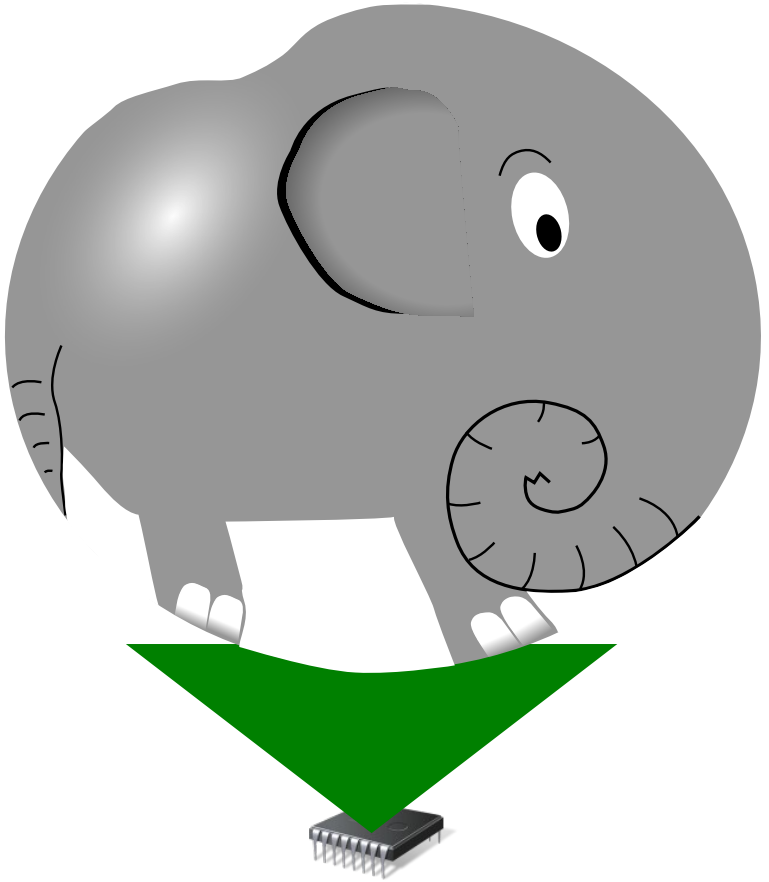
# Professional Seminars II:
# Operating Systems for Embedded Systems

