

# CST8207 – Linux OS I

Boot loaders

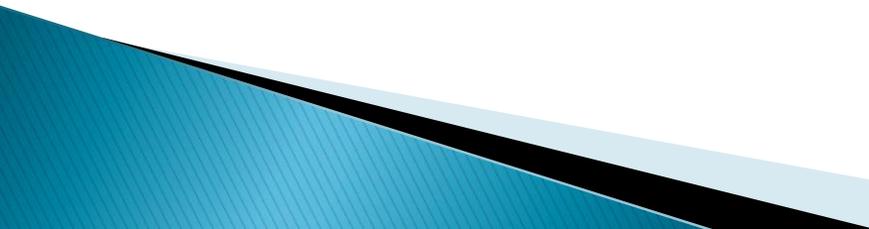
# Topics Covered

- ▶ Boot Loaders: Specifically Grub, but lilo is another and NTLDR (windows – not discussed, but it is a boot loader)

# Associated Readings

- ▶ Chapter 15 (pages 543, 551)

# What is a boot loader

- ▶ A very small program used in the bootstrap process
    - Bootstrap: Incremental process of loading an OS kernel into memory and running it without outside assistance
  - ▶ Frequently lives on the starting sectors of a hard disk (MBR: Master Boot Record)
  - ▶ Responsible for locating the kernel (kept in the `/` or `/boot` directory)
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# The Boot Process

- ▶ The BIOS, stored in an EEPROM (Electrically Erasable, Programmable, Readonly Memory) gains control of the system
  - ▶ After POST (Power On System Test) control is transferred to the MBR
  - ▶ MBR usually passes control to the partition boot record
  - ▶ This transfer starts the boot loader which loads and starts the kernel
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# /boot

- ▶ Can be placed on a very small filesystem (e.g. floppy)
- ▶ Usually is located near the beginning of the hard drive where the BIOS can access it
- ▶ With the above mentioned layout, the root filesystem can be located anywhere on the hard drive that Linux can access

# Grub

- ▶ Grand Unified Boot Loader
- ▶ Product of the GNU project
- ▶ Conforms to the *multiboot specification*
  - Specifies the relationship between boot loaders and the OS.
  - Any boot loader should be able to load any OS
- ▶ Allows loading of any free OS directly
- ▶ Allows chain loading (loading another boot loader) of proprietary OSes (i.e. Windows)

# Grub

- ▶ Recognizes various types of filesystems and kernel executable formats
  - ▶ Must specify the kernel's filename and location (drive and partition)
  - ▶ Grub receives this information via CLI (Command Line Interface) or menu
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# Grub Menu

- ▶ Generated from `/boot/grub/grub.conf` or the symbolic link `/etc/grub.conf`
- ▶ When installing Linux, grub is configured automatically
- ▶ The menu labels (*title*) start at 0 in `grub.conf`

# Grub Defined

- ▶ `root (hd $x$ , $y$ )`
- ▶ `kernel /vmlinuz-...`
- ▶ `initrd /initrd-...`
  
- ▶ Root – Specifies the location of the root directory (drive  $x$ , partition  $y$ )
- ▶ Vmlinuz refers to the kernel (compiled code)
- ▶ Initrd (Initialize RAM disk): A temporary filesystem used in the boot process
  - Prepares the “real” root filesystem for mounting

# GRUB Naming Convention

## GRUB Device Naming Convention

- Devices are identified by enclosing parenthesis ()
- Hard disks are named hd
- Floppy disks are named fd
- Hard disks are numbered sequentially, starting at 0
- Partitions are numbered sequentially, starting at 0
- *Examples:*
  - (hd0) – First recognized hard disk
  - (fd0) – First recognized floppy diskette
  - (hd0,0) – First partition on first recognized hard disk
  - (hd0,4) – First logical drive on first recognized hard disk

