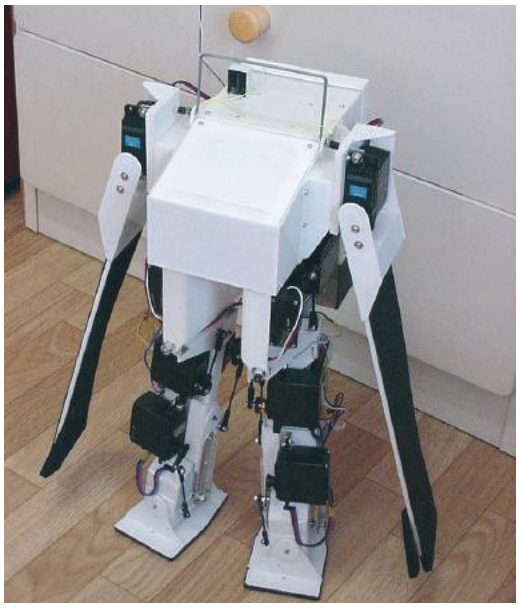
ROBOTICS

In this Unit we will talk about a new branch of Computer Science, Robotics, and you will read about robots, their characteristics, uses and possible future developments.

A. WHAT IS A ROBOT?

1 *Go through the four paragraphs and label them choosing from the list below.*

Par. 1:	☐	**a.** Real and fictional robots
Par. 2:	☐	**b.** Future developments
Par. 3:	☐	**c.** A new branch of computer science
Par. 4:	☐	**d.** Origins and meaning of the term robot



Par. 1 – An area of computer science that has found wide practical use is **robotics**, the design and development of computer controlled mechanical devices that are programmed to move, manipulate objects and interact with the environment.

Par. 2 – The term **robot** comes from the Czech word ***robota***, generally translated as "forced labour". This definition describes the majority of robots fairly well. Most robots in the world are designed for heavy, repetitive manufacturing work. They handle tasks that are difficult, dangerous or boring to human beings. Robots are also employed where requirements of speed, precision, cleanliness exceed what humans can accomplish.

Par. 3 – The robots of the movies, such as C-3PO and the Terminator, are portrayed as fantastic, intelligent, even dangerous forms of artificial life. However, robots of today are not exactly the walking, talking intelligent machines of movies, stories and our dreams. Today, we find most robots working for people in factories, warehouses, and laboratories in the form of robotic arms.

Par. 4 – In the future, robots may show up in other places: our schools, our homes, even our bodies. Robots have the potential to change economy, health conditions and life standards. As the technology progresses, we are finding new ways to use robots. Each new use brings new hopes and possibilities, but also potential dangers and risks.

Answer the following questions.

a. What does the word robot make you think about?
- ☐ a film
- ☐ a novel
- ☐ a dream
- ☐ a video-game

b. Do you or does anyone you know have a robotic co-worker?

c. Would you like to have a robot able to help you do your homework?

2 *Find the correct matchings.*

1. Robots	☐	**a.**	will find their way in schools, hospitals and houses.
2. The robots of the movies	☐	**b.**	advantages but also risks.
3. New uses of robots will have	☐	**c.**	they are fast, precise and reliable.
4. In the future robots	☐	**d.**	are designed for heavy and repetitive works.
5. Robots are used because	☐	**e.**	is mostly used in factories.
6. The robotic arm	☐	**f.**	are intelligent forms of artificial life.

