CSNB113: System Administration

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2nd Topic: Booting, Running and Installation

Starting == Booting - I

When a PC starts, it goes through a number of processes:

- After power-on or hard reset, control is given to the BIOS (Basic Input Output System). It
- Performs a self-test
- Detects basic hardware devices
  - Keyboard
  - Graphic card
    (Input, Output, Control)
- Detects storage devices
  - Floppy disk, CD/DVD drive, Hard disks, PXE (network boot), USB drives

Starting == Booting - II

Once it has 'oriented' itself, it looks for an operating system to start:

- It scans the devices detected during the first phase for an operating system. There can be many drives, and more can contain an operating system. It would take a long time to scan the content of all drives; and more than one can contain an operating system. Therefore

- We can select the sequence in which the BIOS scans the drives, in the BIOS. This is often called 'boot order'

- The BIOS does not scan all the contents of all drives, but only the first 512 Bytes of all drives.

- The BIOS searches these 512 Bytes for a Master Boot Record (MBR)

If it does not find any, it gives up and informs the user

Starting == Booting - III

As soon as a MBR is found on one of devices scanned by the BIOS, the control is passed to this device, and the location of the operating system is 'navigated' to. (A MBR essentially is a pointer to a specific location/address on the specific disk drive.)

- At that location on the drive, a basic program loader needs to be found.
  If this is not the case, the boot process fails

- This program loader then loads the kernel of the operating system.

- The kernel in turn loads the operating system and its applications.

Hard Disk Drives

A Harddisk provides **mass storage** to the system. This storage can be addressed by addressing its **sectors**.

> (All this has historical reasons. A traditional hard disk consists of **platters, with cylinders and sectors** on which the information is accessed with read-and-write-**heads**.
> This model is carried forward even to modern solid-state drives, including USB-drives, that have no platters and sectors. To the operating system it *pretends* to have them, because the operating system *expects* to find sectors on a drive.)

This storage can be split into a number of smaller address ranges, so-called partitions.

This is useful to separate data for example if you want to install different operating systems onto one harddisk.

> (The C: and D: drives that one can have on a single hard disk in Windows are such partitions.)

Also, one can have different **file systems** on different partitions

Partitions

Definition: Partitions are logical harddisks residing on a single physical disk.

PC Systems define three types of partitions:

- **Primary** Partitions
- **Extended** Partitions (container of logical partitions)
- **Logical** Partitions

A PC disk can hold up to 4 primary partitions, or up to three primary partition plus one extended partition.

The extended partition, if there, counts as one primary partition. It is used to hold logical partitions (many are possible).

Partitions - Example

```
Dev Boot Size Id File System Mount point
hda1 * 1G   83 Linux /boot
hda2   16G  83 Linux / (root FS)
hda3   20G  07 HPFS/NTFS
hda4   209G 05 Extended
hda5   2G   82 Linux swap swap
hda6   4G   83 Linux /home
hda7   12G  0b vfat /home/transfer
```

Partitions – File Systems

We have seen different file systems on different partitions in the previous slide.

What is a **file system**?

It is the way how files are organised (in a partition) on the drive:

- How to know **where** they are
- How to know which space is **free**, and which is **used**
- How to **retrieve** the file(s)
- How to recognize damaged files
- How to **remove** / **delete** a file
- How a **directory** and its **sub-directories** are organised

File Systems

The most relevant file systems are:

- **FAT** (File Allocation Table – Using a table containing file names and address locations) used in DOS, early Windows, on thump drives

- **NTFS** (New Technology File System) used in recent Windows

- **EXT** (Extended File System) used for all Linux(es) as default. There are version numbers: ext2, ext3, and ext4 as the most recent one

- **ISO9660** or **CDFS** (Compact Disc File System) specially for optical media: CD, DVD

- **ZFS** (Zettabyte File System) by SUN / Oracle.
  It is designed for high **reliability** and **data integrity**