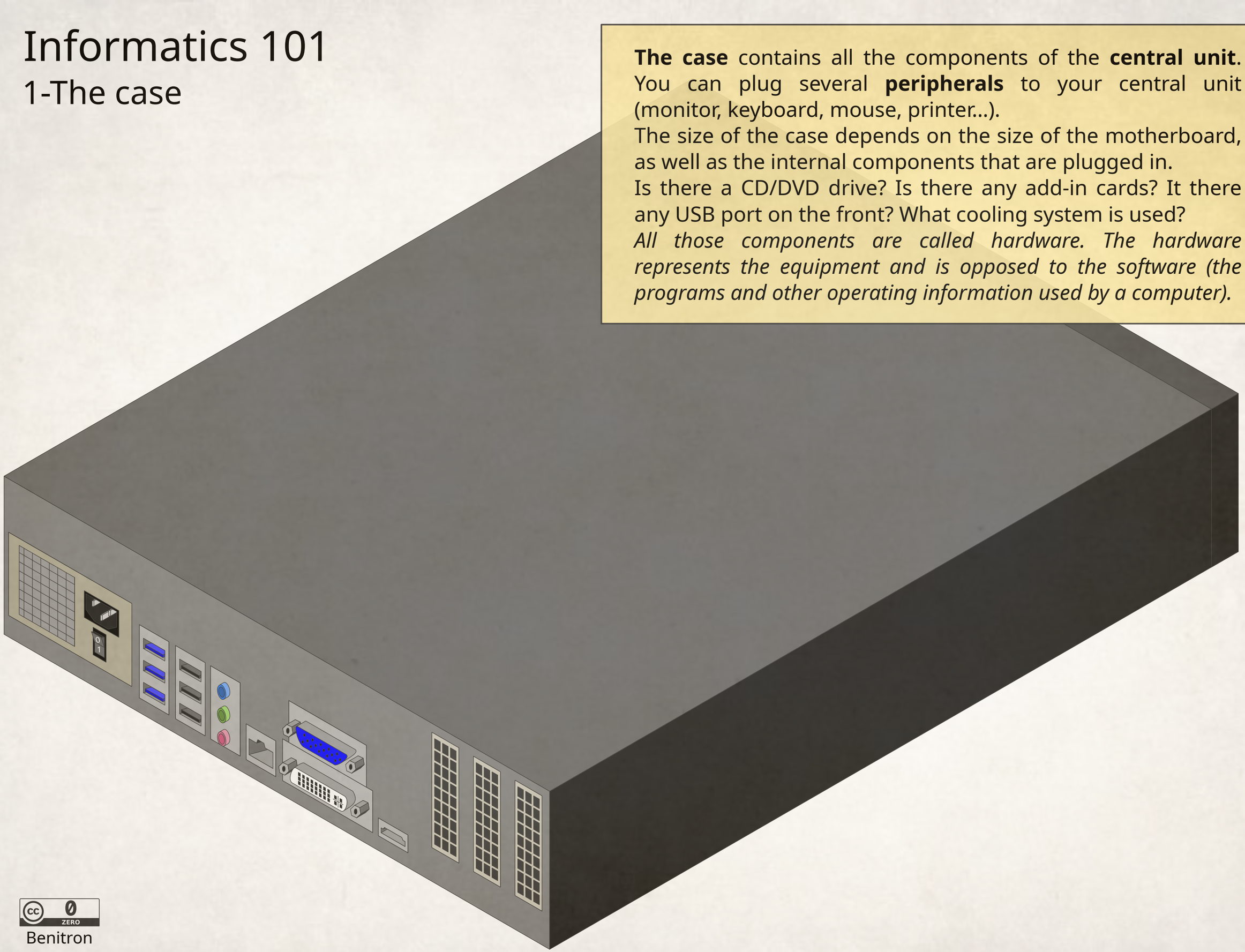
Informatics 101

1-The case

The case contains all the components of the **central unit**. You can plug several **peripherals** to your central unit (monitor, keyboard, mouse, printer...).
The size of the case depends on the size of the motherboard, as well as the internal components that are plugged in.
Is there a CD/DVD drive? Is there any add-in cards? It there any USB port on the front? What cooling system is used?
All those components are called hardware. The hardware represents the equipment and is opposed to the software (the programs and other operating information used by a computer).



Informatics 101
2-Back ports

The ports in the back of a computer are usually ports that you rarely manipulate as they are less accessible.
There often are the power supply, audio ports, multiple ports for the monitor, one ethernet port or several USB ports.
The shapes and colors are indicators, cues to plug at the right place in the right way.
We often find pictograms, symbols that represents what we are plugging.

Power supply: Is to be plug on AC outlet. Often contains a switch and a fan grill to dissipate the heat produced.

USB ports: The USB 3.0 (blue female plugs) are often the most recent and faster than the USB 2.0 (black female plugs). You can plug a USB plug on both, but you will only benefit from the speed if the plugged-in peripheral is also in USB 3.0 (blue male USB).

Audio ports: The line out port is in green (usually for headphones or loudspeakers). The mic in pink is the in port for the microphone. The line in port is for anything else than a microphone and is in blue.

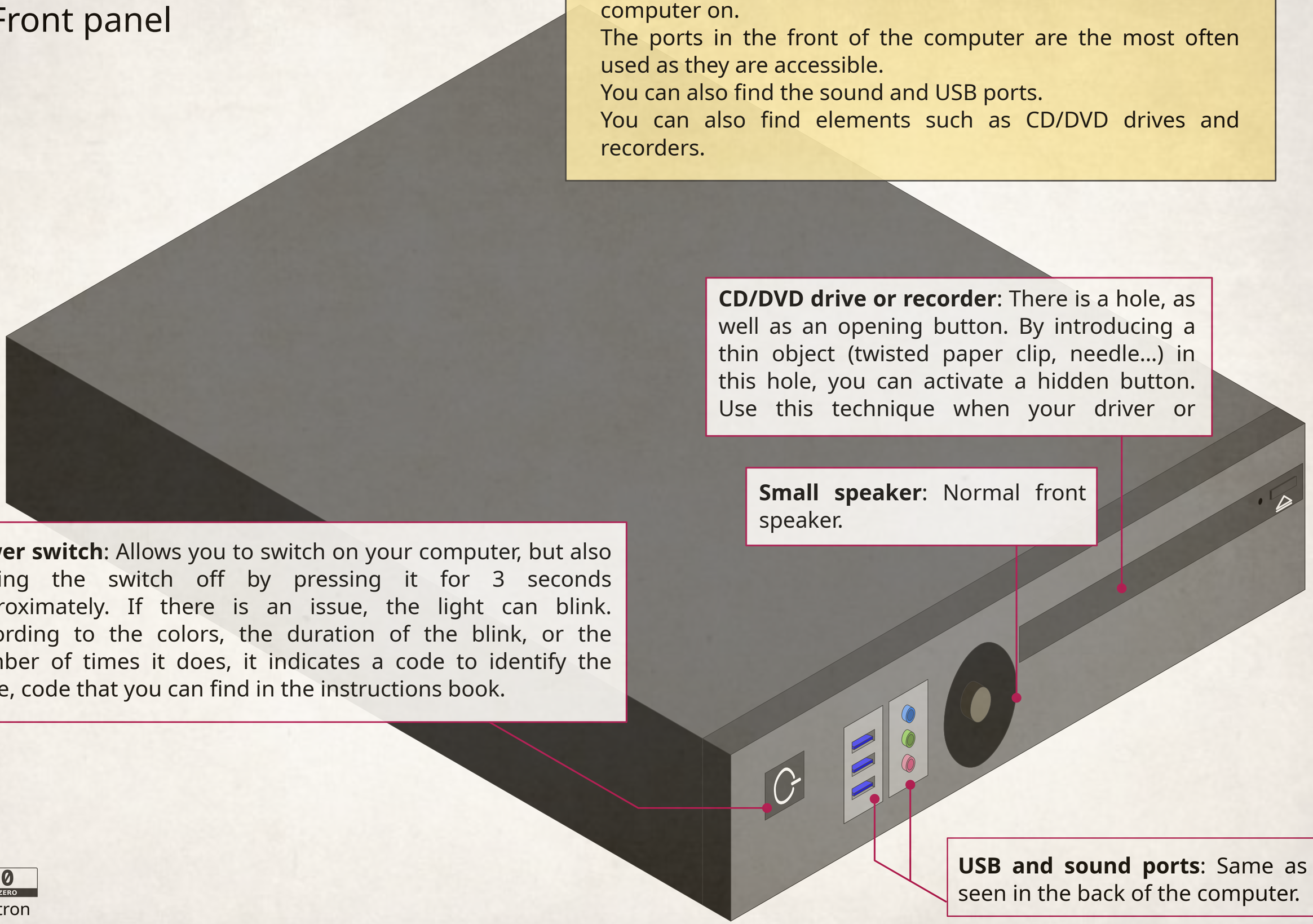
Monitor ports: There are several ports to plug-in a monitor. There are usually the VGA port (in blue), that needs to be screwed on the sides, the DVI port (in white), that needs to be screwed as well. A more recent one, HDMI, enables to transmit sound and image, as opposed to the two other mentioned that only transmit image.

