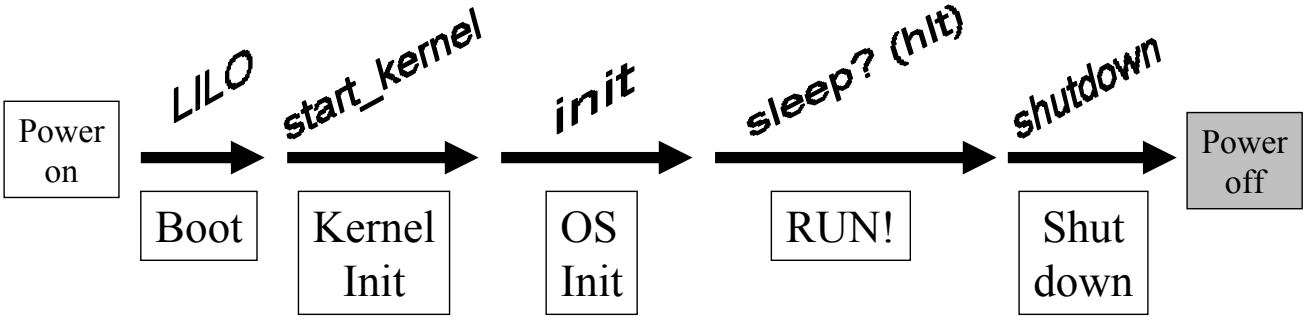
1. Booting and Kernel Initialization

System Lifecycle: Ups & Downs

- Booting
- Kernel Initialization
- init: Process Number One
- Shutdown
- Advanced Boot Concepts
- Power Management

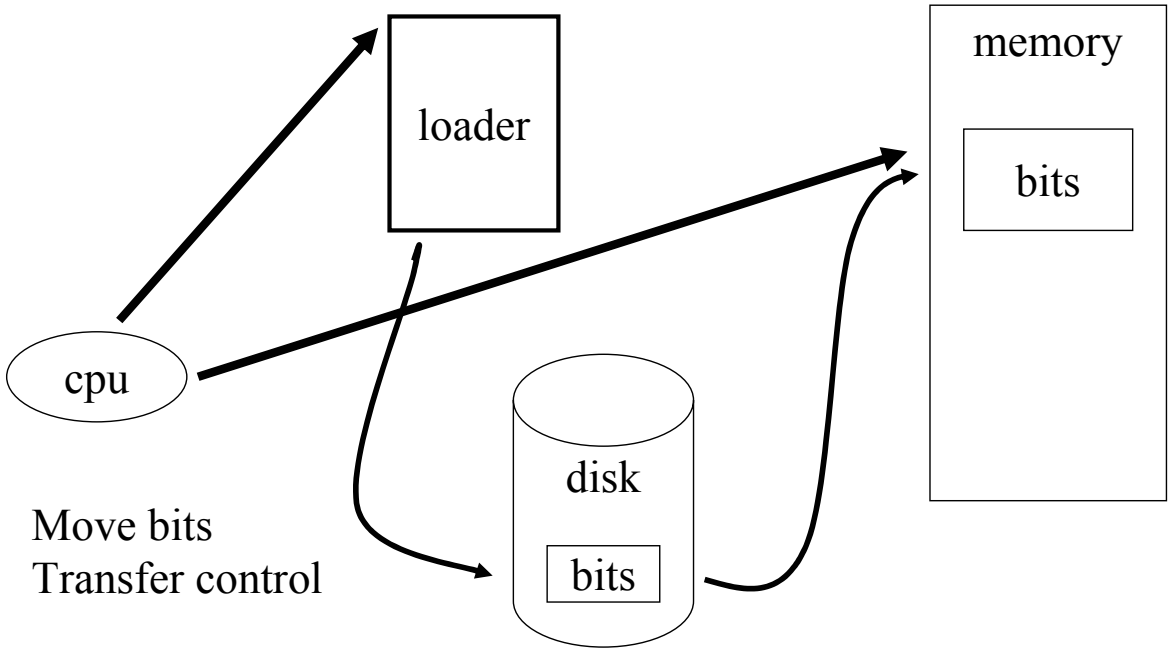


Boot Terminology

- Loader
  - Program that moves bits from disk (usually) to memory and then transfers CPU control to the newly "loaded" bits (executable)
- Bootloader / Bootstrap
  - Program that loads the "first program" (the kernel)
- Boot PROM / PROM Monitor / BIOS
  - Persistent code that is "already loaded" on power-up
- Boot Manager
  - Program that lets you choose the "first program" to load

