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ENGLISH FOR ROBOTICS

Навчальний посібник з англійської мови для студентів освітньої програми «Автоматика та робототехніка»

Рекомендовано Вченою радою НУК

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У посібнику наведено вправи та оригінальні тексти за професійною тематикою, спрямовані на формування і розвиток у студентів освітньої програми «Автоматика та робототехніка» навичок усного та писемного мовлення, читання наукової та довідникової літератури за фахом, презентації результатів наукових досліджень на міжнародних конференціях, ведення наукових дискусій англійською мовою.

Навчальний посібник розроблений як основний курс дисципліни «Іноземна мова» (за професійним спрямуванням, англійська) і призначений для студентів 1–2 курсів освітньої програми «Автоматика та робототехніка».

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Unit 1. ROBOTS AND ROBOTICS

Ex.1.1. Read the text and answer the questions below.

Robotics

Robotics is the interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots as well as computer systems for their control, sensory feedback, and information processing. These technologies are used to develop machines that can substitute for humans. Robots can be used in any situation and for any purpose, but today many are used in dangerous environments (including bomb detection and deactivation), manufacturing processes, or where humans cannot survive. Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, and basically anything a human can do. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

The concept of creating machines that can operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century. Throughout history it has been frequently assumed that robots will one day be able to mimic human behavior and manage tasks in a human-like fashion.

Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. Many robots are built to do jobs that are hazardous to people such as defusing bombs, finding survivors in unstable ruins, and exploring mines and shipwrecks. Robotics is also used in STEM (Science, Technology, Engineering, and Mathematics) as a teaching aid.

The advent of nanorobots, microscopic robots that can be injected into the human body, could revolutionize medicine and human health.

Robotics is a branch of engineering that involves the conception, design, manufacture, and operation of robots. This field overlaps with electronics, computer science, artificial intelligence, mechatronics, nanotechnology and bioengineering.

1. What is robotics?
2. What does robotics deal with?
3. Where are robots usually used?
4. In what ways can robots replicate humans?
5. When did the concept of robots appear?
6. When did people start creating robots?
7. What are the examples of using robots?
8. What fields does robotics overlap with?

Ex.1.2. Match the terms with their meanings.

1) design	a) how the robot works
2) construction	b) when and how the robot can be used
3) operation	c) planning a robot
4) use of robots	d) making the robot

Ex.1.3. Match the verbs from the text with their definitions.

1)	substitute for	a)	to look like or be like someone or something
2)	survive	b)	to put something into a person's body
3)	resemble	c)	to make someone feel that they want to do something and can do it
4)	replicate	d)	to accept something to be true without question or proof
5)	inspire	e)	to have existed for a particular length of time
6)	date back	f)	to cover part of the same area
7)	assume	g)	to use something or someone instead of another thing or person
8)	inject	h)	to make or do something again in exactly the same way
9)	revolutionize	i)	to continue to live or exist, especially after coming close to dying or being destroyed or after being in a difficult or threatening situation
10)	overlap	j)	to completely change something so that it is much better

Ex.1.4. Complete the sentences with the following word combinations.

human behavior *deals with* *in appearance* *contributing to* *a rapidly growing* *field* *substitute for humans*

1) Robotics … the design, construction, operation, and use of robots as well as computer systems for their control, sensory feedback, and information processing.

2) These technologies are used to develop machines that can … .

3) Robots can take on any form but some are made to resemble humans … .

4) Many of today's robots are inspired by nature, … the field of bio-inspired robotics.

5) Throughout history, it has been frequently assumed that robots will one day be able to mimic … and manage tasks in a human-like fashion.

6) Today, robotics is …, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily.

Ex.1.5. Match the sciences and their branches with their fields of research.

1) mechanical engineering	a) comprises the physics, engineering, technology and applications that deal with the emission, flow and control of electrons in vacuum and matter
2) electrical engineering	b) manipulation of matter on an atomic, molecular, and supramolecular scale
3) computer science	c) a technical discipline concerned with the study, design and application of equipment, devices and systems which use electricity, electronics, and electromagnetism

4)	electronics	d)	the discipline that applies engineering physics, engineering mathematics, and materials science principles to design, analyze, manufacture, and maintain mechanical systems
5)	mechatronics	f)	the application of principles of biology and the tools of engineering to create usable, tangible, economically viable products
6)	nanotechnology	g)	the study of processes that interact with data and that can be represented as data in the form of programs
7)	bioengineering	h)	a multidisciplinary branch of engineering that focuses on the engineering of both electrical and mechanical systems

Ex.1.6. Explain the meaning of the following words and word combinations. Consult a dictionary if necessary.

Interdisciplinary, sensory feedback, bio-inspired robotics, inspired by nature, frequently assumed, domestically, hazardous to people, teaching aid.

Ex.1.7. Complete the text with the words from the box.

Etymology of the Word "Robotics"

devices	*concept*	*published*	*artificial*	*robots*
introduced		*science fiction*	*androids*	

The word *robotics* was derived from the word *robot*, which was 1) … to the public by Czech writer Karel Čapek in his play *R.U.R. (Rossum's Universal Robots)*, which was 2)… in 1920. The word *robot* comes from the Slavic word *robota*, which means *labour/work*. The play begins in a factory that makes 3)… people called *robots*, creatures that can be mistaken for humans – very similar to the modern ideas of 4)… . Karel Čapek himself did not coin the word. He wrote a short letter in reference to an etymology in the *Oxford English Dictionary* in which he named his brother Josef Čapek as its actual originator.

According to the *Oxford English Dictionary*, the word *robotics* was first used in print by Isaac Asimov, in his 5)… short story *"Liar!"*, published in May 1941 in *Astounding Science Fiction*. Asimov was unaware that he was coining the term; since the science and technology of electrical 6)… is *electronics*, he assumed *robotics* already referred to the science and technology of 7)… . In some of Asimov's other works, he states that the first use of the word *robotics* was in his short story *Runaround* (Astounding Science Fiction, March 1942), where he introduced his 8)… of The Three Laws of Robotics. However, the original publication of "Liar!" predates that of "Runaround" by ten months, so the former is generally cited as the word's origin.

Ex.1.8. Read the text and choose appropriate heading (1–7) to each paragraph. You don't need two of them.

1) From entertainment to practical use
2) Future of robots
3) First robots
4) Variety of robots
5) What is a robot?
6) User-friendly robots
7) Applications of robots

Robots

A_____

A robot is a machine – especially one programmable by a computer – capable of carrying out a complex series of actions automatically. Robots can be guided by an external control device or the control may be embedded within. Robots may be constructed on the lines of human form, but most robots are machines designed to perform a task with no regard to their aesthetics.

B_____

Robots can be autonomous or semi-autonomous and range from humanoids such as Honda's *Advanced Step in Innovative Mobility* (ASIMO) and TOSY's *TOSY Ping Pong Playing Robot* (TOPIO) to industrial robots, medical operating robots, patient assist robots, dog therapy robots, collectively programmed *swarm* robots, UAV drones such as General Atomics MQ-1 Predator, and even microscopic nanorobots. By mimicking a lifelike appearance or automating movements, a robot may convey a sense of intelligence or thought of its own. Autonomous things are expected to proliferate in the coming decade, with home robotics and the autonomous car as some of the main drivers.

C_____

From the time of ancient civilization (2000 BC) there have been many accounts of user-configurable automated devices and even automata resembling animals and humans, designed primarily as entertainment. As mechanical techniques developed through the Industrial age (18^{th}–19^{th} centuries), there appeared more practical applications such as automated machines, remote-control and wireless remote-control.

D_____

The first electronic autonomous robots were created by William Grey Walter in Bristol, England in 1948. In the late 1940s John T. Parsons and Frank L. Stulen invented

Computer Numerical Control (CNC) machine. The first commercial, digital and programmable robot was built by George Devol in 1954 and was named the Unimate. It was sold to General Motors in 1961 where it was used to lift pieces of hot metal from die casting machines at the Inland Fisher Guide Plant in the West Trenton section of Ewing Township, New Jersey.

E_____

Robots have replaced humans in performing repetitive and dangerous tasks which humans prefer not to do, or are unable to do because of size limitations, or which take place in extreme environments such as outer space or the bottom of the sea. There are concerns about the increasing use of robots and their role in society. Robots are blamed for rising technological unemployment as they replace workers in increasing numbers of functions. The use of robots in military combat raises ethical concerns. The possibilities of robot autonomy and potential repercussions have been addressed in fiction and may be a realistic concern in the future.

1. What is robot?
2. What are the two types of robot control?
3. Why do robots have different forms?
4. Do robots need human support?
5. What was the name of the first commercial, digital and programmable robot?
6. When was it made?
7. What kinds of tasks do robots do?
8. Where are robots used?

Ex.1.9. Decide whether the statements are true or false according to the text above.

1. Robots can carry out a complex series of actions automatically.

2. There are two types of robots control: external and internal.

3. Most robots resemble humans in their shape.

4. A robot may convey a sense of intelligence or thought of its own.

5. Home robotics and the autonomous car were expected to be very popular in the last decade.

6. Since the ancient times automated devices have had serious practical applications.

7. The first electronic autonomous robots were created in the middle of the 19th century.

8. The first commercial, digital and programmable robot was used in the USA.

9. Robots have replaced humans in performing repetitive tasks because the tasks are dangerous.

10. People are concerned about the role of robots in the society.

Ex.1.10. Match the sentences' halves.

1)	Robot is a programmable machine which …	a)	…or semi-autonomous (they need human support to operate).
2)	Robot control can be …	b)	…(they repeat the same action over and over again) and dangerous tasks.
3)	Robots have different …	c)	…can do tasks automatically.
4)	Robots can be autonomous (they don't need help to operate) …	d)	…dangerous environments (including bomb detection and deactivation), manufacturing processes, or where humans cannot survive or reach.

5)	The first commercial, digital and …	e)	…external (outside the robot) and internal (inside the robot).
6)	Robots do repetitive …	f)	…forms due to their tasks.
7)	Robots are used in extreme environments (outer space, the bottom of the sea), …	g)	programmable robot Unimate was built in 1954.

Ex.1.11. Match the verbs from the text with their definitions.

1)	programmable	a)	independent and having the power to make its own decisions
2)	carry out	b)	partially independent and having the power to make its own decisions
3)	aesthetics	c)	able to be programmed
4)	autonomous	d)	to increase a lot and suddenly in number
5)	semi-autonomous	e)	involving doing or saying the same thing several times
6)	proliferate	f)	the effect that an action, event, or decision has on something
7)	remote control	g)	to do or complete something
8)	repetitive	h)	using a system of radio signals rather than wires to connect computers, mobile phones, etc. to each other

9)	repercussion	i)	a system for controlling something such as a machine or vehicle from a distance, by using electrical or radio signals
10)	wireless	j)	the formal study of art, especially in relation to the idea of beauty

Ex.1.12. Match the words with the prepositions from the box to make word combinations.

by	*by*	*from…to*	*for*	*within*	
out	*to*	*to*	*as*		

Carry…, guided…, embedded…, no regard…, range…, such…, created…, used…, blamed… .

Ex.1.13. Read and complete the text with the phases below.

Main Principles of Robots

There are many types of robots; they are used in many different environments and for many different uses, although being very diverse in application and form they all share three basic similarities when it comes to their construction:

1. Robots all have some kind of mechanical construction, a frame, form or shape designed to achieve a particular task. For example, a robot 1)_____, might use caterpillar tracks. The mechanical aspect is mostly the creator's solution to completing the assigned task and 2)_____ . Form follows function.

2. Robots have electrical components which power and control the machinery. For example, the robot with caterpillar tracks would need 3)_____ to move the tracker treads.

That power comes in the form of electricity, which will have to 4)_____, a basic electrical circuit. Even petrol powered machines that get their power mainly from petrol still require 5)_____ which is why most petrol powered machines like cars, have batteries. The electrical aspect of robots is used for movement (through motors), sensing (where electrical signals are used to measure things like heat, sound, position, and energy status) and operation (robots need some level of electrical energy supplied to their motors and sensors in order to activate and perform basic operations).

3. All robots contain some level of computer programming code. A program is 6)_____ . In the caterpillar track example, a robot that needs to move across a muddy road may have the correct mechanical construction and receive the correct amount of power from its battery, but 7)_____ . Programs are the core essence of a robot, it could have excellent mechanical and electrical construction, but if its program is poorly constructed its performance will be very poor (or it may not perform at all). There are three different types of robotic programs: 8)_____. A robot with remote control programming has a preexisting set of commands that it will only perform if and when it 9)_____, typically a human being with a remote control. It is perhaps more appropriate to view devices controlled primarily by human commands as falling in the discipline of automation rather than robotics. Robots that use artificial intelligence interact with their environment on their own without a control source, and 10)_____ using their preexisting programming. Hybrid is a form of programming that incorporates both AI and RC functions.

a) receives a signal from a control source
b) some kind of power
c) designed to travel across heavy dirt or mud

d) travel through a wire and originate from a battery
e) remote control, artificial intelligence and hybrid
f) an electric current to start the combustion process
g) how a robot decides when or how to do something
h) can determine reactions to objects and problems they encounter
i) would not go anywhere without a program telling it to move
j) dealing with the physics of the environment around it

Ex.1.14. Answer the questions to the text above.

1. What are the main principles of robots?
2. What is mechanical construction of a robot based on?
3. What is the task of electrical components of a robot?
4. Why do most petrol powered machines have batteries?
5. What is the core essence of a robot?
6. What is a program?
7. What are the types of robotic programs? Describe them.

Ex.1.15. Match the words in two columns to complete word combinations from the text above.

1)	diverse	a)	solution
2)	mechanical	b)	in application
3)	caterpillar	c)	control
4)	creator's	d)	programming
5)	electrical	e)	track
6)	petrol	f)	intelligence
7)	remote	g)	construction
8)	artificial	h)	process
9)	preexisting	i)	circuit
10)	combustion	j)	powered

Ex.1.16. Divide following words and word combinations into three groups.

Form of electricity, frame, petrol powered machines, electrical energy, remote control, electric current, preexisting set of commands, battery, artificial intelligence, form or shape, hybrid, combustion process.

Mechanical construction	*Electrical components and machinery*	*Computer programming*

Ex.1.17. Read the text and answer the questions below.

Robotic Muscles

Scientists from two of the USA's elite universities have pioneered a new method of creating artificial muscles. The scientists have dubbed their discovery as a "soft robot". It is a 2.6-gram "muscle" that looks like a small bag with many water-filled compartments. It has been given amazing strength by supporting it with an origami-inspired structural framework. This allows the artificial muscle to lift an object that is 1,000 times its own weight. The New Scientist website said this weight-to-strength ratio is the equivalent of a newborn baby lifting a large 4WD car. The ground-breaking discovery could greatly benefit many areas of science, medicine, robotics and engineering.

The scientists are from the Massachusetts Institute of Technology and Harvard University. They are experts in the field of soft robotics. They said their new soft robot muscle can be made in just 10 minutes and costs less than one dollar. Researcher, professor Robert Wood, hopes to create "softer" robots that are more similar to humans. He said: "Humans are normally soft and brittle compared to the big industrial

robots that you might find on an assembly line. The next step is to take this system and develop it into a fully functional robot." Dr Daniela Rus explained that the robots could be like the human hand. They could be strong enough to grip any object firmly, while being soft and gentle.

1. How many of the USA's elite universities were mentioned in the article?
2. How much does the new artificial muscle weigh?
3. What did scientists use as an inspiration when creating the muscle?
4. How many times its own weight can the muscle lift?
5. What did a website say the weight-strength ratio was like a baby lifting?
6. What are the scientists expert in the field of?
7. How much does the artificial muscle cost?
8. What did a researcher say humans were, besides soft?
9. What did a doctor say the robot muscle could be like?
10. How did a doctor say the artificial robot could grip objects?

Ex.1.18. Decide if the statements are true or false according to the text above.

1. Scientists from two universities made a robotic muscle.
2. The new robotic muscle weighs about 2.6 kg.
3. The scientists took inspiration from origami to create the muscle.
4. The strength of the muscle is like a baby lifting a 4-wheel drive car.
5. The scientists are experts in the field of muscles and bodybuilding.
6. The new muscle costs less than a dollar to make.

7. The scientists hope to create harder robots, like industrial robots.

8. The scientists say robots will never be like the human hand.

Ex.1.19. Match the words with their definitions.