RJ45 port: It is used to connect to internet (wired connection).

Add-in cards: Free slots that can be used to add other cards (for the sound, video, more USB ports, RJ45 or other components).

Informatics 101
3-Front panel

On the front panel, you usually find the switch that turns the computer on.
The ports in the front of the computer are the most often used as they are accessible.
You can also find the sound and USB ports.
You can also find elements such as CD/DVD drives and recorders.



CD/DVD drive or recorder: There is a hole, as well as an opening button. By introducing a thin object (twisted paper clip, needle...) in this hole, you can activate a hidden button. Use this technique when your driver or

Small speaker: Normal front speaker.

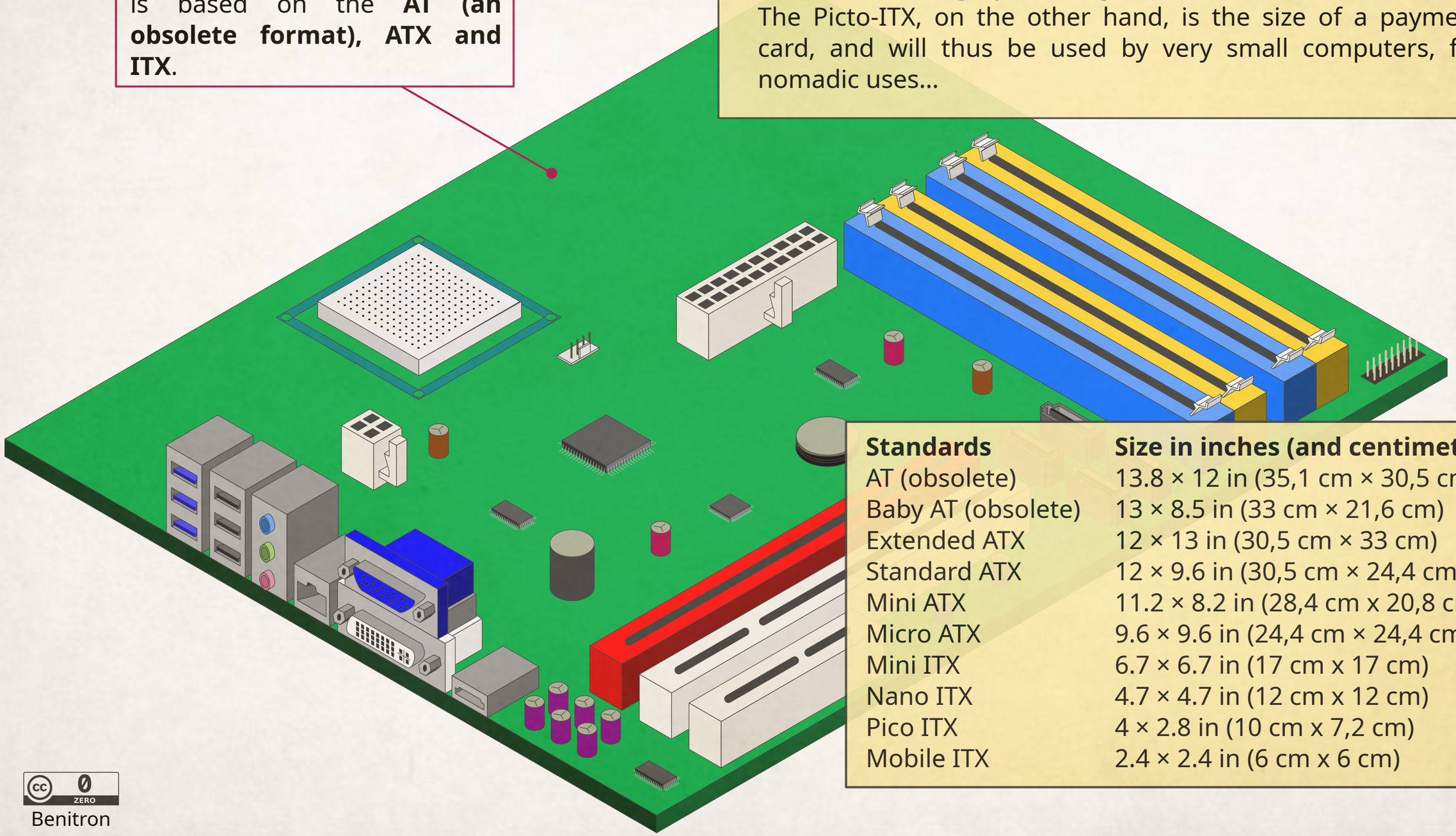
Power switch: Allows you to switch on your computer, but also forcing the switch off by pressing it for 3 seconds approximately. If there is an issue, the light can blink. According to the colors, the duration of the blink, or the number of times it does, it indicates a code to identify the issue, code that you can find in the instructions book.

USB and sound ports: Same as seen in the back of the computer.

Informatics 101
4-The motherboard

The **motherboard** connects all the components of the **central unit**.
A bigger motherboard will often provide more connections than a smaller one.
Choose the format of the motherboard according to your needs (RAM quantity, add-in cards, number of hard drives...).
For example, the motherboard Extended-ATX can be used to make videos, do graphic design or host a server.
The Picto-ITX, on the other hand, is the size of a payment card, and will thus be used by very small computers, for nomadic uses...

The format of the motherboard is based on the **AT (an obsolete format), ATX and ITX**.



Standards	Size in inches (and centimeters)
AT (obsolete)	13.8 × 12 in (35,1 cm × 30,5 cm)
Baby AT (obsolete)	13 × 8.5 in (33 cm × 21,6 cm)
Extended ATX	12 × 13 in (30,5 cm × 33 cm)
Standard ATX	12 × 9.6 in (30,5 cm × 24,4 cm)
Mini ATX	11.2 × 8.2 in (28,4 cm x 20,8 cm)
Micro ATX	9.6 × 9.6 in (24,4 cm × 24,4 cm)
Mini ITX	6.7 × 6.7 in (17 cm x 17 cm)
Nano ITX	4.7 × 4.7 in (12 cm x 12 cm)
Pico ITX	4 × 2.8 in (10 cm x 7,2 cm)
Mobile ITX	2.4 × 2.4 in (6 cm x 6 cm)