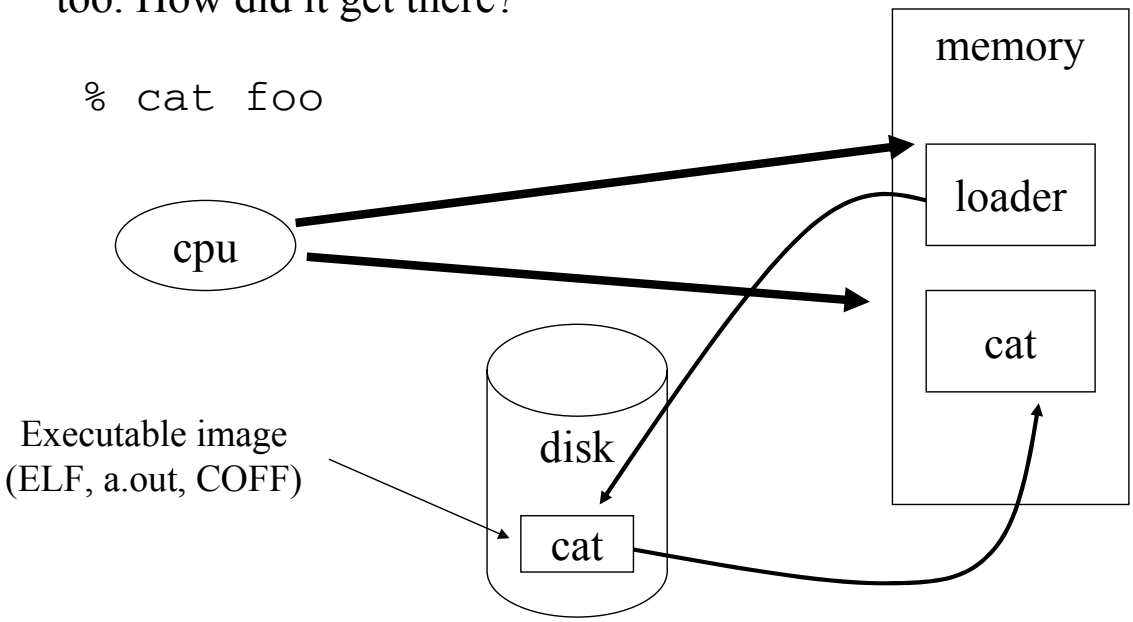
What's a Loader?

- A program that moves bits (usually) from disk to memory and then transfers control to the newly loaded bits (executable).



Who Loads the Loader?