## Booting *nix



R04
Ángel Perles

# Contents

- Objectives
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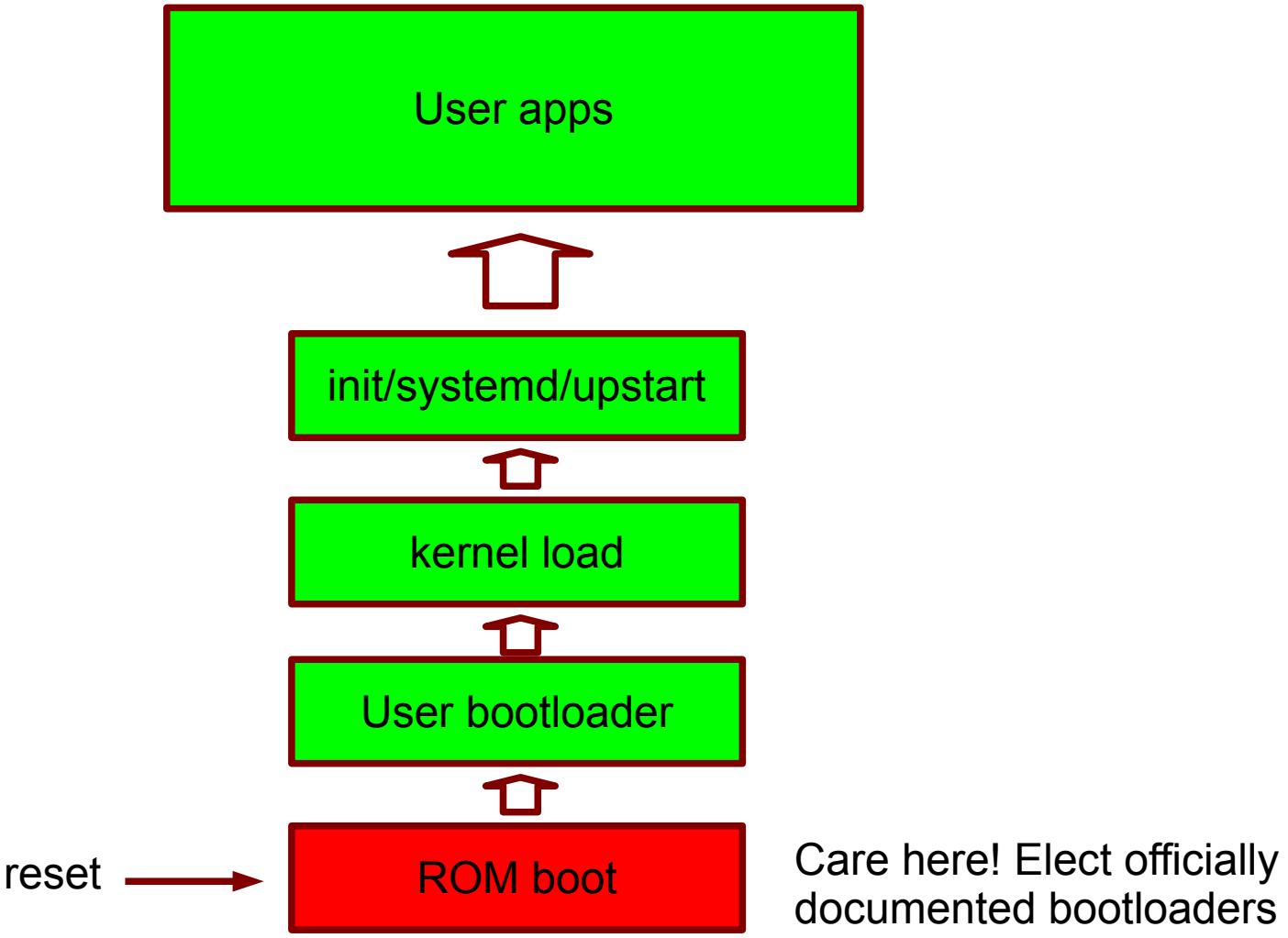
# Objectives

- To understand the general booting sequence of *nix OSes
- To know the particular start-up of Linux
- To practice applying it to ARM-based boards
  - Example with Raspberry Pi board
  - The same for your iPhone, Google Android, ...

