# Computers Course

## First concepts

### Computers

Computers are devices that process information from an internal or external source. This can come from a keyboard, mouse, button, game controller, etc. **Informatics** is the discipline that includes the study and application of using computers to process information. It is often also called information technology or **computer science**.

The act of inputting this information is also known as entering **data.** For computers running data processing **instructions.** A series of instructions for a computer to do something specific is called **program.**

Computing can separate everything into two groups one that deals only with the programs and another that deals with the devices themselves. Most people call everything that deals with programs **software;** and everything that deals with devices **hardware**.

### Computers

The most common type of computer today is the **personal computer** or **PC.** And from these, there are usually two different types. The less portable **desktop** for use in a home or office, and the more portable computer that is often called **laptop**, **notebook** or **netbook**. Desktop PCs typically come as a box or tower computer that is used in conjunction with a screen, keyboard, and other accessories provided separately (peripherals). Laptops have all the internal parts of a desktop (screen, keyboard, etc) but comes as one complete piece that is more compact. There is also other kind of personal computers called **tablets** or **handled devices** that includes modern **cell phones, all of** which have computer capabilities. For example, they can be used to access email, the internet, and run software programs like a regular computer.

*Figure 1: The most common types of personal computers today. Desktops, laptops, phones and tablets*

Desktop computers are easier to disassemble, handle, and understand. In this course, we will deal first with desktop computers and their corresponding components for laptops afterwards.

### The CPU

The CPU is the **central processing unit**. It works by interpreting and processing the program instructions. It is like the brain and the heart of computers. There must be a coordination between the different things a computer have to do, specially when working at very high speed. To do so, the CPU pulses and send signals at a rate called frequency and is usually measured in **megahertz,**a million beats per second, and **gigahertz**, which is billion beats per second.

### Memory

Memory is what retain the information when the computer is on in a similar manner as our awareness or mind does. These are the elements in which computers write and/or read information. This information can be both instructions and data. There are read-only memories and read and write iones. The latter is the family of **RAM (Random Access Memory).** All contents of RAM are erased when we turn off the computer. The amount of information that fits within the memory is measured in **megabytes**, whose meaning will be explained later. Memory has time cycles in which information remains stored. These time cycles are also measured in megahertz. There are other types of memory such as **ROM** or **EPROM** that are read-only or limited write. Another type of commonly used memory is **flash,** where you can write and read data many times. Unlike other types of RAM memory, flash memory is not erased when are turned off or disconnected from the equipment where they were.

The part that reads or writes to memory is the same CPU. The CPU can only write or read to memory according to specified cycles of time. The most common types of RAM in computers today are the **DDRAM** that comes in four versions DDRAM-1, 2, 3 and 4. DDRAM have replaced an older memory version named **SDRAM,** which is now less common but still manufactured. SDRAMs differ externally of DDRAMs by having two slits on their bottom part instead a single one.. There are two different types of SDRAM, which work at different speeds. They are the PC100 and PC133. PCs more than 27 years old may have an even older type of memory called **SRAM.**

**Connectors and slots**

The parts within computers are connected via **interfaces. Industry standards** specify the physical dimensions and electrical characteristics of each kind of interface. These standards differ on the number, position and function of the various channels (metallic strips or *traces*) the connectors have. Electrical signals travel over the channels in compliance with communications standards known as **protocols.** The most common type of connector is **PCI (Peripheral Component Interconnect).** Usually computers have female slots where the different parts or pieces are connected by plugs. The parts that are connected to computers are often referred **to as cards** when they are internal and **peripherals** when they are external. The most widespread connector is the **USB (Universal Serial Bus)** that is replacing most other kind of connectors, even for multimedia purposes. With the time different USB connectors appeared that are currently being replaced in most devices by the **Type-C (USB-C)**.