Paragraph 1

1)	elite	a)	separate sections or parts of something
2)	pioneered	b)	made or produced by human beings rather than occurring naturally, usually as a copy of something natural
3)	artificial	c)	developed or was the first to use or apply a new method, area of knowledge, or activity
4)	dubbed	d)	equal in value, amount, meaning, etc.
5)	compartments	e)	a group of people, schools, organizations, etc. thought to be the best in a particular society or category, especially because of their power, talent, or wealth
6)	ratio	f)	gave an unofficial name or nickname to someone or something
7)	equivalent	g)	the relation between two amounts showing the number of times one value contains or is contained within the other (e.g. 4:1, 10:1, 1000-to-one, etc.)

Paragraph 2

1)	experts	a)	hard but likely to break or shatter easily
2)	brittle	b)	working or operating well and effectively
3)	industrial	c)	strongly
4)	assembly line	d)	of or relating to big factories and the production of raw materials and goods
5)	functional	e)	take and keep a tight hold of something; grasp tightly
6)	grip	f)	a system of workers and machines in a factory that allows something to be made or put together part-by-part or process-by-process
7)	firmly	g)	people who know everything and are knowledgeable of or have a great skill in a particular area

Ex.1.20. Match the following synonyms from the article above.

1)	elite	a)	pioneering
2)	artificial	b)	area
3)	compartments	c)	sections
4)	object	d)	grasp
5)	ground-breaking	e)	crème de la crème
6)	field	f)	breakable
7)	experts	g)	manufacturing
8)	brittle	h)	synthetic
9)	industrial	i)	thing
10)	grip	j)	specialists

Unit 2. HISTORY OF ROBOTS

Ex.2.1. Read the paragraphs and put them in correct order to complete the text.

History of Robots

A. In 1920, Karel Capek published his play R.U.R. (Rossum's Universal Robots), which introduced the word "robot." However, it was thirty years before the first industrial robot went to work. In the 1950s, George Devol designed the Unimate robot which started work in 1961. Unimation, the company Devol founded with robotic entrepreneur Joseph Engelberger, was the first robot manufacturing company. The robot was originally seen as a curiosity, to the extent that it even appeared on The Tonight Show in 1966. Soon, robotics began to develop into another tool in the industrial manufacturing arsenal.

B. Robotics became a burgeoning science and more money was invested. Robots spread to Japan, South Korea and many parts of Europe over the last half century, to the extent that projections for the 2011 population of industrial robots are around 1.2 million. Additionally, robots have found a place in other spheres, as toys and entertainment, military weapons, search and rescue assistants, and many other jobs. Indeed, robots are being launched into space to complete the next stages of extraterrestrial and extrasolar research.

C. In the Middle Ages (5^{th}–15^{th} centuries), in both Europe and the Middle East, automatons were popular as part of

clocks and religious worship. The Arab polymath Al-Jazari (1136–1206) left texts describing and illustrating his various mechanical devices, including a large elephant clock that moved and sounded at the hour, a musical robot band and a waitress automaton that served drinks. In Europe, there is an automaton monk extant that kisses the cross in its hands. Many other automata were created that showed moving animals and humanoid figures that operated on simple cam systems, but in the 18th century, automata were understood well enough and technology advanced to the point where much more complex pieces could be made. French engineer Jacques de Vaucanson is credited with creating the first successful biomechanical automaton, a human figure that plays a flute.

D. Many sources attest to the popularity of automatons in ancient and Medieval times. Ancient Greeks and Romans (3000 BC–500AD) developed simple automatons for use as tools, toys, and as part of religious ceremonies. Predating modern robots in industry, the Greek God Hephaestus was supposed to have built automatons to work for him in a workshop. Unfortunately, none of the early automatons are extant.

E. The Industrial Revolution (18^{th}–19^{th} centuries) and the increased focus on mathematics, engineering and science in England in the Victorian age added to the momentum towards actual robotics. Charles Babbage (1791–1871) worked to develop the foundations of computer science in the early-to-mid nineteenth century. His most successful projects were the difference engine and the analytical engine. Although never completed due to lack of funds, these two machines laid out the basics for mechanical calculations. Others such as Ada Lovelace recognized the future possibility of computers creating images or playing music.

F. Automata continued to provide entertainment during the 19^{th} century, but coterminous with this period was the

development of steam-powered machines and engines that helped to make manufacturing much more efficient and quick. Factories began to employ machines to either increase work loads or precision in the production of many products.

Ex.2.2. Match the stages in history of robots with the events.

1)	The Ancient Times (3000 BC – 500AD)	a)	Factories began to use machines to increase workloads and precision in production.
2)	The Middle Ages (5^{th}–15^{th} centuries)	b)	There was increased focus on mathematics, engineering and science that caused development of robotics.
3)	The Industrial Revolution (18^{th}–19^{th} centuries)	c)	Automatons became more complex but they were still used for entertainment.
4)	The 19^{th} century	d)	The word "robot" was introduced; the first commercial industrial robot Unimate started work.
5)	The 20^{th} century	e)	Robotics is a fast developing science. Robots are widely used in manufacturing, scientific research, for mili-tary purposes, in industry, for householding, for entertainment, etc.
6)	The 21^{st} century	f)	First idea of robots appeared. Greeks and Romans developed simple automatons for entertainment (tools, toys) and as part of religious ceremonies.

Ex.2.3. Answer the questions to the text above.

1. When did the first idea of robots appear?
2. What were the first robots?
3. What were they used for? Give examples.
4. Why did the interest to robots increase in the Industrial Revolution?
5. Why did the factories begin to use machines in manufacturing in the 19th century?
6. When and by whom was the word "robot" introduced?
7. When was the first commercial industrial robot designed?
8. When did it start work?

Ex.2.4. Decide whether the statements are true or false.

1. Ancient Greeks and Romans developed simple automatons for entertaining.
2. In the Middle Ages automatons were used for first scientific researches.
3. The Industrial Revolution caused development of robotics.
4. In the 18th century manufacturers started using machines in their factories.
5. In 1961 the first industrial robot Unimate was designed by George Devol.
6. There were more than one million industrial robots in 2011.

Ex.2.5. Match the words with their definitions.

1)	entrepreneur	a)	outside the solar system
2)	launch	b)	a machine that operates on its own without the need for human control, without thinking or feeling

3)	extrasolar	c)	to give someone something that they need
4)	advance	d)	to begin something such as a plan or introduce something new such as a product
5)	automaton	e)	the quality of being exact and accurate
6)	workshop	f)	someone who starts their own business
7)	provide	g)	a room or building where things are made or repaired using machines and/or tools
8)	precision	h)	to go or move something forward, or to develop or improve something

Ex.2.6. Put the words into correct order to make sentences.

1) for / developed / Greeks and Romans / use /automatons / as / and / tools / toys / Ancient /simple.

2) invested / more / Robotics / a / science / and / money / burgeoning / was / became.

3) French / automaton / credited / Jacques de Vaucanson / with / the / successful / engineer / biomechanical / is / creating / first.

4) added / to / robotics / Industrial / England / the / towards / momentum / actual / in / Revolution / The.

5) designed / George Devol / which / the / work /Unimate / 1961 / started / in.

6) being / complete / stages / extrasolar / launched / space / Robots / are / into / to / next / of / the / extraterrestrial / research / and.

Ex.2.7. Complete the text with the words from the box.

devices	*complex*	*think*	*actions*	*resemble*
gears	*touch*	*frame*	*robot*	*principles*
	breakthrough	*programmable*		

Although the development of robots seems a very modern idea, the 1)… behind this new technology were known thousands of years ago. Even ancient Greeks and Romans used mechanical cogs and 2)… which are now an essential part of robot technology. In the Middle Ages there was a real 3)… in the development of robot engineering. At that time many types of mechanical 4)… appeared. At the end of the 17th century engineers already knew about most of the mechanical components that make up a modern 5)… . Throughout history inventors have produced a variety of seemingly magical mechanical devices capable of quite life-like 6)… . These devices were not 7)…, they were simply performing a set of operations. Different scientists and engineers have applied many advances in this field since that time. Today's robot is a very 8)… structure. A metal or plastic 9)… serves for a skeleton, and a variety of actuators provide muscle power. But the new humanoids are not just bodies, they are also sophisticated sensing machines with cameras, microphones, even specific sensors that imitate the sense of 10)… . And then there are the brains. Nowadays scientists haven't yet created such a robot that can 11)… . But who knows, maybe in the future it will not only 12)… a human being in appearance but will also have the capacity to think and feel.

Ex.2.8. Match the words in two columns to complete word combinations from the text above.

modern	part
ancient	devices
mechanical	structure
essential	Greeks and Romans
mechanical	frame
complex	robot
metal	power
muscle	cogs and gears

Ex.2.9. Read the text and choose the correct item.

The First "Humanoid" Robot

By definition of the word, Herbert Televox was the first *ever / never* humanoid robot. Built by Ron Wensley *at / in* 1927, the robot *is able to / could* lift the receiver to accept a telephone call and control simple processes by operating switches according *to / on* the signals it *received / receives*. While the robot did not have the ability to speak when it *was / is* first created, it later learnt to say two simple sentences.

Despite / However, although Televox lacked the *ability / possibility* to speak, it had the ability to listen *by / with* a sensitive microphone placed close to the telephone receiver and *could / can* respond *to / on* actions based on sound and pitch. These sonic signals *allowed / let* Televox to control switches and consequently the appliances that *was / were* attached to it.

Televox was humanoid in appearance, *however / because*, the humanoid appearance comes from a basic cut *out / down* that was added to the robot when it was demonstrated.

Herbert Televox was *ever / only* the starting point for Westinghouse Electric and Manufacturing Co. They later went *down / on* to create 'Elektro the Moto-Man' in 1937 which many people consider *to be / be* the real first humanoid robot.

Ex.2.10. Answer the questions to the text above.

1. What was the name of the first "humanoid" robot?
2. When was it built?
3. What could it do?
4. Where did its humanoid appearance come from?
5. Was Herbert Televox the real first humanoid robot?

Ex.2.11. Read the text and decide if the statements are true or false.

The Three Laws of Robotics

The Three Laws of Robotics (often shortened to The Three Laws or known as Asimov's Laws) are a set of rules devised by the science fiction author Isaac Asimov. The rules were introduced in his 1942 short story "Runaround" (included in the 1950 collection *I, Robot*), although they had been foreshadowed in a few earlier stories. The Three Laws, quoted as being from the "Handbook of Robotics, 56th Edition, 2058 A.D.", are:

First Law. A robot may not injure a human being or, through inaction, allow a human being to come to harm.

Second Law. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

Third Law. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

These form an organizing principle and unifying theme for Asimov's robotic-based fiction, appearing in his *Robot* series, the stories linked to it, and his *Lucky Starr* series of young-adult fiction. The Laws are incorporated into almost all of the positronic robots appearing in his fiction, and cannot be bypassed, being intended as a safety feature. Many of Asimov's robot-focused stories involve robots behaving in unusual and counter-intuitive ways as an unintended consequence of how

the robot applies the Three Laws to the situation in which it finds itself. Other authors working in Asimov's fictional universe have adopted them and references, often parodic, appear throughout science fiction as well as in other genres.

The original laws have been altered and elaborated on by Asimov and other authors. Asimov himself made slight modifications to the first three laws in various books and short stories to further develop how robots would interact with humans and each other. In later fiction where robots had taken responsibility for government of whole planets and human civilizations, Asimov also added a fourth, or zeroth law, to precede the others:

Zeroth Law. A robot may not harm humanity, or, by inaction, allow humanity to come to harm.

The Three Laws, and the zeroth, have pervaded science fiction and are referred to in many books, films, and other media. They have impacted thought on ethics of artificial intelligence as well.

1. The Three Laws of Robotics are a set of rules devised by the scientist Isaac Asimov in 1942.
2. First Law states that robots mustn't be dangerous for people.
3. Second Law states that robots don't have to obey the orders of human beings if they are against the First Law.
4. Third Law states that robots must take care of themselves.
5. The Three Laws were first published in science fiction.
6. The Three Laws were adopted by other authors.
7. Asimov never changed or modified the Laws.
8. Asimov added a forth law because the influence of robots on people in his books became global.
9. Zeroth Law states that robots mustn't harm humanity.
10. The Three Laws and the zeroth have impacted thought on ethics of artificial intelligence.

Ex.2.12. Match the verbs with their definitions.

1)	interact	a)	to bring together; combine
2)	quote	b)	to avoid something by going around it
3)	obey	c)	to repeat the words that someone else has said or written
4)	unify	d)	to include someone in something
5)	impact	e)	to communicate with or react to
6)	bypass	f)	to change something, usually slightly
7)	intend	g)	to have an influence on something
8)	involve	h)	to accept or start to use something new
9)	adopt	i)	to act according to what you have been asked or ordered to do by someone in authority
10)	alter	j)	to have as a plan or purpose

Ex.2.13. Read the text and answer the questions below.

Brief History of Robots in Dates

400 BC

400 BC was the real starting point of robotics, when Mathematician Archytas created the first steam powered mechanical bird. In its best run, it flew approximately 200 meters before running out of steam. This was not only the first robot ever created, it was also one of the first instances of scientific research into flying.

1495

Around 1495, Leonardo da Vinci sketched a plan for the first recorded “humanoid robot”, known as Leonardo’s Robot. The robot could stand, sit, raise its visor and individually

move its arms. The entire robot was operated by a number of pulleys and cables.

1913

In 1913, Henry Ford installed the world's first conveyor belt assembly line in his car factory. Henry Ford wanted his Model T car to be affordable for everyone, to do this he needed to be able to build them more efficiently. The conveyor belt assembly line reduced the time it took to build a Model T from over 12 hours down to 93 minutes.

1921

The 1920s was the first time that robots broke into mainstream media. In 1921 the word "robot" was first coined by Czech playwriter Karel Capek, in his play R.U.R (Rossum's Universal Robots). The play was about a factory that built artificial people, robots, to be servants for humans.

1927

Herbert Televox was first created by Westinghouse Electric and Manufacturing Co in 1927, as the first "humanoid" robot. Televox's creation started the developmental process leading to their later robots such as Elektro was more widely accepted as the first advanced humanoid robot to be created.

1941

In 1941 Isaac Asimov, a legendary science fiction writer, released the short story "Liar!" that outlines the three laws of robotics. Asimov's three laws are still considered the best safety restrictions that a robot could be programmed to abide. The three laws are:

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 any orders given to it by human beings, except where such orders would conflict with 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.

The story was later recompiled into “I, Robot” which was reproduced as a movie in 2004.

1952

In 1952, Alan Turing developed the test to determine if a machine truly has the power to think for itself. To pass the test, a robot or machine must be indistinguishable from a human during a conversation.

The Turing test is still used to this day to test robots and artificial intelligence bots. However, the test is subjective because bots are often much better at specific subjects and may only be indistinguishable from a human during specific conversation topics.

1961

In 1961, the first digitally operated and programmable robot, the Unimate, was installed on the General Motors assembly line. The robot was used to lift hot pieces of metal from a die casting machine and stack them. The Unimate became the basis of many of the industrial robots still used in assembly lines today.

1977

George Lucas releases the first Star Wars movie in 1977 which became one of the highest grossing movie franchises of all time. The movie inspired a new generation of research by demonstrating a human future shared with robots such as the now famous R2-DT and C-3PO.

1996

IBM created a computer known as Deep Blue in 1996 with one of the first instances of artificial intelligence (before deep learning artificial intelligence was created a decade later). The computer was designed to play chess and on May 11th 1997 it beat world chess champion Garry Kasparov.

1997

The first ever Robocup tournament was held in Japan in 1997. The aim of Robocup was to promote AI and robotics research

by offering a publicly appealing but formidable challenge. The goal of the Robocup is to have a fully automated team of robots that has the ability to beat the world's best football team by the year 2050.

2000

After more than two decades of research Honda debuts ASIMO. ASIMO had 11 robotic predecessors that were developed in order to research bipedal walking robots. Upon its release ASIMO was the most advanced robot in the world, since then it has been continually developed and was the first robot capable of running, jumping and using the stairs. ASIMO is still seen as one of the most advanced robots in the world today.

2006

Aldebaran Robotics release Nao, a small 2' tall humanoid robot, used worldwide by universities as a research platform and educational tool. Nao has become the face of social robotics. Nao has also replaced Sony's Aibo robot dog and has become the standard platform for the Robocup. Over 5,000 of these robots are being used in more than 50 different countries and have been programmed to do number of things such as help in company receptions, care homes and even help Autistic children.