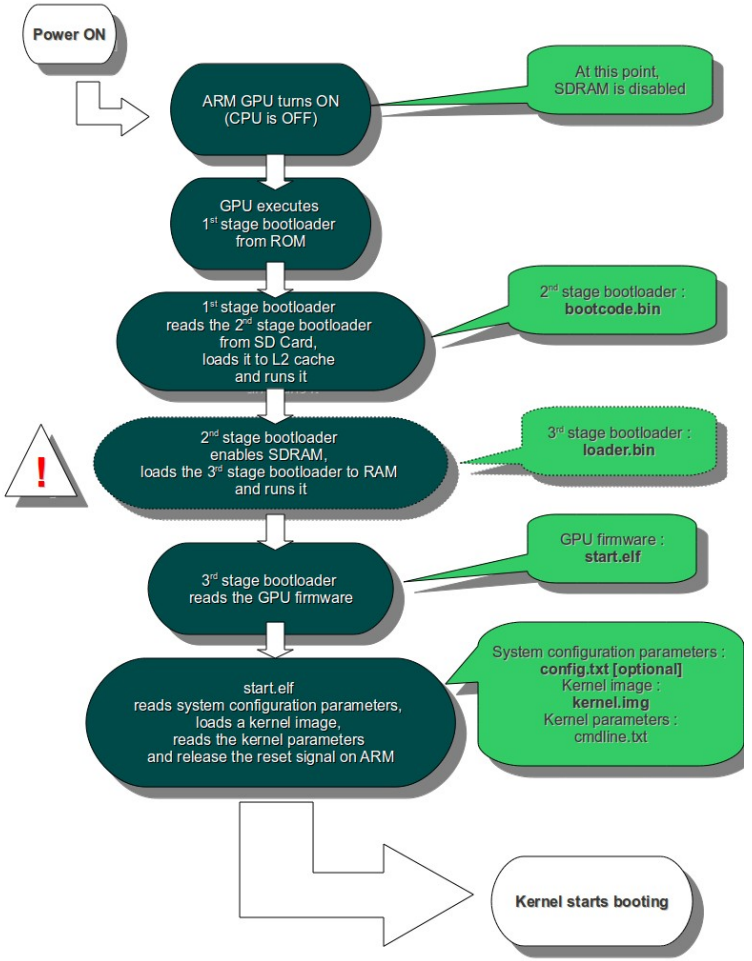
# Boot sequence

- Very generic one for Linux



# Boot sequence

- Raspberry Pi (old image, boot 2+ boot 3 are now only one stage)



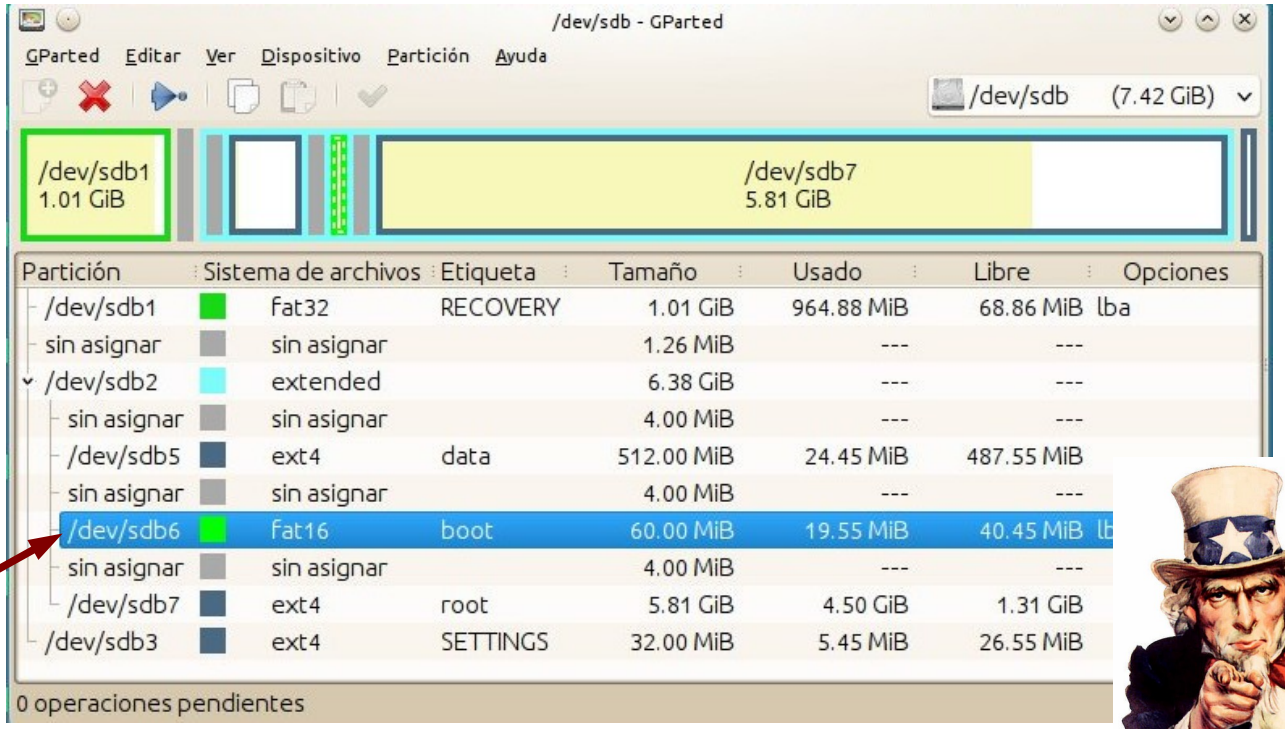

source http://myembeddedlinux.blogspot.com.es/2013/05/raspberry-pi-boot-sequence.html

