

Bootloaders

presented by

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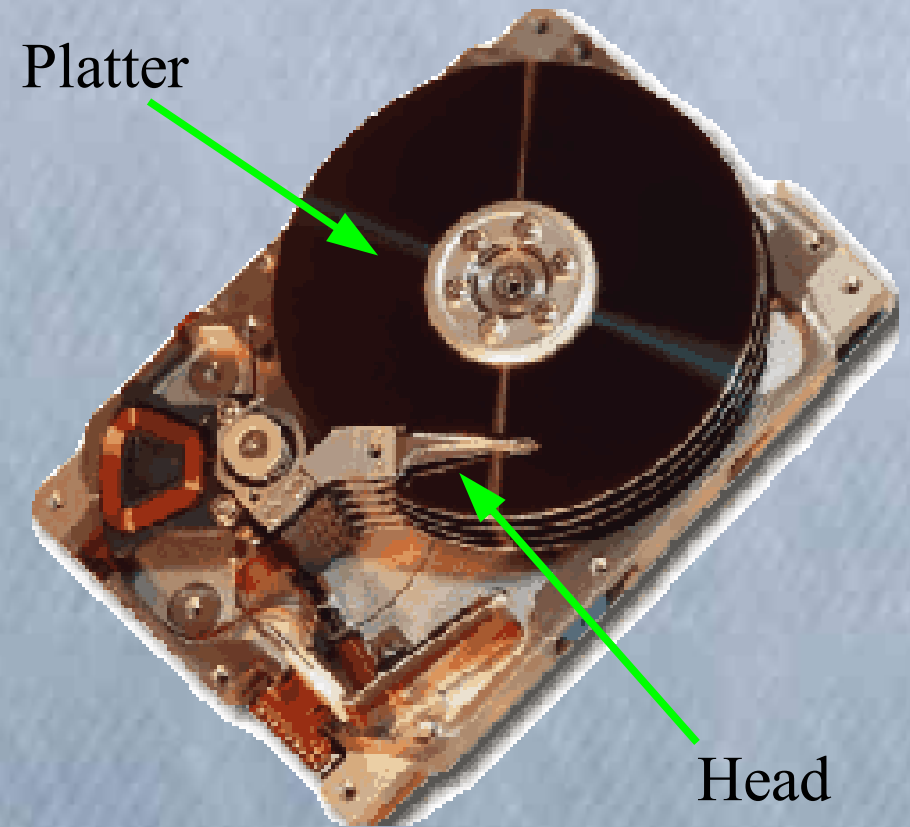
UNCC-LUG
12 December 2003

Agenda

- What is a bootloader?
- What is stored on my hard drive?
- How does a computer turn on?
- Where is the bootloader stored?
- Which bootloaders are there?
- What do I do if my bootloader gets screwed up?

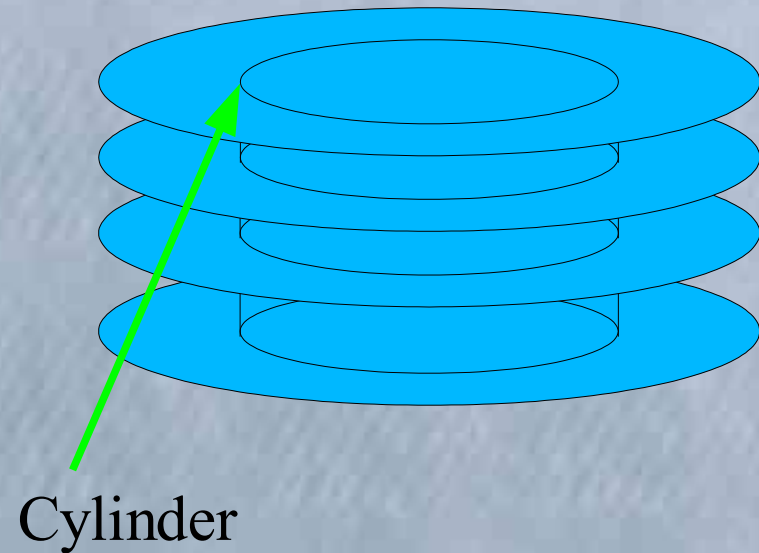
Parts of a Hard Drive

- Hard drives store data magnetically on a set of platters.
- The information is read by 'heads'. Each side of a platter has its own head.