2010

NASA and General Motors revealed Robonaut 2, a highly advanced humanoid robot that was part of the Discovery shuttle launch in 2011. Robonaut was designed to assist NASA with space walks and has enough dexterity to use tools and work alongside astronauts in future space expeditions. NASA later went on to develop Valkyrie, a robot that has been developed with the ability to ultimately setup habitats on Mars prior to human arrival.

2016

Hanson Robotics release Sophia, a social robot with silicone skin, and the ability to interact with people and display more

than 50 facial expressions. Sophia has been covered media around the world and has participated in many high-profile interviews. The Sophia robot is also the first ever robot to be granted citizenship of a country.

2019 and onwards...

The future of robotics is an exciting prospect…

1. What was the first "robot" ever?
2. What could Leonardo's Robot do?
3. What was the effect of the conveyor belt assembly line installed in Hanry Ford's car factory?
4. When did the process of creating humanoid robots start?
5. What are the Isacc Asimov's three laws of robotics?
6. What is the purpose of the Turing test?
7. Why was the movie Star Wars essential in robotics development?
8. What was the purpose of the first computer with artificial intelligence?
9. What was the new that ASIMO robot could do?
10. What is the use of humanoid robots in space?
11. What is the special about Sophia the robot?

Ex.2.14. Match the sentences' halves.

1)	The first steam powered mechanical bird…	a)	…was about a factory that built artificial people, robots, to be servants for humans.
2)	Leonardo's Robot…	b)	…to promote AI and robotics research.
3)	Henry Ford wanted …	c)	…may not injure a human being or, through inaction, allow a human being to come to harm.

4)	The play R.U.R (Rossum's Universal Robots) by Karel Capek…	d)	…could stand, sit, raise its visor and individually move its arms.
5)	A robot …	e)	…was one of the first instances of scientific research into flying.
6)	To pass the Turing test…	f)	…beat world chess champion Garry Kasparov.
7)	The movie Star Wars inspired a new generation of research by…	g)	…is still seen as one of the most advanced robots in the world today.
8)	The first computer with artificial intelligence…	h)	…his Model T car to be affordable for everyone.
9)	The aim of Robocup was…	i)	…the first ever robot to be granted citizenship of a country.
10)	ASIMO can run and jump and…	j)	…a robot or machine must be indistinguishable from a human during a conversation.
11)	NASA go on to develop a robot with the ability…	k)	…demonstrating a human future shared with robots.
12)	The Sophia robot is…	l)	…to ultimately setup habitats on Mars prior to human arrival.

Ex.2.15. Match the events in the robotics history with the dates they occurred.

400 BC	a)	the first "humanoid" robot Herbert Televox was created
1495	b)	Isaac Asimov introduces his three laws of robotics
1913	c)	the first steam powered mechanical bird was created
1921	d)	the first Star Wars movie was released
1927	e)	Leonardo da Vinci sketched a plan for the first recorded 'humanoid robot'

1941	f)	the first ever Robocup tournament was held in Japan
1952	g)	Karel Capek introduced the word “robot”
1961	h)	Henry Ford installed the world’s first conveyor belt assembly line in his car factory
1977	i)	the first computer with artificial intelligence was created by IBM
1996	j)	The first walking robots ASIMO was created
1997	k)	Alan Turing developed the Turing test to determine if a machine truly has the power to think for itself
2000	l)	a highly advanced humanoid robot was installed in a shuttle to assist NASA with space walks
2006	m)	the first digitally operated and programmable robot, the Unimate, was installed in industry production
2010	n)	the first social robot with silicone skin, and the ability to interact with people and display facial expressions was released
2016	o)	the first humanoid robot started to be used worldwide by universities as a research platform and educational tool

Ex.2.16. Complete the text with the words from the box.

prayer	*beloved*	*legend*	*imitate*	*spring*
inventor	*lifelike*	*device*	*heavens*	*levers*

The Mechanical Monk

The 16th century “mechanical monk” may have been the result of King Phillip II of Spain keeping up his end of a holy bargain. According to 1)…, Phillip II’s son and heir suffered a head injury, and the King vowed to the 2)… that he would deliver a miracle if the boy were spared. When the Prince recovered, Phillip II commissioned a clockmaker and

3)… named Juanelo Turriano to build a lifelike recreation of 4)… Franciscan friar Diego de Alcalá (later Saint Diego). Completed sometime in the 1560s, Turriano's 15-inch-tall automaton is powered by a wound 5)… and uses an assortment of iron cams and 6)… to move on three small wheels concealed beneath its monk's robe. Artificial feet step up and down to 7)… walking, and the friar's eyes, lips and head all move in 8)… gestures. Working together, these elements give the impression of a monk deep in 9)… . The robot can walk in a square pattern mouthing devotionals, nodding its head and occasionally beating its chest with its right arm and kissing a rosary and cross with its left. The 450-year-old 10)… is still operational today, and is held at the Smithsonian in Washington, D.C.

Ex.2.17. Read the text and decide if the statements below are true or false.

Deep Blue versus Kasparov

Deep Blue and Kasparov played each other on two occasions. The first match began on 10 February 1996, in which Deep Blue became the first machine to win a chess game against a reigning world champion (Garry Kasparov) under regular time controls. However, Kasparov won three and drew two of the following five games, beating Deep Blue by a score of 4–2. The match concluded on 17 February 1996.

After the match, Deep Blue was upgraded and played Kasparov again in May 1997, winning the six-game rematch 3½–2½, ending on 11 May. Deep Blue won the deciding game after Kasparov made a mistake in the opening and became the first computer system to defeat a reigning world champion in a match under standard chess tournament time controls.

Writer Nate Silver suggests that a bug in Deep Blue's software led to a seemingly random move (the 44th in the

first game of the second match) which Kasparov misattributed to "superior intelligence". Subsequently, Kasparov experienced a decline in performance due to anxiety in the following game, though he rejects this interpretation.

After the loss, Kasparov said that he sometimes saw deep intelligence and creativity in the machine's moves, suggesting that during the second game, human chess players had intervened on behalf of the machine, which would be a violation of the rules. IBM denied that it cheated, saying the only human intervention occurred between games. Kasparov demanded a rematch, but IBM had dismantled Deep Blue after its victory and refused the rematch. The rules allowed the developers to modify the program between games, an opportunity they said they used to shore up weaknesses in the computer's play that were revealed during the course of the match. Kasparov requested printouts of the machine's log files, but IBM refused, although the company later published the logs on the Internet.

Kasparov called Deep Blue an "alien opponent" but later stated that "It was as intelligent as your alarm clock". According to Martin Amis, two grandmasters who played Deep Blue agreed with each other that "It's like a wall coming at you".

Deep Blue, with its capability of evaluating 200 million positions per second, was the first and fastest computer to face a world chess champion in a formal match. Today, in computer-chess research and matches of world-class players against computers, the focus of play has shifted to software chess programs, rather than using dedicated chess hardware. Modern chess programs like Houdini, Rybka, Deep Fritz or Deep Junior are more efficient than the programs during Deep Blue's era. Whereas Deep Blue relied on many preset settings fine-tuned by chess masters and computer scientists, a number of modern chess engines such as Leela Chess Zero use artificial neural networks to fine-tune their behavior without much preset knowledge.

In a November 2006 match between Deep Fritz and world chess champion Vladimir Kramnik, the program ran on a computer system containing a dual-core Intel Xeon 5160 CPU, capable of evaluating only 8 million positions per second, but searching to an average depth of 17 to 18 plies in the middlegame thanks to heuristics; it won 4–2.

1. Deep Blue and Kasparov played only one match.
2. Kasparov beat Deep Blue in the match in Fabruary 1996.
3. After the first match, Deep Blue was upgraded.
4. Deep Blue and Kasparov played another match in May 1996.
5. Kasparov beat Deep Blue in the second match again.
6. Afer the second match, Kasparov suggested that human chess players had intervened on behalf of the machine.
7. IBM confessed that it cheated.
8. After the second game, Kasparov demanded a rematch, but IBM refused it.
9. There are a number of modern chess programs today that are more efficient than the programs during Deep Blue's era.

Ex.2.18. Match the words from the columns to complete word combinations from the text above.

1)	Deep	a)	opponent
2)	world	b)	Blue
3)	time	c)	of the rules
4)	chess	d)	neural networks
5)	random	e)	champion
6)	on behalf	f)	controls
7)	violation	g)	of the machine
8)	human	h)	tournament
9)	alien	i)	move
10)	artificial	j)	intervention

Ex.2.19. Put the words into correct order to complete sentences from the text above.

1. each / occasions / Deep Blue / on / and / played / Kasparov / other / two.
2. champion / became / world / Deep Blue / the / first / against / machine / to / win / a / game / chess / a .
3. was / played / 1997 / Deep Blue / in / and / Kasparov / again / May / upgraded.
4. won / Kasparov / Deep Blue / the / made / game / after / deciding / a / mistake.
5. deep / moves / said / he / saw / intelligence and creativity / sometimes / in / the / that / machine's / Kasparov.
6. occurred / denied / it / cheated / that / the / that / only / intervention / human / saying / between / IBM / games.

Ex.2.20. Complete the text with the words from the box.

location	*humans*	*application*	*direction*
detect	*displayed*	*distinguish*	*ability*
lifespan	*respond*	*nodding*	*torso*

ASIMO

ASIMO (Advanced Step in Innovative Mobility) is a humanoid robot created by Honda in 2000. It is currently 1)… in the Miraikan museum in Tokyo, Japan. On 8 July 2018, Honda posted the last update of ASIMO through their official page stating that it would be ceasing all development and production of ASIMO robots in order to focus on more practical applications using the technology developed through ASIMO'S 2)… . The name was chosen in honor of Isaac Asimov.

ASIMO has the 3)… to recognize moving objects, postures, gestures, its surrounding environment, sounds and faces, which enables it to interact with 4)… . The robot can detect the movements of multiple objects by using visual

information captured by two camera "eyes" in its head and also determine distance and 5)… . This feature allows ASIMO to follow or face a person when approached. The robot interprets voice commands and human gestures, enabling it to recognize when a handshake is offered or when a person waves or points, and then 6)… accordingly. ASIMO's ability to 7)… between voices and other sounds allows it to identify its companions. ASIMO is able to respond to its name and recognizes sounds associated with a falling object or collision. This allows the robot to face a person when spoken to or look towards a sound. ASIMO responds to questions by 8)… or providing a verbal answer in different languages and can recognize approximately 10 different faces and address them by name.

There are sensors that assist in autonomous navigation. The two cameras inside the head are used as a visual sensor to 9)… obstacles. The lower portion of the torso has ground sensor which comprises one laser sensor and one infrared sensor. The laser sensor is used to detect ground surface. The infrared sensor with automatic shutter adjustment based on brightness is used to detect pairs of floor markings to confirm the navigable paths of the planned map. The pre-loaded map and the detection of floor markings help the robot to precisely identify its present 10)… and continuously adjust its position. There are front and rear ultrasonic sensors to sense the obstacles. The front sensor is located at the lower portion of the 11)… together with the ground sensor. The rear sensor is located at the bottom of the backpack.

In honor of ASIMO's 10th anniversary in November 2010, Honda developed an 12)… for the iPhone and Android smartphones called «Run with ASIMO.» Users learn about the development of ASIMO by virtually walking the robot through the steps of a race and then sharing their lap times on Twitter and Facebook.

Ex.2.21. Answer the questions to the text above.

1. What is ASIMO?
2. When was ASIMO created?
3. Has ASIMO ever been updated?
4. Why did the developers choose the name ASIMO for the robot?
5. What abilities does ASIMO have?
6. What assists ASIMO in autonomous navigation?
7. What is the purpose of the application "Run with ASIMO"?

Ex.2.22. Match the words with their definitions.

1)	lifespan	a)	to control or influence something directly, or to decide what will happen
2)	respond	b)	an accident that happens when two vehicles hit each other with force
3)	gesture	c)	something that blocks you so that movement, going forward, or action is prevented or made more difficult
4)	determine	d)	a movement of the hands, arms, or head, etc. to express an idea or feeling
5)	handshake	e)	the human body considered without head, arms, or legs
6)	collision	f)	to say or do something as a reaction to something that has been said or done
7)	verbal	g)	close to a particular number or time although not exactly that number or time
8)	approximately	h)	the length of time for which a person, animal, or thing exists
9)	obstacle	i)	to make an arrangement or meeting certain
10)	confirm	j)	the day on which an important event happened in a previous year

11)	torso	k)	a greeting or expression of agreement
12)	anniversary	l)	spoken rather than written

Ex.2.23. Complete the text with phrases (a–j) below.

Sophia

Sophia is a social humanoid robot developed by Hong Kong-based company Hanson Robotics. Sophia was activated on February 14, 2016, and made her first public appearance at South by Southwest Festival in mid-March 2016 in 1)_____.

Sophia has been covered by media around the globe and has participated in many high-profile interviews. In October 2017, Sophia "became" a Saudi Arabian citizen, the first robot to 2)_____. In November 2017, Sophia was named the United Nations Development Programme's first ever Innovation Champion and is the first non-human to be given any United Nation title.

Cameras within Sophia's eyes combined with computer algorithms allow her to see. She can follow faces, sustain eye contact, 3)_____. She is able to process speech and have conversations using a natural language subsystem. Around January 2018, Sophia was upgraded with functional legs and 4)_____. CNBC has commented on Sophia's "lifelike" skin and her ability to emulate more than 50 facial expressions.

Sophia is conceptually similar to the computer program ELIZA, which was one of the 5)_____. The software has been programmed to give pre-written responses to specific questions or phrases, like a chatbot. These responses are used to create the illusion that the robot is able to understand conversation, including stock answers to questions like "Is the door open or shut?"

David Hanson has said that Sophia would ultimately be a good fit to serve in 6)_____. In 2019 Sophia displayed the ability to create drawings, 7)_____.

Sophia has been interviewed in the same manner as a human, striking up conversations with hosts. Some replies have been nonsensical, while others have impressed interviewers such as *60 Minutes'* Charlie Rose. In a piece for CNBC, when the interviewer expressed concerns about robot behavior, Sophia joked 8)_____ and watching too many Hollywood movies". Musk tweeted that Sophia should watch *The Godfather* and asked «what's the worst that could happen?» Business Insider's chief UK editor Jim Edwards interviewed Sophia, and while the answers were "not altogether terrible", he predicted she was a step towards "conversational artificial intelligence". At the 2018 Consumer Electronics Show, a BBC News reporter described talking with Sophia as «a slightly awkward experience».

On October 11, 2017, Sophia was introduced to the United Nations with a brief conversation with the United Nations Deputy Secretary-General, Amina J. Mohammed. On October 25, at the Future Investment Summit in Riyadh, the robot was "granted Saudi Arabian citizenship», becoming the first robot ever to have a nationality, described as a publicity stunt. This attracted controversy as some commentators wondered if this implied that Sophia 9)_____, or whether a deliberate system shutdown could be considered murder. Social media users used Sophia's citizenship to criticize Saudi Arabia's human rights record. In December 2017, Sophia's creator David Hanson said that Sophia would use her citizenship to advocate for 10)_____; *Newsweek* criticized that «What [Hanson] means, exactly, is unclear».

a) including portraits
b) first attempts at simulating a human conversation
c) and recognize individuals
d) women's rights in her new country of citizenship

e) Austin, Texas, United States
f) the ability to walk
g) that he had “been reading too much Elon Musk
h) healthcare, customer service, therapy and education
i) receive citizenship of any country
j) could vote or marry

Ex.2.24. Answer the questions to the text above.

1. What is Sophia?
2. When and where was Sophia activated?
3. What country provided citizenship to Sophia?
4. What are the Sophia’s abilities?
5. How was Sophia upgraded in 2018?
6. How can Sophia “speak”?
7. What areas might Sophia be used in the future?
8. How does Sophia behave during interviews?
9. What do interviewers say about Sophia’s behavior?
10. What are the contradictions of Sophia’s citezenship?

Ex.2.25. Match the words from the columns to complete word combinations from the text above.

1)	humanoid	a)	contact
2)	public	b)	Champion
3)	high-profile	c)	intelligence
4)	Innovation	d)	language
5)	eye	e)	program
6)	natural	f)	service
7)	facial	g)	appearance
8)	computer	h)	experience
9)	artificial	i)	robot
10)	awkward	j)	stunt
11)	publicity	k)	expressions
12)	customer	l)	interviews

Unit 3. INDUSTRIAL ROBOTS

Ex.3.1. Read the text and answer the questions below.

Industrial Robots

When engineers devised a steam engine in the 18th century, people said that they had already invented everything possible. However, mankind has produced a great number of other inventions since that time. Robots are one of them. Nowadays people use 90 % of robots for heavy, repetitive manufacturing work. These robots handle tasks that are difficult, dangerous or boring to human beings.