# Bootloader

- Hell! Where are these things?
  - Some things in ROM <- closed source !!!!!!!!!!
  - Some in the boot partition of the SD (FAT -> pay Microsoft)

see here your Raspberry OS based SD partition

boot, boot




Use *gparted* to take a look at your SD

# Bootloader

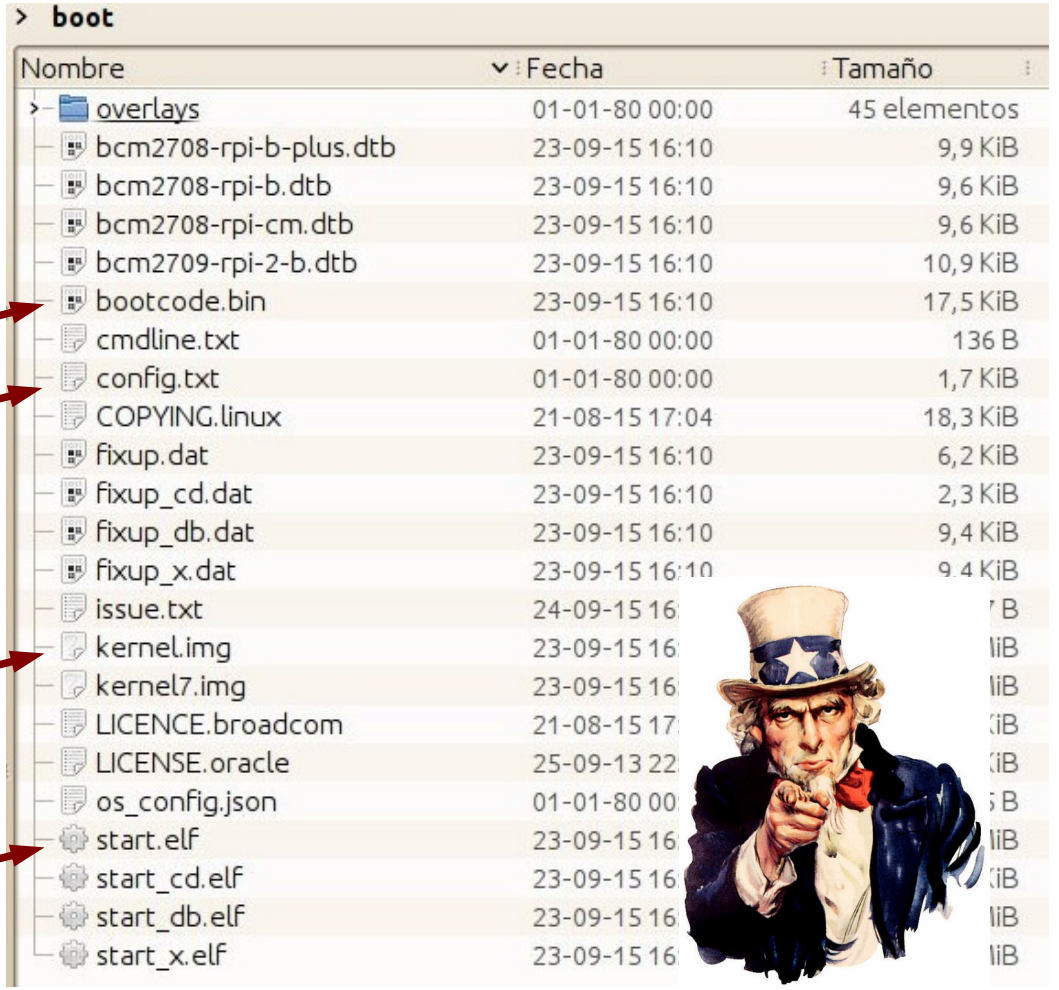
- Let's take a look assuming your are using a Linux box
  - Insert SD
  - Mount the boot partition
  - Look at config.txt file