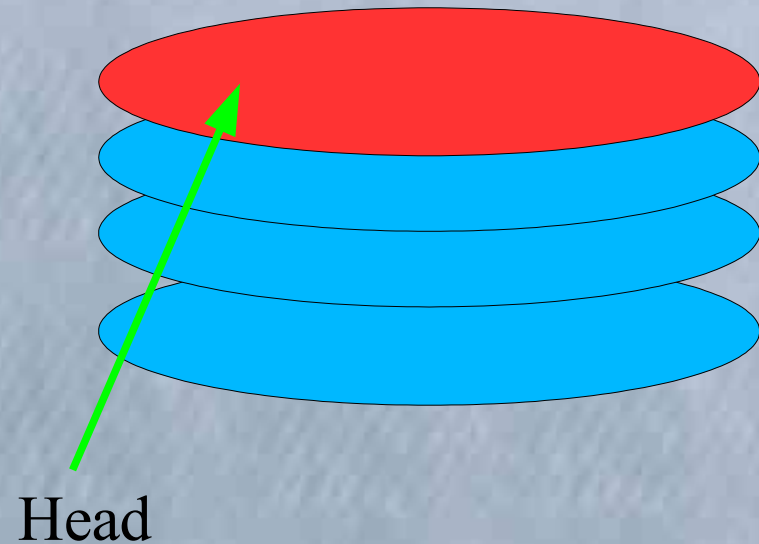
Parts of a Hard Drive

- Each specific location on a hard drive can be identified by its:
 - Cylinder
 - Head
 - Sector



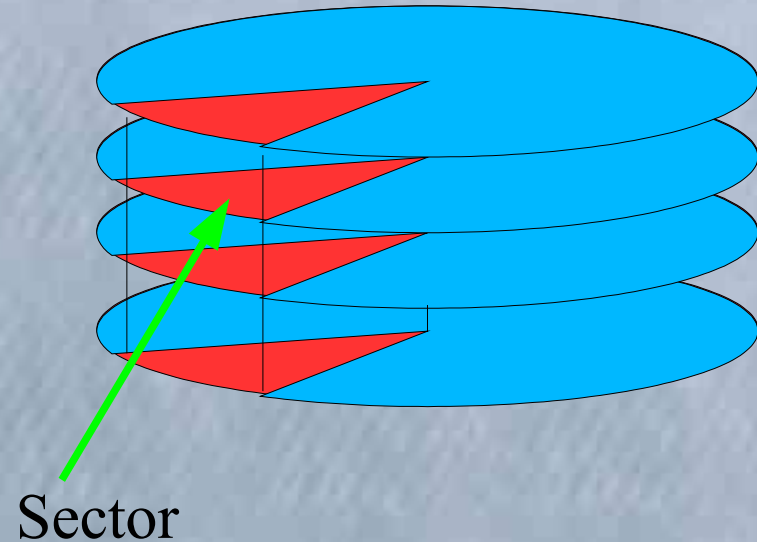
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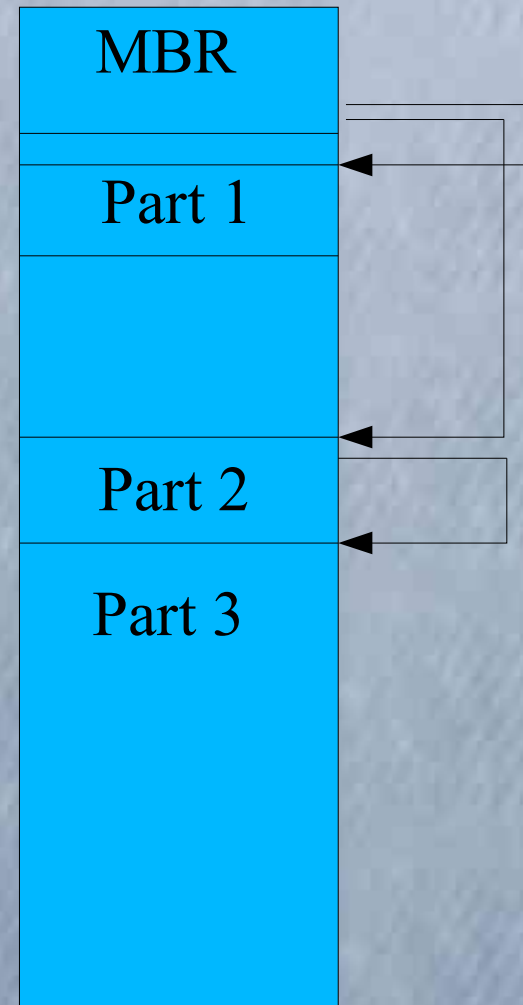
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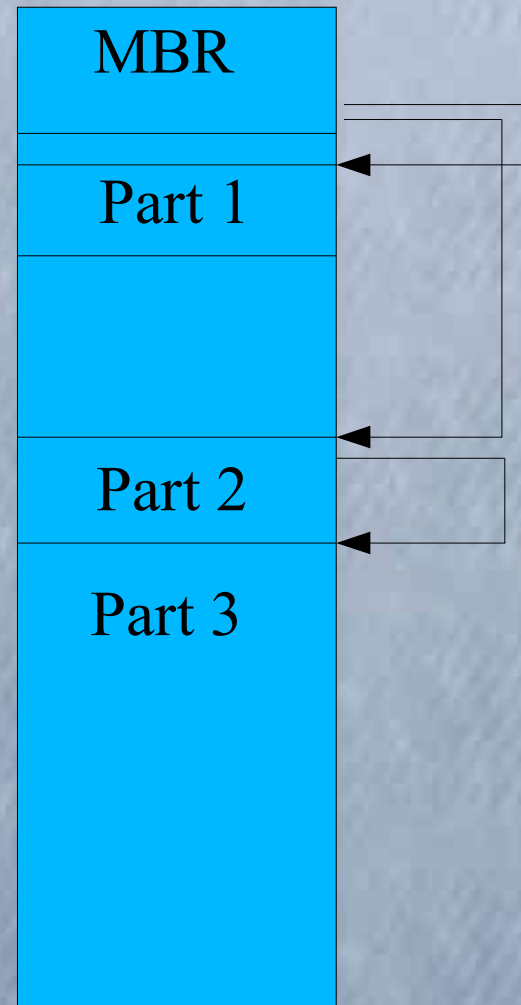
Location of Data on a Hard Drive