Available connectors by USB standard

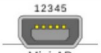
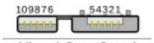
| Standard | | USB 1.0 1996 | USB 1.1 1998 | USB 2.0 2000 | USB 2.0 Revised | USB 3.0 2008 | USB 3.1 2013 | USB 3.2 2017 | USB4 2019 | USB4 2.0 2022 |
|---|---|---|---|---|---|---|---|---|---|---|
| Max Speed | Current marketing name | *Basic-Speed* | | *High-Speed* | | *USB 5Gbps* | *USB 10Gbps* | *USB 20Gbps* | *USB 40Gbps* | *USB 80Gbps* |
| | Original label | *Low-Speed & Full-Speed* | | | | *SuperSpeed*, or *SS* | *SuperSpeed+*, or *SS+* | *SuperSpeed USB 20Gbps* | | |
| | Operation mode | | | | | USB 3.2 Gen 1×1 | USB 3.2 Gen 2×1 | USB 3.2 Gen 2×2 | USB4 Gen 3×2 | USB4 Gen 4×2 |
| | Signaling rate | 1.5 Mbit/s & 12 Mbit/s | | 480 Mbit/s | | 5 Gbit/s | 10 Gbit/s | 20 Gbit/s | 40 Gbit/s | 80 Gbit/s |
| Connector | Standard-A |  Type-A 1.0 - 1.1 | |  Type-A 2.0 | |  Type-A SuperSpeed | |  [rem 1] | — | |
| | Standard-B |  Type-B | | | |  Type-B SuperSpeed | |  [rem 1] | | |
| | Mini-A | [rem 2] | |  Mini-A | | — | | | | |
| | Mini-AB[rem 3][rem 4] | | |  Mini-AB | | | | | | |
| | Mini-B | | |  Mini-B | | | | | | |
| | Micro-A[rem 5] | [rem 2][rem 6] | | |  Micro-A |  Micro-A SuperSpeed | |  [rem 1] | — | |
| | Micro-AB[rem 3][rem 7] | | | |  Micro-AB |  Micro-AB SuperSpeed | |  [rem 1] | | |
| | Micro-B | | | |  Micro-B |  Micro-B SuperSpeed | |  [rem 1] | | |
| | Type-C (USB-C) | [rem 6] | | |  (Enlarged to show detail) | | | | | |
| *Remarks:* | 1. Limited to max speed at 10 Gbit/s, since only one-lane (×1) operation mode is possible.<br>2. Backward compatibility given.<br>3. Only as receptacle.<br>4. Accepts both Mini-A and Mini-B plugs.<br>5. Only as plug.<br>6. Backward compatibility given by USB 2.0 implementation.<br>7. Accepts both Micro-A and Micro-B plugs. | | | | | | | | | |

*Figure 2: Different kinds os USB connectors. USB-C is at the bottom.*

## The sound card

Sound cards are the components that generate sound according in response to signals given by the CPU. Usually they have three audio jacks that are identified by color and a MIDI interface used to connect musical instruments and other devices.


*Figure 3* Sound card *Sound Blaster*

## The video card

The video card, also called **the GPU,** is responsible for producing a video image from data sent from memory by the CPU. The connector and signal from the video card to your monitor typically follows one of a few standards: **SVGA**, **S-video**, **DVI** and **HMDI**, which is the most widespread today and it si also known as DisplayPort. HDMI and some SVI connectors provide sound output as well. Video cards include their own RAM chips, but of a different type from the regular system RAM, as will be explained later. Other distinguishing features of a GPU are special types of connectors and cooling technologies such as radiators, fans, cooling tubes that carry liquids, etc. The capabilities, complexity, cost, and power consumption of GPUs varies by model and manufacturer.