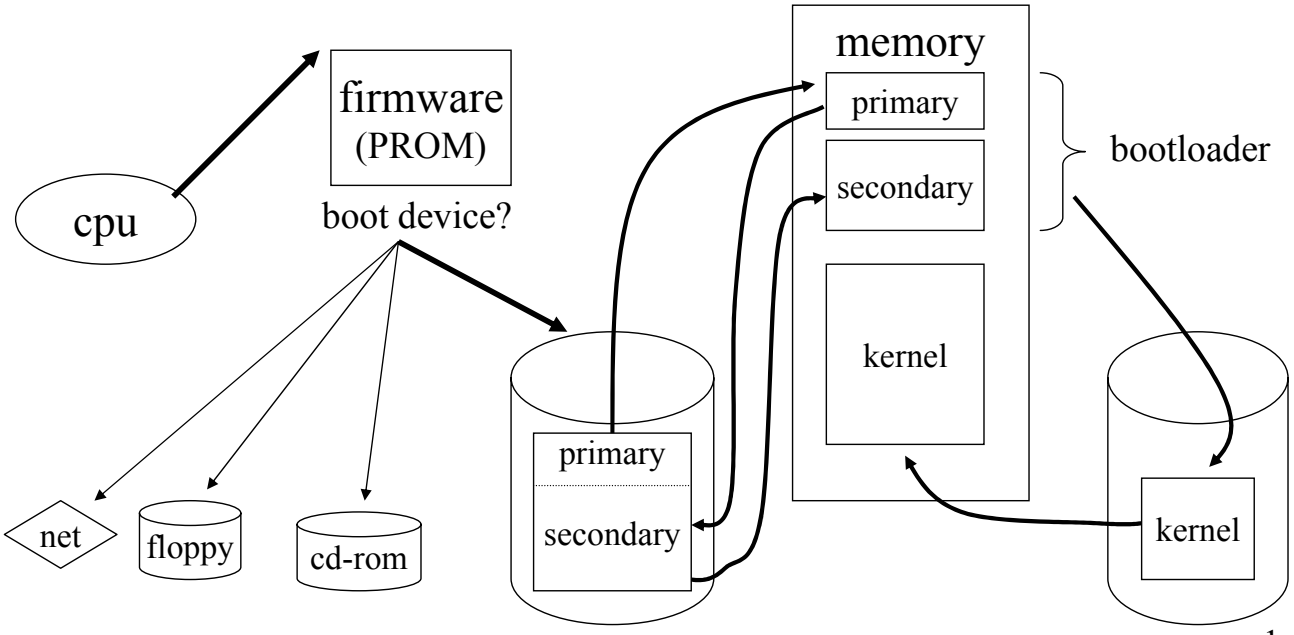
- Of course, the loader is just a program and it resides in memory too. How did it get there?



- We need a "loader loader" …

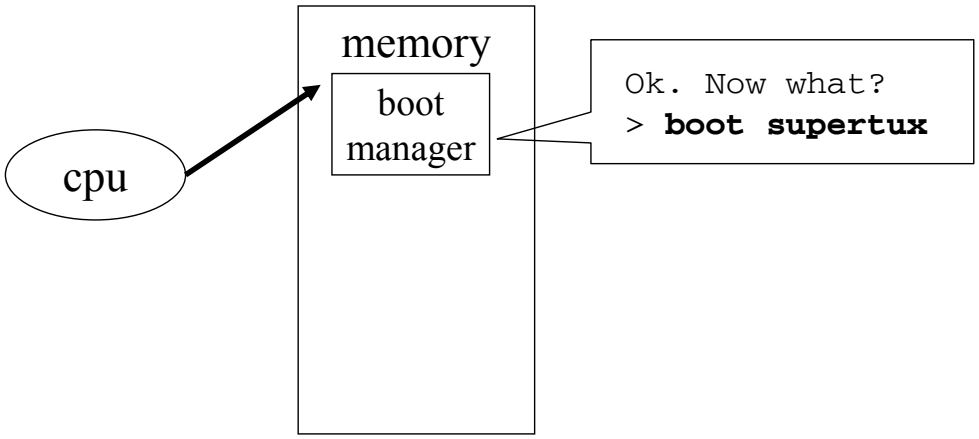
Bootstrap Loader (Bootloader)

- The program that loads the "first program"
- Usually "staged": primary, secondary
- Requires firmware support ("hardware bootstrap")



