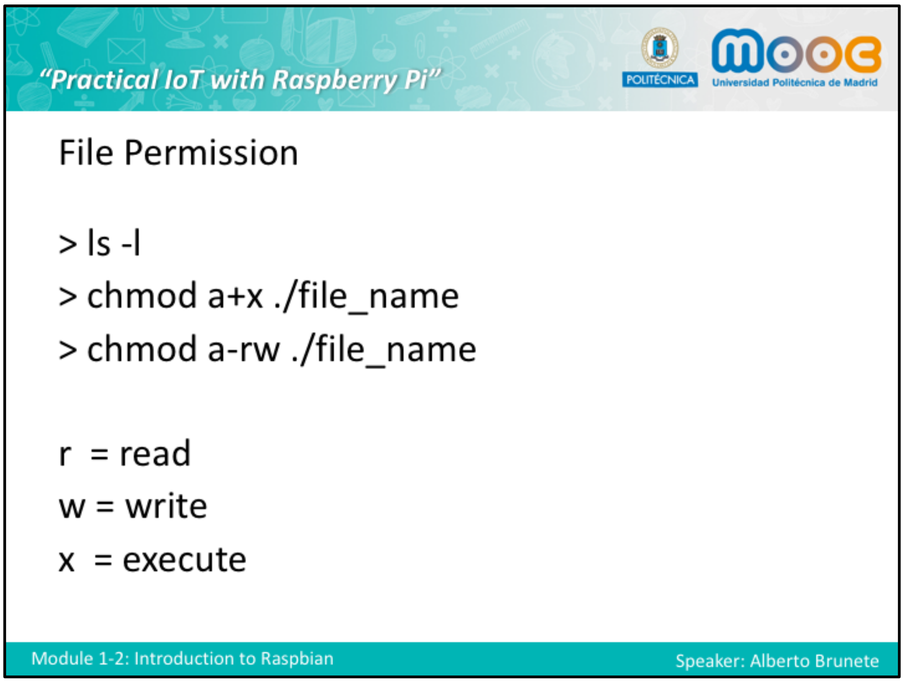
The way Linux deals with drives, files, folders and devices is somewhat different to other operating systems. Instead of having multiple drives labelled with a letter, everything appears as a branch beneath what is known as the root file system.

If you login to the Pi and type ls / you’l lsee various directories displayed. Some of these are areas of the SD card for storing files, while others are virtual directories for accessing different portions of the operating system or hardware.

- bin: Operating system-related binary files
- dev: All the devices connected to the system can be accessed from here.
- etc: stores miscellaneous configuration files,
- home: Each user gets a subdirectory beneath this directory to store all their personal files.
- lib: This is a storage space for libraries, which are shared bits of code required by numerous different applications.
- usr: This directory provides storage for user-accessible programs.



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File Permission

```
> ls -l
> chmod a+x ./file_name
> chmod a-rw ./file_name
```

r = read
w = write
x = execute

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In order to execute files, they have to be executable. Each file or directory has three basic permission types: read, write, and execute. Use

```
> ls -l
```

To check the permissions.

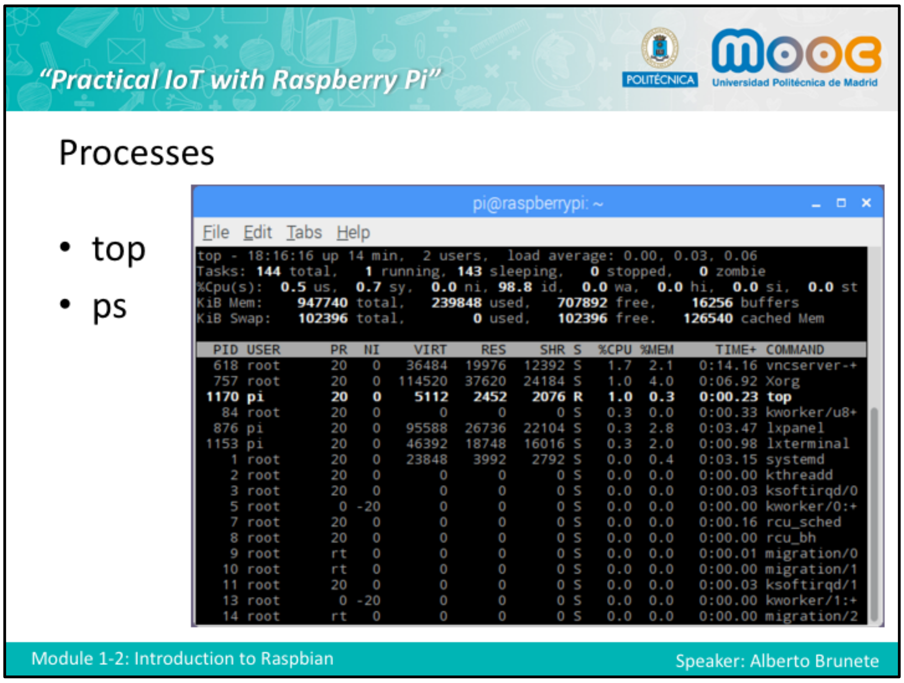
When in the command line, the permissions are edited by using the command ***chmod***. You can assign the permissions explicitly or by using a binary reference as described below.

