3 The CPU

CPU is the abbreviation of **Central Processing Unit** and is the computer component that **carries out** the instructions contained in a program using the working and the I/O memory. If we compare a computer to a human being, the CPU is definitely the brain.
The main components of a CPU are the **Arithmetic and Logic Unit** (**ALU**), which is the processing component where the logic and arithmetic operations are processed, and the **Control Unit** (**CU**), whose task is to coordinate all the actions needed for the **processing** of a single instruction or set of instructions. The Control Unit communicates with the working memory and input/output devices to give the ALU the correct sequence of data and instructions to process and to take the results from it.
Apart from the ALU and Control Unit, the CPU also contains memory components called **registers**, where data (operands) are **loaded** from time to time and are required by the ALU for every single operation. The result of every operation executed by the ALU is placed in a register called an 'accumulator' and later moved by the Control Unit to the working memory in order to free some space for the next computation results.
The term CPU was not used during the production of the first electronic calculators **because of** the dimensions of the electronic components at the time. That is, thermionic valves, the ALU and the Control Unit were placed in two different rooms, so they were two different blocks located in different places. The first CPU ever put into business was the IBM 709 Central Processing Unit, which had thermionic valves, but was situated in one room only and used in an IBM computer called IBM 709 Data Processing System in 1958.
With the introduction of transistors and integrated circuits, the CPU has gradually reduced in size, from occupying a **whole** room to a single electronic board that you could hold in one hand as an integrated circuit. This is the **shape** that everybody knows nowadays because it is in every personal computer and is known as a **microprocessor**.
The first CPU, even if in limited numbers, started to be sold in 1971. It was fully contained in a monolithic integrated circuit and was the Intel 404 **microprocessor** designed by an Italian, **Federico Faggin**, who later made other Intel microprocessors with even better performance. After working for Intel, Federico Faggin founded and directed Zilog, the first company which produced only microprocessors and which later gave birth to the famous Z80, a microprocessor which is still being produced today and which was the main component of several successful personal computers made in the 1980s. Because of these products, which increasingly became more powerful and cheaper, Federico Faggin made a **remarkable** contribution to the spread of personal computers and electronic devices in general.

GLOSSARY

carry out (v.): eseguire
processing: elaborazione
loaded: caricato
because of: a causa di, in ragione di
whole: intero
shape: forma
microprocessor: microprocessore
remarkable: notevole

The CPU

CHECK YOUR KNOWLEDGE

1. Answer the following questions by choosing the correct option.

1. What is the purpose of the CPU?
   - ☐ A. To create data.
   - ☐ B. To store data.
   - ☐ C. To process data.

2. What does the Control Unit do?
   - ☐ A. It controls and monitors communications between the computer and any attached hardware.
   - ☐ B. It holds the data and programs that the CPU needs.
   - ☐ C. It carries out calculations and logic operations.

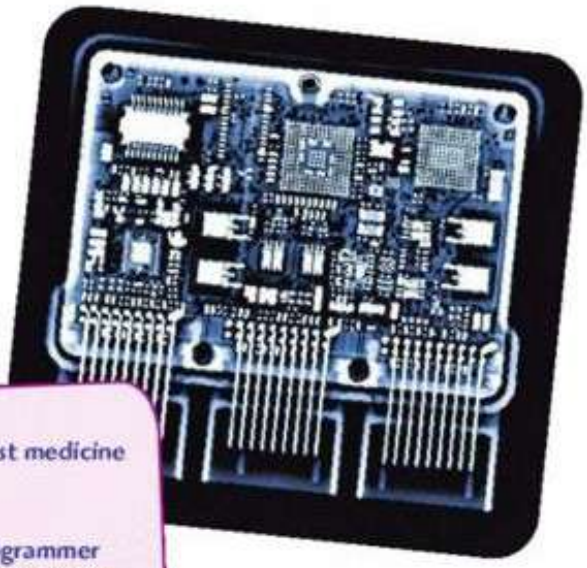
3. What does the Arithmetic and Logic Unit do?
   - ☐ A. It controls and monitors communications between the computer and any attached hardware.
   - ☐ B. It holds the data and programs that the CPU needs.
   - ☐ C. It carries out calculations and logic operations.

