The Bootloader

How Grub works, booting other OSs

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A computing department
A bootloader can be very simple, provide minimal functionality

Can pay money for tools such as System Commander, or BootMagic (with Partition Magic)

Or use LILO, or better still, Grub.

Grub aims to boot anything on an Intel 86 architecture
Booting Windows on an Intel Computer

- BIOS loads **MBR** (Master Boot Record), first 512 bytes of “first” hard disk to RAM
- BIOS jumps to this code
- That code (by default) reads first sector of first active partition, the **boot sector**
- boot sector code then loads the operating system
Disk sectors, cylinders

The rings are called *cylinders*:
Methods of Booting

- BIOS always loads MBR
- MBR can load a bootloader, such as grub’s stage2 or LILO
- Booting OS directly:
  - bootloader can load an operating system kernel directly
- Chaining bootloaders:
  - bootloader can load another bootloader which in turn loads an operating system
How grub works

- We install “stage1” of grub into MBR
- stage1 reads stage1_5 or stage2 from a list of disk blocks
- stage1 loads stage1_5 from hard disk
- stage1_5 can now read files on the hard disk, and loads stage2
- stage2 of grub provides commands to support many features
Features of grub

- support directly loading many different operating system kernels
- can directly read many file system formats
- can load a configuration file from disk
- can decompress files automatically
- can read any device that the BIOS recognises
- is independent of drive geometry
- can detect all RAM
- supports Logical Block Address mode (LBA)
- supports network booting
- supports remote (serial) terminals
Installing grub into MBR from floppy

- Create a grub installation disk
  - see the lab sheet to see how
- Boot computer with this disk, type:
  
  ```
  grub> find /boot/grub/stage2
  grub> root (hd\text{x},\text{y})
  grub> setup (hd\text{x})
  ```
Installing grub into MBR from floppy — 2

- What happens when type
  ```
  grub> find /boot/grub/stage2
  ```
  - grub searches all partitions for that file
  - lists the partitions that contain `stage2` of grub

- What happens when type
  ```
  grub> root (hd\text{x}, y)
  ```
  - The “\text{x}” and “\text{y}” were found in previous step
  - grub mounts the partition, and determines file system type
Installing grub into MBR from floppy — 3

- What happens when type
  
  `grub> setup (hdx)`

  - grub copies small `stage1` to MBR of disk `x`
  - installs a list of sectors containing the `stage1_5` file
  - aim is so `stage1` can load `stage1_5` when booting
Booting using grub

- BIOS loads stage1 from MBR
- stage1 knows which sectors of hard disk contain stage1_5, so
  - loads stage1_5 into RAM,
  - jumps to that code
- stage1_5 can now read the file system containing stage2
- reads stage2 from hard disk
- stage2 can read the menu in /boot/grub/grub.conf
- stage2 can boot (almost?) any operating system from any disk BIOS can read