3 *The class is divided into groups of four. Each student in the group will report one of the topics of the text.*

4 *There are five mistakes in the following passage. Find and correct them. Then listen to the recording and check your answers.*

Some history

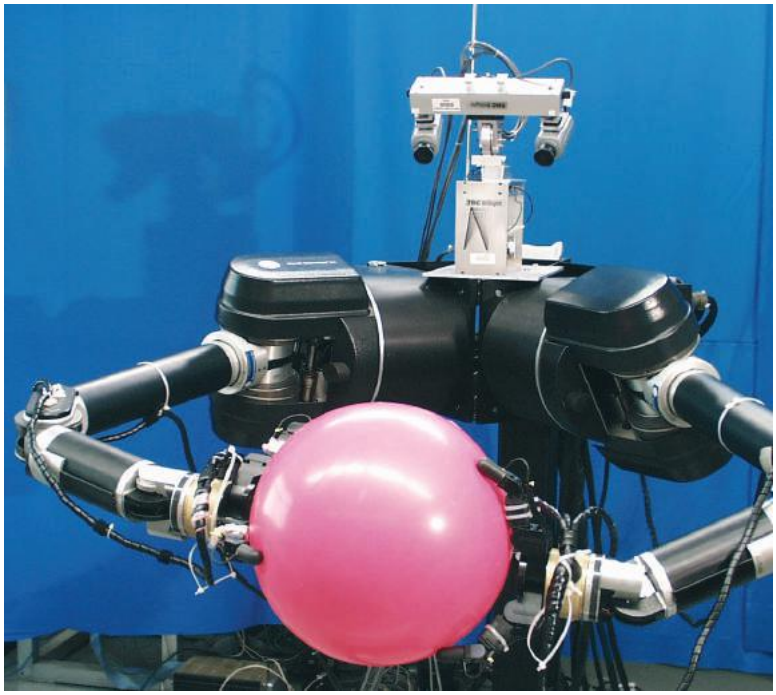
The Czech playwright Karel Čapek originated the term *robot* in his 1920 play "R.U.R." In the tragedy, machine clerks overthrow their human creators when a scientist gives them food. Dozens of authors and filmmakers have revisited this scenario over the years.
Isaac Asimov took a more optimistic view in several poems and short stories. In his works, robots are benign, helpful beings that adhere to a code of non-violence against animals, the "Laws of robotics".

a. ..... instead of .....
b. ..... instead of .....
c. ..... instead of .....
d. ..... instead of .....
e. ..... instead of .....

GLOSSARY

cleanliness: pulizia
fairly: abbastanza
to portray: rappresentare
warehouse: magazzino

B. WHAT A ROBOT LOOKS LIKE



A robot is a machine that can be programmed to perform a variety of jobs, which usually involve moving or handling objects. Robots can range from simple machines to highly complex, computer-controlled devices. Almost all robots have a movable body, some have motorised wheels, and others have dozens of movable segments connected by **joints**. A robot usually needs five parts: **controller**, **drive**, **arm**, **end-effector**, **sensor**.

Controller – Every robot is connected to a computer, known as the controller, which makes the different parts work together. The controller also allows the robot to be networked to other systems, so that it may work with other machines or robots. Most of today's robots have controllers that are run by programs and are entirely pre-programmed by people. In the future, controllers with artificial intelligence could allow robots to think on their own, even program themselves.

Drive – The drive is the "engine" that drives the links, the sections between the joints, into their desired position. Without a drive, a robot could not move. Most drives are powered by air, water pressure, or electricity.

Arm – Robot arms come in all shapes and sizes. The arm is the part of the robot that positions the end-effector and sensors to do their pre-programmed business. Many, but not all, resemble human arms. Each joint gives the robot a degree of freedom. So, a simple robot arm with three degrees of freedom could move in three ways: up and down, left and right, forward and backward. Most working robots today have six degrees of freedom. As a result, they are designed to move in at least six ways (a human arm, in comparison, has 7 degrees of freedom).

End-effector – The end-effector is the "hand" connected to the robot's arm. It could be a tool such as a drill, pliers, tweezers, spray painter or blowtorch. Some robots can change or have more than one end-effector and be reprogrammed for different tasks.

Sensor – The sensors send the robot information in the form of electronic signals about its surroundings and let it know the exact position of the arm, or the state of the world around it.