*Figure 3: View SVGA connectors, S-Video and DVI*

*Figure 2: ATI video card*

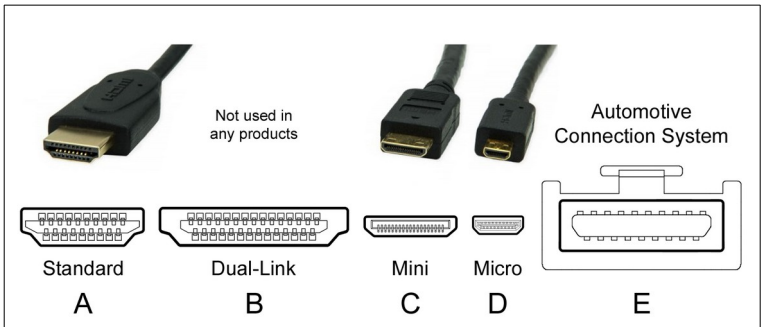



*Figure 5: Different connector types for HDMI*

## Motherboard

The **motherboard** is like the backbone of a desktop computer . Itsupports all the cards and connectors, the power supply and the CPU. The motherboard is not only a physical structure, but also coordinates and monitors the functioning of the various parts of the computer using electrical signals. It decides when the computer will turn on and off, which speed the CPU and memory will run at, and the relative priority of the various disks and storage systems. The motherboard is controlled by a small but powerful program called **the BIOS.** The BIOS is stored in flash memory or an internal EPROM on the motherboard that is never erased.