The most common manufacturing robot is the robotic arm. It typically consists of seven metal segments. Tiny motors or actuators put them into operation when a special computer gives them certain instructions.

An industrial robotic arm with six joints closely resembles a human arm – it has the equivalent of a shoulder, an elbow and a wrist. This type of robot has six degrees of freedom, i.e. it can turn in six different ways. A human arm, by comparison, has seven degrees of freedom. Your arm moves your hand from place to place. Similarly, the robotic arm moves an end effector from place to place. You can supply robotic arms with all sorts of end effectors, which will perform a certain task, for example it will grasp and carry different objects. Robotic hands often have builtin pressure sensors that tell the computer how hard the robot is gripping a particular

object. That's why the robot doesn't drop or break whatever it's carrying. Robots do their work more efficiently than human beings because they are so precise. They always drill in the exactly the same place, and they always tighten bolts with the same amount of force, no matter how many hours they've been in operation.

1. What kind of work are robots mostly used today for?
2. What is the most common manufacturing robot?
3. How many parts does the robotic arm usually consist of?
4. What puts the parts into operation?
5. Why do industrial robotic arm resemble a human arm?
6. What does "six degrees of freedom" mean?
7. How many degrees of freedom do robotic and human arms have?
8. What is the function of the robotic hands' builtin pressure sensors?
9. Why do robots do their work more efficiently than human beings?

Ex.3.2. Decide whether these statements are true or false. Correct the false ones.

1. When engineers created a robot, people thought that they had already created everything possible.
2. Engineers create almost all robots for entertainment nowadays.
3. The most widely spread manufacturing robot is the robotic arm.
4. A special programme in the computer tells the robot not to drop the object it is carrying.
5. Robots are more efficient in their work than human beings because they are smarter.

Ex.3.3. Match the words with their definitions.

1)	actuator	a)	a device that is used to record that something is present or that there are changes in something
2)	joint	b)	a body part or cell that reacts to a stimulus in a particular way
3)	effector	c)	the force you produce when you press something
4)	sensor	d)	the process of making parts of a machine or system work together
5)	segment	e)	a place where two things are fastened together
6)	shoulder	f)	the part of the body between the hand and the arm
7)	elbow	g)	part of a machine or system that moves something or makes something work
8)	wrist	h)	one of the two parts of the body at each side of the neck that join the arms to the rest of the body
9)	pressure	i)	one of the smaller groups or amounts that a larger group or amount can be divided into
10)	operation	j)	the part in the middle of the arm where it bends

Ex.3.4. Match the verbs with their synonyms.

1)	devise	a)	to grab; to capture
2)	resemble	b)	to develop; to design
3)	grasp	c)	to bore
4)	grip	d)	to deliver; to produce
5)	precise	e)	to look like
6)	drill	f)	to specify; to itemize
7)	tighten	g)	to understand; to find out
8)	supply	h)	to drag out

Ex.3.5. Read the text and choose correct items.

History of Industrial Robotics

The earliest known industrial robot, conforming to the ISO definition *was / were* completed by "Bill" Griffith P. Taylor in 1937 and published *at / in* Meccano Magazine, March 1938. The crane-like device was built almost entirely using Meccano parts, and powered *to / by* a single electric motor. Five axes of movement *was / were* possible, including grab and grab rotation. Automation was achieved using punched paper tape to energise solenoids, *who / which* would facilitate the movement of the crane's control levers. The robot *could / was able* stack wooden blocks *in / on* pre-programmed patterns. The number of motor revolutions required for each desired movement was first plotted on graph paper. This information was then *transferred / transferring* to the paper tape, which was also driven by the robot's single motor.

George Devol applied *on / for* the first robotics patents *at / in* 1954 (granted *at / in* 1961). The first company *to produce / produced* a robot was Unimation, founded *with / by* Devol and Joseph F. Engelberger in 1956. Unimation robots were also called programmable transfer machines *for / since* their main use at first was to transfer objects from one point to another, less than a dozen feet or so apart. They *were used / used* hydraulic actuators and were programmed in joint coordinates, i.e. the angles of the various joints were stored during a teaching phase and replayed in operation. They were accurate to *with / within* 1/10,000 of an inch. Unimation later licensed their technology to Kawasaki Heavy Industries and GKN, manufacturing Unimates in Japan and England respectively.

In 1969 Victor Scheinman at Stanford University invented the Stanford arm, an all-electric, 6-axis articulated robot designed *to / for* permit an arm solution. This allowed it accurately - */ to* follow arbitrary paths in *the /* - space and widened

the potential use of the robot to *more / most* sophisticated applications such as assembly and welding. Scheinman then designed a second arm for the MIT AI Lab, called the «MIT arm.»

Industrial robotics took *off / of* quite quickly in Europe, with both ABB Robotics and KUKA Robotics bringing robots to the market in 1973. ABB Robotics introduced IRB 6, among *the /* - world's first commercially available all electric micro-processor controlled robot. The first two IRB 6 robots were sold *in / to* Magnusson in Sweden for grinding and polishing pipe bends and were installed in production *in / on* January 1974.

Interest *in / to* robotics increased in the late 1970s and many US companies entered the field, including large firms like General Electric and General Motors. Westinghouse sold Unimation to Stäubli Faverges SCA of France in 1988, which is still making articulated robots for general industrial and cleanroom applications and even bought the robotic division of Bosch in late 2004. Only *few / a few* non-Japanese companies ultimately managed *to /* - survive in this market, the major ones being: Adept Technology, Stäubli, the Swedish-Swiss company ABB Asea Brown Boveri, the German company KUKA Robotics and the Italian company Comau.

Ex.3.6. Answer the questions to the text above.

1. What did the earliest known industrial robot look like?
2. What were the first industrial robot possibilities?
3. What were the first Unimation robots used for?
4. How accurate were the first Unimation robots?
5. What invention in robotics helped significantly develop assembling and welding?
6. What was the world's first commercially available all electric micro-processor controlled robot used for?
7. When was the boom in robotics?

Ex.3.7. Match the words with their definitions.

1)	axis	a)	a particular way in which something is done, is organized, or happens
2)	solenoid	b)	the space between two lines or surfaces at the point at which they touch each other, measured in degrees
3)	lever	c)	operated by or involving the pressure of water or some other liquid
4)	pattern	d)	a real or imaginary straight line going through the centre of an object that is spinning
5)	dozen	e)	to make something into small pieces or a powder by pressing between hard surfaces
6)	hydraulic	f)	a bar or handle that moves around a fixed point
7)	angle	g)	to curve
8)	assembly	h)	a device, consisting of a wire wrapped in the shape of a cylinder, that acts like a magnet when electricity goes through it
9)	grind	i)	the process of putting together the parts of a machine or structure
10)	bend	j)	a group or collection of twelve

Ex.3.8. Match the words with their opposites.

1)	accurate	a)	roughen
2)	transfer	b)	give
3)	polish	c)	multiple
4)	welding	d)	withdraw
5)	grab	e)	partially
6)	widen	f)	bought
7)	entirely	g)	narrow
8)	single	h)	cutting
9)	sold	i)	inexact

Ex.3.9. Match the words to complete word combinations from the text above.

1)	industrial	a)	rotation
2)	crane-like	b)	patterns
3)	electric	c)	levers
4)	grab	d)	actuators
5)	control	e)	motor
6)	graph	f)	phase
7)	pre-programmed	g)	robot
8)	teaching	h)	paper
9)	hydraulic	i)	device
10)	articulated	j)	robot

Ex.3.10. Read the text and answer the questions below.

Industrial Robots' Structure

A typical industrial robot consists of a tool, an industrial robotic arm, a control cabinet, a control panel, a teach pendant, as well as some other peripheral equipment. So what is what?

A tool is a device designed for a specific task, for example, welding or painting. The robot arm is the thing that moves the tool. But not every industrial robot resembles an arm.

A control cabinet resembles robot's brains. A control panel and a teach pendant make up the user environment. These parts usually come together.

A control panel is intended to be used by operator to do some routine tasks. For example, changing programs or controlling the peripheral devices. Whereas the teach pendant is usually used only in time of programming, although, it can be left connected to the control cabinet if additional memory is needed to execute a program.

An industrial robot can be successfully used instead of a human worker. There are jobs that no one really wants to do. These are those repetitive, tedious jobs that require a lot

of monotonous action from a worker, like picking something from one conveyor to another.

If it is always the same task you could use an automated solution tailored specifically for your needs. What if it's not the case? The situation where a factory needs to be more and more flexible is becoming more and more common. In these cases a reprogrammable robot which can be used for different tasks is the right solution.

Also, you should consider a robot worker for those tasks that are hazardous for a human worker. For example, surface treatment with dangerous chemicals and work in the environment that is hazardous. In many cases like the ones mentioned it is wiser and cheaper in the long term to use a robot than to hire a worker.

And of course, there are jobs that can't be done by a human. Like lifting very heavy weights or working in conditions unsuitable for human life. Again, specific automated solutions can be applied in many of these cases. However, if flexibility is required then a robot should be considered.

1. What does a typical industrial robot consist of?
2. What are the functions of the industrial robot's components?
3. What do some of them resemble?
4. In what kind of work are industrial robots more successful than humans? Give examples.

Ex.3.11. Complete the following sentences. Use them to make a summary of the text.

1) A typical industrial robot consists of … .
2) A tool is a device designed for … .
3) The robot arm is the thing that … .
4) A control cabinet resembles … .
5) A control panel is intended to be used by operator to do … .

6) An industrial robot can be successfully used … .

7) In many cases it is wiser and cheaper in the long term to use a robot … .

Ex.3.12. Complete the sentences with the word combinations from the box.

a control panel *a teach pendant (2)* *flexibility* *an industrial robot* *an industrial robotic arm*

1) A typical industrial robot consists of a tool, … , a control cabinet, a control panel, … , as well as some other peripheral equipment.

2) A control panel and … make up the user's environment.

3) … is intended to be used by operator to do some routine tasks.

4) … can be successfully used instead of a human worker.

5) If … is required then a robot should be considered.

Ex.3.13. Match the sentences' halves to complete full sentences.

1) The robot arm is…	a) … a device designed for a specific task, for example, welding or painting.
2) A tool is…	b) … the thing that moves the tool.
3) An industrial robot can…	c) … intended to be used by operator to do some routine tasks.
4) A control panel is…	d) … make up the user's environment.
5) A control panel and a teach pendant…	e) … be successfully used instead of a human worker.

Ex.3.14. Read the text and answer the questions below.

Basic Components of Robots

The structure of a robot is usually mostly mechanical and is called a ***kinematic chain***. It is functionally similar to the skeleton of human body.

Controller is the brain of the industrial robotic arm and allows the parts of the robot to operate together. It works as a computer and allows the robot to also be connected to other systems. The robotic arm controller runs a set of instructions written in code called a program. The controller is the processing interface between the robot and its environment. It provides intelligence and feedback to the robot through the compilation of the sensor measurements. It also acts as a storage device, retaining the sensory information and inputted programs. The computation engine is generally able to process many tasks at one time and seamlessly changes calculations to account for sensory information. The controller includes the hardware that interfaces with the outside world. It stores the user interface, which is used to input various commands.

Actuators are like muscles of the robot, the parts which convert stored energy into movement. By far the most popular actuators are electric motors that spin a wheel or gear, and linear actuators that control industrial robots in factories. But there are some recent advances in alternative types of actuators, powered by electricity, chemicals, or compressed air.

Sensors allow the robot to gather information about its environment. This information can be used to guide the robot's behavior. Some sensors are relatively familiar pieces of equipment. Other types of sensors are more complex, and give a robot more interesting capabilities. Robots equipped with Light Detection and Ranging (LIDAR) sensors use lasers to construct three dimensional maps of their surroundings as they navigate through the world. Supersonic sensors are a cheaper

way to accomplish a similar goal only using high frequency sound instead of lasers. Sensors allow the robotic arm to receive feedback about its environment. One use of these sensors is to keep two robots that work closely together from bumping into each other. Vision sensors allow a pick and place robot to differentiate between items to choose and items to ignore.

Cameras allow the robot to construct a visual representation of its environment. This allows the robot to judge attributes of the environment that can only be determined by vision, such as shape and color, as well as aid in determining other important qualities, such as the size and distance of objects.

Microphones allow robots to detect sounds. Some robots come equipped with thermometers and barometers to sense temperature and pressure.

1. How is mechanical structure of a robot called?
2. What is the controller?
3. What are the functions of the controller?
4. What are the actuators?
5. What do sensors do?
6. Why do some robots need cameras?
7. What other equipment is used in robots?

Ex.3.15. Match the words with their definitions.

1)	controller	a)	a connection between two pieces of electronic equipment, or between a person and a computer
2)	interface	b)	a piece of computer equipment in which information and instructions can be kept
3)	compilation	c)	the ability to do something
4)	storage device	d)	having or appearing to have height, length, and width

5)	hardware	e)	reaction to a process or activity, or the information obtained from such a reaction
6)	sensor	f)	a device used to operate or control a machine, a computer game, etc.
7)	gear	g)	a collection of information arranged in a list, report, book, etc.
8)	capability	h)	a device that discovers and reacts to changes in such things as movement, heat, and light
9)	three dimensional	i)	the physical and electronic parts of a computer, rather than the instructions it follows
10)	feedback	j)	a device, often consisting of connecting sets of wheels with teeth (= points) around the edge, that controls how much power from an engine goes to the moving parts of a machine

Ex.3.16. Match the verbs with their synonyms.

1)	convert	a)	to perform; to carry out
2)	spin	b)	to hit
3)	accomplish	c)	to estimate; to evaluate
4)	bump	d)	to rotate
5)	judge	e)	to define
6)	determine	f)	to transform; to turn into

Ex.3.17. Match the robot's components with their functions. More than one option is possible.

controller	a)	runs a set of instructions written in code called a program
actuators	b)	allow the robot to gather information about its environment

sensors	c)	allow robots to detect sounds
cameras	d)	is the processing interface between the robot and its environment
microphones	e)	are like the muscles of a robot, the parts which convert stored energy into movement
thermometers	f)	allow the robot to judge attributes of the environment that can only be determined by vision, such as shape and colour, as well as aid in determining other important qualities, such as the size and distance of objects
barometers	g)	works as a computer and allows the robot to also be connected to other systems
	h)	allow a robot to construct a visual representation of its environment
	i)	the brain of the industrial robotic arm
	j)	allow the robotic arm to receive feedback about its environment
	k)	allows the parts of the robot to operate together
	l)	allow robots to sense temperature
	m)	provides intelligence and feedback to the robot through the compilation of the sensor measurements
	n)	are electric motors that spin a wheel or gear
	o)	allow robots to sense pressure
	p)	acts as a storage device, retaining the sensory information and inputted programs
	q)	are either relatively familiar pieces of equipment or more complex, and give a robot more interesting capabilities

r) recently can be powered by electricity, chemicals, or compressed air
s) stores the user interface, which is used to input various commands
t) allow a pick and place robot to differentiate between items to choose and items to ignore

Ex.3.18. Complete the sentences with the words or word combinations from the box.

a computer	*human body*	*electric motors*
a visual representation		*lasers*
the processing interface		*sensory information*

1. The structure of a robot is similar to the skeleton of … .
2. The controller works as … and allows the robot to also be connected to other systems.
3. The controller is … between the robot and its environment.
4. The computation engine is generally able to process many tasks at one time and seamlessly changes calculations to account for … .
5. By far the most popular actuators are … that spin a wheel or gear.
6. Robots equipped with Light Detection and Ranging (LIDAR) sensors use … to construct three dimensional maps of their surroundings.
7. Cameras allow a robot to construct … of its environment.

Ex.3.19. Read the text and answer the questions below.

Mechanical Structure of Robot

Depending on the type of robot and the application, the mechanical structure of a robot can be divided into two parts, the main manipulator and a wrist assembly. The manipulator

will position the end effector while the wrist will control its orientation.

The work envelope is the space that can be reached by the end of the robot arm. All interaction between the robot, and other machines, parts and processes must take place within the work envelope.

The structure of a robot consists of a number of links and joints. A joint will allow relative motion between two links. Two types of joints are used: a revolute joint to produce rotation and a linear prismatic joint. To achieve complete control of the end effectors position and orientation a minimum of six joints are required. The basic robot arm has three joint; this allows the tool at the end of the arm to be positioned anywhere in the robots working envelope. Even though there are a large number of robot configurations that are possible, only five configurations are commonly used in industrial robotics.