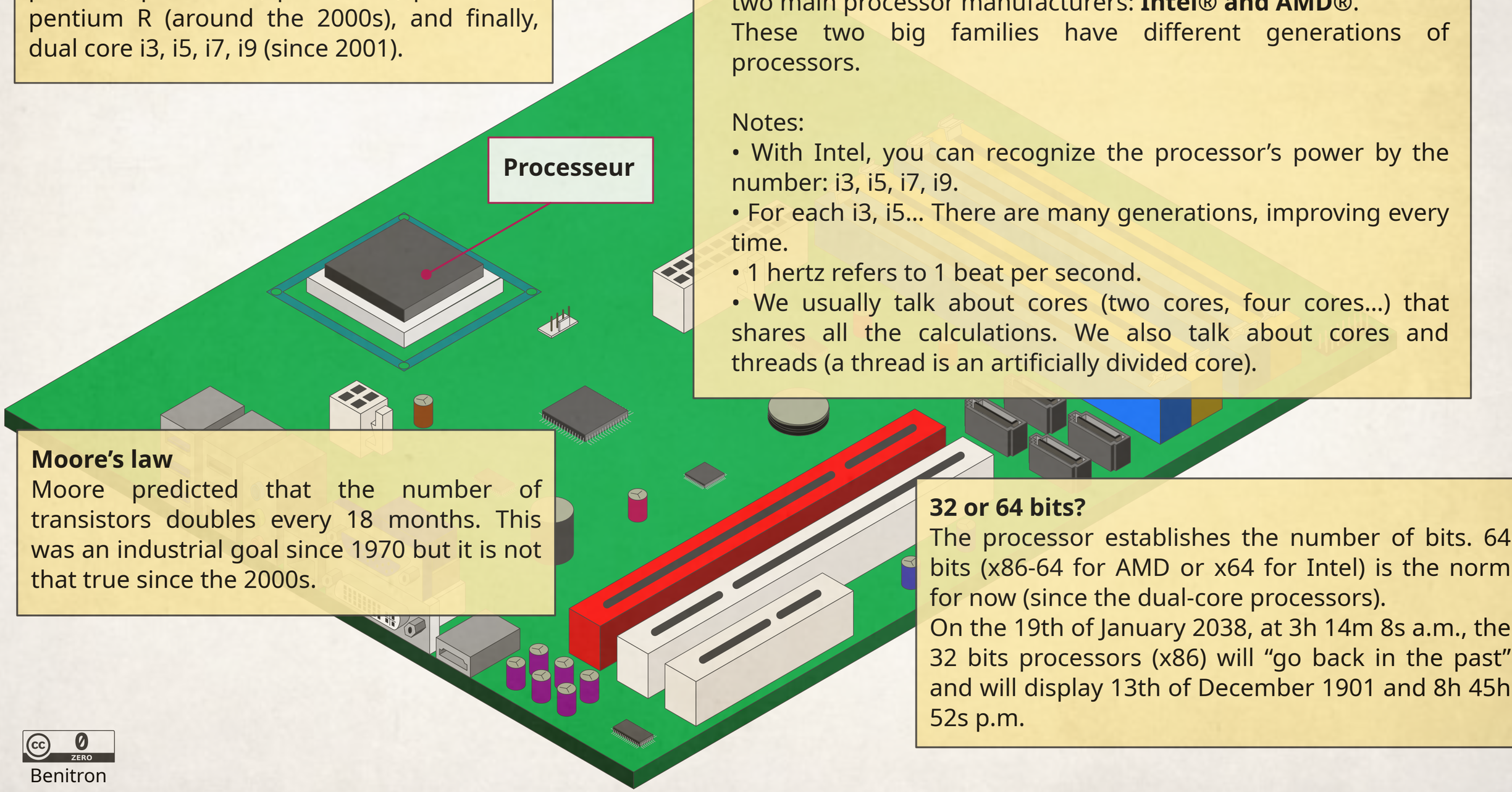
Informatics 101
5-The processor

Intel historical point
In order, with Intel, there was the processors 186, 286, 386, 486 (around the 90s), then pentium, pentium 2, pentium 3, pentium 4, pentium R (around the 2000s), and finally, dual core i3, i5, i7, i9 (since 2001).

The **processor** performs machine operations from software. The more powerful they are, the more the machine can perform heavy operations.
The frequency of the processor refers to the number of operations performed in a second by the processor. It is expressed in gigahertz (GHz).

There are two big component families, that are equal to the two main processor manufacturers: **Intel® and AMD®**.
These two big families have different generations of processors.

Notes:
• With Intel, you can recognize the processor's power by the number: i3, i5, i7, i9.
• For each i3, i5... There are many generations, improving every time.
• 1 hertz refers to 1 beat per second.
• We usually talk about cores (two cores, four cores...) that shares all the calculations. We also talk about cores and threads (a thread is an artificially divided core).

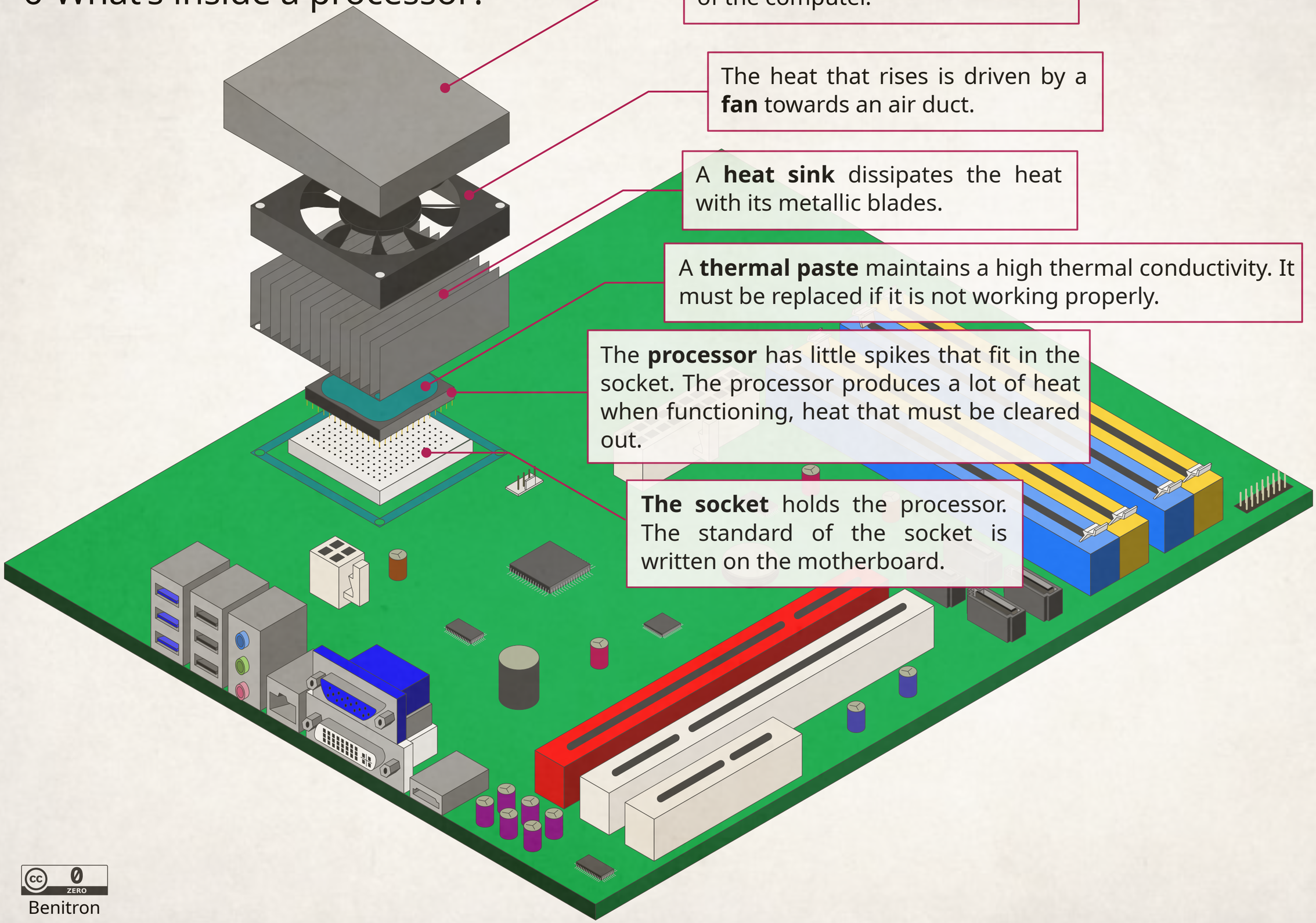


Moore's law
Moore predicted that the number of transistors doubles every 18 months. This was an industrial goal since 1970 but it is not that true since the 2000s.