4. What can often be referred to as the registers in a CPU?
   - ☐ A. The Control Unit.
   - ☐ B. The Immediate Access Store.
   - ☐ C. The Arithmetic and Logic Unit.

5. How many instructions can a CPU process at a time?
   - ☐ A. One.
   - ☐ B. Many.
   - ☐ C. It does not process instructions.

6. When the CPU fetches the instruction from the main memory, where does it store it?
   - ☐ A. In the Control Unit.
   - ☐ B. In the Arithmetic and Logic Unit.
   - ☐ C. In the Immediate Access Store.

7. What is it called when the CPU carries out the action of an instruction?
   - ☐ A. Fetching the instruction.
   - ☐ B. Decoding the instruction.
   - ☐ C. Executing the instruction.



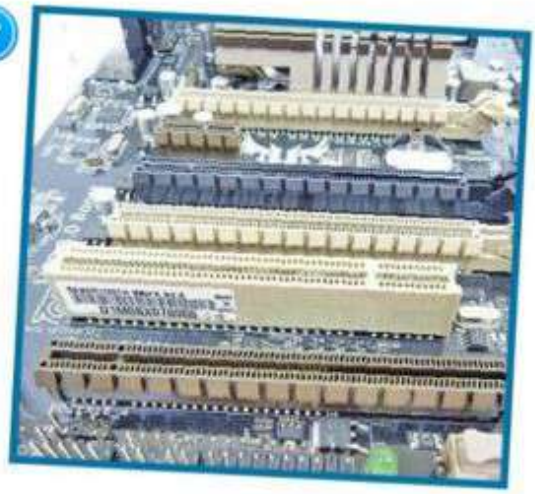
LOL

Wise people say that laughter is the best medicine - have a go!

Last summer, an unlucky computer programmer drowned at sea. Many people were on the shore and heard him cry out in despair 'F1! F1!', but nobody understood.
(F1 = Help)

From www.academictips.org

4 The Motherboard



The **motherboard** is an electronic board which constitutes a physical and electrical support for the components of a computer, especially the CPU and memories. Like all electronic boards, the motherboard is a **printed** circuit board where all the electronic components are soldered to make the system work. The **bus**, which is the set of links that allows the CPU, memory and peripherals to communicate with each other, is one of the fundamental components of the architecture of a computer and is made with appropriate **copper** tracks inside the motherboard.

The first motherboards had quite a number of **expansion slots** that allowed other boards, used to manage various input and output devices such as the keyboard, mouse, video, printers and storage devices (hard disk, floppy disk, CD and DVD players), to be connected to them. Modern motherboards integrate all the electronics needed to create a complete computer: video card, USB ports for connecting a keyboard, mouse, printer and even the board for the network connection thanks to the recent progress in the production of increasingly complex and smaller integrated circuits. These **features** make it extremely easy, at least for insiders, to assemble a personal computer. You can just plug in the CPU and the memory and connect the mass storage devices through special cables to the specially made connectors on the motherboard.

Probably the most difficult operation during the assembly phase is inserting the whole thing in a case equipped with the **power supply** which is needed to provide the right electrical parameters to all the components, to make them work properly.

In choosing a motherboard we need to take into account the necessary CPU to work with; in fact every motherboard contains a **socket** that holds an integrated circuit or a microprocessor corresponding to the desired CPU. The main difference between microprocessors is the number and positioning of their pins and the data that is sent and received through them. The socket connections must correspond to the chosen CPU pins, otherwise the system might not work properly or, even worse, it can get damaged. These are the reasons why companies produce more than one type of motherboard, so it can **support** families of CPUs; therefore, a group of CPUs share the same pins.

GLOSSARY

motherboard: scheda madre
printed: stampato
copper: rame
expansion slot: slot di espansione
feature: caratteristica
power supply: fonte di alimentazione
socket: presa
support (v.): sostenere, supportare

READING COMPREHENSION

1. After reading the passage, answer the following questions.

1. What is a motherboard? .....
2. Why can it be considered an electrical support? .....
3. What is the function of the bus? .....
4. What are the main features of modern motherboards? .....
5. What is it important to do during the assembly phase of a motherboard? .....
6. What is the role of a socket within the motherboard? .....
7. What is important to remember in order to avoid the risk of damaging the system? .....
8. Why are there different types of motherboards on the market? .....