For example, we can create a file in the text editor. If we check its permissions, we'll see that we cannot execute the file.

If we make chmod a+x ./test2

we will be able to execute the file, although it does nothing so far.

Use a+ to give permissions, and a- to remove them https://www.linux.com/learn/understanding-linux-file-permissions



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Processes

- top
- ps

```
top - 18:16:16 up 14 min,  2 users,  load average: 0.00, 0.03, 0.06
Tasks: 144 total,   1 running, 143 sleeping,   0 stopped,   0 zombie
%Cpu(s):  0.5 us,  0.7 sy,  0.0 ni, 98.8 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem:    947740 total,   239848 used,   707892 free,    16256 buffers
KiB Swap:   102396 total,        0 used,   102396 free.   126540 cached Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
  618 root      20   0   36484  19976  12392 S   1.7  2.1   0:14.16 vncserver-+
  757 root      20   0  114520  37620  24184 S   1.0  4.0   0:06.92 Xorg
 1170 pi        20   0    5112   2452   2076 R   1.0  0.3   0:00.23 top
   84 root      20   0       0      0      0 S   0.3  0.0   0:00.33 kworker/u8+
  876 pi        20   0   95588  26736  22104 S   0.3  2.8   0:03.47 lxpanel
 1153 pi        20   0   46392  18748  16016 S   0.3  2.0   0:00.98 lxterminal
    1 root      20   0   23848   3992   2792 S   0.0  0.4   0:03.15 systemd
    2 root      20   0       0      0      0 S   0.0  0.0   0:00.00 kthreadd
    3 root      20   0       0      0      0 S   0.0  0.0   0:00.03 ksoftirqd/0
    5 root       0 -20       0      0      0 S   0.0  0.0   0:00.00 kworker/0:+
    7 root      20   0       0      0      0 S   0.0  0.0   0:00.16 rcu_sched
    8 root      20   0       0      0      0 S   0.0  0.0   0:00.00 rcu_bh
    9 root      rt   0       0      0      0 S   0.0  0.0   0:00.01 migration/0
   10 root      rt   0       0      0      0 S   0.0  0.0   0:00.00 migration/1
   11 root      20   0       0      0      0 S   0.0  0.0   0:00.03 ksoftirqd/1
   13 root       0 -20       0      0      0 S   0.0  0.0   0:00.00 kworker/1:+
   14 root      rt   0       0      0      0 S   0.0  0.0   0:00.00 migration/2
```