32 or 64 bits?
The processor establishes the number of bits. 64 bits (x86-64 for AMD or x64 for Intel) is the norm for now (since the dual-core processors).
On the 19th of January 2038, at 3h 14m 8s a.m., the 32 bits processors (x86) will "go back in the past" and will display 13th of December 1901 and 8h 45h 52s p.m.

Informatics 101

6-What's inside a processor?



The **air duct** guides the heat out of the computer.

The heat that rises is driven by a **fan** towards an air duct.

A **heat sink** dissipates the heat with its metallic blades.

A **thermal paste** maintains a high thermal conductivity. It must be replaced if it is not working properly.

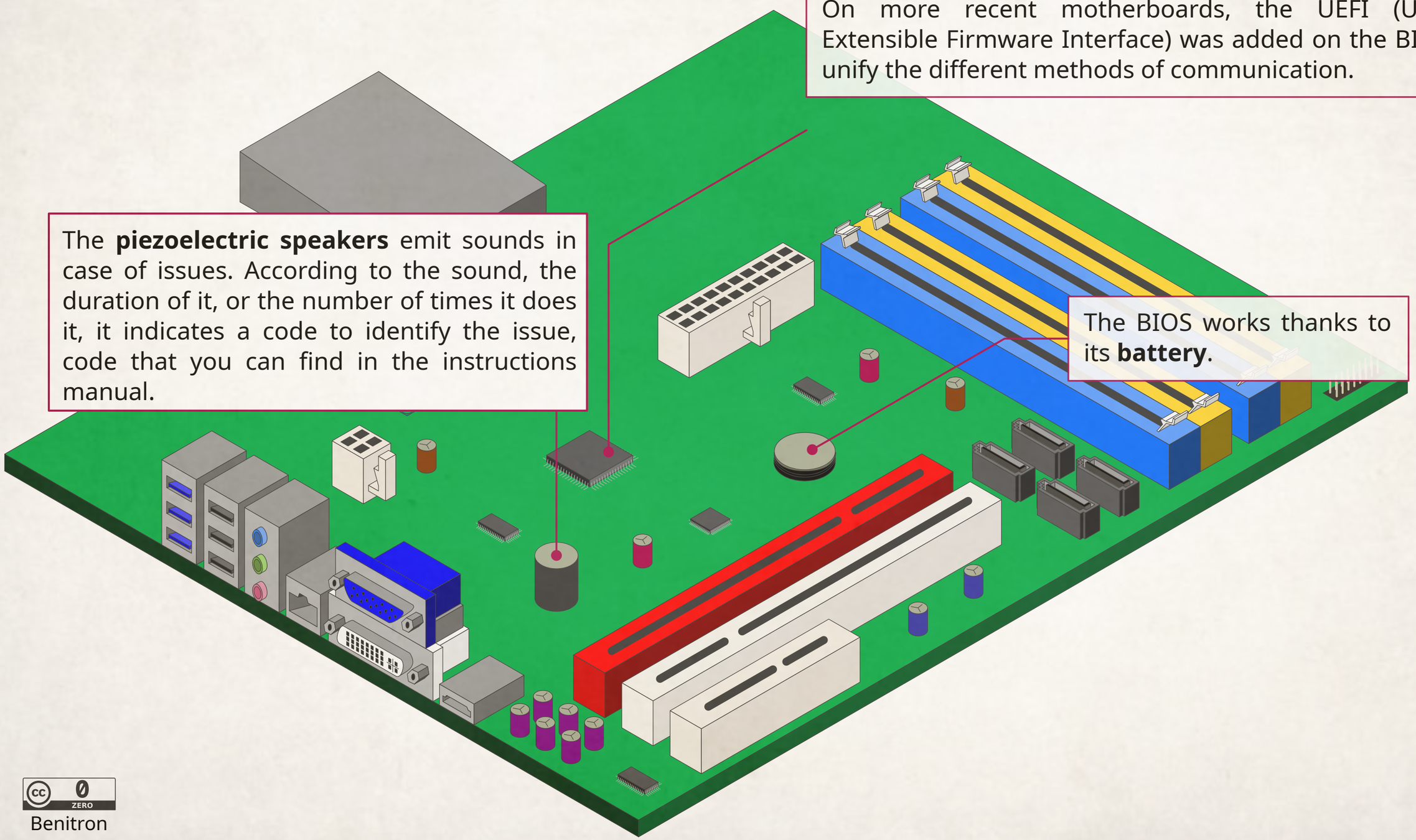
The **processor** has little spikes that fit in the socket. The processor produces a lot of heat when functioning, heat that must be cleared out.

The socket holds the processor. The standard of the socket is written on the motherboard.

Informatics 101
7-The BIOS

The **BIOS system** (Basic Input/Output System) is a firmware on a motherboard. It is used by the microprocessor of the computer to enable the start of the computing system after it is turned on.
On more recent motherboards, the UEFI (Unified Extensible Firmware Interface) was added on the BIOS to unify the different methods of communication.

The **piezoelectric speakers** emit sounds in case of issues. According to the sound, the duration of it, or the number of times it does it, it indicates a code to identify the issue, code that you can find in the instructions manual.



The BIOS works thanks to its **battery**.

Informatics 101

8-The random-access memory or RAM

Random-access memory is a volatile memory, which means it loses data over time.
It takes advantage on the speed of a program's execution.
RAMs are in order of age and performances: SDRAM, DDR, DDR2, DDR3, DDR4, DDR5...

Indexing slots avoid the misplacement of a type of memory.

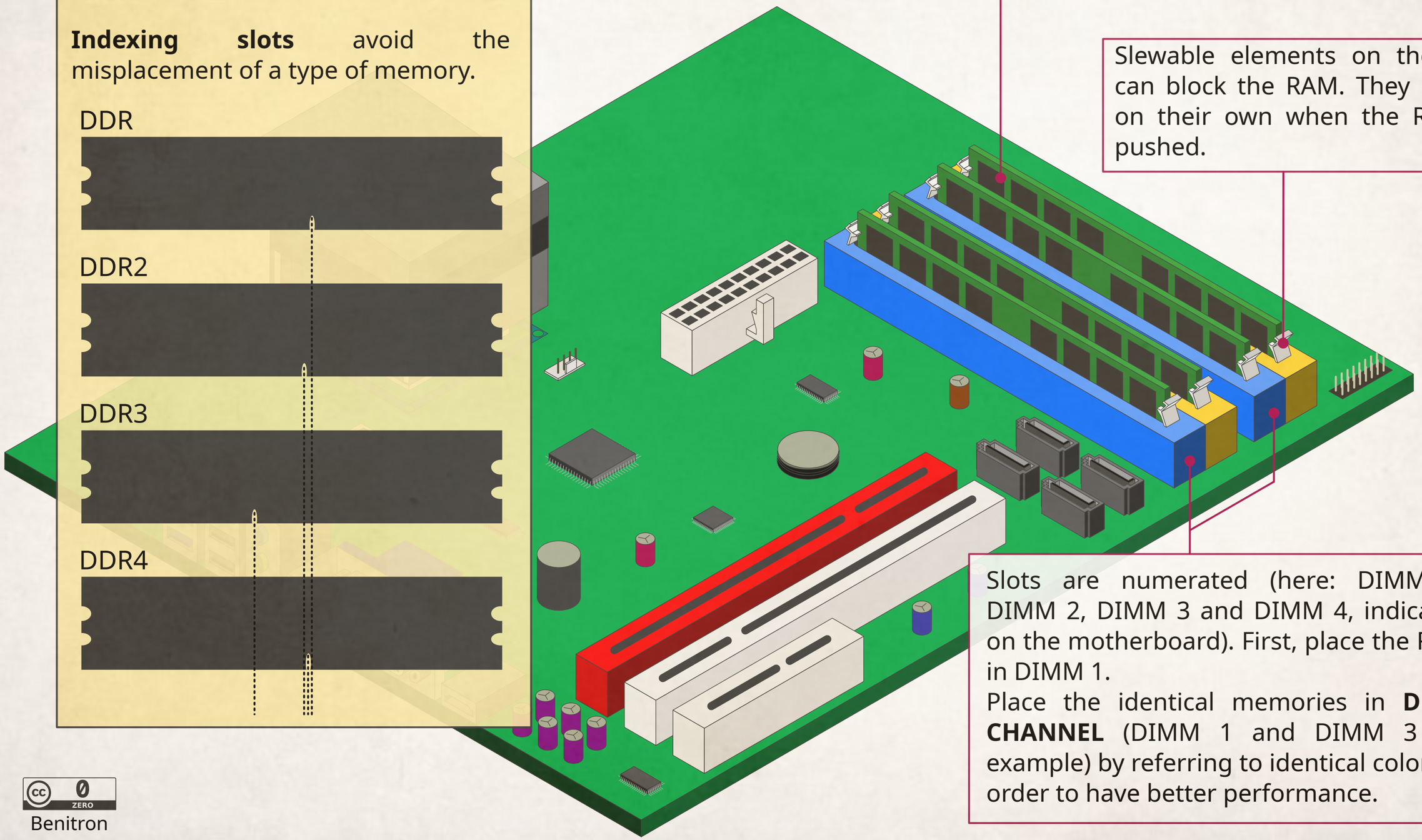
DDR

DDR2

DDR3

DDR4

Slewable elements on the side can block the RAM. They set up on their own when the RAM is pushed.