Boot 1st stage

Boot configuration

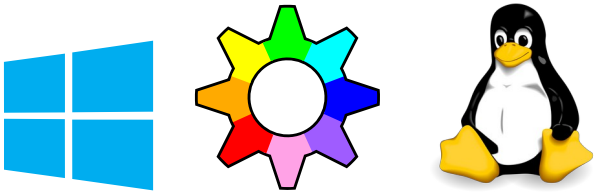
Linux kernel

Boot 2nd + 3rd stage



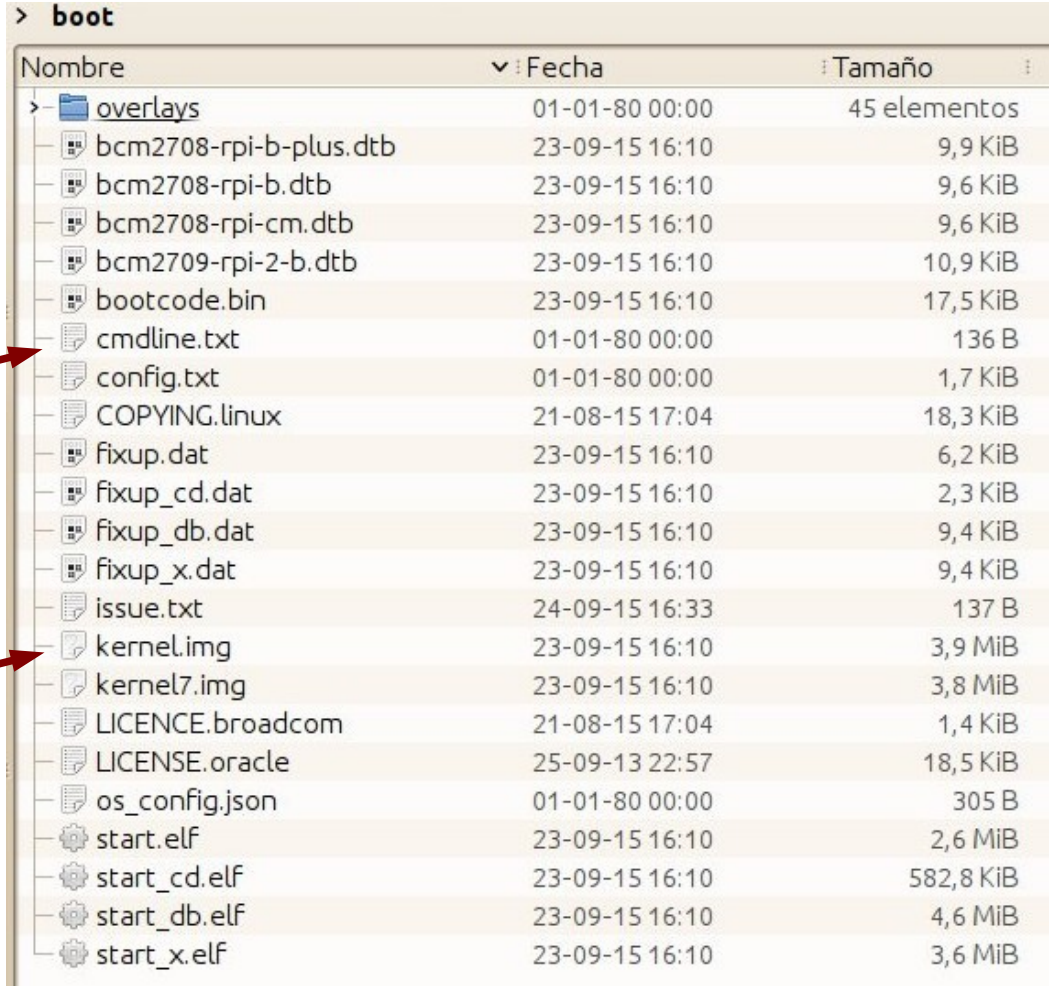
# Linux kernel

- The 3rd boot stage loads the OS
  - Microsoft Windows, RISC OS, Linux ...
  - kernel.img file is Linux!
  - and cmdline.txt the params
  - look at cmdline.txt