- MBR
 - First sector of the drive.
 - Contains:
 - Bootloader.
 - Partition table.
 - Magic signature “55AA”.
- Partitions
 - Store the data on the drive.



DOS Partitions

- There are three types of partitions:
 - Primary
 - MBR table entry #1
 - Extended
 - These form a linked list of partitions.
 - MBR table entry #2
 - Logical
 - Contained within the logical partitions



LBA

- *LBA: Linear Block Addressing.*
- LBA is a method where the blocks on a disk drive are sequentially numbered from 0 to n instead of using the CHS system.
- SCSI has always used LBA while ATA used CHS to identify sectors.
- There are two modes:
 - LBA: The linear address data is 'translated' to CHS.
 - LBA32: A 32-bit address is stored in the partition table.

INT 13

- INT 13: Internal Operation 13
- The designers of computers *never* plan for the future.
- INT 13 is a set of functions implemented in the BIOS that DOS programs can use to access a hard drive.
 - Only understands CHS; does not understand LBA32.
 - Limits hard drives to 2^{24} sectors, about 8.1 GB.

The Chain of Execution

- The computer's power is turned on.
- The CPU loads and executes the BIOS.
- The BIOS initializes devices and discovers the hard drives.
- The hard drives are searched for a bootloader.
- The bootloader boots the operating system.

The DOS bootloader

```
OFFSET 0 1 2 3 4 5 6 7 8 9 A B C D E F
000000 fa33c08e d0bc007c 8bf45007 501ffbfcc
000010 bf0006b9 0001f2a5 ea1d0600 00bebe07
000020 b304803c 80740e80 3c00751c 83c610fe
000030 cb75efcd 188b148b 4c028bee 83c610fe
000040 cb741a80 3c0074f4 be8b06ac 3c00740b
000050 56bb0700 b40ecd10 5eebf0eb febf0500
000060 bb007cb8 010257cd 135f730c 33c0cd13
000070 4f75edbe a306ebd3 bec206bf fe7d813d
000080 55aa75c7 8bf5ea00 7c000049 6e76616c
000090 69642070 61727469 74696f6e 20746162
0000a0 6c650045 72726f72 206c6f61 64696e67
0000b0 206f7065 72617469 6e672073 79737465
0000c0 6d004d69 7373696e 67206f70 65726174
0000d0 696e6720 73797374 656d0000 00000000
0000e0 00000000 00000000 00000000 00000000
0000f0 TO 0001af SAME AS ABOVE
0001b0 00000000 00000000 00000000 00008001
0001c0 0100060d fef83e00 00000678 0d000000
0001d0 00000000 00000000 00000000 00000000
0001e0 00000000 00000000 00000000 00000000
0001f0 00000000 00000000 00000000 000055aa
```

- Stored in the MBR.
- Loaded by BIOS into 0000:7c00.
- Code starts at first sector of the drive.
- Partition table is stored at 0x0001BE
 - Stores four partitions
 - More available with extended partitions.