Slots are numerated (here: DIMM 1, DIMM 2, DIMM 3 and DIMM 4, indicated on the motherboard). First, place the RAM in DIMM 1.
Place the identical memories in **DUAL CHANNEL** (DIMM 1 and DIMM 3 for example) by referring to identical colors in order to have better performance.

Informatics 101

9-What’s inside the RAM?

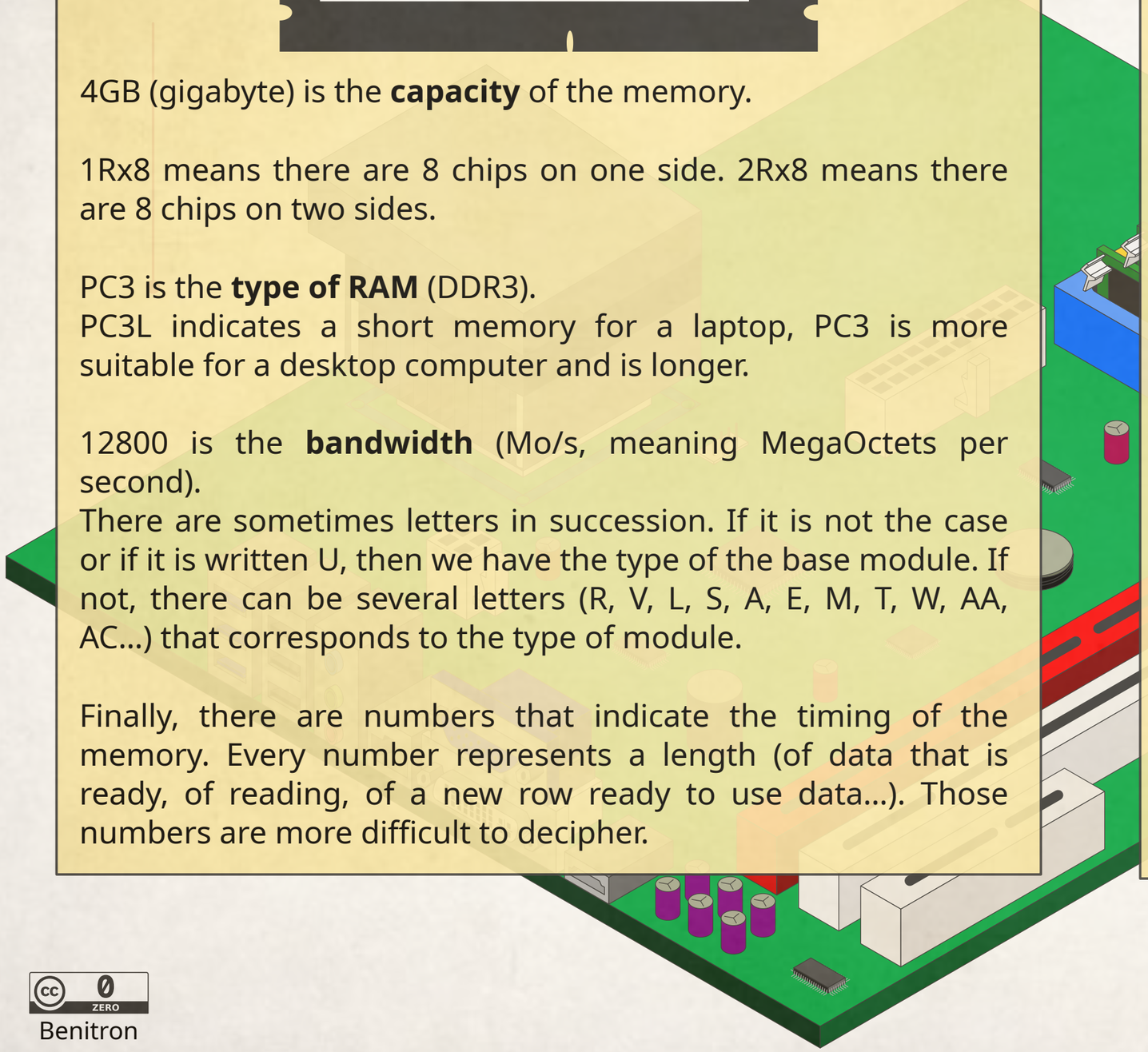
4GB (gigabyte) is the **capacity** of the memory.

1Rx8 means there are 8 chips on one side. 2Rx8 means there are 8 chips on two sides.

PC3 is the **type of RAM** (DDR3).
PC3L indicates a short memory for a laptop, PC3 is more suitable for a desktop computer and is longer.

12800 is the **bandwidth** (Mo/s, meaning MegaOctets per second).
There are sometimes letters in succession. If it is not the case or if it is written U, then we have the type of the base module. If not, there can be several letters (R, V, L, S, A, E, M, T, W, AA, AC...) that corresponds to the type of module.

Finally, there are numbers that indicate the timing of the memory. Every number represents a length (of data that is ready, of reading, of a new row ready to use data...). Those numbers are more difficult to decipher.



The RAM is standardized and is made of several inscriptions to decipher.
Its **capacity**, the **type of RAM** and the **bandwidth** are the three main inscriptions.
The frequency depends on the processor (also called CPU) and the motherboard.
It can be written in two different format. It is then possible to convert it from one to the other. Here is an example with the DDR 4 converted in PC4.

DDR 4	**PC4**
DDR4-1600	PC4-12800
DDR4-1866	PC4-14900
DDR4-2133	PC4-17000
DDR4-2400	PC4-19200
DDR4-2666	PC4-21333
DDR4-2933	PC4-23466
DDR4-3200	PC4-25600

Transfer rate (MT/s) — Bandwidth (Mo/s)

You usually try to keep the same memory type when you replace a defective one.