# Installing GRUB

## Installing GRUB

- ▶ Type **grub** at the command line: this will load grub and display the grub command line.
  - *Example:* `grub >`
- 1. Type **setup** and provide the two arguments using GRUB device naming convention: the boot sector location, the GRUB images location.
  - *Example:* `grub > setup (hd0) (hd0,1)`
  - *Note:* If your `/boot` partition is mounted on a separate partition, specify the device on which the boot partition is located.
- 2. Exit grub with the **quit** command
  - *Example:* `grub > quit`

# grub.conf - *Example #1*

```
default=0
```

```
timeout=15
```

```
splashimage=(hd0,2)/boot/grub/splash.xpm.gz
```

```
title Fedora (2.6.23.15.137.fc8)
```

```
    root (hd0,2)
```

```
    kernel /boot/vmlinuz-2.6.23.15.137.fc8 ro root=/dev/hda3
```

```
    initrd /boot/initrd-2.6.23.15.137.fc8.img
```

```
title DOS/Windows - Alternative #1
```

```
    chainloader (hd0,0)+1
```

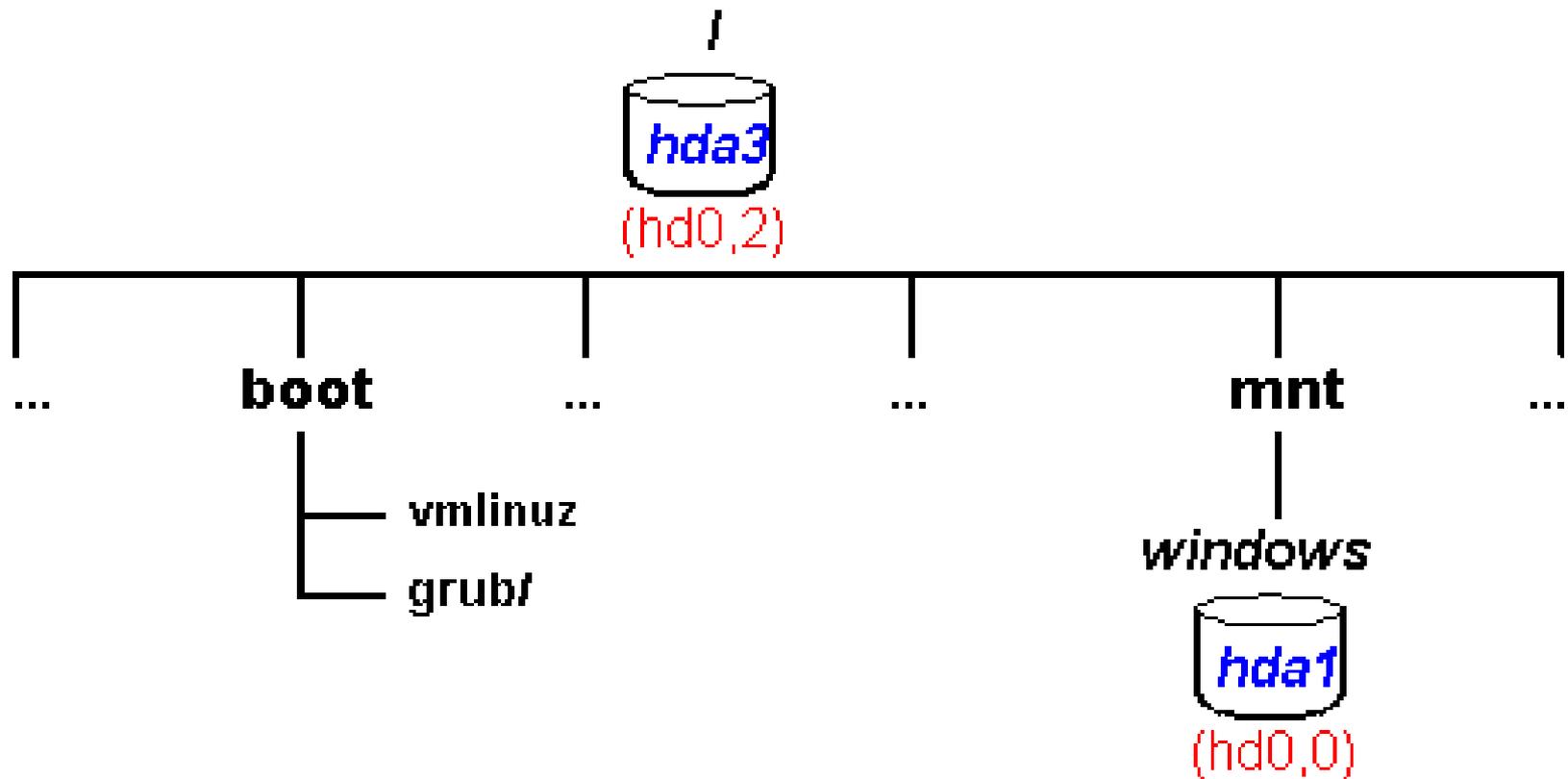
```
title DOS/Windows - Alternative #2
```

```
    root (hd0,0)
```

```
    rootnoverify (hd0,0)
```

```
    chainloader +1
```