1. What are the two main parts of the mechanical structure of a robot?
2. What are their functions?
3. What is the work envelope?
4. What is a joint?
5. What are the two types of joints used in robots?
6. How many joints are possible in the robot structure?

Ex.3.20. Match the terms with their definitions.

1) main manipulator	a) device or tool that's connected to the end of a robot arm where the hand would be
2) wrist assembly	b) movable components of the robot that cause relative motion between adjacent links
3) end effector	c) rigid members connecting the joints

4) work envelope	d) joint that provides a linear sliding movement between two bodies
5) links	e) the main device used to manipulate materials without direct contact
6) joints	f) the particular arrangement or pattern of a group of related things
7) revolute joint	g) device that provides a plurality of movable arm sections having a tool supporting wrist at the outer end
8) prismatic joint	h) the entire work area that a robot can reach and operate in
9) tool	i) one-degree-of-freedom kinematic pair used in mechanisms
10) configuration	j) a piece of equipment that you use to help you do a job

Ex.3.21. Read the text and answer the questions below.

Technical Description of Industrial Robots

- *Number of axes* – two axes are required to reach any point in a plane; three axes are required to reach any point in space. To fully control the orientation of the end of the arm (i.e. the *wrist*) three more axes (yaw, pitch, and roll) are required.
- *Degrees of freedom* – this is usually the same as the number of axes.
- *Working envelope* – the region of space a robot can reach.
- *Kinematics* – the actual arrangement of rigid members and joints in the robot, which determines the robot's possible motions. Classes of robot kinematics include articulated, cartesian, parallel and SCARA.
- *Carrying capacity or payload* – how much weight |a robot can lift.
- *Speed* – how fast the robot can position the end of its arm. This may be defined in terms of the angular or linear

speed of each axis or as a compound speed i.e. the speed of the end of the arm when all axes are moving.

- *Acceleration* – how quickly an axis can accelerate. Since this is a limiting factor a robot may not be able to reach its specified maximum speed for movements over a short distance or a complex path requiring frequent changes of direction.
- *Accuracy* – how closely a robot can reach a commanded position. When the absolute position of the robot is measured and compared to the commanded position the error is a measure of accuracy. Accuracy can be improved with external sensing for example a vision system or Infra-Red. Accuracy can vary with speed and position within the working envelope and with payload.
- *Repeatability* – how well the robot will return to the programmed position. This is not the same as accuracy. It may be that when told to go to a certain X-Y-Z position that it gets only to within 1 mm of that position. This would be its accuracy which may be improved by calibration. But if that position is taught into controller memory and each time it is sent there it returns to within 0.1mm of the taught position then the repeatability will be within 0.1mm.
- *Motion control* – for some applications, such as simple pick-and-place assembly, the robot need merely return repeatably to a limited number of pre-taught positions. For more sophisticated applications, such as welding and finishing (spray painting), motion must be continuously controlled to follow a path in space, with controlled orientation and velocity.
- *Power source* – some robots use electric motors, others use hydraulic actuators. The former are faster, the later are stronger and advantageous in applications such as spray painting, where a spark could set off an explosion; however, low internal air-pressurisation of the arm can prevent ingress of

flammable vapours as well as other contaminants. Nowadays, it is highly unlikely to see any hydraulic robots in the market. Additional sealings, brushless electric motors and spark-proof protection eased the construction of units that are able to work in the environment with an explosive atmosphere.

- *Drive* – some robots connect electric motors to the joints via gears; others connect the motor to the joint directly (direct drive). Using gears results in measurable 'backlash' which is free movement in an axis. Smaller robot arms frequently employ high speed, low torque DC motors, which generally require high gearing ratios; this has the disadvantage of backlash. In such cases the harmonic drive is often used.
- *Compliance* – this is a measure of the amount in angle or distance that a robot axis will move when a force is applied to it. Because of compliance when a robot goes to a position carrying its maximum payload it will be at a position slightly lower than when it is carrying no payload. Compliance can also be responsible for overshoot when carrying high payloads in which case acceleration would need to be reduced.

1. How many axes are required to reach any point in a plane and in space?
2. What is another name for number of axes?
3. What is a working envelope?
4. What does determine the robot's possible motions?
5. What is carrying capacity?
6. What defines the robot's speed?
7. What is acceleration?
8. What is the difference between accuracy and repeatability?
9. When is motion control more important?
10. What are the kinds of power source?
11. What kinds of drives are used in robots?
12. What is compliance?

Ex.3.22. Decide if the statements are true or false.

1. Three axes are enough to fully control the orientation of the end of the arm.
2. Degrees of freedom control orientation of the end of the arm.
3. Kinematics determines the robot's possible motions.
4. Robot's speed is the linear speed of its main axis.
5. Repeatability may be improved by calibration.
6. Motion control is very important for sophisticated applications, such as welding and finishing (spray painting).
7. Hydraulic robots are very popular now.
8. Backlash is the disadvantage of a direct drive.
9. The robot's axis changes its position slightly when it has a payload.

Ex.3.23. Match the terms with their definitions.

1)	joint	a)	the speed at which an object is travelling
2)	capacity	b)	the fact of something such as a bomb exploding
3)	payload	c)	a place where two things are fastened together
4)	calibration	d)	a strong, negative reaction to something, esp. to change
5)	velocity	e)	a device, often consisting of connecting sets of wheels with teeth around the edge, that controls how much power from an engine goes to the moving parts of a machine
6)	explosion	f)	the total amount that can be contained or produced
7)	gear	g)	the act of spending more than originally planned

8)	ratio	h)	the units of measurement marked on an instrument so that it can measure accurately
9)	backlash	i)	the amount of goods that a robot can carry
10)	overshoot	j)	a comparison of two numbers calculated by dividing

Ex.3.24. Match the words in the first column to the ones in the second column to complete word combinations from the text above.

1)	working	a)	sensing
2)	carrying	b)	control
3)	angular or linear	c)	motor
4)	external	d)	capacity
5)	programmed	e)	atmosphere
6)	motion	f)	envelope
7)	power	g)	protection
8)	electric	h)	position
9)	hydraulic	i)	drive
10)	spark-proof	j)	speed
11)	explosive	k)	source
12)	direct	l)	actuator

Ex.3.25. Match the sentences' halves.

1)	To fully control the orientation of the end of the arm…	a)	… to reach its specified maximum speed for movements over a short distance or a complex path requiring frequent changes of direction.
2)	Kinematics determines…	b)	...which is free movement in an axis.
3)	Speed may be defined in terms of…	c)	…speed and position within the working envelope.

4) Since acceleration is a limiting factor, a robot may not be able…	d) …six axes are required.
5) Accuracy can vary with…	e) …to follow the path in space, with controlled orientation and velocity.
6) Repeatability is how well the robot…	f) …the angular or linear speed of each axis or as a compound speed.
7) For sophisticated applications, motion must be continuously controlled…	g) …the robot's possible motions.
8) Low internal air-pressurisation of the arm can…	h) …it will be at a position slightly lower than when it is carrying no payload.
9) Using gears results in measurable 'backlash'…	i) … returns to the programmed position.
10) Because of compliance when a robot goes to a position carrying its maximum payload…	j) … prevent ingress of flammable vapours as well as other contaminants.

Ex.3.26. Read the text and answer the questions below.

Robot Programming and Interfaces

The setup or programming of motions and sequences for an industrial robot is typically taught by linking the robot controller to a laptop, desktop computer or (internal or Internet) network.

A robot and a collection of machines or peripherals are referred to as a workcell, or cell. A typical cell might contain a parts feeder, a molding machine and a robot. How the robot interacts with other machines in the cell must be programmed.

*Software.*The computer is installed with corresponding interface software. The use of a computer greatly simplifies the

programming process. There are two basic entities that need to be taught (or programmed): positional data and procedure. For example, in a task to move a screw from a feeder to a hole the positions of the feeder and the hole must first be taught or programmed. Secondly the procedure to get the screw from the feeder to the hole must be programmed, for example, a signal to indicate when the screw is in the feeder ready to be picked up. The purpose of the robot software is to facilitate both these programming tasks.

Teaching the robot positions may be achieved by a number of ways:

Positional commands. The robot can be directed to the required position using a text based commands in which the required X-Y-Z position may be specified and edited.

Teach pendant. Robot positions can be taught via a teach pendant. This is a handheld control and programming unit. The common features of such units are the ability to manually send the robot to a desired position and adjust the position. They also have a means to change the speed since a low speed is usually required for careful positioning, or while test-running through a new or modified routine. A large emergency stop button is usually included as well. Typically once the robot has been programmed there is no more use for the teach pendant.

Lead-by-the-nose – this is a technique offered by many robot manufacturers. In this method, one user holds the robot's manipulator, while another person enters a command which de-energizes the robot causing it to go into limp. The user then moves the robot by hand to the required positions and/or along a required path while the software logs these positions into memory. The program can later run the robot to these positions or along the taught path. This technique is popular for tasks such as paint spraying.

Offline programming is where the entire cell, the robot and all the machines or instruments in the workspace are mapped

graphically. The robot can then be moved on screen and the process simulated. A robotics simulator is used to create embedded applications for a robot, without depending on the physical operation of the robot arm and end effector.

Robot simulation tools allow for robotics programs to be conveniently written and debugged off-line with the final version of the program tested on an actual robot. The ability to preview the behavior of a robotic system in a virtual world allows for a variety of mechanisms, devices, configurations and controllers to be tried and tested before being applied to a «real world» system.

Others. In addition, machine operators often use user interface devices, typically touchscreen units, which serve as the operator control panel. The operator can switch from program to program, make adjustments within a program and also operate a host of peripheral devices that may be integrated within the same robotic system. These include end effectors, feeders that supply components to the robot, conveyor belts, emergency stop controls, machine vision systems, safety interlock systems, barcode printers and a great number of other industrial devices which are accessed and controlled via the operator control panel.

The teach pendant or PC is usually disconnected after programming and the robot then runs on the program that has been installed in its controller. However a computer is often used to ‘supervise’ the robot and any peripherals, or to provide additional storage for access to numerous complex paths and routines.

1. How is programming of motions and sequences for an industrial robot typically taught?
2. What is a workcell (cell)?
3. What two options must be programmed in the programming process?

4. What kinds of commands are used to direct a robot to the required position?
5. How does teach pendant work?
6. How many times can teach pendant be used?
7. What is lead-by-the-nose technique?
8. What is the advantage of offline programming?
9. What is the purpose of robot simulation?
10. What can an operator do using the control panel?

Ex.3.27. Match the words with their definitions.

1)	laptop	a)	fixed into the surface of something
2)	peripheral	b)	a circuit conductor between the power supply source and a final branch circuit over current device
3)	embedded	c)	using somebody's hands
4)	feeder	d)	a connection between two pieces of electronic equipment, or between a person and a computer
5)	software	e)	something dangerous or serious, such as an accident, that happens suddenly or unexpectedly and needs fast action in order to avoid harmful results
6)	interface	f)	a piece of equipment that can be connected to a computer
7)	facilitate	g)	to move or develop slowly and with difficulty
8)	manually	h)	the instructions that control what a computer does; computer programs
9)	emergency	i)	to make something possible or easier
10)	limp	j)	a computer that is small enough to be carried around easily and is flat when closed

Ex.3.28. Complete the text with the words from the box.

transport	*flow*	*hazardous*	*place*	*welds*
substrate	*paths*	*clean*	*thin*	*pattern*

Applications of Industrial Robots

Industrial robots are used in a variety of applications. These include:

A_____

Capable of manipulating products as diverse as car doors to eggs, industrial robots are fast and powerful as well as dexterous and sensitive. Applications include pick and 1)… from conveyor line to packaging, and machine tending, where raw materials are fed by the robot into processing equipment such as with injection molding machines, CNC mills and lathes and presses.

B_____

Industrial robots load corrugated cartons or other packaged items onto a pallet in a defined 2)… . Robotic palletizers rely on a fixed position or overhead gantry robot with special tooling that interfaces with the individual load components, building simple to complex layer patterns on top of a pallet that maximize the load's stability during 3)… . There are three primary types of palletizing: inline or layer forming, depalletizing or unloading, and mixed case.

C_____

Due to their dangerous nature, laser, plasma and water jet cutters are frequently used with robots. Hundreds of different cutting 4)… can be programmed into the robot, which produces precise accuracy and path following with greater flexibility than most dedicated cutting machines.

D_____

Multi-axis robots can grind, trim, fettle, polish and 5)… almost any part made in any material for a consistent quality finish.

E_____

To apply sealant or glue, a robot follows a path accurately with good control over speed while maintaining a consistent bead of the adhesive 6)… . Robots are frequently used for sealing applications in the car industry to seal in windows.

F_____

Due to the volatile and 7)… nature of solvent-based paints and coatings, robots are used in spray applications to minimize human contact. Paint robots typically have 8)… arms because they don't carry much weight, but need maximum access and movement fluidity to mimic a human's application technique.

G_____

Used for both seam (MIG, TIG, arc and laser) and spot welding, robots produce precise 9)…, as well as control parameters such as power, wire feed and gas 10)… .

Ex.3.29. Choose the best headline for paragraphs A–G.

1. Sealing and gluing
2. Finishing
3. Spraying
4. Handling
5. Welding
6. Palletizing
7. Cutting

Ex.3.30. Complete the text with the words from the box.

inspection	*sensors*	*sample*	*freedom*	*lander*
perform	*known*	*uses*	*cameras*	

Notable Robotic Arms

In space, the Space Shuttle Remote Manipulator System also 1)… as Canadarm or SRMS and its successor Canadarm 2 are examples of multi degree of 2)… robotic

arms. These robotic arms have been used to 3)… a variety of tasks such as 4)… of the Space Shuttle using a specially deployed boom with 5)… and 6)… attached at the end effector, and also satellite deployment and retrieval manoeuvres from the cargo bay of the Space Shuttle.

The *Curiosity* rover on the planet Mars also 7)… a robotic arm.

TAGSAM is a robotic arm for collecting a 8)… from a small asteroid in space on the spacecraft OSIRIS-REx.

The 2018 Mars 9)… InSight has a robotic arm called the IDA which has camera, grappler, and is used to move special instruments.

Unit 4. UNDERWATER ROBOTICS

Ex.4.1. Read the text and answer the questions below.

Marine Robotics in Oceanic Engineering

The world's oceans cover 2/3 of the earth's surface and have been critical to human welfare throughout history. As in ancient times, they enable the transport of goods between nations. Presently, the seas represent critical sources of food and other resources such as oil and gas. In the near term, we may soon see the emergence of offshore mining for metals as well as the exploitation of gas hydrates. Conversely, the ocean can also threaten human safety and damage infrastructure through natural phenomena such as hurricanes and tsunamis.

Scientific understanding of the deep sea is expanding rapidly through the use of a variety of technologies. The first scientific explorations were conducted primarily through the use of diving and human occupied submersibles, complemented by a variety of other technologies such as towed or lowered instruments, trawls, dredges, autonomous seafloor instruments, and deep sea drilling. More recently remotely operated and autonomous vehicles have begun to revolutionize seafloor exploration, often returning superior data products at reduced costs. In the near future, seafloor observatories linked by fiber optic cables and satellites will return massive amounts of data from coastal and deep sea sites. These observations will complement those from conventional expeditionary investigations, and will require teleoperated or robotic intervention during installation and for service.

Offshore oil and gas installations are presently serviced almost exclusively by Remotely Operated Vehicles (ROVs), physically connected via a tether to receive power and data, with human divers used only for the most shallow installations. Subsea systems require extensive work capability during installation, and need frequent inspection and intervention to support drilling operations, actuate valves, repair or replace subsea components, and to accomplish a variety of tasks required to maintain production rates and product quality. The trend toward robotic and teleoperated subsea intervention is certain to continue as offshore oil and gas production moves into deeper waters, and economic considerations push key production steps from surface platforms to the seafloor. Remotely operated manipulators enable these systems to perform complex tasks such as debris removal, cleaning using abrasive tools and to operate a variety of nondestructive testing tools. The effectiveness of using ROVs decreases with depth mainly due to the cost increase and the difficulties of handling the long tether.

Autonomous Underwater Vehicles (AUVs) are free-swimming, unoccupied underwater vehicles that can overcome the limitations imposed by ROV tethers for some tasks. Such vehicles carry their own energy supplies (presently batteries, perhaps fuel cells in the future) and communicate only through acoustics and perhaps optical links in the near future. Limited communications require these vehicles to operate independently of continuous human control, in many cases the vehicles operate completely autonomously.