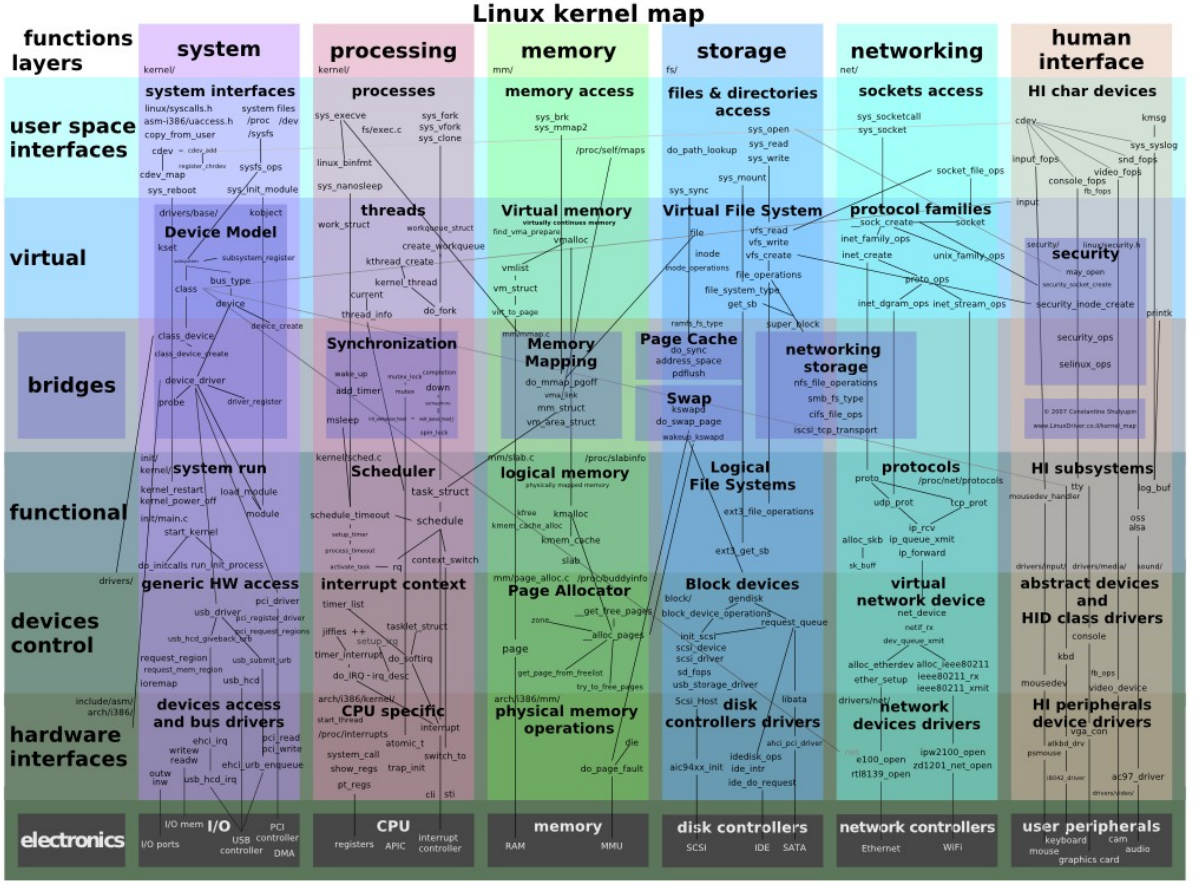
Linux kernel basic conf.

Linux kernel



# Linux kernel

- The Linux kernel is an static file (3rd boot stage loads the OS)
  - Monolithic + modular design: part static, part dynamic
    - open terminal, run lsmod