# grub.conf – Example #1



# grub.conf – *Example #2*

```
default=0
```

```
timeout=15
```

```
splashimage=(hd0,1)/grub/splash.xpm.gz
```

```
title RedHat Linux (2.6.23.15.137.fc8)
```

```
    root (hd0,1)
```

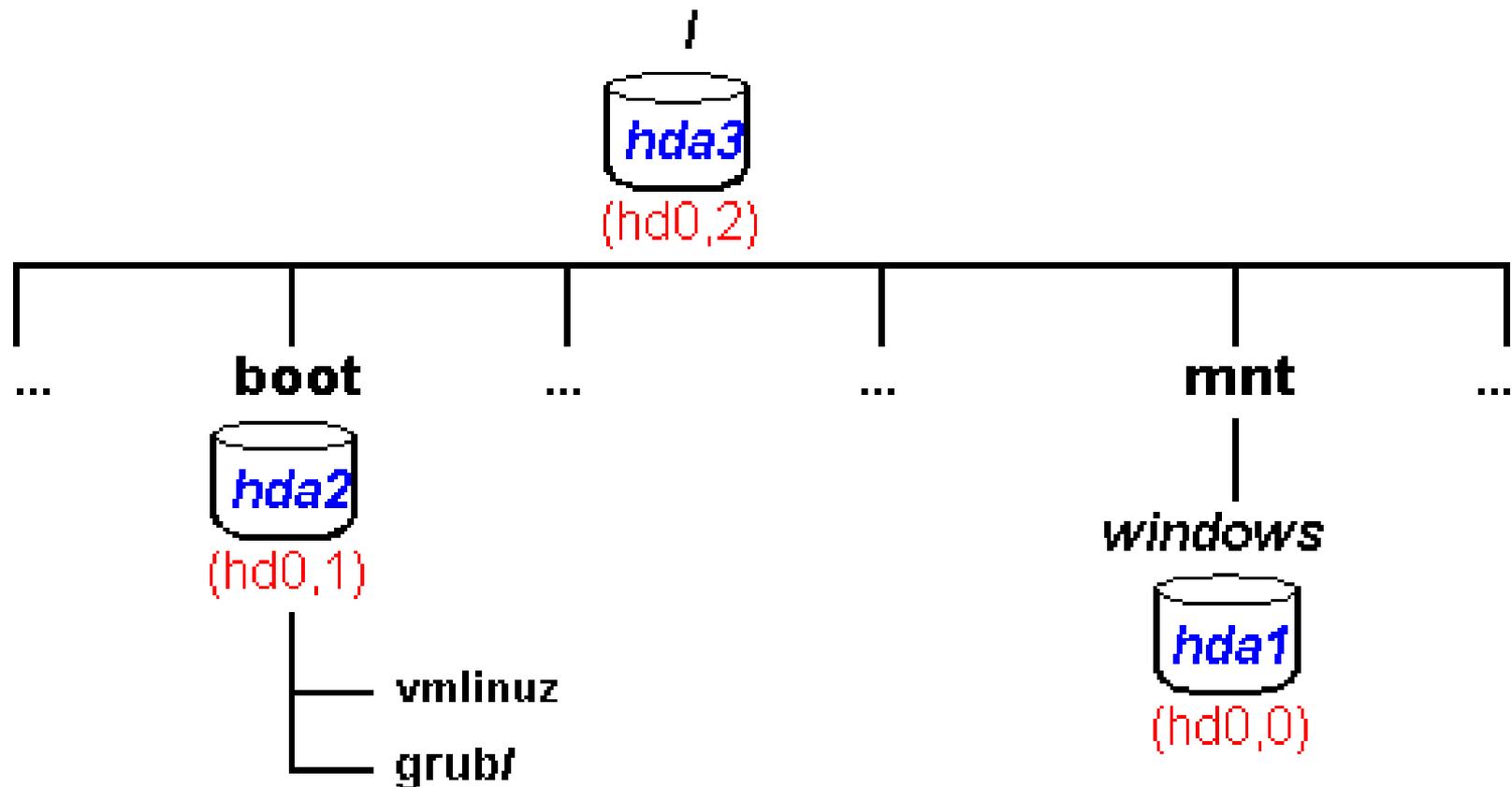
```
    kernel /vmlinuz-2.6.23.15.137.fc8 ro root=/dev/hda3
```

```
    initrd /initrd-2.6.23.15.137.fc8.img
```

```
title DOS/Windows
```

```
    chainloader (hd0,0)+1
```