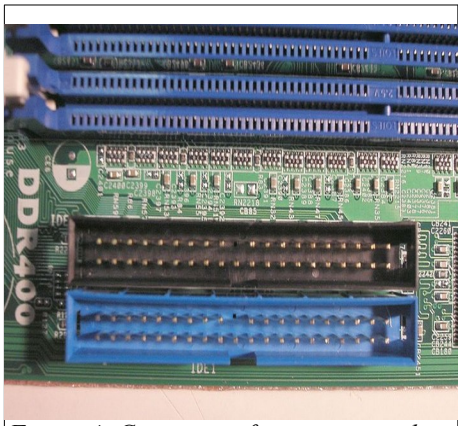



*Figure 4: Connectors for memory and disk on the mother board*

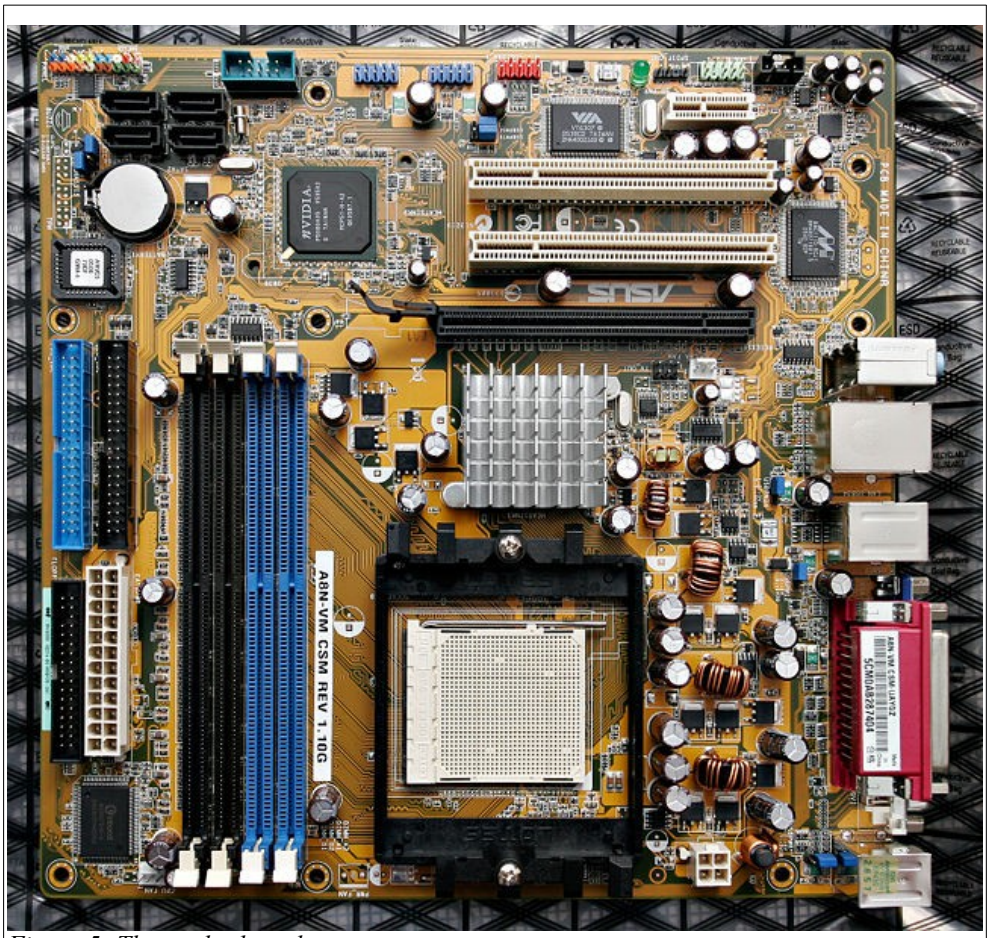



*Figure 5: The motherboard*

## Storage units

Storage units are devices that computers use to store information permanently analogous to the parts of our brains that store long term memories. The storage units are similar in function to the RAM memory chips described above, but are usually much slower, store much more data, and retain this data after the computer turns off and on again. The most common types of storage are magnetic disks. These may be **hard drives** or also **floppy** disks in older systems.

Floppy disks are small, flat, round sheets of magnetic material wrapped in plastic envelopes. To read and write data to them, you must insert them into a device in the computer called a **floppy disk drive.** PCs today usually do not include floppy disk drives, but it continues to be possible to add them. Floppy disks have limited capacity and are

considered obsolete.

Hard drives are read and written much faster and have more capacity than floppy disks. They have a number of stacked, rigid disks within that are very delicate discs and cannot be removed. Their capacity is measured in hundreds or thousands of gigabytes, typically holding hundreds of times as much data as RAM. Hard drives have an interface on the back, which serves to connect them to the PC, a feed inlet and a connector or manual configuration called a **jumper.** The types of interfaces include **IDE, SATA** and **SCSI.** The SATA connection standard is noticeably faster and more efficient than IDE. Currently there are two versions, SATA 1 and SATA 2, which differ in their rates of transfer data specifications. SCSI hard drives are large capacity storage interfaces more frequently used in servers in corporate environments than in PCs. More recently hard drives are being replaced by **solid-state drives** (**SSD**) which are much more faster but less reliable. The types of interfaces of SSDs are the regular SATA and a plurality of standards called mSATA, M.2, U.2, NF1/M.3/NGSFF and XFM Express similar to RAM connectors with slits and more often found in laptops.


*Figure 6: Hard disk with SATA connector to the left side,and input jumper power supply at its right end*

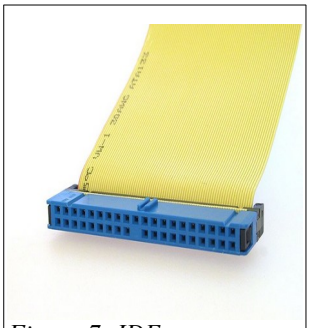


*Figure 7: IDE connector*

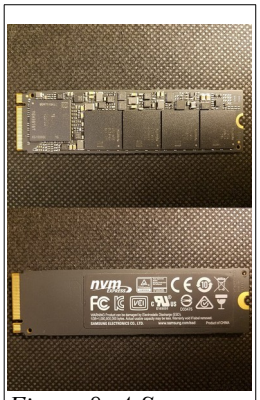


*Figure 8: A Samsung M.2 NVMe SSD*

Other very common storage devices are optical drives. These units include both read and read/rewrite optical discs. Optical disks can be of three types: **CD**, **DVD** or **Blue Ray.** Like floppy disks, these discs can be inserted and removed from a drive and carried easily from computer to computer. DVDs have a capacity seven times greater than CDs and are also faster. Both DVDs and CDs can be read only, read/write once or read with multiple write. The devices that read the discs are called the **CD** or **DVD-ROM** drive. Those that have the capability of recording are called **CD recorders.**

The optical storage devices have the same connectors as hard drives in the back plus an audio output that connects to a speaker inside the computer for listening music to CDs. Usually motherboards have two connectors for hard drives and optical disks. Each connector can receive two drives. A primary and a secondary. The position of the jumper determines whether a storage unit is primary or secondary.