AUVs are currently used for scientific survey tasks, oceanographic sampling, underwater archeology and under-ice survey. Military applications, such as mine detection and landing site survey, are presently operational, and more ambitious applications such as long-term undersea surveillance are in engineering development. Presently, AUVs are incapable

of sampling or manipulations tasks like those done routinely by ROVs, as typical work environments tend to be complex and challenging even to skilled human pilots.

1. What is the role of the seas and oceans for mankind?
2. How were the first scientific explorations of the seas conducted?
3. What revolutionized seafloor exploration?
4. How are offshore oil and gas installations presently serviced?
5. Why is robotic and teleoperated subsea intervention getting more popular?
6. What is an Autonomous Underwater Vehicle?
7. What are the applications of AUVs?

Ex.4.2. Decide if the sentences are true or false.

1. The ocean provides very important resources to people.
2. The first scientific explorations were conducted with the presence of a human.
3. Revolution in seafloor exploration occurred when human began to dive much deeper than he used to.
4. Offshore oil and gas installations are presently serviced mostly by human divers.
5. Robotic and teleoperated subsea intervention tends to be used in offshore oil and gas production due to economic reasons.
6. AUVs are more efficient than ROVs in depth because their tethers are much longer.
7. Autonomous Underwater Vehicles are totally autonomous and carry their own energy supplies.
8. Acoustics is the only way for AUVs to communicate with humans.
9. Autonomous Underwater Vehicles are currently unable to be used for military purposes.

10. Presently, AUVs are unable to do all the tasks done routinely by ROVs.

Ex.4.3. Complete the sentences with the words from the box.

ROVs	*unoccupied*	*explore*	*ROV*	*AUV*
provide	*Offshore*	*military*	*dangerous*	*tether*

1) Oceans … water, transport ways, food, oil and gas.

2) Oceans can be … because they cause hurricanes and tsunamis.

3) We must … oceans to use transport ways; food (fish); oil and gas; and to predict hurricanes, tsunamis.

4) … is Remotely Operated Vehicle.

5) ROVs are physically connected to the main system via a … to receive power and data.

6) … is Autonomous Underwater Vehicle.

7) AUVs are freeswimming, … underwater vehicles.

8) … oil and gas installations use ROVs in water to clean them, to remove debris, to check if they have any damages.

9) Offshore oil and gas installations can't use … in deep waters because it's difficult to handle a very long tether.

10) AUVs are used for scientific research (oceanographic sampling, underwater archeology and under-ice survey) and for … purposes (mine detection).

Ex.4.4. Put the stages of scientific exploration of the ocean in correct order.

Seafloor observatories linked by fiber optic cables and satellites; human occupied submersibles + different tools; ROVs and AUVs; people diving.

Ex.4.5. Complete the table to compare ROVs and AUVs.

ROVs	AUVs
Physically connected with a tether to the main system.	
	Can swim freely.
Get energy via a tether from the main system.	
	Communicate through acoustics (optical links in the near future).
	Used to do scientific research and in military applications (mine detection, landing site survey, etc.).

Ex.4.6. Match the words with their definitions.

1)	valve	a)	having only a short distance from the top to the bottom
2)	offshore	b)	a device that opens and closes to control the flow of liquids or gases
3)	submersible	c)	bottom of the sea
4)	shallow	d)	to remove unwanted things from the bottom of a river, lake, etc.
5)	dredge	e)	away from or at a distance from the coast
6)	debris	f)	a type of ship that can travel underwater
7)	vehicle	g)	a device sent up into space to travel around the earth
8)	fiber optic	h)	broken or torn pieces of something larger
9)	satellite	i)	a rope or chain used to tie something to a fixed place

10)	intervention	j)	something used to transport people or goods
11)	tether	k)	glass or plastic fibers used to send light that contains information or images around curves
12)	seafloor	l)	the act or fact of becoming involved intentionally in a difficult situation

Ex.4.7. Match the verbs with their synonyms.

1)	complement	a)	to support; to sustain; to keep
2)	drill	b)	to take; to invade; to capture
3)	maintain	c)	to get over
4)	remove	d)	to complete; to supplement; to elaborate
5)	occupy	e)	to collect samples; to try
6)	overcome	f)	to bore
7)	sample	g)	to find out; to discover
8)	detect	h)	to delete

Ex.4.8. Match the words in the columns to complete word combinations from the text above.

1)	offshore	a)	submersibles
2)	human occupied	b)	intervention
3)	seafloor	c)	mining
4)	fiber optic	d)	Vehicle
5)	robotic	e)	detection
6)	Remotely Operated	f)	exploration
7)	debris	g)	cables
8)	abrasive	h)	sampling
9)	oceanographic	i)	removal
10)	mine	j)	tools

Ex.4.9. Complete the text with the words from the box.

military	*law*	*vehicles*	*commercial*	*purposes*
dangerous	*submerged*	*gyroscopic*		
underwater	*remotely*	*design*		

Historical Background

Boats have been used by humans before recorded history, but 1)… able to go under water are more recent. Perhaps the first recorded idea of an 2)… machine came from Aristotle: according to legend he built the skaphe andros (boat-man) that allowed Alexander the Great to stay 3)… for at least half a day during the war of Tiro in 325 B.C. This is probably unrealistic, if true it would precede Archimedes's 4)… first articulated approximately in 250 B.C.

Leonardo Da Vinci may have been the first to 5)… an underwater vehicle. His efforts were recorded in the Codex Atlanticus, written between 1480 and 1518. Legends say that Leonardo worked on the idea of an underwater 6)… machine but he destroyed the results as he judged them to be too 7)… .

The first use of feedback theory for marine control was probably the Northseeking device, patented in 1908, that used 8)… principals to develop the first autopilot. From that point, the use of feedback theory in the marine control grew continuously. It is interesting to notice that the PID (Proportional Integral Derivative) control commonly used today in numerous industrial applications, was first formally analyzed in 1929 by Minorsky. The first 9)… operated underwater vehicle, POODLE was built in 1953, and the ROV evolved through the 1960s and 1970s mostly for military 10)… . In the 1980s ROVs became established for use in the commercial offshore industry and began to emerge for scientific applications. The first tetherless, autonomous vehicles were built for experimental purposes in the 1970s.

Currently, AUVs are becoming increasingly commonplace for scientific, military, and 11)… applications.

Ex.4.10. Put the sentences into correct historical order.

1. ROVs became established for use in the commercial offshore industry and began to emerge for scientific applications.
2. The Northseeking device was patented.
3. Leonardo worked on the idea of an underwater military machine.
4. Boats have been used by humans before recorded history.
5. The first recorded idea of an underwater machine came from Aristotle.
6. The first tetherless, autonomous vehicles were built for experimental purposes.
7. The Archimedes's law was first articulated.
8. The first remotely operated underwater vehicle POODLE was built.
9. AUVs are becoming increasingly commonplace for scientific, military, and commercial applications.
10. The Proportional Integral Derivative was first formally analyzed by Minorsky.

Ex.4.11. Match the events with the dates they occurred.

325 B.C.	a)	The first remotely operated underwater vehicle (ROV) POODLE was built.
250 B.C.	b)	ROVs became used in the commercial offshore oil and gas industry and for scientific applications.
1480 – 1518	c)	The first autonomous underwater vehicles (AUVs) were built.
1908	d)	Leonardo Da Vinci may have designed an underwater vehicle.

1953	e)	AUVs are becoming very important for scientific (oceanographic sampling, underwater archeology and under-ice survey), military (mine detection), and commercial applications (offshore oil and gas mining).
The 1960s – 1970s	f)	Aristotle designed the skaphe andros (boat-man).
The 1970s	g)	Archimedes's law was first articulated.
The 1980s	h)	ROVs evolved for military purposes.
Currently	i)	The Northseeking device was invented.

Ex.4.12. Put the verbs in correct forms.

An autonomous underwater vehicle _____ (be) a robot that _____ (travel) underwater without _____ (require) input from an operator. AUVs _____ (constitute) part of a larger group of undersea systems _____ (know) as unmanned underwater vehicles, a classification that _____ (include) non-autonomous remotely operated underwater vehicles (ROVs) –_____ (control) and _____ (power) from the surface by an operator/pilot via an umbilical or _____ (use) remote control. In military applications an AUV is more often _____ (refer) to as an unmanned undersea vehicle (UUV). Underwater gliders _____ (be) a subclass of AUVs.

Ex.4.13. Read the text and choose the best headline (1–7) for each paragraph (A–E). You don't need two of them.

1. Air crash investigations
2. Military applications
3. Illegal research

4. Scientific Research
5. Hobby
6. Cargo carrying
7. Commercial (oil and gas industry)

Applications of Underwater Robotics

Until relatively recently, AUVs have been used for a limited number of tasks dictated by the technology available. With the development of more advanced processing capabilities and high yield power supplies, AUVs are now being used for more and more tasks with roles and missions constantly evolving.

A_____

The oil and gas industry uses AUVs to make detailed maps of the seafloor before they start building subsea infrastructure; pipelines and subsea completions can be installed in the most cost effective manner with minimum disruption to the environment. The AUV allows survey companies to conduct precise surveys of areas where traditional bathymetric surveys would be less effective or too costly. Also, post-lay pipe surveys are now possible, which includes pipeline inspection. The use of AUVs for pipeline inspection and inspection of underwater man-made structures is becoming more common.

B_____

AUVs are used to study lakes, the ocean, and the ocean floor. A variety of sensors can be affixed to AUVs to measure the concentration of various elements or compounds, the absorption or reflection of light, and the presence of microscopic life. Examples include conductivity-temperature-depth sensors (CTDs), fluorometers, and pH sensors. Additionally, AUVs can be configured as tow-vehicles to deliver customized sensor packages to specific locations.

An example of an AUV interacting directly with its environment is the Crown-Of-Thorns Starfish Robot (COTSBot),

created by the Queensland University of Technology (QUT). This autonomous robot is able to identify the Crown-Of-Thorns Starfish (Acanthaster planci) using a neural network , which are harmful to the Great Barrier Reef, and inject the starfish with a lethal dose of bile salts, eradicating the threat.

C_____

Many roboticists construct AUVs as a hobby. Several competitions exist which allow these homemade AUVs to compete against each other while accomplishing objectives. Like their commercial brethren, these AUVs can be fitted with cameras, lights, or sonar. As a consequence of limited resources and inexperience, hobbyist AUVs can rarely compete with commercial models on operational depth, durability, or sophistication. Finally, these hobby AUVs are usually not oceangoing, being operated most of the time in pools or lake beds. A simple AUV can be constructed from a microcontroller, PVC pressure housing, automatic door lock actuator, syringes, and a DPDT relay. Some participants in competitions create open-source designs.

D_____

Autonomous underwater vehicles, for example AUV ABYSS, have been used to find wreckages of missing airplanes, e.g. Air France Flight 447, and the Bluefin-21 AUV was used in the search for Malaysia Airlines Flight 370.

E_____

The U.S. Navy Unmanned Undersea Vehicle (UUV) Master Plan identified the following UUV's missions:

- Intelligence, surveillance, and reconnaissance
- Mine detection
- Anti-submarine warfare
- Inspection/identification
- Oceanography
- Communication/navigation network nodes

- Payload delivery
- Information operations
- Time-critical strikes

Ex.4.14. Answer the questions to the text above.

1. Why are AUVs being used for more tasks now than they used to?
2. How does the oil and gas industry use AUVs?
3. What is the purpose of using AUVs for scientific research?
4. Where can AUVs made by hobbyists be used?
5. What military missions of AUVs are identified?
6. What else can AUVs be used for?

Ex.4.15. Decide if the statements are true or false.

1. The development of more advanced processing capabilities and high yield power supplies has increased the possibilities of using AUVs.
2. The oil and gas industry uses AUVs to extract (take out) oil and gas from the ocean floor.
3. They rarely use AUVs for pipeline inspection and inspection of underwater man-made structures.
4. AUVs can investigate lakes, the ocean, and the ocean floor with the help of a variety of sensors affixed.
5. Hobbyists usually make AUVs for entertainment.
6. Homemade AUVs can't compete with commercial models because of lack of resources and experience.
7. Rescue teams use AUVs for searching parts of missing airplanes.
8. The use of AUVs for military purposes is unlimited.

Ex.4.16. Put the words in correct order to make sentences.

1. were / tasks / past / used / for / a / AUVs / in / number / limited / of / the.

2. detailed / oil and gas / AUVs / to / The / make / maps / uses / seafloor / of / the / industry.

3. AUVs / The / use / of / becoming / for / is / more / inspection / common / pipeline.

4. of / sensors / concentration / can / be / to / AUVs / to / measure / the / of / elements / A / variety / various / the / in / water / affixed.

5. are / other / There / competitions / AUVs / allow / homemade / to / against / compete / which / each / several.

6. airplanes / wreckages / vehicles / missing / Autonomous / are / to / underwater / used / find / of.

Ex.4.17. Complete the text with appropriate phrases from the list.

AUVs' Design

Hundreds of different AUVs have been designed over the past 50 or so years, but only a few companies 1)_____ . There are around 10 companies that sell AUVs on the international market.

Vehicles range in size from 2)_____ to large diameter vehicles of over 10 metres length. Large vehicles have advantages in terms of 3)_____; smaller vehicles benefit significantly from lower logistics (for example: support vessel footprint; launch and recovery systems).

The market is effectively split into three areas: 4)_____ applications. The majority of these roles utilize a similar design and operate in a cruise (torpedo-type) mode. They collect 5)_____ at speeds between 1 and 4 knots.

Commercially available AUVs include various designs, such as the small REMUS 100, the larger HUGIN 1000 and 3000, the Bluefin Robotics 12-and-21-inch-diameter (300 and 530 mm) vehicles. Most AUVs follow 6)_____ as this

is seen as the best compromise between size, usable volume, hydrodynamic efficiency and ease of handling. There are some vehicles that make use of a modular design, enabling components to be changed easily by the operators.

7)_____ and designs are now following commercial requirements rather than being purely developmental. Upcoming designs include hover-capable AUVs for inspection and light-intervention (primarily for the offshore energy applications), and hybrid AUV/ROV designs that 8)_____ as part of their mission profile. Again, the market will be driven by 9)_____ and expensive ship time.

As of 2008, a new class of AUVs are being developed, which mimic designs found in nature. Although most are currently in their experimental stages, these biomimetic (or bionic) vehicles are able to 10)_____ by copying successful designs in nature. Two such vehicles are Festo's AquaJelly (AUV) and the EvoLogics BOSS Manta Ray.

a) data while following a preplanned route
b) man portable lightweight AUVs
c) the market is evolving
d) endurance and sensor payload capacity
e) achieve higher degrees of efficiency in propulsion and maneuverability
f) sell vehicles in any significant numbers
g) scientific, commercial offshore (oil and gas, etc.) and military
h) the traditional torpedo shape
i) financial requirements and the aim to save money
j) switch between roles

Ex.4.18. Answer the questions to the text above.

1. How many companies sell AUVs on the international market?

2. What are the advantages of large and smaller AUVs?
3. What are the three main applications of AUVs?
4. What is the average speed of AUVs for collecting data?
5. What are the examples of commercially available AUVs?
6. What is the traditional shape for most AUVs and why?
7. What requirements are AUVs' designs following now?
8. What are the upcoming designs?
9. What are the advantages of the new class AUVs which mimic designs found in nature?

Ex.4.19. Decide if the sentences are true or false.

1. Hundreds of different AUVs have been designed over the half a century.
2. Less than a dozen companies sell AUVs internationally.
3. Almost all AUVs are approximately of the same size.
4. Large AUVs can be equipped with a larger number of sensors than smaller ones.
5. The AUV's design is usually determined by its application.
6. Torpedo shape is the most spread one in AUVs due to its technical characteristics.
7. Modular design is difficult to maintain.
8. The market of AUVs follows scientific purpose first of all.
9. Some vehicles can combine the functions of AUVs and ROVs.
10. A new class of AUVs has designs copied from nature.

Ex.4.20. Match the words with their definitions.

1)	logistics	a)	to operate or control something that could be difficult or dangerous
2)	vessel	b)	to change or develop gradually
3)	footprint	c)	a large boat or a ship
4)	knot	d)	a force that pushes something forward
5)	handle	e)	the careful organization of a complicated activity so that it happens in a successful and effective way
6)	portable	f)	ability to make a planned action that is intended to obtain an advantage
7)	evolve	g)	the mark made by something
8)	propulsion	h)	light and small enough to be easily carried or moved
9)	maneuverability	i)	a long, thin bomb that travels underwater in order to destroy the ship at which it is aimed
10)	torpedo	j)	a measure of the speed of ships

Ex.4.21. Read the text and answer the questions below.