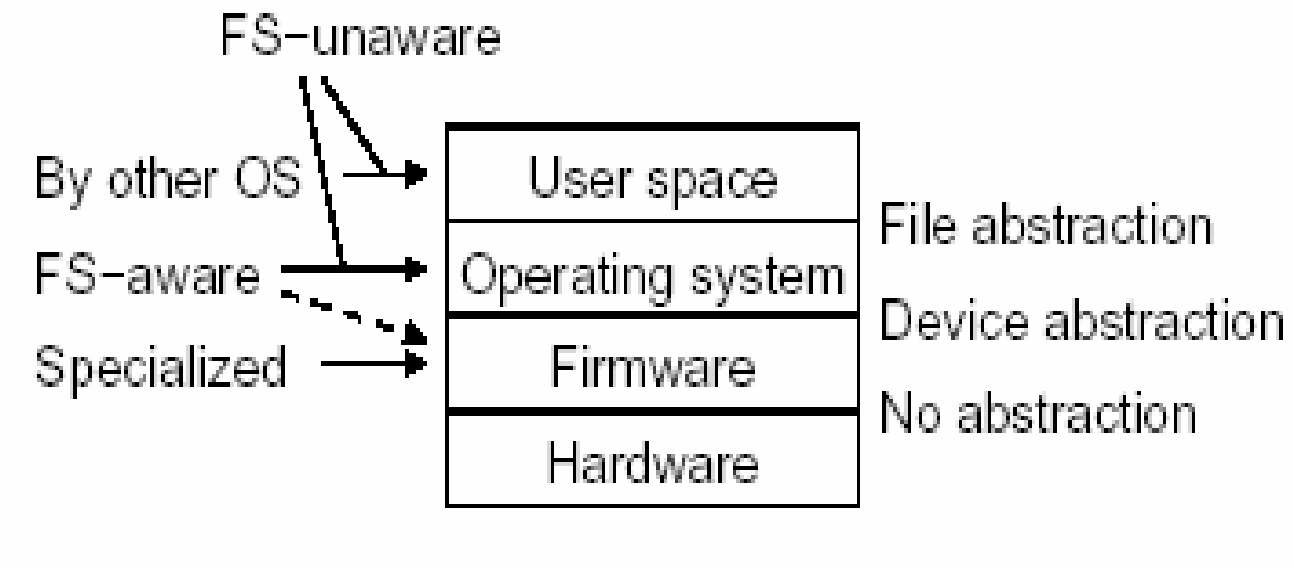
Boot Managers

- Code loaded by firmware bootstrap that allows choice of boot image, specification of boot parameters, etc.
- Adds another "layer" to boot process but increases flexibility, supports "multiboot" configurations
- Examples: LILO, System Commander