**The power supply**

Computers need electricity in order to run. The power supply is a transformer that sends electric current to the various elements of the PC. It has many connector points and other smaller connectors that feed electricity to drives. The voltage going to the motherboard is about 5 volts and the disk drives is 18 volts.

Today most of the power supplies meet the Energy Star standard, which identifies products that use energy efficiently ( energy is only used when the computer is running) we distinguish two types of sources. AT and ATX (most common).

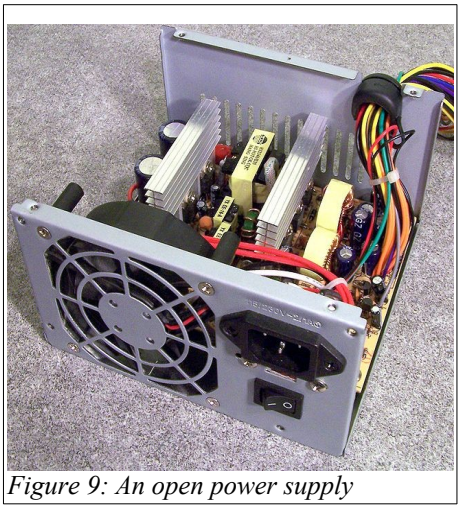


*Figure 9: An open power supply*

**The cooling system.**

The cooling system is the system that ventilates the computer and each of the system components.

A overheating system can cause loss of data or damage to the various electronic components of the computer.

Air ventilation → cool air is created through the combination of fans and heat sinks. They usually appear in the most devices that are most sensitive to overheating (i.e. microprocessors, graphics cards, and chipsets) or attached to a box as additional fans, watercooling or cooling liquid → the last two are controlled through a circuit system that contains cooling liquid.

*Figure 10: Fan cooler*

*Figure 11: Liquid cooling system*

## Hands On Repair

Learning to fix a computer is like learning to repair any other appliance. We saw above that each piece that makes up a computer has a specific purpose. With the right clues, faults can be traced back to the specific part that must be replaced or repaired. The first thing you have to do is open the computer's case and see what's on the motherboard. It is important to check that you have enough RAM, a hard drive, a graphics card and, optionally, a sound card, network card, and optical drive. Once we know everything is in place the next step is to verify that everything is connected and moving parts such as fans are free of dust, dirt and obstacles. It is a little surprising, but many times dust is the reason why computers do not work well. Dust and dirt trap heat and can even jam fans

causing devices to overheat or turn off. Many people throw out computers thinking them broken, and it turns out that when someone cleans them they spring back to life. To clean the dust you can use a brush, a cloth with alcohol, or compressed air, but never water.

After completing this first reconnaissance, we can try turning on the computer. If nothing happens we will have to test the power supply. To do that, carefully unplug the power connector from the motherboard and make a bridge between the black and green wires on the connector. The connector looks like a comb. To remove it we must press little plastic locks on either side. Avoid using too much force. If making the bridge with the power unplugged makes the fan in the power supply turn that suggests the power supply is in good working order. If not, then the power supply is likely the culprit. Many power supplies have a fuse that can be changed when it blows. Others simply are ruined and need to be replaced. If we identify a faulty power supply and replace its fuse or the whole unit with a working one, then we can turn on the computer again and proceed to diagnose any potential further problems.