TRANSLATION

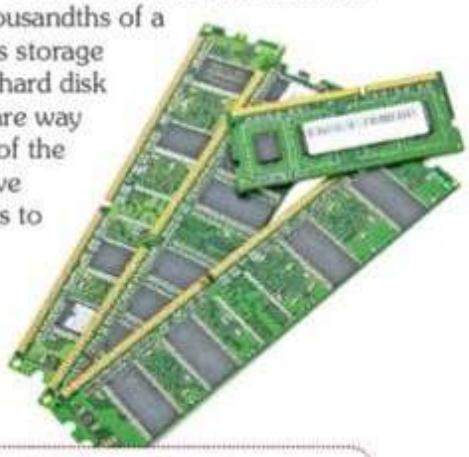
2. Translate the following sentences into English.

1. I computer sono usati per vari scopi come scrivere, elaborare dati e informazioni.
2. La scheda madre funziona da centro delle comunicazioni.
3. Più in fretta lavora la CPU, più potente è il computer.
4. Il codice ASCII onnipresente è stato originariamente definito come un set di caratteri a sette bit.
5. L'unità di capacità di stoccaggio di misura è il byte.

5 Memory

The component of the computer used to **store** or remember information.
All computers have some internal memory located within the system and close to the central processor.
One of the fundamental components of computer architecture is the **working memory**, which **holds** data and instructions required for the processing done by the CPU and which stores the results from every computation. The working memory is better known as **RAM** in modern computers.
Random Access Memory is electronic memory available as integrated circuits.
From the logic point of view, we can think of the memory as a set of **cells** where every cell can contain a byte, which is equal to an alphanumeric character. Each cell is identified by a progressive number called 'address', which unambiguously identifies that cell, **thus** allowing the CPU to select any single cell to read or edit its contents.
The term Random Access refers to the way that the CPU reaches the various memory cells, that is, via their address instead of being accessed sequentially like in memory tapes, where the desired cell is found by analysing the cells one by one. The 'random' term could be misleading because there are no random things in the mechanisms of memory management.
The main features of all memories, including RAM, are **storage capacity** and **access time**. **The former** is the amount of data that can be stored, while **the latter** is the read/write speed of data in the memory itself.
The storage capacity unit of measurement is the **byte,** which corresponds to the amount of memory needed to store an alphanumeric character as well as the size of a single cell.

In modern computers, especially when referring to RAM or storage devices (hard disk, CD and DVD), the capacity is expressed in multiples of bytes: kilobytes, megabytes, gigabytes and terabytes. A **kilobyte** equals 1,024 bytes (2 to the power of 10), a **megabyte** equals 1,024 kilobytes, a **gigabyte** equals 1,024 megabytes, and a **terabyte** equals 1,024 gigabytes. To have a reasonably accurate idea of size, we can replace the factor 1,024 with 1,000, which **allows** an easier calculation. We can therefore say that a kilobyte is approximately 1,000 bytes, a megabyte is approximately one million bytes, one gigabyte is about one billion bytes, and so on.
The access time is the time span that goes from the moment when a memory device (RAM or mass memory) receives the request from the CPU to read or write data in a particular cell, to the time when the data is actually read or written. Since the writing operation is usually more expensive in terms of time, the access time is related to writing.
The access time is measured in **submultiples** of a second and is generally expressed in nanoseconds (billionths of a second) for electronic types of memories like RAM, and in milliseconds (thousandths of a second) for mass storage devices such as hard disk devices, which are way slower because of the necessity to move mechanical parts to terminate their operation.