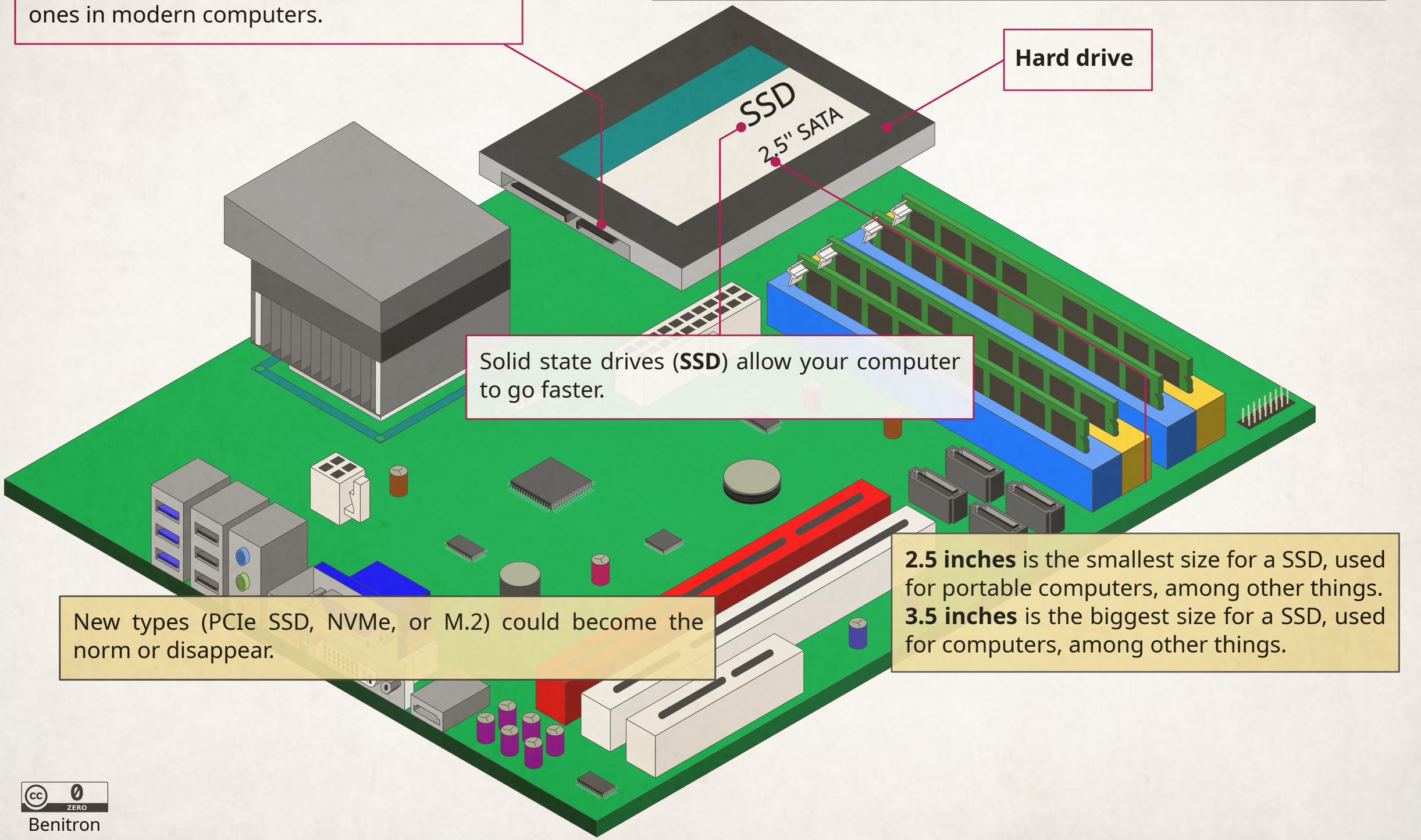
You will take a similar one but with a bigger capacity if you want better performance, while watching out for the compatibility with the processor and the motherboard.

Informatics 101

10-The internal hard drive

The **hard drive** is the storage of the computer.
On it, you can find every software, apps, data, operating system...
The more Gb or Tb (Gigabytes or Terabytes) the bigger the storage.

SATA sockets, like here, replaced the IDE ones in modern computers.



Solid state drives (**SSD**) allow your computer to go faster.

2.5 inches is the smallest size for a SSD, used for portable computers, among other things.
3.5 inches is the biggest size for a SSD, used for computers, among other things.

New types (PCIe SSD, NVMe, or M.2) could become the norm or disappear.

Informatics 101
11-The add-in cards

Add-in cards are extensions of the motherboard. Therefore, you can add audio cards, network cards, graphics cards for the screen, cards with ports for USB, mouse, keyboard...

Notes:
• Add-in cards are added to increase capacities (better graphics, more USB ports...) or to replace a dysfunctional port.
• There are two sizes of add-in cards: slim, for computers that are not very large, and normal.
• If the motherboard's processor is also called CPU, the graphics card's processor is called GPU.

There is a diversity of ports on the motherboard, depending on the generation and the types of the added cards.
There are more ports than the ones displayed here; you can find AGP, PCI or PCIe (for PCI-express) slots in many sizes.
Their sizes and slots have an indexing slot role.

Free spaces for **add-in cards**.

Informatics 101

12-The power supply

Connection of the power supply on the hard drive.

An **air duct** guides the heat out of the computer.

Connection of the power supply on the motherboard.

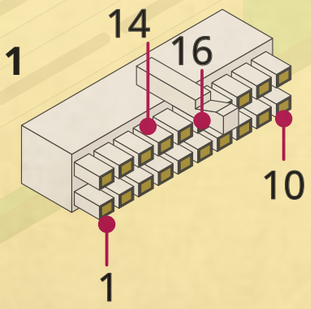
Alimentation

The **power of an electric supply** (in Watt = Volt x Current) depends on the components of a computer. The power needs to be at least as high as all the power of the components added together.
The power supply provides energy to the motherboard and components surrounding it (CD/DVD drives in front, hard drive...).
The motherboard acts as an electrical relay towards the front components and sometimes towards the add-in cards.

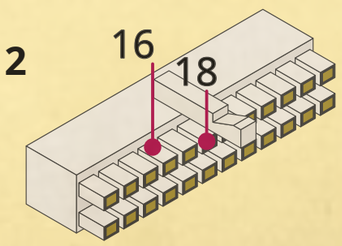
Electrical hazards: The hazards are close to non-existent, even if the computer is open or turned on.
However, **NEVER** open a power supply (defective or not), **EVEN WHEN THE POWER IS OFF**! It converts the AC electrical current, the electrical hazards would be high and potentially important in terms of physical injuries!

Shunt a power supply
To force the start of a single power supply, it is possible to use a paper clip to “shunt” (bypass) with the pin 14 and 16 for an ATX 1 (20 ”pins” or “slots”) or 16 and 18 for an ATX 2 (24 pins).
It is a way to see if a power supply is working.

ATX 1



ATX 2



Benitron

Informatics 101

13-Miscellaneous details

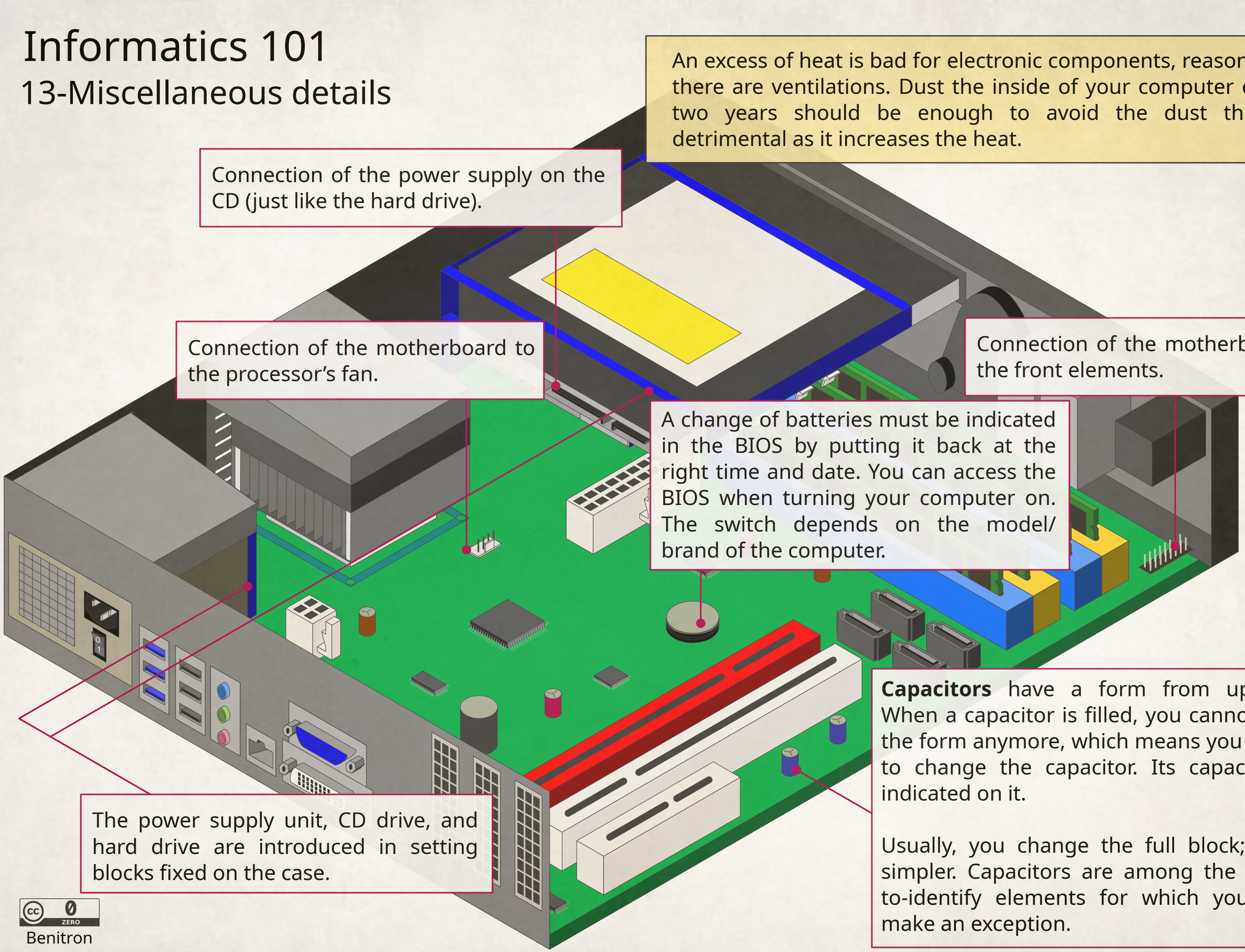
An excess of heat is bad for electronic components, reason why there are ventilations. Dust the inside of your computer every two years should be enough to avoid the dust that is detrimental as it increases the heat.