Sensors

AUVs carry sensors to navigate autonomously and map features of the ocean. Typical sensors include compasses, depth sensors, sidescan and other sonars, magnetometers, thermistors and conductivity probes. Some AUVs are outfitted with biological sensors including fluorometers (also known as chlorophyll sensors), turbidity sensors, and sensors to measure pH, and amounts of dissolved oxygen.

Navigation

Radio waves cannot penetrate water very far, so as soon as an AUV dives it loses its GPS signal. Therefore, a standard way for AUVs to navigate underwater is through dead reckoning.

Navigation can however be improved by using an underwater acoustic positioning system. When operating within a net of sea floor deployed baseline transponders this is known as LBL navigation. When a surface reference such as a support ship is available, ultra-short baseline (USBL) or short-baseline (SBL) positioning is used to calculate where the sub-sea vehicle is relative to the known (GPS) position of the surface craft by means of acoustic range and bearing measurements. To improve estimation of its position, and reduce errors in dead reckoning (which grow over time), the AUV can also surface and take its own GPS fix. Between position fixes and for precise maneuvering, an Inertial Navigation System on board the AUV calculates through dead reckoning the AUV position, acceleration, and velocity.

Propulsion

There are a couple of propulsion techniques for AUVs. Some of them use a brushed or brush-less electric motor, gearbox, Lip seal, and a propeller which may be surrounded by a nozzle or not. All of these parts embedded in the AUV construction are involved in propulsion. Other vehicles use a thruster unit to maintain the modularity. Depending on the need, the thruster may be equipped with a nozzle for propeller collision protection or to reduce noise submission, or it may be equipped with a direct drive thruster to keep the efficiency at the highest level and the noises at the lowest level. Advanced AUV thrusters have a redundant shaft sealing system to guarantee a proper seal of the robot even if one of the seals fails during the mission.

Underwater gliders do not directly propel themselves. By changing their buoyancy and trim, they repeatedly sink and ascend; airfoil «wings» convert this up-and-down motion to forward motion. The change of buoyancy is typically done through the use of a pump that can take in or push out water. The vehicle's pitch can be controlled by changing the center of mass of the vehicle. For Slocum gliders this is done internally by

moving the batteries, which are mounted on a screw. Because of their low speed and low-power electronics, the energy required to cycle trim states is far less than for regular AUVs, and gliders can have endurances of months and transoceanic ranges.

Power

Most AUVs in use today are powered by rechargeable batteries (lithium ion, lithium polymer, nickel metal hydride etc.), and are implemented with some form of Battery Management System. Some vehicles use primary batteries which provide perhaps twice the endurance – at a substantial extra cost per mission. A few of the larger vehicles are powered by aluminum based semi-fuel cells, but these require substantial maintenance, require expensive refills and produce waste product that must be handled safely. An emerging trend is to combine different battery and power systems with supercapacitors.

1. What is the function of AUVs' sensors?
2. What are the examples of AUVs' sensors?
3. What is the standard way for AUVs to navigate underwater?
4. What are the other ways for AUVs to navigate underwater?
5. What do propulsion techniques for AUVs usually use?
6. What may thruster be equipped with for a good propulsion?
7. What kind of propulsion system do underwater gliders use?
8. What are most AUVs powered by today?
9. What is the emerging trend in AUVs' power systems?

Ex.4.22. Decide if the statements are true or false.

1. AUVs need sensors to navigate deep under water successfully.

2. Sensors are used to investigate deep water environment.

3. AUVs use GPS signal to navigate as radio waves cannot penetrate water very far.

4. Dead reckoning is the second popular way to navigate under water after GPS.

5. Underwater Acoustic Positioning System is useless for underwater navigation.

6. The most successful navigation is provided by using dead reckoning, Inertial Navigation System and GPS signal combined together.

7. There is a unique propulsion system used by AUVs.

8. Thruster is used in underwater gliders as a propulsion unit.

9. All AUVs today use batteries as a power system.

10. Combining different batteries and power systems with supercapacitors is supposed to increase endurance and efficiency of missions.

Ex.4.23. Match the terms with their definitions.

1)	glider	a)	a narrow piece attached to the end of a tube
2)	compass	b)	the force produced by a system for moving a vehicle or other object
3)	sonar	c)	a device for finding direction with a needle that can move easily and that always points to magnetic north
4)	propulsion	d)	the ability to continue doing something for a long time
5)	gearbox	e)	an aircraft that has long fixed wings and no engine and flies by gliding
6)	nozzle	f)	a propulsive device used by watercraft for station keeping, attitude control
7)	thruster	g)	the ability to float

8) endurance h) a metal box containing the gears in a vehicle
9) buoyancy i) equipment, especially on a ship, that uses sound waves to discover how deep it is

Ex.4.24. Match the words from the columns to complete terms from the text above and explain their meanings.

1)	depth	a)	positioning
2)	dissolved	b)	thruster
3)	short-baseline	c)	probes
4)	conductivity	d)	oxygen
5)	precise	e)	motor
6)	brushed electric	f)	glider
7)	lip	g)	maneuvering
8)	direct drive	h)	batteries
9)	underwater	i)	seal
10)	rechargeable	j)	sensors

Ex.4.25. Decide which of the following groups do these terms belong to.

Rechargeable batteries, nozzle, compasses, depth sensors, thruster, brushed electric motor, sidescan, dead reckoning, nickel metal hydride, sonars, buoyancy, precise maneuvering, Lip seal, magnetometers, noise submission, short-baseline (SBL) positioning, gearbox, underwater acoustic positioning system, thermistors, conductivity probes, lithium ion, underwater gliders, fluorometers, endurance, turbidity sensors, propeller, ultra-short baseline positioning, lithium polymer, brush-less electric motor, redundant shaft sealing system, supercapacitors.

Sensors	Navigation	Propulsion	Power

Ex.4.26. Complete the text with the words from the box.

temperature	*causes*	*discharge*	*glacier*
enter	*underwater*	*salinity*	*rise*
	autonomous	*scientists*	

EcoSUB AUV to Explore Hostile Arctic Environment

An 1)… robotic vehicle will go on an Arctic research mission deemed too dangerous for humans in a bid to help 2)… understand the true extent of melting from Arctic glaciers.

A team from the Scottish Association for Marine Science (SAMS) in Oban will deploy a small 3)… underwater vehicle (AUV) known as an ecoSUB to the foot of a melting 4)… in Arctic Norway. The aim is to learn more about the effect of meltwater on a process called 'calving', which 5)… huge chunks of ice to break off the glacier edge.

Less than a metre in length and just four kilogrammes in weight, the ecoSUB will 6)… one of the most hostile environments on the planet to take measurements such as 7)… and 8)… . The work will give researchers a clearer picture of how warming ocean properties affect the calving process.

ecoSUB's readings will help researchers better understand the process of sub-glacial 9)…, a term given to melt water that flows down through the glacier and out into the ocean. This water is fresher than the surrounding sea water, so starts to 10)… in the water column, creating a plume that pulls in warmer Atlantic water. As it rises, it circulates and creates a sandpaper effect against the face of the glacier. This process undermines the wall of ice, causing huge chunks to collapse into the sea.

Unit 5. TYPES OF ROBOTS

Ex.5.1. Read the text and choose the best option for each question below.

Robots and Androids

Engineers are trying to make computers think and behave like humans. By combining Artificial Intelligence and engineering techniques, they are building many different types of robots and androids.

Robots are devices that move and react to sensory input. They usually contain software that runs automatically, without the intervention of a person. Today, robots are used in a wide variety of contexts, from factories to space exploration. We drive cars that have been welded by industrial robots; we buy products that have been made and packaged by robots in an assembly line; we use machines that have been built by them.

Our life is affected by robotics in many other ways. Tiny computers are used to monitor the heart rate and blood pressure, micromachines and insect-sized robots help doctors in heart operations and other complicated surgery. In the future, tiny robotic creatures, called Nanobots, will be injected into the human body and move through the arteries, curing illnesses.

Robots are also used in dangerous situations – for example, in repairing nuclear plants, cleaning toxic waste and defusing bombs. Robotics has also been incorporated into the first smart homes, where there are gadgets that regulate the central heating, sensors that control the solar panels, robot maids that do the housework, etc.

Some research centers are even building Androids – robots that have the shape and capabilities of a human being. In the near future, androids will be available for sale. They will have access to the Internet, be a guide for the blind, assist elderly people at home; they could even be a 24-hour security guard for your home, sounding the alarm in case of fire and phoning the police if there is a burglary.

1. Which word could best describe robots that look like human beings?

a. androids-robots

b. Nanobots

c. engineers

2. The stage of mass production in which parts of a product move along for progressive assembly is called … .

a. research centers

b. factories

c. hospital

3. We can say that the study and use of robots could refer to … .

a. hospital

b. nuclear plants

c. research centers

4. According to the passage, “tiny robotic creatures” mean … .

a. androids

b. security guard

c. nanobots

5. In smart homes, what is integrated to be functioned?

a. robotics

b. nanobots

c. androids

6. What are the techniques of the engineers to build different types of robot and android?

a. They combine Artificial Intelligence and engineering techniques together.

b. They combine Artificial Intelligence and mathematics together.

c. They combine engineering techniques and calculus formulas together.

7. We use robots to help people in many ways nowadays, except…?

a. in assembling cars

b. in packing things

c. in doing clearance sales

8. In medical system, why do we need to create 'Nanobots'?

a. to help doctor cure illnesses

b. to be able to go to blood stream

c. to save people's lives

9. What kind of dangerous situation that the robots could work for people?

a. doing housework

b. fixing things in nuclear plants

c. being helper for blind

10. Is the android-robot available for sale now?

a. not yet

b. hopefully

c. yes, but expensive

11. What is inside robots which make them run automatically?

a. software contains human voice

b. software with remote control

c. independent software

12.… help doctor in heart operations and difficult surgery.

a. insect-sized robots

b. micro-machines
c. monitor

Ex.5.2. Read the text and complete it with the types of robots given below.

Types of Robots by Application

Nowadays, robots do a lot of different tasks in many fields and the number of jobs entrusted to robots is growing steadily. That's why one of the best ways how to divide robots into types is a division by their application.

1)… are robots used in an industrial manufacturing environment. Usually these are articulated arms specifically developed for such applications as welding, material handling, painting and others. This type could also include some automated guided vehicles and other robots.

2)… have been designed for the purpose of rescuing people. Common situations that employ rescue robots are mining accidents, urban disasters, hostage situations, and explosions. The benefits of rescue robots to these operations include reduced personnel requirements, reduced fatigue, and access to otherwise unreachable areas.

3)… are used in medicine and medical institutions. They include surgical robots which are in most telemanipulators and rehabilitation robots tailored for assisting different sensorimotor functions (e.g. arm, hand, leg, ankle), assisting therapeutic training, and sensorimotor performance (ability to move) of patient.

4)… are different data gathering robots; robots made to show off technologies; robots used for research, etc., for instance, underwater robots, to maintain offshore oil and gas installations.

5)… are autonomous robots or remote-controlled mobile robots designed for military applications, from transport to search & rescue and attack. This type of robots includes bomb

disposal robots, different transportation robots, reconnaissance drones. Often robots initially created for military purposes can be used in law enforcement, search and rescue and other related fields.

6)… are robots used in space as a separate type to explore space and planets' surfaces; they can withstand harsh conditions, like extreme temperatures or high levels of radiation. Robots can also do things that would be too risky or impossible for astronauts. This type of robots is used on the International Space Station.

7)… are robots used at home. This type of robots includes many quite different devices such as robotic vacuum cleaners, robotic pool cleaners, sweepers, gutter cleaners and other robots that can do different chores.

8)… are used for entertainment. This is a very broad category. It starts with toy robots such as the running alarm clock and ends with real heavyweights such as articulated robot arms used as motion simulators.

a) Space robots
b) Industrial robots
c) Entertainment robots
d) Military robots
e) Medical robots
f) Domestic or household robots
g) Rescue robots
h) Service robots

Ex.5.3. Answer the questions to the text above.

1. What are the types of robots by applications?
2. What is the most spread industrial robot?
3. In what situations and why are rescue robots used?
4. What are the main functions of medical robots?
5. What kind of robots is used for scientific research?

6. What are the functions of military robots?
7. Why are robots more efficient in space works than human astronauts?
8. How can usually household robots help people?
9. Give examples of entertainment robots.

Ex.5.4. Decide if the statements are true or false according to the text above. Correct the false ones.

1. The articulated arm is the only industrial robot.
2. Rescue robots are highly important because in some situations they can do the work that people physically can't perform.
3. Some medical robots can replace patient's part of body if necessary.
4. The underwater robot is a kind of industrial robots.
5. Military robots have a wide range of applications.
6. Space robots do the work that could be done by people but it's cheaper to use robots.
7. Household robots can make people's everyday lives much more relaxing.
8. Entertainment robots are of a great importance for scientific researches due to their simulation abilities.

Ex.5.5. Rearrange the letters in the brackets to complete the following sentences.

1) (STIMECDO) type of robots includes many quite different devices such as robotic vacuum cleaners, robotic pool cleaners, sweepers, gutter cleaners and other robots that can do different chores.

2) (DUINSTRIAL) robots are used in an industrial manufacturing environment.

3) (LIRAMITY) type of robots includes bomb disposal robots, different transportation robots, reconnaissance drones.

4) Toy robots are considered to be (ERTENNTTAINME) robots.

5) Robots made to show off technologies, robots used for research are (VERSICE) robots.

Ex.5.6. Match the types of robots with their functions.

Types of Robots	**Functions of Robots**
1) Industrial robots	a) gathering data; showing off technologies; maintenance of offshore oil and gas installations
2) Rescue robots	b) vacuum cleaning, pool cleaning, sweeping, gutter cleaning
3) Medical robots	c) transport, search, rescue, attack, bomb disposal
4) Military robots	d) helping people in urban disasters, hostage situations, and explosions
5) Space robots	e) entertaining
6) Service robots	f) exploring space and planets' surfaces; space walks
7) Domestic or household robots	g) assisting sensorimotor functions, therapeutic training, and sensorimotor performance (ability to move) of patient
8) Entertainment robots	h) welding, material handling, painting

Ex.5.7. Complete the table below.

Type of robots	**Application**
	Exploring the site and sending colour images to Earth

	Helping during operations, assisting surgeons
Industrial robots	
Military robots	
	Using as motion simulators
Domestic robots	

Ex.5.8. Complete the text with the words from the box.

conditions	*dangerous*	*teams*	*supplies*
earthquake	*durability*	*victims*	*trapped*
designed	*mobile*	*flood*	*navigate*	*discovery*

Rescue Robots

Rescue operations can greatly benefit from robotics technology. After a natural disaster such as an 1)… or 2) …, it is often very dangerous for teams of rescue workers to go into affected areas to locate 3) … . The idea behind robots for rescue activities is to create robust robots that can travel into areas too 4)… for humans and rescue dogs. Robots can be used to assess the situation (e.g. the integrity of a building) and to locate people who may be 5)… and to relay the location back to the rescue 6)…, so that all efforts can be concentrated on areas where victims are known to be.

Robots are also being 7)… to travel faster and cover greater areas than teams of humans can, reducing the time between a natural disaster and 8)… of victims. Robots are also being developed to carry items such as medical 9)… and food to known victims, thereby focusing resources where need is known to be greatest.

The main research issues within the field of 10)… robotics for search and rescue missions focus on 11)… and usability of robots – how to design robots that are easily transported, can

function efficiently in all weather 12)… and that have long lasting power, and robots that can 13)… themselves and have effective enough sensors to pick out victims.

Ex.5.9. Answer the questions to the text above.

1. What is the idea behind robots for rescue activities?
2. How can robots help resque teams?
3. What are the advantages of robots compared to humans in resque activities?

Ex.5.10. Read the text and answer the questions below.

Robots in Medicine and Pharmacy

Robotic surgery is a type of surgical procedures that is done using robotic systems. Robotically-assisted surgery was developed to try to overcome the limitations of pre-existing minimally-invasive surgical procedures and to enhance the capabilities of surgeons performing open surgery.