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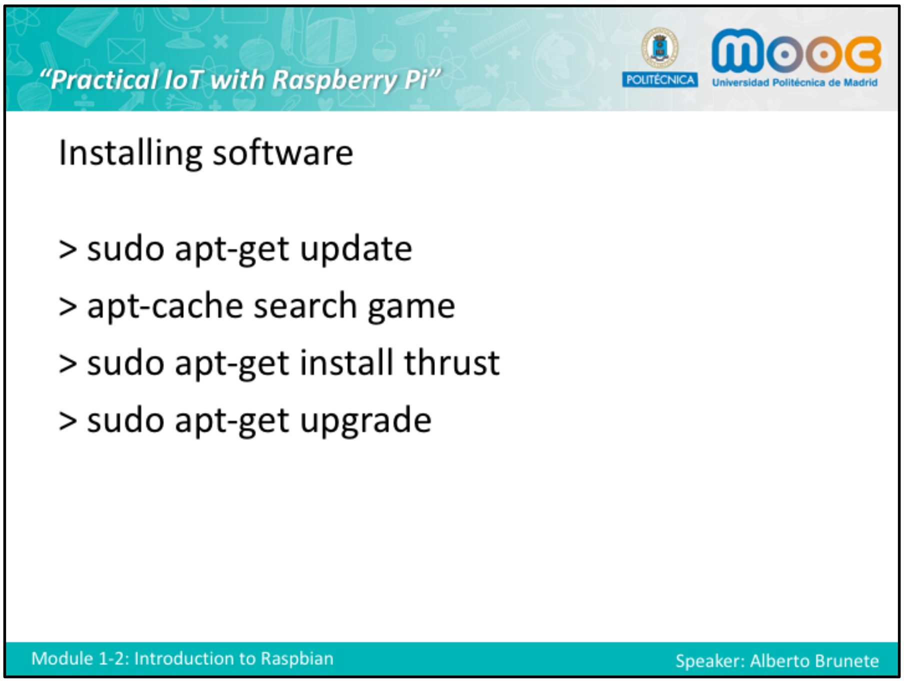
A process is an instance of a program running in a computer. A process can initiate a subprocess, which is a called a *child* process. We can have several processes running in our system. For example one process to gather data, one process to use the data, and one process to send the data to the cloud.

To see the processes running in our system we use the command ps. It provides information about our currently running processes. If you want to see all running processes, including the system ones, use the top command. Press “q” to exit.



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Installing software

```
> sudo apt-get update
> apt-cache search game
> sudo apt-get install thrust
> sudo apt-get upgrade
```

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Installing new software onto the Pi is simple. It includes a tool called apt, which is a powerful package manager. Packages are what Linux calls a piece of software, or a collection of different pieces of software designed to work together.

Although apt is designed to be operated from the command line, it’s very user-friendly and easy to learn. There are GUIs for apt, such as the popular Synaptic Package Manager, but they often struggle to run on the Pi due to the lack of memory. As a result, we recommend using apt from the terminal.

The first step to install a new piece of software is to make sure the apt cache is as fresh as possible by running an update:
sudo apt-get update

The second thing is to find the name of the package. Either in the web or internet or using:
apt-cache search

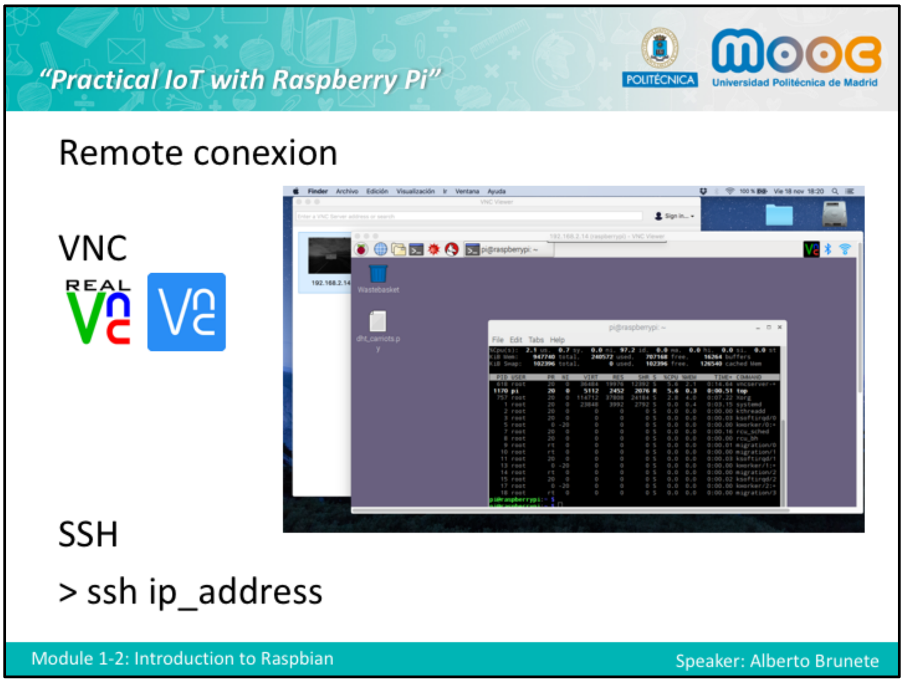
Then, using
sudo apt-get install

to install the package.