5 *Refer back to the text and say if the following statements are true (T) or false (F). Correct the false ones.*

		T	F
a.	A robot is generally made up of four parts.	☐	☐
b.	The controller allows the robot to be connected to other devices.	☐	☐
c.	Robotic arms look like human arms.	☐	☐
d.	A simple robot has six degrees of freedom.	☐	☐
e.	A robot has the same degrees of freedom as a human arm.	☐	☐
f.	The drive is the engine that moves the different segments of the robot.	☐	☐
g.	Robots can only have one end-effector.	☐	☐
h.	Sensors send information to the robot's controller in form of electric signals.	☐	☐

6 *Pair Work. Refer back to the text and in turns ask and answer the following questions.*

a. What is a robot? .....

b. What are the joints used for? .....

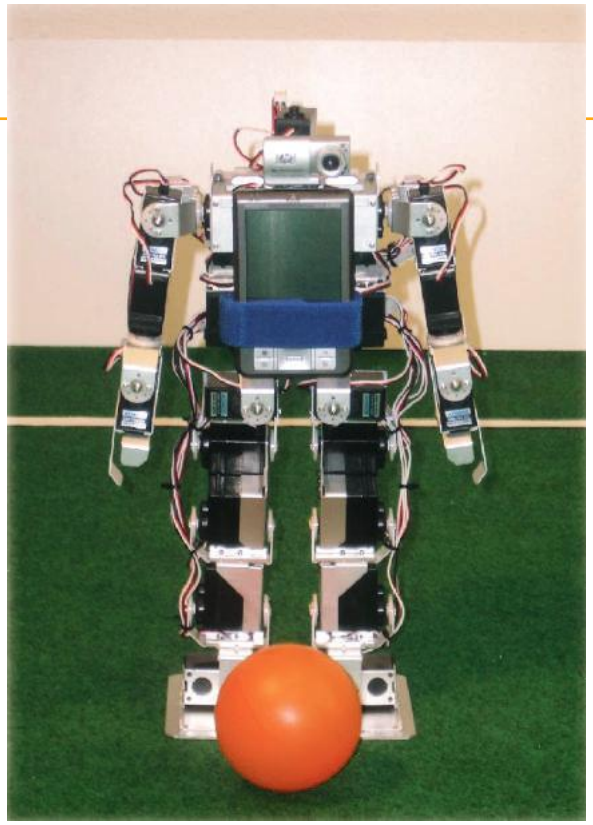
c. What is the controller? .....

d. What is the arm? .....

e. Where are the different tools located? .....

f. What do the sensors do? .....

7 *Write down the answers and join them into a summary of the reading passage.*



GLOSSARY

blowtorch: cannello saldatore
degree: grado
drill: trapano
end-effector: estremità interattiva
joint: giunto, articolazione
to network: collegare in rete
pliers: pinze
to run: gestire, far funzionare
tool: attrezzo
tweezers: pinzette

MOVING DEEPER

Asimov's Laws of Robotics

In 1950 **Isaac Asimov** proposed his three "Laws of Robotics":

1) *A robot may not injure a human being or, through inaction, allow a human being to come to harm.*
2) *A robot must obey the orders given it by human beings except where such orders would conflict the First Law.*
3) *A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.*

Asimov developed the Three Laws because he was tired of the science-fiction stories of the 1920s and 1930s in which robots, like Frankenstein's creation, turned on their creators and became dangerous monsters. The positronic brains of Asimov's robots were designed around the Three Laws, so that it was impossible for the robots to function without them. The Laws were introduced in his 1942 story "Runaround". Asimow later felt that the initial laws were insufficient to protect society in general, and in 1985 in Robots and Empire he created a prequel "Zeroth" Law, to which the others were subordinate:

0) *A robot may not injure humanity or, through inaction, allow humanity to come to harm.*

GLOSSARY

to come to harm: trovarsi in situazioni pericolose

positronic: positronico, basato su particelle di carica positiva

C. WHY A ROBOT?

8 *This is a text dealing with "robot applications". Try to complete it with the correct words taken from the ones below.*