Connection of the power supply on the CD (just like the hard drive).

Connection of the motherboard to the processor's fan.

Connection of the motherboard to the front elements.

A change of batteries must be indicated in the BIOS by putting it back at the right time and date. You can access the BIOS when turning your computer on. The switch depends on the model/ brand of the computer.



Capacitors have a form from upside. When a capacitor is filled, you cannot see the form anymore, which means you need to change the capacitor. Its capacity is indicated on it.

Usually, you change the full block; it is simpler. Capacitors are among the easy-to-identify elements for which you can make an exception.

The power supply unit, CD drive, and hard drive are introduced in setting blocks fixed on the case.

Informatics 101

14-The circuits

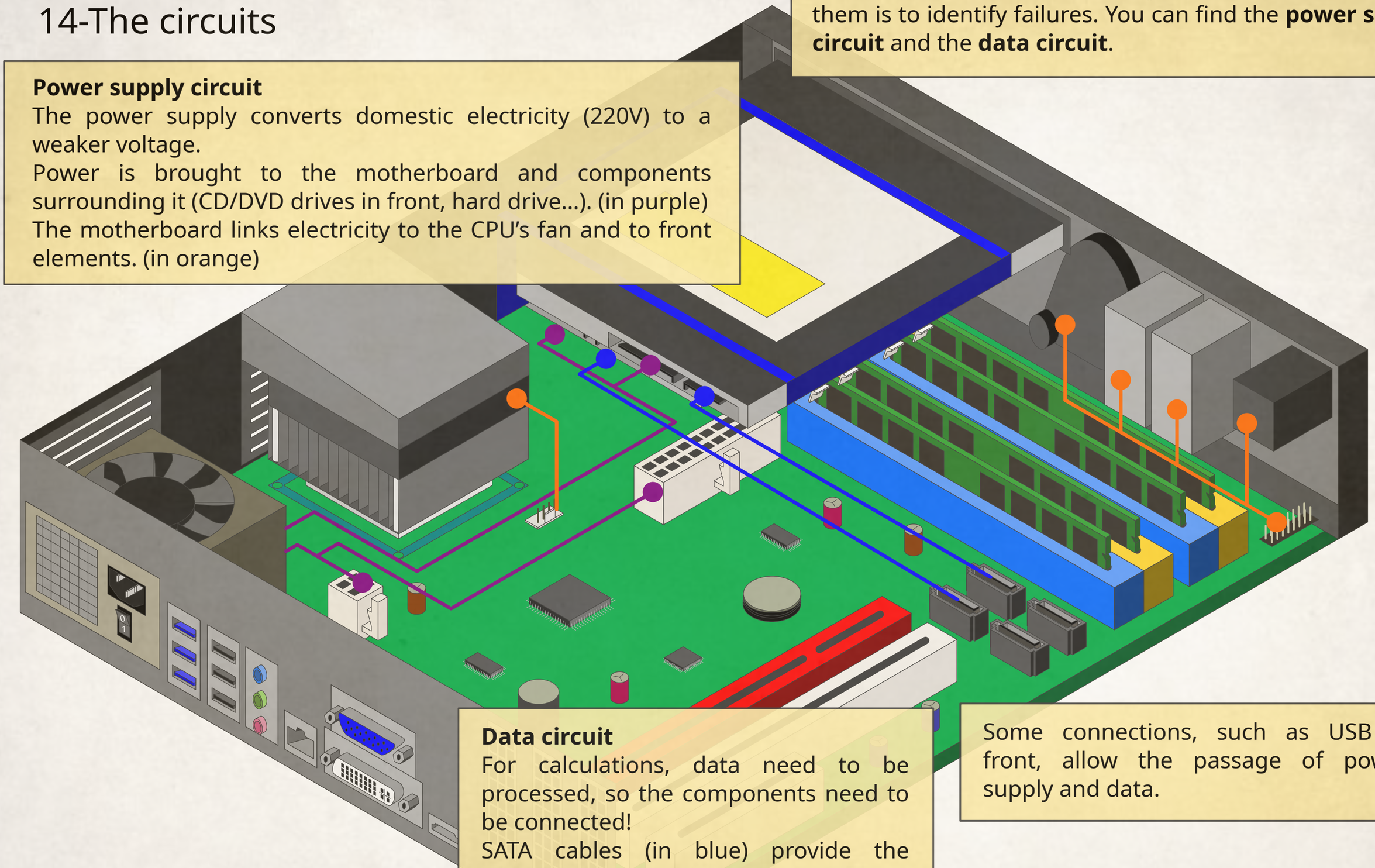
The computer has numerous types of circuits, to identify them is to identify failures. You can find the **power supply circuit** and the **data circuit**.

Power supply circuit

The power supply converts domestic electricity (220V) to a weaker voltage.

Power is brought to the motherboard and components surrounding it (CD/DVD drives in front, hard drive...). (in purple)

The motherboard links electricity to the CPU's fan and to front elements. (in orange)



Data circuit

For calculations, data need to be processed, so the components need to be connected!

SATA cables (in blue) provide the internal connection. External connections are provided by every ports on the front and behind.

Some connections, such as USB in front, allow the passage of power supply and data.