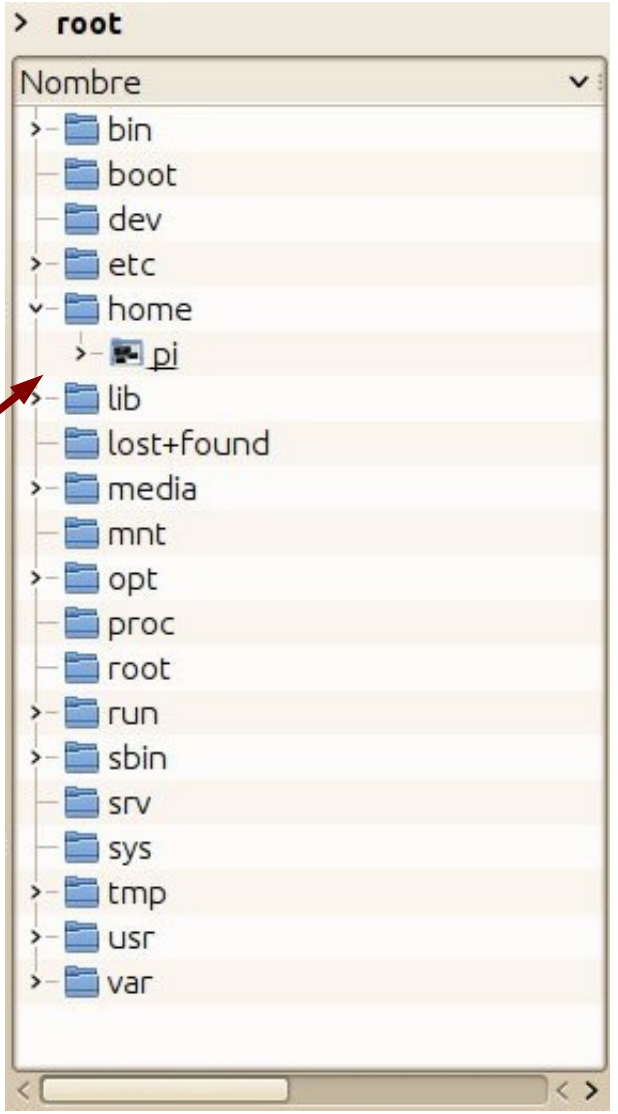



See https://makelinux.github.io/kernel/map/

# Root filesystem (/)

- Next step is to mount the “root” (/)
  - Basic filesystem structure
  - Libraries, kernel modules, device files, ...
  - Applications  (main and customizations)
  - and system initialization ...

take a look to
your SD root partition



# Root filesystem (/)

- ... system initialization
  - spawn process PID 1 (init or systemd or upstart)
  - that loads other processes
  - and configurations
  - and services (e.g. check /etc/rc.d)
  - ...
  - ... till user prompt or a given app

$ dmesg | less

# Root filesystem (/)

- Raspbian based on Debian wheezy use init (sysvinit)
- Raspbian based on Debian stretch use systemd
  - parallelization
  - lots of information are now obsolete in Internet

```
[    2.231932] mmc0: host does not support reading read-only switch, assuming write-en
able
[    2.247779] mmc0: new high speed SDHC card at address 9149
[    2.259437] mmcblk0: mmc0:9149 SD08G 7.42 GiB
[    2.273583]  mmcblk0: p1 p2 < p5 p6 p7 > p3
[    2.347212] EXT4-fs (mmcblk0p7): mounted filesystem with ordered data mode. Opts: (
null)
[    2.361122] VFS: Mounted root (ext4 filesystem) readonly on device 179:7.
[    2.378496] devtmpfs: mounted
[    2.387908] Freeing unused kernel memory: 416K (80776000 - 807de000)
[    2.413539] usb 1-1: New USB device found, idVendor=0424, idProduct=9514
[    2.426072] usb 1-1: New USB device strings: Mfr=0, Product=0, SerialNumber=0
[    2.439934] hub 1-1:1.0: USB hub found
[    2.449655] hub 1-1:1.0: 5 ports detected
[    2.711384] random: systemd urandom read with 65 bits of entropy available
[    2.729034] systemd[1]: systemd 215 running in system mode. (+PAM +AUDIT +SELINUX +
IMA +SYSVINIT +LIBCRYPTSETUP +GCRYPT +ACL +XZ -SECCOMP -APPARMOR)
[    2.733201] usb 1-1.1: new high-speed USB device number 3 using dwc_otg
[    2.761692] systemd[1]: Detected architecture 'arm'.
[    2.853526] usb 1-1.1: New USB device found, idVendor=0424, idProduct=ec00
[    2.866864] usb 1-1.1: New USB device strings: Mfr=0, Product=0, SerialNumber=0
```


And yes, I'm aware that this is too much information.