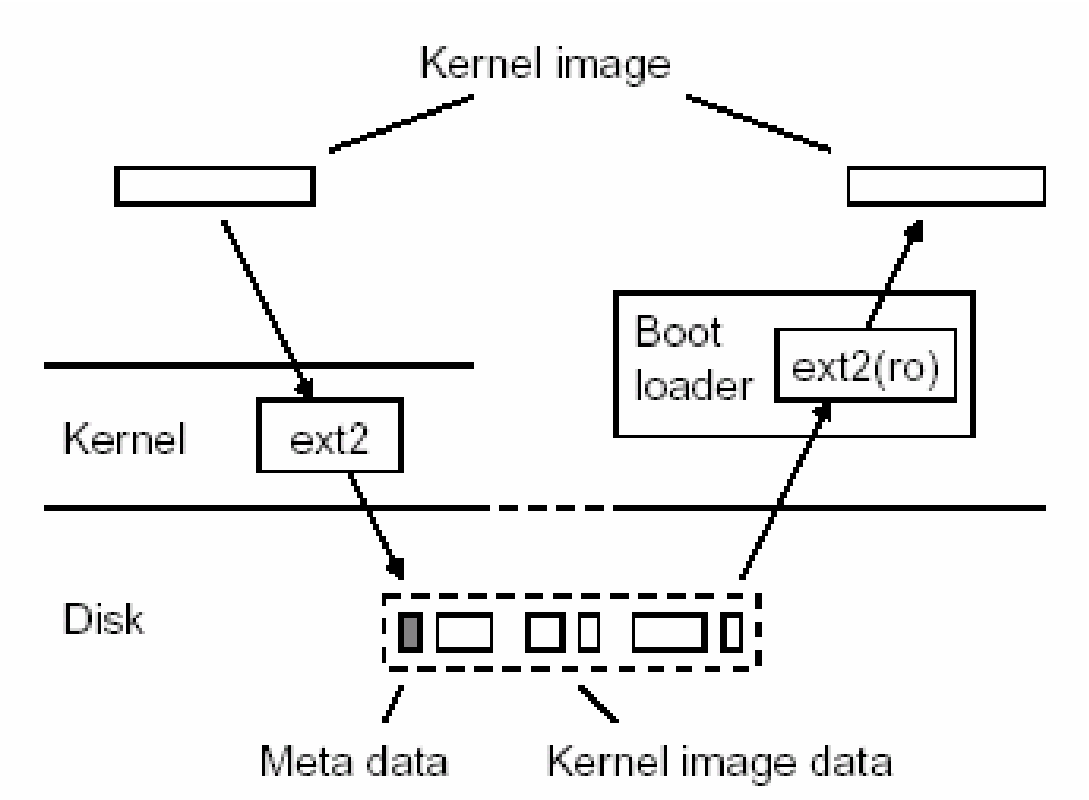
Boot Manager

- Two types:
  - Filesystem aware, such as GRUB
  - Filesystem unaware, such as LILO



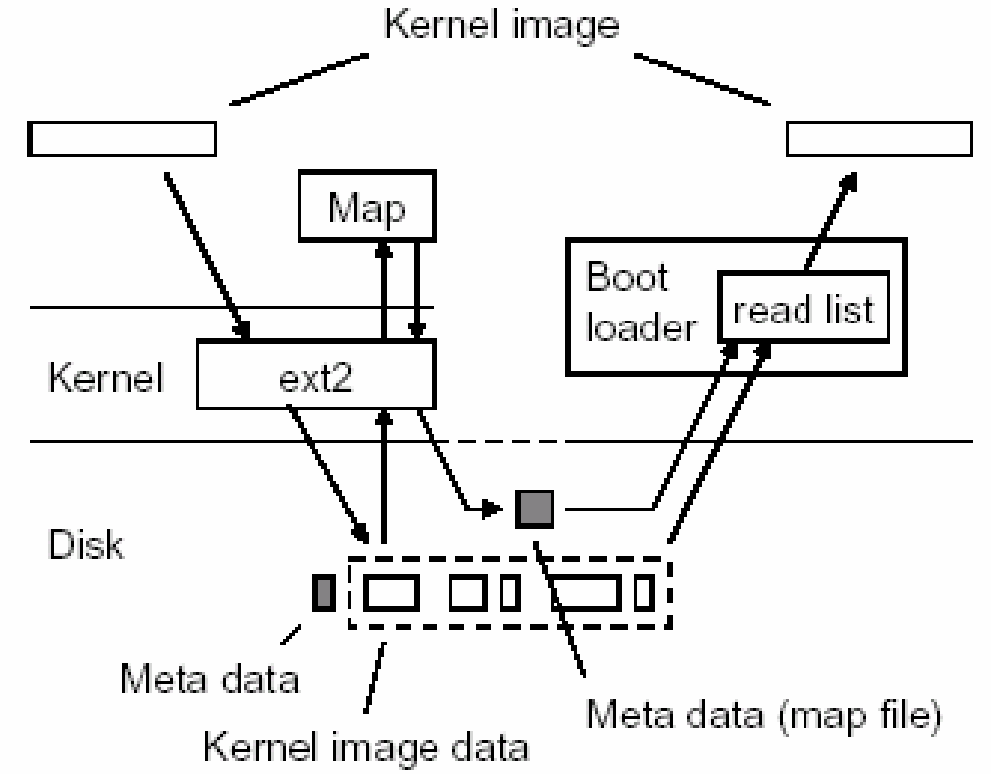
Data flow with filesystem aware boot loader