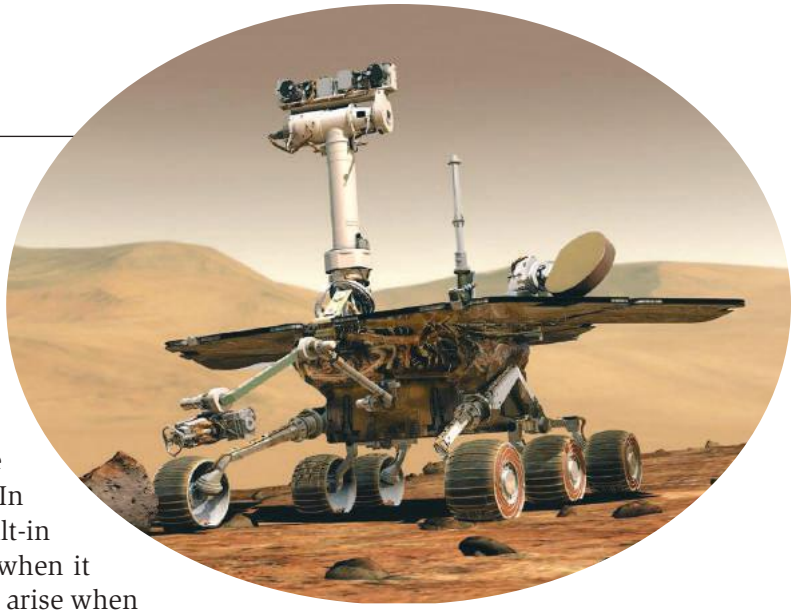
business – assembly – computer – repetitive – operations – tasks – blood – precise
efficiently – nuclear – competition – factories – applications

Most robot applications are for (1) ..... that are either dangerous or unpleasant for human beings. 90% of all robots used today are found in (2) ..... . These kinds of robots are referred to as **industrial robots**. Robots are useful in industry for a variety of reasons. In today's economy, a (3)..... needs to be efficient to keep up with the (4) ..... Installing robots is often a way business owners can be more competitive, because robots can do things more (5)..... than people. Besides, robots never get sick or need to rest, so they can work 24 hours a day, 7 days a week.
Most industrial robots work in auto (6)..... lines, putting cars together. Robots can do a lot of this work because they are very (7)..... : they always drill exactly in the same place, and they always tighten bolts with the same amount of force, no matter how many hours they have been working.
Manufacturing robots are also very important in the (8)..... industry where they mount microchips on circuit boards. In medical laboratories, robots handle potentially hazardous materials, such as (9)..... or urine samples and very high-precision robots can assist surgeons with delicate operations. In other cases, robots are used in (10)..... ..... , monotonous tasks in which human performance might degrade over time. Robots can perform these repetitive, high-precision (11)..... without fatigue and stopping.
Activities in environments that pose great danger to humans, such as locating sunken ships, cleanup of (12) ..... waste, prospecting for underwater mineral deposits, and active volcano exploration, are ideally suited to robots. Recent (13)..... ..... have seen robots exploring distant planets and new uses will be found in the future.

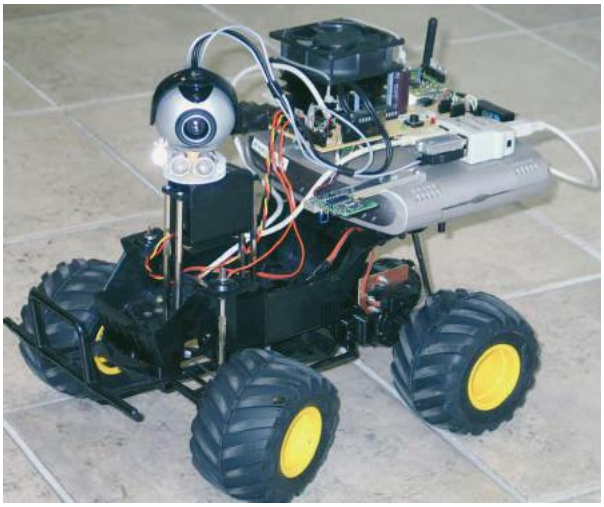
GLOSSARY

to get sick: ammalarsi
to keep up with: stare al passo con
sample: campione
sunken: affondato