If a package depends on other packages, apt will automatically find them and prepare them for installation.

Afterwards, to update packages use:

```
sudo apt-get upgrade
```



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Remote conexion

VNC

SSH

> ssh ip_address

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In order to use the Pi you need a screen, a keyboard and a mouse. Since we are using the Pi for embedded applications, these are not always available. For that purpose we can have the Pi running somewhere and we can connect to it through a remote connection. We’ll see two options: ssh and vnc.

Using SSH is very simple, but sometimes we have to enable it first.

Type the following command:
sudo raspi-config
in the terminal, then navigate to advanced options and ssh, hit Enter and select Enable or disable ssh server.
reboot
After Pi is restarted check ip-address with the command
ifconfig
Note the inet addr!

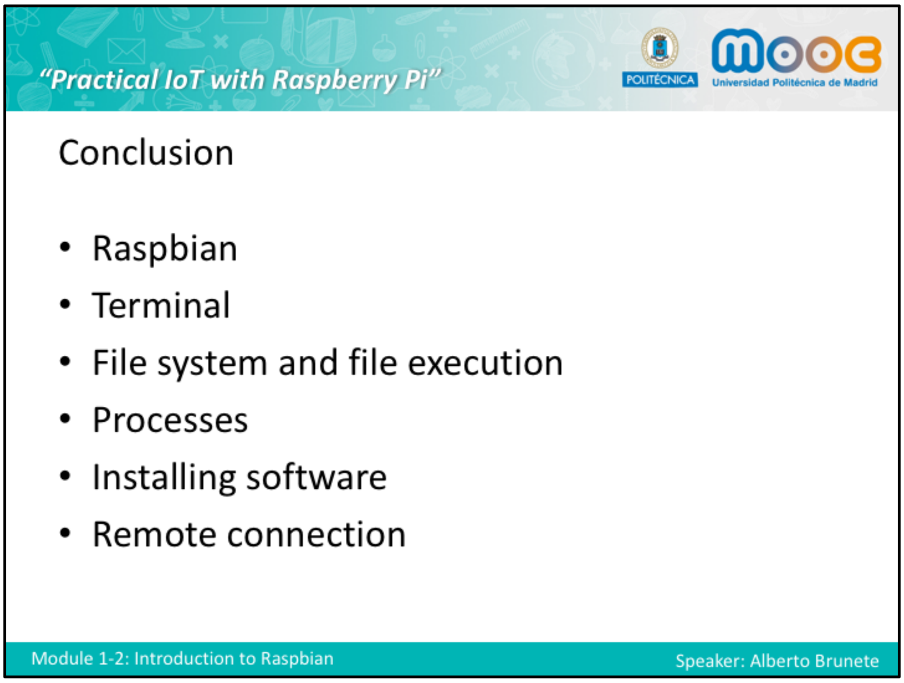
Then, from a terminal, run ssh pi@ipaddress, insert the password, and you're in!

The second option is VNC. That is the one I am using to record this video.

VNC is a graphical desktop sharing system that allows you to remotely control the desktop interface of one computer from another computer or mobile device. It transmits the keyboard and mouse, or touch, events from the controller, and receives updates to the screen over the network from the remote host.

Although VNC Server is included on the Raspberry Pi by default, you will need to enable it yourself. VNC Server will then start automatically whenever your Raspberry Pi is powered on.
You can enable VNC Server graphically or via the command line:
ENABLING VNC SERVER GRAPHICALLY
On your Raspberry Pi, boot into the desktop.
Select **Menu > Preferences > Raspberry Pi Configuration > Interfaces**.
Ensure **VNC** is **Enabled**.

On your Raspberry Pi find you IP.
On the device you'll use to take control, download VNC Viewer. And connect the the IP address of the Raspberry.



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Conclusion

- Raspbian
- Terminal
- File system and file execution
- Processes
- Installing software
- Remote connection

Module 1-2: Introduction to Raspbian

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In this lesson we have introduced Raspbian, the operating system of the Raspberry Pi. It is very important that you feel confortable with it before you move on this course.

We have reviewed how to use the terminal, the file system, how to execute files, the processes, and how to install software and packages using apt.

Finally, we have seen how to remotely connect to the raspberry with SSH and VNC.