- Such as GRUB



Data flow with filesystem unaware boot loader

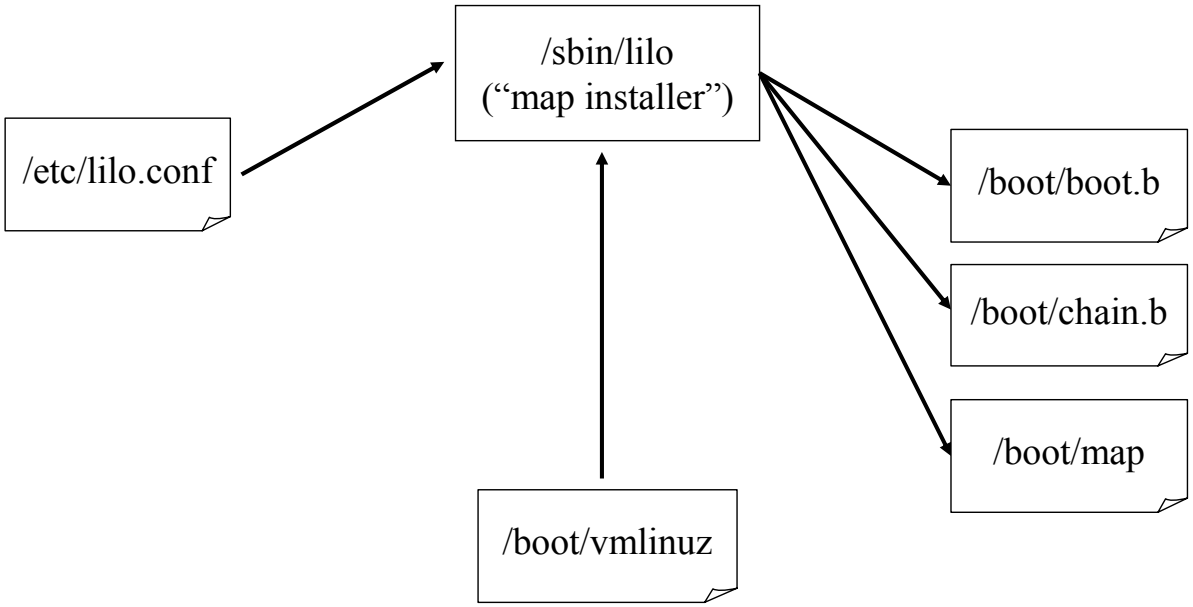
- Such as LILO



LILO: LInux LOader

- A versatile boot manager that supports:
  - Choice of Linux kernels
  - Boot time kernel parameters
  - Booting non-Linux kernels
  - A bewildering variety of configurations
- Characteristics:
  - Lives in MBR or partition boot sector
  - Has no knowledge of filesystem structure so…
  - Builds a sector "map file" (block map) to find kernel
- /sbin/lilo – "map installer"
  - Builds map file, boot sector
  - Run after change to kernel or /etc/lilo.conf

LILO Components



Example lilo.conf File

```
boot=/dev/hda
map=/boot/map
install=/boot/boot.b
prompt
timeout=50
default=linux

image=/boot/vmlinuz-2.2.12-20
        label=linux
        initrd=/boot/initrd-2.2.12-20.img
        read-only
        root=/dev/hda1
```


start_kernel

- **`init/main.c:start_kernel`**

- identify bootstrap processor (BSP)
- setup_arch()
- init crucial subsystems
- parse_options()
- setup kernel profiling
- enable interrupts (sti())
- calibrate_delay() -- BogoMIPS
- init subsystems needing delay
- check_bugs()
- smp_init()
- spawn init as a “kernel thread”

- become idle process!

Other bootloaders

- SYSLINUX
  - SYSLINUX is a boot loader for the Linux operating system which operates off an MS-DOS/Windows FAT filesystem.
  - SYSLINUX is probably not suitable as a general purpose boot loader. It can only boot Linux from a FAT filesystem, and not, for example, ext2
  - In order to create a bootable Linux floppy using SYSLINUX, prepare a normal MS-DOS formatted floppy. Copy one or more Linux kernel files to it, then execute the DOS command:
    syslinux [-s] a:

- LoadLin
  - a DOS program that has the capability to launch a Linux kernel from the DOS prompt (with boot-args) assuming that certain resources are available.
  - Example boot command

```
LOADLIN bzimage /dev/ram rw initrd=diskimage
```

```
@echo off
cls
choice /t:y,5 "Do you wish to boot Linux? "
if errorlevel 2 goto End
c:\loadlin c:\vmlinuz root=/dev/hdc2 ro
:End
```