D. MOBILE ROBOTS



Robotic arms are relatively easy to build and program because they only operate within a confined area. More difficult is to create a robot able to move around.
The first obstacle is to give the robot a working locomotion system. Wheels and tracks are the best solution if the robot has to move over smooth ground. In addition most mobile robots have a built-in **balance system** that tells the computer when it needs to correct its movements. Problems arise when designers build legged robots. Bipedal locomotion (walking on two legs) is rather unstable and difficult to implement in robots. To create more stable robot walkers, designers commonly look at the animal world, specifically insects. Six-legged insects have exceptionally good balance, and they adapt well to a wide variety of soil.



Most mobile robots have a remote control which can communicate with the robot through an attached wire, or using radio or infrared signals. Remote robots, often called **puppet robots**, are useful for exploring dangerous or inaccessible environments.
More advanced robots are the **autonomous robots** that can act on their own, independent of any controller. The basic idea is to program the robot to respond a certain way to outside stimuli. The very simple **bump-and-go robot**, for example, is a robot which has a **bumper sensor** to detect obstacles. When you turn the robot on, it zips along in a straight line. When it hits an obstacle, the bumper sensor tells it to back up, turn to the right and move forward again. In this way, the robot changes direction any time it encounters an obstacle.

Mobile robots use infrared or ultrasound sensors to see obstacles. The robot sends out a sound signal or a beam of infrared light and detects the signal's reflection. The robot locates the distance to obstacles based on how long it takes the signal to bounce back.
Last generation robots use **stereo vision** to see the world around them. Two cameras give these robots depth perception, and image-recognition software gives them the ability to locate and classify various objects. Robots might also use

microphones and smell sensors to analyse the world around them. This sort of system is very useful for exploratory robots that operate on other planets.
Technology is still developing and robots are becoming more and more complex and able to carry out complex operations and make decisions. Perhaps the most dramatic changes in future robots will arise from the development of artificial intelligence which is moving rapidly from university laboratories to practical applications in industry with the creation of machines able to perform cognitive tasks, such as strategic planning and learning from experience.

9 *Refer to the text and match the following words to the correct definitions.*

1.	balance system	☐	**a.** More advanced robots that don't depend on a controller.
2.	puppet robot	☐	**b.** Walking on two legs.
3.	autonomous robot	☐	**c.** Robot with a sensor to detect obstacles.
4.	bipedal locomotion	☐	**d.** cameras and software which give the robot depth perception and ability to locate objects.
5.	bumper-and-go robot	☐	**e.** Device which tells the computer when to correct its movement.
6.	stereo vision	☐	**f.** Device which is used to communicate with a robot.
7.	remote control	☐	**g.** Robot with a remote control.

10 *Look back at the text and answer the following questions.*

a. Why is it difficult to create a robot able to move around?
b. How is it possible to create more stable robots?
c. How does a bump-and-go robot work?
d. What are the characteristics of mobile robots?
e. What are the last generation robots equipped with?
f. What will bring about new developments in robotics?

11 *Work with a partner. Look at these statements. Say if each sentence is true or false and correct the false ones. Exchange roles.*

a. Robotics is a very recent branch of computer science.
b. Robots are very useful and common in industry.
c. Robots in movies are very similar to the real ones.
d. The robotic arm is similar to a human arm.
e. It's very easy to make a robot walk.
f. There are different types of robots.