When we turn on a PC, the motherboard scans the entire system to check if everything is in order and whether it should continue starting the system. The technical term for this is Power On Self Test (POST). It communicates the results of these checks to us by means of sequences of beeps of different durations. Here are some:

1. No beeps: No power (perhaps the cable is unplugged, is broken or the power supply is damaged – the point is that there is no power to the motherboard) or it may be that the speaker that emits the beeps fails to produce a tone (which can be tested separately).
2. Continuous: Error in the power supply (current evil comes, or the power supply box is annoyed, there is more to change).
3. Constant beeps: The motherboard is faulty, i.e. is broken, the worst that can happen to us.
4. One long beep: RAM error. Typically the RAM is not fastened well to the motherboard but could be faulty.
5. One long, another short: Error on the motherboard or ROM Basic. This happens a lot with old motherboards. People often pull the short.
6. One long beep and two short: Error recognizing the graphics card. The port may fail, so there would no longer be changed port, but may also be that the graphics card is defective.
7. Two long and one short: Error in synchronizing the images. Surely problem of graphical beeps.
8. Two short: Memory parity error (parity is a form of error checking). This occurs especially in old computers carrying two memory modules in two modules. This would mean that one module failed or does not have an even number of memory modules, which may be required in certain computers.
9. Three short: This indicates that there is an error in the first 64K of RAM.
10. Four shorts: Error in the timer or counter.
11. Five short: This indicates that the processor or graphics card won't start. It usually happens from overheating.
12. Six: Keyboard error: If this happens try another keyboard. If it still does not work it may the keyboard port where the keyboard plugs into the computer.
13. Seven: Virtual processor mode error. Virtual mode one of the ways a CPU can use memory. It's used to support older MSDOS programs.
14. Eight: Error writing to video RAM.
15. Nine: Error in the checksum (error detection code) of the BIOS RAM.

We often hear beeps we do not understand but the system continues to start and operates normally. In that case it would issue the error detector or that kind of scan that causes us to turn the computer plate.

The beep code information given here is for guidance only, not accurate, as it can vary depending on the model.

**For AWARD BIOS:**

1. 1 Long Beep: problem of memory
2. 1 Long Beep, and 2 short beeps: Error in Video card
3. 1 Long Beep, and 3 short beeps: Video Error (BRI Graph.)
4. Continuous Beeps: Memory or video problem

**For AMI BIOS:**

1. 1 Beep: Error in DRAM memory refresh
2. 2 Beeps: Parity circuit failure
3. 3 beeps: Error in first 64KB of RAM memory
4. 4 Beeps: Timing system failure
5. 5 Beeps: Processor
6. 6 Beeps: Fault Controller Gate A20 keyboard
7. 7 Beeps: Virtual mode exception
8. 8 Beeps: Failure to read / write memory display
9. 9 Beeps: ROM BIOS checksum error
10. 10 Beeps: Error reading / writing to the CMOS when shutting down
11. 11 Beeps: Cache memory error
12. 1 Long Beep, 3 Short: Failure of Conventional / Extended Memory
13. 1 Long Beep, 8 Short: Failure testing video
14. Continuous Beep: Most surely memory or video problem
15. 1 Long Beep: All tests passed, no problem.

**For IBM BIOS:**

1. No beep or a short one: No power or loose card.
2. 1 Short beeps and Normal Start: The device is OK.
3. 2 Short beeps: POST Error. See screen error code.
4. Continuous or short beep: No power, loose card.
5. Short Repetitive beeps, or Short beep: No power, loose card.
6. 1 long and one short beep: Problem on the motherboard.
7. 1 long and two short beeps: Problem Video (Display Circuitry Mono / CGA).
8. 1 long and three beeps: Problem EGA display circuit
9. 3 long beeps: Error on the keyboard or controller
10. 1 beep and black screen or garbled image: Video Circuitry failure

**The BIOS**

To access or enter the set up menus of the BIOS, reboot or turn on the computer and repeatedly press the **"DEL"** key on your keyboard. (Depending on the PC, this could instead be F2, F10, ESC, etc.) To know for sure which key to press watch the bottom of the screen when the computer starts for a message like **"**Press XXX to enter setup for XXX"where XXX is the key to press.