The DOS bootloader

- There are problems with this bootloader:
 - Can only boot primary partitions.
 - Supports CHS and not LBA.
 - Cannot ask user which OS to boot.
 - Cannot pass kernel arguments to the Linux kernel.
- Because of these problems, other bootloaders have been written.

LILO

- LILO: *Linux LOader*
- Lilo is the well-worn standard bootloader for most Linux systems.
- New versions are able to overcome the 8 GB CHS limit by using LBA.
- Supports a menu of up to 16 images.
- Default installed bootloader for RedHat and Debian.

LILO Setup

- LILO can be installed in the MBR of a drive or a bootsector of a partition.
 - MBR is usually easiest to use, but gets erased when installing Windows.
- Once LILO is downloaded and installed, one must edit the `/etc/lilo.conf` file.
- The configuration syntax is documented in the `lilo.conf(5)` manpage.
 - Type ``man 5 lilo.conf'` to view the page.

Examine lilo.conf

Troubleshooting LILO

- Install, install, install
 - Because of the way LILO is designed, it must be reinstalled each time that the kernel is upgraded, lilo upgraded, or a fly lands on your computer.
- If LILO says only “LI” on startup, LILO cannot find its second stage loader.
 - You need to run a rescue disk and reinstall LILO.
- Always have a spare bootdisk. LILO is easy to break and it cannot be reconfigured in its boot screen.

GRUB!

- GRUB: *G*Rand *U*nified *B*ootloader
- Originally a bootloader designed for the HURD.
- Able to boot almost any operating system.
- Easy to reconfigure on the fly.
- Does not require constant re-installs.
- Able to boot off of the network.

GRUB knows (hd0), not /dev/hda

- GRUB has its own way of naming partitions.
- GRUB always starts with 0, not 1.
- The floppy drive is (fd0).
- Hard Drives are (hdX) where X is the drive number.
- If one needs to specify a particular partition, one uses the syntax (hdX,N) where N is the partition number.

GRUB Installation

- GRUB can be installed two ways:
 - Using GRUB directly:
 - Run the `grub` command and type:
 - `root (hd0,0)`
 - `setup (hd0) #` Use a partition number to install into a partition's bootsector.
 - Or use `grub-install`
 - This is easy, but deprecated.
 - `grub-install '(hd0)'`

Examine GRUB configuration

Brief overview of PowerPC Bootloaders

- On OldWorld Macintoshes:
 - Quik and BootX are the only options.
 - BootX is easy to use, but requires MacOS to be installed.
 - Quik is harder to install and use. It is similar to lilo.
- On NewWorld Macintoshes (machines with OpenFirmware):
 - yaboot is the best option.
 - Image detection is similar to grub's, but yaboot uses OpenFirmware paths.

ISOLINUX

- Designed for bootable CD-ROMs.
- Bootable CD-ROMs use the El-Torito specification with ISO 9660.
 - Each CD-ROM uses two data files:
 - Disk image with boot sector containing bootloader.
 - Catalog file that states where the image is stored on the CD.
Automatically generated
- ISOLINUX is used on Timos' Rescue CD.

Demonstration of Timos' Rescue CD to reinstall GRUB

- Boot off of the CD, requiring entering BIOS to tell computer to boot of CD.
- Login is `root'. Password is `rescue'.
- Mount hard drive:
 - `mount /dev/hda6 /mnt -o rw`
- Run and install grub:
 - `grub`
- Unmount hard drive:
 - `umount /mnt`

References

- Linux Large Disk HOWTO
 - <http://www.win.tue.nl/~aeb/linux/Large-Disk-3.html>
- MBR - How it works
 - <http://www.ata-atapi.com/hiwmbr.htm>
 - *And various other pages on this website.*
- Grub
 - <http://www.gnu.org/software/grub/>
- LinuxISO
 - <http://syslinux.zytor.com/iso.php>