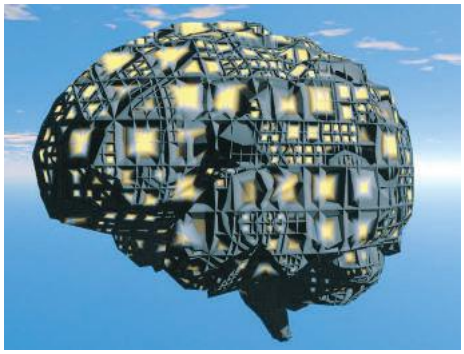
GLOSSARY

to bounce back: rimbalzare indietro **track**: binario

E. ARTIFICIAL INTELLIGENCE

12 *Label the paragraphs choosing from the list below.*

Par. 1:	☐	**a.** Schools of thought
Par. 2:	☐	**b.** Present and future developments
Par. 3:	☐	**c.** Definition of AI
Par. 4:	☐	**d.** Recent developments
Par. 5:	☐	**e.** Robot's intelligence test
Par. 6:	☐	**f.** The aim of science

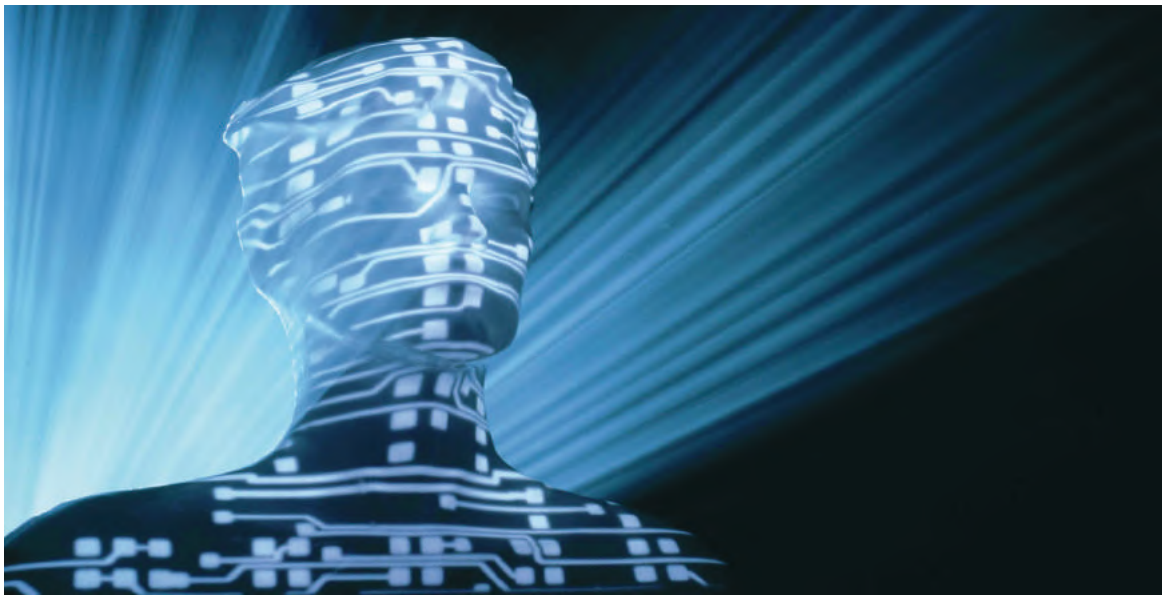


Par. 1 – Artificial intelligence, or AI for short, is one of the most exciting areas of robotics. AI is a combination of computer science, physiology, and philosophy. It is a broad topic, consisting of different fields with a common denominator: the creation of machines that can "think".

Par. 2 – Within this fascinating area there are three main schools: trying to model what humans do, trying to do what people do but easier and better, and trying to build new tools with "fantastic" capabilities.