Now we see the BIOS set up screen we wished to access. Different BIOS types will have different looking BIOS but they each serve the same purpose, so once you've seen one nother will be familiar. In all cases, we move through the different options offered using the arrow keys and will select an option by pressing Enter. If you look at the bottom of the screen there will be a legend telling us how to perform the different available operations. To return to the home screen after selecting options that change to a new screen press **ESC**. Then choose to save the changes to the BIOS.

Once we make the changes we require in the bios, such as changing the boot

sequence, autodetect units, etc., we save these changes, i.e., burn them permanently into memory to be effective at the next boot PC. To do this, once we return to the initial BIOS screen after making changes, we can save in two ways:

1. By selecting the SAVE & EXIT SETUP (Save and exit the bios)
2. Press the **F10** key

In both cases, the window will ask us to select **Y (YES)** to accept save changes or **N (NO)** to reject them, i.e. to not keep the changes we have made.

At times will specify **vary the boot sequence in the BIOS** for eg installing your operating system. The boot sequence is the one that will decide starting order will follow the different units of our PC, ie where the pc will go to look for information to boot the computer.

Once inside the BIOS, we're going to line **Advanced BIOS Features** or **Advanced Setup** in other BIOS and press Enter as well.

to boot from the CD

Configure
In the First Boot Device option: **CD-ROM**(reading unit Cds)
In option:the Second Boot Device option **HDD-0**(primary-master HDD)
The Third Boot Device **FLOPPY**(Floppy)
Then hit **ESC** (Escape) so we return to the initial screen of the bios, and now only subtract save the changes and restart the pc with the new settings we have selectedwell.

to boot from the hard disk

Configure
In the First Boot Device option: **HDD-0**(hard disk primary-master)
The Second Boot Device option: **CD- ROM**(reading unit CDs)
On the Third Boot Device option: **FLOPPY**(Floppy)
Then hit **ESC** (Escape) so we return to the initial screen of the bios, and now only subtract save your changes and reboot the pc with the new configuration we have chosen as well.

to boot from the floppy

Configure
In the First Boot Device option: **FLOPPY**(Floppy)
The Second Boot Device option: **HDD-0**(hard disk primary-master)
The Third Boot Device option: **CD ROM**(reading unit Cds)
Then hit **ESC** (Escape) so we return to the initial screen of the bios, and now only subtract save your changes and reboot the PC with the new settings we have selected.

Sometimes will specify **Detect hard drives or readers** recently installed in our pc, since the new place them on the computer may start our operating system and they do not appear. Depending on the type of BIOS this action could take place otherwise I shall report the most common and hope to guide for other situations. Denter the bios, we go to theline **Standard CMOS Features** .(which is usually the first column on the left), and press Enter to access all the options inside

In this section we look at the lines:
**Primary IDE Master:** Master Device primary channel Slave.:
**IDE Primary** slave device of the primary channel Master.
**IDE Secondary** Device master secondary channel..
**IDE Secondary Slave** Slave Device subchannel **

Detecting IDE hard disk

We are located on the line IDE Primary Master or at the IDE where we've set from jumpers for that purpose have these devices, so it is selected and press ENTER.

We show a new window where you will press ENTER on the online **Ide HDD auto detection** and at the bottom they appear the data on the drive.

For changes future units can leave already selected by default **Automatic** detection,so that when we place a new BIOS device will automatically find itself without having to follow this method.

Then hit ESC (Escape) so we return to the initial screen BIOS, and now only subtract **save changes bios** and restart the PC with recognized units.

As readers detect or CD recorders

We are located on the Secondary IDE slave line or at the Ide where we configured from the jumpers that this effect have these devices, so it is selected and press ENTER. We follow the same steps as for detecting the hard drive.

In some bios do not need to configure the auto detection. Simply a menu will appear with options for primary and secondary disks, you move to each of the options and pressing **Enter** on them will detect each of the devices. Then only remains to save the changes. As we do if there are changes that do not know cancel the

Often the BIOS has anomalous behavior we do not know how to change BIOS. This usually happens when we receive a computer and someone played with the advanced BIOS options. In this case, we look at the main menu option to load the default settings, "load defaults", this will restore the factory settings and then can already make changes like doing our usual boot from the CD, etc.