GLOSSARY

store (v.): immagazzinare
hold (v.): tenere, contenere
cell: cella
thus: in modo da, così
the former... the latter: il primo/i primi... il secondo/i secondi
allow (v.): permettere, consentire
submultiple: sottomultiplo

VOCABULARY – PAIR WORK

1. Read the passage and with a classmate look for the definitions of the following terms.

1. RAM
2. Working memory
3. Milliseconds
4. Address
5. Storage capacity
6. Memory
7. Gigabyte

READING COMPREHENSION

2. Read the passage and decide if the following sentences are true (T) or false (F). Correct the false ones.

	T	F
1. 'RAM' is not available as integrated circuits.	☐	☐
2. Access time is measured in multiples of bytes.	☐	☐
3. RAM is a typical feature of modern computers.	☐	☐
4. Terabytes are multiples of bytes.	☐	☐
5. Access time, as well as storage capacity, is available only in specific types of computer memory.	☐	☐
6. Hard disk devices are slow because they lack memory.	☐	☐
7. 1,024 kilobytes make a megabyte.	☐	☐

READING COMPREHENSION

3. Reorder the multiples of bytes, starting with the smallest one.

[.....] Gigabyte [.....] Kilobyte [.....] Terabyte [.....] Megabyte

6 Bits and Codes

We have seen that a byte is the unit of data storage capacity for the memory, and corresponds to the space needed to store an alphanumeric character. **Despite** its reduced capacity, the byte is not the smallest information unit that can be memorised in a computer – the **bit** is. The meaning of the word 'bit' also comes from the words **binary digit**, a number that can assume two values only: **0** and **1**. Other information, such as true or false, or yes or no, can be associated with these **values**.

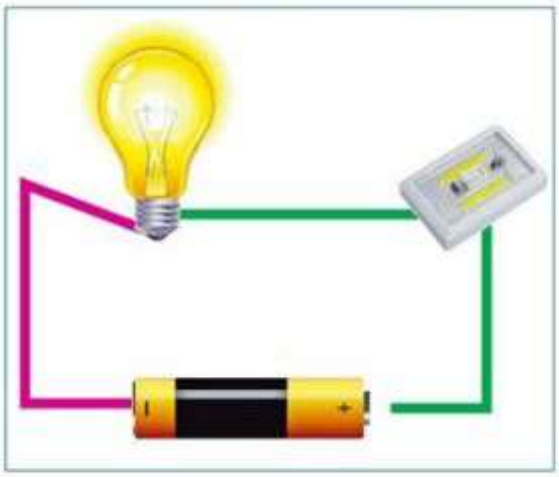
It is possible to represent (encode) any number or any generic information by using a set of bits in a binary system. For instance, if we want to represent the traffic light state, we can associate 11 with green, 00 with red, 01 with amber and 10 with **blinking** amber. As the example shows, the higher the amount of information to represent is, the higher the amount of bits to associate with each information (to have a string of zeroes and a bit that identifies each piece of information in a unique way) is going to be. We can say that a byte is a string of 8 bits since we need 8 bits to represent any of the standard alphanumeric **keyboard** characters.

We can ask ourselves why computer memory is represented as sets of binary digits such as 0 and 1. Well, the answer is quite simple: 0 and 1 are values that can be easily generated, memorised, processed and transmitted by electronic circuits. Let's analyse this picture to clarify the above statement: a lamp will turn on as we turn its **switch** on, and will turn off as we turn its switch off. Both switch states can be represented with values like 0 when the switch is on and 1 when it's off.

Indeed, a computer can be seen as a gigantic matrix of switches operated by appropriate electrical signals rather than by our manual intervention. The first electronic computers had these switches made with **vacuum tubes**.

GLOSSARY

despite: nonostante
digit: cifra
value: valore
blinking: lampeggiante
keyboard: tastiera
switch: interruttore



modern computers use **transistors**, located directly **inside** as integrated circuits. We might ask ourselves 'What is a bit?'. Well, we could say that it is a transistor with infinitesimal dimensions within a memory chip or a CPU. The invention of the transistor, as we know it today, was made by William Shockley, who designed it in 1948 and received a Nobel Prize for Physics in 1956 along with colleagues Walter Brattain and John Bardeen. A drastic reduction in the size of electronic equipment, which is one of the main obstacles to the development of increasingly complex and powerful computers, was made possible with the use of transistors **instead of** vacuum tubes.

GLOSSARY
inside: all'interno
instead of: in luogo di, invece di

VOCABULARY

1. Match the pictures with the words in the box.

string • CPU • vacuum tubes • matrix • transistor • electronic circuit

1. .....