Informatics 101

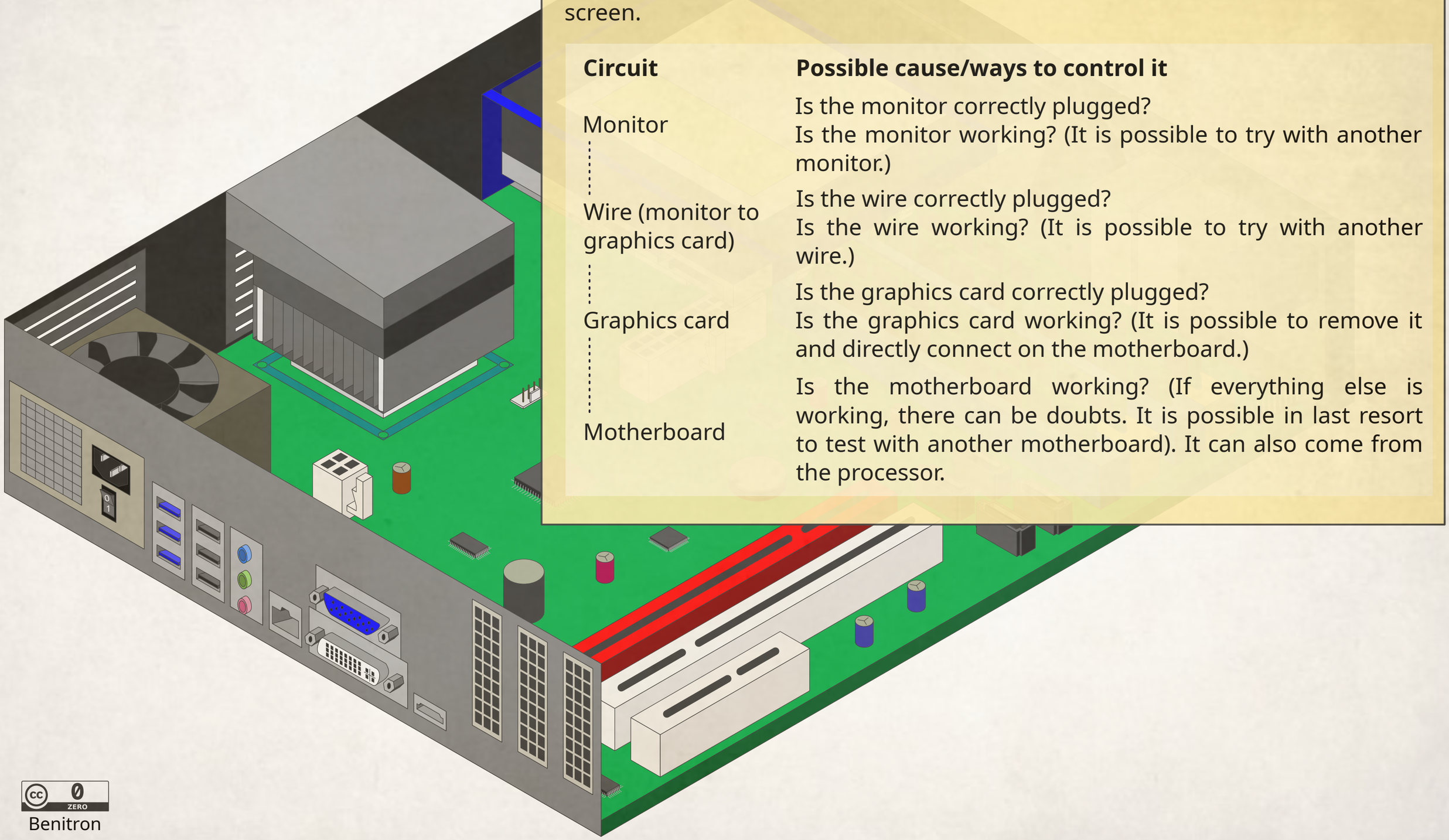
15-Issues

When there is an issue or failure, it is important to understand how the circuit works.

Case of no display

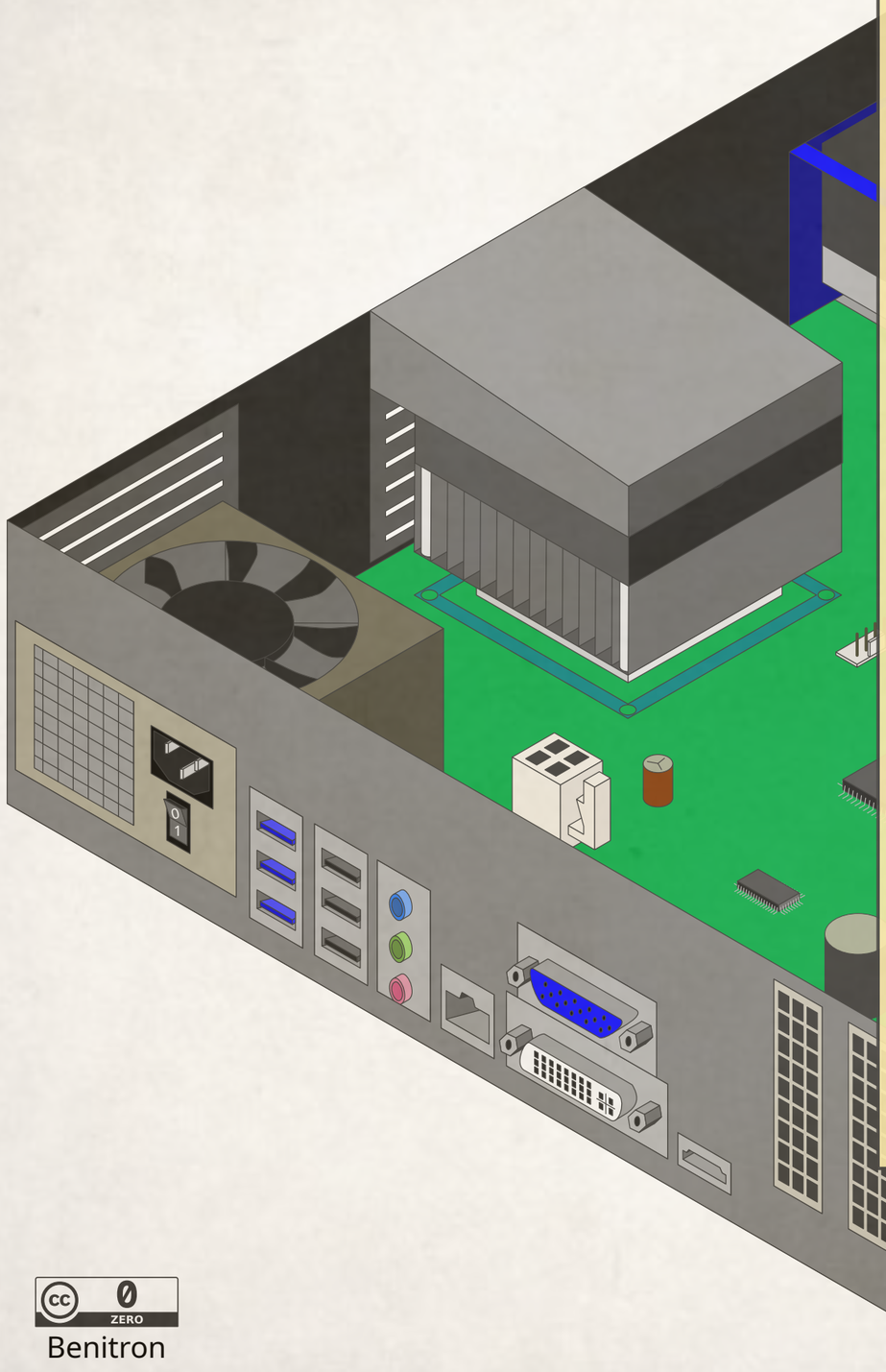
The computer and the monitor are turned on but nothing is displayed on the screen.

Circuit	Possible cause/ways to control it
Monitor	Is the monitor correctly plugged? Is the monitor working? (It is possible to try with another monitor.)
Wire (monitor to graphics card)	Is the wire correctly plugged? Is the wire working? (It is possible to try with another wire.)
Graphics card	Is the graphics card correctly plugged? Is the graphics card working? (It is possible to remove it and directly connect on the motherboard.)
Motherboard	Is the motherboard working? (If everything else is working, there can be doubts. It is possible in last resort to test with another motherboard). It can also come from the processor.



Informatics 101

16-Things you should know



Abnormally loud when turning your computer on: Check the fans (badly fixed, element touching the fan's blades)

Monitor display: When it is possible, the issues will be displayed on the monitor when you turn your computer on.

Priority: A graphics card has priority over the motherboard. So, if there is a graphics card, you should connect there.

BIOS beeps: When turning your computer on, beeps can indicate a code to help you identify what is wrong. These BIOS beeps can be short or long, and codes can change depending on the computer's brand. You can find these codes on the internet. Sometimes, the code gives a wrong reason for the issue. When the beeps indicate the motherboard, you should test the RAM or the clean boot mode first.

Clean boot: You can use a clean boot if you struggle to identify a failure (specifically if you have multiple failures). You take away everything that is not useful for the computer (add-in cards and components surrounding the motherboard; leave the hard drive at least).

Multiple failures: A failure can come from multiple factors, which is harder to identify. You can then use the clean boot.

Power switch blinking: Just like BIOS beeps, a light blinking can be a code for a failure.

Failure frequency: Some failures happen more often than others. With experience, you know that cable failures are rare for example.