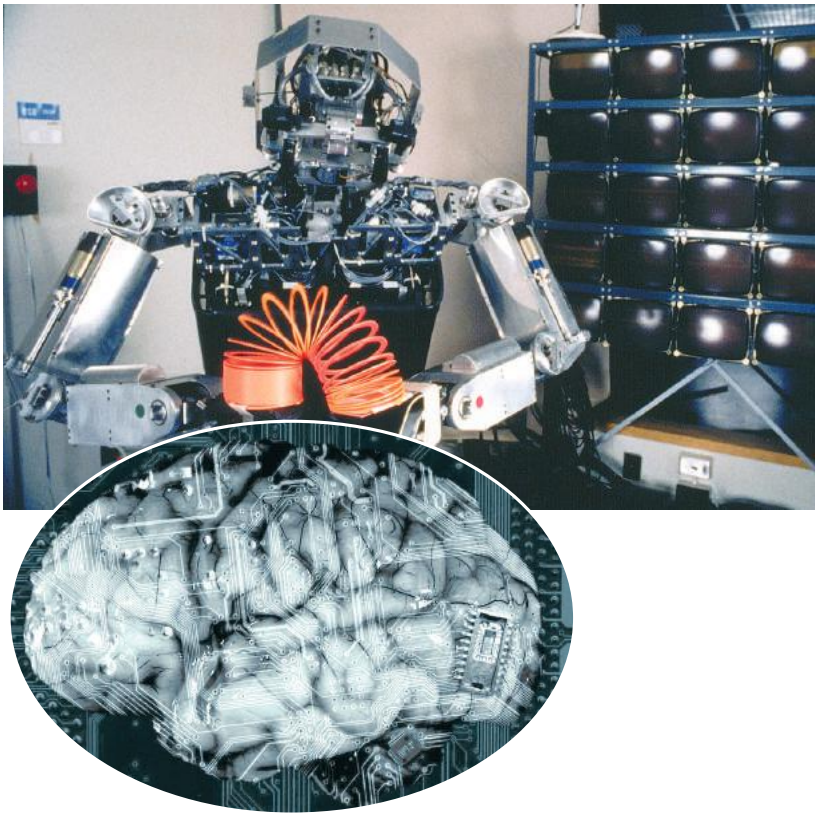
Par. 3 – The three schools all agree on one point: trying to build machines that model what humans do. So AI researchers try to enable computers and machines to mimic human intelligence and sensory processing abilities, and model human behaviour with computers to improve our understanding of intelligence.

Par. 4 – Perhaps the best way to measure the intelligence of a machine is the test of the British computer scientist Alan Turing (*Computing Machinery and Intelligence*, 1950). He stated that a computer would deserve to be called intelligent if it could deceive a human into believing that it was human.



Par. 5 – Over the last decades the number of AI researchers has grown from a dozen to thousands of engineers and specialists; and from programs capable of playing chess to systems designed to diagnose disease. Advanced-level computer languages, as well as computer interfaces and word-processors owe their existence to the research into artificial intelligence.

Par. 6 – Nowadays the many branches of AI research include machine learning, inference, cognition, knowledge representation, problem solving, case-based reasoning, natural language understanding, speech recognition, computer vision, and artificial neural networks. The advancements in the quest for artificial intelligence have affected, and will continue to affect our jobs, education, and lives.



13 *Find in the text the equivalents of the following Italian words and expressions.*

a. uniformarsi: .....
b. di gran lunga maggiori: .....
c. imitare: .....
d. diagnosticare: .....
e. malattia: .....
f. essere in debito di: .....

14 *Complete the following sentences.*

a. AI is a branch of science whose aim is ..... .
b. The three schools within this science agree on one point: ..... .
c. Alan Turing stated that a computer would deserve to be called intelligent if ..... .
d. Advanced-level computer languages owe their existence to ..... .
e. The number of AI researchers has grown from ..... .
f. The many branches of AI research include ..... .

GLOSSARY

broad: ampio
chess: scacchi
to deceive someone into believing: far credere a qualcuno
to deserve: meritarsi
quest for: ricerca di