2. .....

3. .....

4. .....

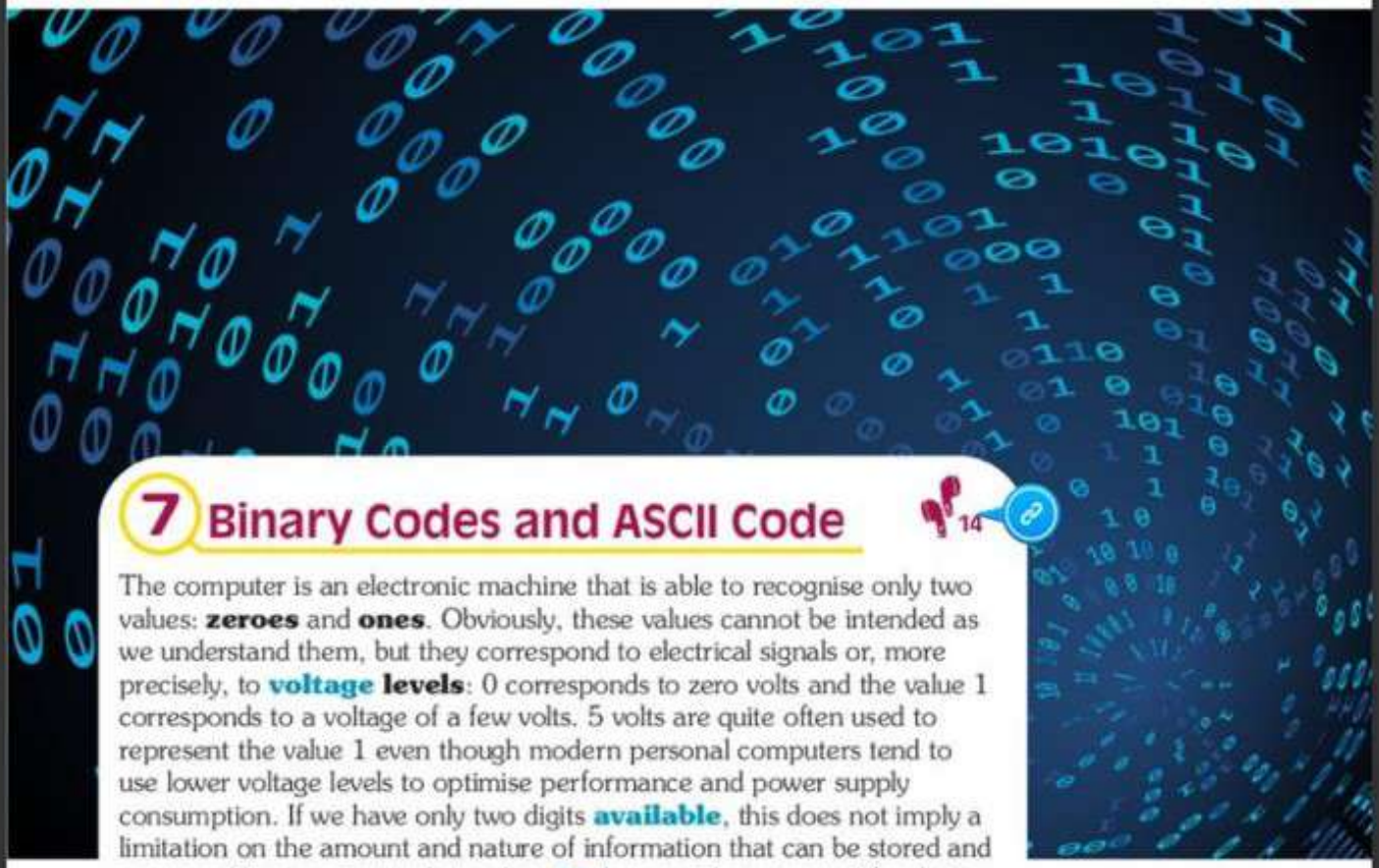
5. .....

6. .....