## The operating system (OS)

An **operating system** (OS) is a program or set of programs that perform basic management processes of a computer system, and allows normal performance of other operations.

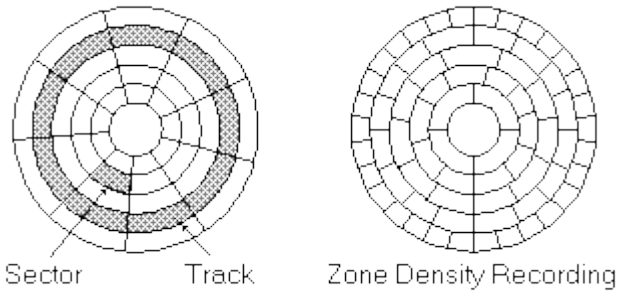
Note that it is a mistake common very widespread call the complete toolset operating system, ie, the inclusion in the same term programs such as file explorer, navigator and all kinds of tools that allow interaction with the operating system, also called kernel. One of the most prominent examples of this difference is the Linux kernel, which is the core of the GNU operating system, which are called GNU. This precision error is due to the upgrading of the information held in the late 80s, when the philosophy of basic operating structure of large computers[2] to be redesigned to bring it to homes and ease of use They changed the concept of multiuser computer (many users at the same time) for a single-user system (only one user at a time) easier to manage. (See AmigaOS, BeOS or MacOS as pionerosde such modernization, when the Amiga, were baptized with the nickname *Video Toasters*for its capacity for video editing round robin multitasking environment with thousands of color management and intuitive interfaces for 3D design e2n.

One purpose of the operating system that manages the core intermediary is to manage localization resources and hardware access protection, a fact that relieves application programmers from having to deal with these details. They are found in most electronic appliances that use microprocessors to run. (Mobile phones, DVD players, computers, radios, etc.)

**ORGANIZATION LOGIC HARD DRIVE:**

A disc internally consists of the following elements:

And the structure of the disk itself:




As we see in the images, an album is really a cylinder comprises several disks having two faces turn. Each face is divided into a set of tracks and each track on a set of sectors. All secores occupy 512MB; and is the minimum amount of data that a hard drive can read or writefollows.

any hard disk is organized as

| **MBR** | **DISK PARTITIONS** |
|---|---|

The first 512 MB (that is, the first sector of the disk), form the **MBR.** Here the number of partitions that there are, what type they are and what is the active partition on the disk to give you access stored.

The **disk partitions** are the ways you can divide your hard disk, for example, to install it multiple operating systemsbe:...

Partitions can **primary** or **extended**

A hard disk, you can only have 4 primary partitions, of which only one is the active partition (which is being used)
A disk can have multiple extended partitions ( These are often used to add data to the system), which in turn are divided into logical partitions example.

Consider an

Suppose we want to install on a drive, two operating systems: WINDOWS XP and Ubuntu, and I leave for the WINDOWS system with a separate space for storing data. Well, then, what you could do would be:

1. See how much storage space need each system. Think, that will be the minimum space that you will give the partition holding turn the system. Typically, give as much space to store the system and all the data we want.

2. As in our case, we only want to install two operating systems, we can create only 2 primary partitions and one extended, to store data.

3. Assuming that your disk is 250GB, could split as

- 10 GB toe xtended partition
- follows:...100 GB for Linux partition that will store
- the rest for Windows XP partition that stores

EL disc internally thus have the :

| MBR | WINDOWS | UBUNTU | D |
|---|---|---|---|

**NOTE:** Keep in mind that each operating system has its own operating system. For example, Ubuntu, when installed, automatically need 2 partitions: one where you store the data, and one for memory operations. However, the computer can make partitions to your liking, considering that this only be a logical way to organize your information on disk.