# grub.conf - Example #2



# /boot/grub/grub.conf

## grub.conf entries

### ▶ Global options

- **default** *n* [opt.]: The *n*th boot image, starting at 0, is booted. Otherwise, first image is booted.
- **timeout** *20* [opt.]: Number of seconds before booting into default image.
- **password** *sesame* [opt.]: Disable interactive editing and/or protect all images that include the lock option

### ▶ Linux Image options

- **title** *Linux*: Menu title of boot image
- **kernel** *(hd0,1)/boot/vmlinuz root=/dev/sda3*: Location of Linux kernel file
- **lock** [opt.]: Requires password to boot image

*Note:* To find out about additional grub commands, type help at the grub shell.

# GRUB Shell

## Booting without a GRUB menu

- ▶ Stage 2 uses the file system to access the configuration file.
  - *Note: This means, as long as the file is not moved, modifications can be made without the need of reinstalling GRUB.*
- ▶ If grub.conf is not present, stage 2 cannot display a menu. In this case it will display the grub shell.
- ▶ At the grub shell, commands can be entered to load a boot image.
  - *Example:*
    - `grub > kernel (hd0,X)/boot/vmlinuz root=/dev/hdaY`
    - `grub > boot`
- ▶ *Note: The grub shell can also be accessed by pressing c when the menu is presented. [Esc] brings you back to the menu. Pressing e allows you to edit boot image entries of grub.conf. Pressing b boots the edited image.*

# Passing kernel parameters

## Kernel parameters

- ▶ Fixing a kernel panic (missing filesystem)
  - grub > root (hd0,2)
  - grub > kernel (hd0,2)/boot/vmlinuz root=/dev/sda5
  - grub > initrd (hd0,2)/initrd-xxx.img
- ▶ Booting into single user mode
  - grub > kernel (hd0,2)/boot/vmlinuz s root=/dev/sda3
- ▶ Booting into a different runlevel
  - grub > kernel (hd0,2)/boot/vmlinuz 4 root=/dev/sda3
- ▶ Confirming the startup of individual services
  - grub > kernel (hd0,2)/boot/vmlinuz confirm  
root=/dev/hda3