READING COMPREHENSION – PAIR WORK

2. After reading the passage, answer the following questions with a classmate.

1. What is a byte?
2. Is the byte the smallest information unit that can be memorised in a computer?
3. What does 'bit' stand for?
4. How many values can a binary digit have?
5. Why is using a set of bits in a binary system important?
6. Why is a byte said to be a string of 8 bits?
7. To what extent do the components of the first electronic computers and the modern ones differ?
8. Why was William Shockley awarded the Nobel Prize for Physics in 1956?



7 Binary Codes and ASCII Code

The computer is an electronic machine that is able to recognise only two values: **zeroes** and **ones**. Obviously, these values cannot be intended as we understand them, but they correspond to electrical signals or, more precisely, to **voltage levels**: 0 corresponds to zero volts and the value 1 corresponds to a voltage of a few volts. 5 volts are quite often used to represent the value 1 even though modern personal computers tend to use lower voltage levels to optimise performance and power supply consumption. If we have only two digits **available**, this does not imply a limitation on the amount and nature of information that can be stored and processed by a computer, but only a **tie** that must be respected for their representation, or their encoding.
Thanks to techniques like floating point representation, we can display either large or small numbers without using long and difficult sequences of 0s and 1s.
When the information to represent is not a numeric value, then we should associate to each piece of information a sequence (**binary string**) of zeros and ones in such a way as to make each element identified by distinguishing it from others. This is called '**encoding**'. The more information there is to be encoded, the longer the binary strings will be. To clarify the concept of encoding, let's assume we have to represent the four compass points. We can associate North with 00, South with 01, East with 10 and West with 11. But even if we had to represent the intermediate points NE, SE, NW and SW we would not have any available long string combinations of zeros and ones formed by at least three digits or three bits. In this way we can associate a binary string with any distinct information and get, for example, 000 for North, 001 for South, 010 for East, 011 for West, 100 for North East, 101 for South East, 110 for North West and finally 111 for South West. Encoding can also be done by using more binary digits than what is strictly necessary, and so by referring to the previous example we could have to select strings of four or more bits using only a portion of possible distinct combinations **arising from** them. In this case, the encoding is defined as **redundant** and is mainly used in telecommunications for the recognition and automatic error correction in data transmission.

GLOSSARY

voltage: tensione elettrica
available: disponibile, a disposizione
tie: vincolo
encoding: codifica
arise from (v.): verificarsi, avere origine da
redundant: ridondante

Data encryption requires the producers of digital electronic systems to adopt some specific rules. For example, a manufacturer of keyboards cannot adopt a coding of its own choice as we did for the cardinal points, but must respect a standard which is known as **ASCII code**. This encoding guarantees that by connecting the keyboard produced by company X to the computer produced by company Y, when we press 'A' the computer will recognise the code sent by the keyboard as the character 'A'. ASCII stands for American Standard Code for Information Interchange and is the standard for the exchange of information. It provides the basis to associate a string of eight binary digits, or a byte to every character, and then **justifying** what we have previously said: one byte corresponds to the memory space required to contain an **alphanumeric** character.

GLOSSARY
justify (v.): spiegare, giustificare
alphanumeric: alfanumerico

VOCABULARY

1. **Use a monolingual dictionary and orally explain the following words taken from the passage above. Do you understand them all?**

- Sequence
- Binary string
- To encode
- Redundant
- Encryption
- To require
- Abbreviation
- Alphanumeric

Meet a Very Special Computer – HAL 9000

Hal 9000 is a peculiar computer indeed. It is one of the main characters – in a way, the protagonist – of Stanley Kubrick's film *2001: A Space Odyssey*. As the title suggests, the story takes place on the Discovery One spaceship which is controlled and maintained by the high-tech computer Hal 9000. *2001: A Space Odyssey* was filmed and released in 1968, and being a science fiction movie, the computer was given features that made it very different from real computer machines of that time.

Hal 9000 can:

- speak;
- recognise faces and people;
- read lips;
- play chess;
- express and infer emotions.

PET Writing – Part 3

2. **Read the following quotation and write a short text to comment it and express your point of view. Write your answer in about 100 words.**

'I do not fear computers. I fear the lack of them.' (Isaac Asimov)

.....

.....

.....

.....

.....