In the case of robotically-assisted minimally-invasive surgery, instead of directly moving the instruments, the surgeon uses one of two methods to administer the instruments. These include using a direct telemanipulator or through computer control. A telemanipulator is a remote manipulator that allows the surgeon to perform the normal movements associated with the surgery. The robotic arms carry out those movements using end-effectors and manipulators to perform the actual surgery. In computer-controlled systems, the surgeon uses a computer to control the robotic arms and its end-effectors, though these systems can also still use telemanipulators for their input. One advantage of using the computerized method is that the surgeon does not have to be present, leading to the possibility for remote surgery.

Rehabilitation robot is any automatically operated machine that is designed to improve movement in persons

with impaired physical functioning. There are two main types of rehabilitation robots. The first type is an assistive robot that substitutes for lost limb movements. An example is the Manus ARM (assistive robotic manipulator), which is a wheelchair-mounted robotic arm that is controlled using a chin switch or other input device.

The second type of rehabilitation robot is a therapy robot, which is sometimes called a rehabilitator. Research in neuroscience has shown that the brain and spinal cord retain a remarkable ability to adapt, even after injury, through the use of practiced movements. Therapy robots are machines or tools for rehabilitation therapists that allow patients to perform practice movements aided by the robot.

Robotic prosthetic limb is a well-established research area that integrates advanced mechatronics, intelligent sensing, and control for achieving higher order lost sensorimotor functions while maintaining the physical appearance of amputated limb. Robotic prosthetic limbs are expected to replace the missing limbs of an amputee restoring the lost functions and providing aesthetic appearance. The main aspects are enhanced social interaction, comfortable amputee's life, and productive amputee to the society. With the advancement of sensor technology, in the last few decades significant contributions have been made in this area. Much of the work is still in the research stage and more research and development work is anticipated in the coming years where the ultimate goal is to produce a device which can generate human-like motions.

Pharmacy automation involves the mechanical processes of handling and distributing medications. Any pharmacy task may be involved, including counting small objects (*e.g.,* tablets, capsules); measuring and mixing powders and liquids for compounding; tracking and updating customer information in databases (e.g., personally identifiable information (PII),

medical history, drug interaction risk detection); and inventory management.

1. What are the applications of robots in medicine and pharmacy?
2. What are the two methods to administer instruments in surgery?
3. What is the advantage of using computerized method?
4. What are the two main types of rehabilitation robots?
5. What are the functions of rehabilitation robots?
6. What is robotic prosthetic limb?
7. What are the main purposes of robotic prosthetic limb?
8. How can robots be used in pharmacy?

Ex.5.11. Decide if the statements are true or false.

1. Robotically-assisted surgery was developed to minimize the invasion of surgical procedures.
2. Using direct telemanipulator allows to carry out remote controlled surgeries.
3. Rehabilitation robot may substitute for lost limb movements.
4. Therapy robots help patients adapt to their disability.
5. Robotic prosthetic limb is a device that looks like an amputated limb.
6. The main goal of scientists in Robotic prosthetic limb area is to produce a device which can generate human-like motions.
7. Robots can be used to prescribe medicines to patients.
8. Robots in pharmacy help do routine work.

Ex.5.12. Match the words with their definitions.

1) surgery	a)	done by cutting into or putting something into the body

2)	invasive	b)	a treatment that helps someone feel better, grow stronger, etc., especially after an illness
3)	rehabilitation	c)	the process of returning to a healthy or good way of life
4)	assistive	d)	the set of nerves inside the spine that connect the brain to other nerves in the body
5)	limb	e)	the treatment of injuries or diseases in people or animals by cutting open the body and removing or repairing the damaged part
6)	chin switch	f)	an artificial body part, such as an arm, foot, or tooth, that replaces a missing part
7)	therapy	g)	designed for people who have physical difficulties and need help
8)	spinal cord	h)	most extreme or important because either the original or final, or the best or worst
9)	prosthetic	i)	an arm or leg of a person or animal
10)	ultimate	j)	a small device pushed up or down with your chin that controls and turns on or off some other device

Ex.5.13. Match the verbs with their synonyms.

1)	enhance	a)	to hold
2)	impair	b)	to spread; to extend
3)	retain	c)	to make worse
4)	adapt	d)	to fallow; to trace; to watch
5)	overcome	e)	to conform; to adjust
6)	maintain	f)	to substitute

7)	distribute	g)	to foresee; to look forward
8)	track	h)	to strengthen; to increase
9)	replace	i)	to cover; to get over
10)	anticipate	j)	to support; to sustain

Ex.5.14. Read the text and choose the best headline (1–6) for each paragraph (A–D). You don't need two of them.

1. History of Manned Space Robots
2. History of Unmanned Space Robots
3. Recent Unmanned Space Missions
4. Recent Manned Space Missions
5. Types of Space Robots
6. Space Robots Description

Space Robots

A_____

Space robots are the most effective tool in space exploration. The most famous robots in space include orbiters, rovers and landers. Robots are widely being used wherever there is a need for better use of tools and data collection in space.

Robots play a vital role in exploring the hostile environment of outer space. Besides the Earth, the Moon is the only celestial body that humans have stepped on. However, advancements in research are making it possible for robotic missions to reach space faster and gather more information than humans. Robots don't get tired, can operate in airless environment and do not get bored or distracted, making them superior to humans in a lot of ways. The future of deep space exploration, with transit times in the order of decades will surely be carried out by unmanned robots.

Space robots are of various sizes and shapes, which include robot arms, e.g. the Space Shuttle Remote Manipulator System; rovers – Sojourner; landers – Mars Pathfinder; atmospheric

probes – Huygens Titan probe; orbiters – Galileo; and planetary flyby probes – Voyagers 1 and 2.

In general, all space robots have the same components that include a power supply, controller, actuators, sensors and radio communication unit. These sensors collect information about the robot and its environment, the controller processes the information and control instructions, and transmits the command signals to the actuators. The actuators in turn convert the signals and execute the operation.

Autonomous robots are operated independently as the long transmission ranges of radio waves prevent the remote control of such robots in real-time. Rovers that encounter craters, cliffs, rocks and other dangers are operated based on this concept.

B_____

Remotely operated vehicles (ROV) and remote manipulator system (RMS) are the two major types of space robots. A typical ROV can be a rover moving over the terrain upon landing, a lander operated from a stationary point and is in contact with an extra-terrestrial plain or an unmanned spacecraft.

So far, RMS has performed various functions on NASA space missions, by acting as a positioning and anchoring device, remote assembly device and grappler.

C_____

Robotic spacecrafts are mainly used for space exploration activities taking place where the distance and hostility deems the mission too unsafe to send humans.

From 1966 to 1968, a series of Surveyor spacecraft were sent to the Moon. The surveyors triggered by remote control signals sent a number of images back to Earth and analyzed solid samples collected using an extendible claw. The US then planned its manned Apollo Moon missions based on this information.

The first mobile robot to investigate an extra-terrestrial region was the Soviet Lunokhod 1 lunar rover. This rover landed in the surface of Moon in 1970, and it was remote-controlled by

the Soviet technologists. One of the important functions of this robot was its ability to autonomously detect an event of turn over and stop and wait until it received signal from the scientists.

Another interesting and practical application of ROVs is the unmanned deep space probes. For instance, the Voyager 2 is programmed to automatically adjust its operations without requiring any direct human interaction. Launched in 1977, the Voyager 2 has proved itself as one of the greatest unmanned space missions by enabling the scientists to view Neptune, Uranus, Saturn and Jupiter, the planets that humans are unable to collect information from.

D_____

One cutting edge use of unmanned space robotics is NASA's Dawn spacecraft, launched in 2007 to investigate the giant protoplanet Vesta and the dwarf planet Ceres. It is the first mission to orbit an object in the asteroid belt between Mars and Jupiter, and the only spacecraft ever to orbit two destinations beyond earth. Dawn orbited Vesta in 2011–2012 and is currently orbiting and investigating Ceres.

Another ground-breaking use of space robotics is the Rosetta spacecraft, a 10-year mission launched in 2004 to intercept a comet and land a probe on. The mission would take Rosetta into deep space, over five times the Earth's distance from the Sun. This mission achieved many historic firsts, such as being the first spacecraft to orbit a comet's nucleus and take images and the first touchdown on a comet.

Ex.5.15. Answer the questions to the text above.

1. What is the role of robots in exploring outer space?
2. What are the examples of space robots?
3. What are the two major types of space robots?
4. What were the functions of the first rover?
5. What is the purpose of unmanned deep space probes?
6. What are the recent unmanned space missions?

Ex.5.16. Match the words with their definitions.

1)	hostile	a)	unfriendly and not liking something
2)	celestial	b)	a spacecraft designed to land on the surface of a planet or moon
3)	unmanned	c)	of or from the sky or outside this world
4)	rover	d)	a spacecraft that orbits a planet or other celestial body
5)	lander	e)	the landing of an aircraft or of some types of spacecraft
6)	space probe	f)	not having or not needing people to operate or work
7)	orbiter	g)	a small vehicle that can move over rough ground, often used on the surface of other planets
8)	spacecraft	h)	any work that someone believes it is their duty to do
9)	touchdown	i)	a vehicle used for travel in space
10)	mission	j)	robotic spacecraft that does not orbit Earth, but instead, explores further into outer space

Ex.5.17. Match the sentences halves.

1)	Space robots are the most…	a)	…the Soviet Lunokhod 1 lunar rover.
2)	Space robots are…	b)	… investigate the giant protoplanet Vesta and the dwarf planet Ceres.
3)	All space robots have the same components that include…	c)	…of various sizes and shapes.
4)	Remotely operated vehicles and remote manipulator system are…	d)	… effective tool in space exploration.

5)	The first mobile robot to investigate an extra-terrestrial region was…	e)	…a power supply, controller, actuators, sensors and radio communication unit.
6)	The Voyager 2 is programmed to…	f)	…the two major types of space robots.
7)	NASA's Dawn spacecraft was launched in 2007 to…	g)	…intercept a comet and land a probe on.
8)	The Rosetta spacecraft was launched in 2004 to…	h)	… automatically adjust its operations without requiring any direct human interaction.

Ex.5.18. Complete the text with the words from the box.

reproduce	*sensors*	*molecular*	*nonsense*
suggested	*viruses*	*emerging*	*nanometer*
	entrants	*micro surgery*	

Nanorobots

Nanorobotics is the 1)… technology field of creating machines or robots whose components are at or close to the microscopic scale of a 2)… (10^{-9} meters). Also known as «nanobots» or «nanites», they would be constructed from 3)… machines. So far, researchers have mostly produced only parts of these complex systems, such as bearings, 4)…, and synthetic molecular motors, but functioning robots have also been made such as the 5)… to the Nanobot Robocup contest. Researchers also hope to be able to create entire robots as small as 6)… or bacteria, which could perform tasks on a tiny scale. Possible applications include 7)… (on the level of individual cells), utility fog, manufacturing, weaponry and cleaning. Some people have 8)… that if there were

nanobots which could 9)…, the earth would turn into "grey goo", while others argue that this hypothetical outcome is 10)… .

Ex.5.19. Put the words in correct order to make sentences.

1) is / Nanorobotics / whose / the / nanometer / microscopic / field / creating / of / machines / components / at / are / the / scale / technology / of / a.

2) molecular / would / Nanorobots / be / from / machines / constructed.

3) parts / so / Researchers / mostly / produced / far / complex / only / of / these / have / systems.

4) create / small / as / Researchers / to / entire / robots / viruses / as / or / hope / bacteria.

5) tiny / perform / on / Nanorobots / scale / could / tasks / a.

Ex.5.20. Read the text and answer the questions below.

Robot Teachers

If you think of the jobs robots could never do, you would probably put doctors and teachers at the top of the list. It's easy to imagine robot cleaners and factory workers, but some jobs need human connection and creativity. But are we underestimating what robots can do? In some cases, they already perform better than doctors at diagnosing illness. Also, some patients might feel more comfortable sharing personal information with a machine than a person. Could there be a place for robots in education after all?

British education expert Anthony Seldon thinks so. And he even has a date for the robot takeover of the classroom: 2027. He predicts robots will do the main job of transferring information and teachers will be like assistants. Intelligent robots will read students' faces, movements and maybe even brain signals. Then they will adapt the information to each student. It's not a popular opinion and it's unlikely robots will

ever have empathy and the ability to really connect with humans like another human can.

One thing is certain, though. A robot teacher is better than no teacher at all. In some parts of the world, there aren't enough teachers and 9–16 per cent of children under the age of 14 don't go to school. That problem could be partly solved by robots because they can teach anywhere and won't get stressed, or tired, or move somewhere for an easier, higher-paid job.

Those negative aspects of teaching are something everyone agrees on. Teachers all over the world are leaving because it is a difficult job and they feel overworked. Perhaps the question is not 'Will robots replace teachers?' but 'How can robots help teachers?' Office workers can use software to do things like organise and answer emails, arrange meetings and update calendars. Teachers waste a lot of time doing non-teaching work, including more than 11 hours a week marking homework. If robots could cut the time teachers spend marking homework and writing reports, teachers would have more time and energy for the parts of the job humans do best.

1. What can robots do better than humans? Add your ideas.
2. What will robots do in a classroom in 2027 according to Anthony Seldon?
3. What is the obvious advantage of robot teachers compared to human ones?
4. How could robots help human teachers do their work?

Ex.5.21. Decide if the statements are true or false. Correct the false ones.

1. Some jobs seem as if they can be done by robots or computers.
2. Robots are always better at diagnosing illness than doctors.

3. Many experts agree robots will replace teachers by 2027.

4. One advantage of robot teachers is that they don't need to rest.

5. Robot assistants could help teachers by marking homework.

6. Some teachers use robots to reduce their time answering emails and marking homework.

Ex.5.22. Match the words with their definitions.

1)	takeover	a)	the ability to think of new ideas
2)	adapt	b)	to think something is less than it is
3)	underestimate	c)	to work out what kind of illness someone has
4)	empathy	d)	when someone takes control of something, like a job or a place
5)	diagnose	e)	to change something so that it fits better
6)	creative	f)	the ability to deeply understand someone's situation or feelings

Ex.5.23. Choose the best answer.

1. Anthony Seldon thinks teachers will … in the future.
a. help robots in classroom.
b. teach students.
c. no longer exist.
2. Robots will probably never …
a. have human understanding of emotions.
b. be a popular choice for teachers.
c. be intelligent enough to work in education.
3. Some parts of the world …
a. pay robots to teach.
b. already use robots in teaching jobs.
c. have a shortage of teachers.

4. Teachers …
a. work harder than office workers.
b. have less help than office workers.
c. leave their jobs to become office workers.
5. Robots could …
a. empathise with students.
b. mark homework.
c. prepare lessons.

Ex.5.24. Read the text and complete the table below.

Smarter Robots

It won't be much longer before Star Wars-like robots, which can think and move by themselves, will be part of our everyday lives. Following robotic vacuums, which sell over 3,000 units a month in South Korea, robots will be developed and launched commercially for education, medical and military purposes. Experts are predicting explosive growth in the Korean robotics market. This is why, along with the automakers and mobile phone producers, the robot industry is cited as one of the industries expected to be a driving-force behind the nation's economic growth in the future. These days robots are mainly used in industrial capacities such as automobile and semiconductor plants. However, the robot market is seeing exponential growth, as intelligent robots have been developed thanks to the combination of cutting-edge technologies, like information technology and artificial intelligence.

To start with, the volume of the domestic robot market is expected to grow. The industry expects the sales of cleaning robots will also skyrocket to 200,000 in 2022. Experts say that the demand for intelligent robots will rise due to the lack of labour resulting from an aging population and a fall in the birth rate.

Then, Yujin Robotics has developed an educational robot called "Jupiter", which is programmed to read children English children's books. If children get bored with listening to stories, the robot can even resort to singing and dancing to draw the attention of youngsters. "Jupiter updates itself by downloading 200 children's stories and songs from a computer via the wireless Internet," said Yujin Robotics president Shin Kyung-chul.

Dasa Tech has also completed the development of security guard robots in cooperation with security service company Samsung SI. Equipped with surveillance cameras in their eyes, the robots monitor the inside and outside of a house and take pictures of suspicious people and intruders. The pictures are transmitted to the headquarters of Samsung SI. Dasa Tech researcher Choi Chang-hyuk said that security guard robots can find intruders early, enabling security firm staff to get to the scene in time.

Firefighting robots developed by Dongil Fatec will be placed in public areas, like subway stations and museums. These robots, which are connected to the water supply, can penetrate deep into the flames and extinguish fires at their core.

The use of robots for military purposes is also fast becoming a reality. A mine locater robot "ROBHA", developed by Yujin robotics, sounds the alarm when it detects explosives, like mines, poisonous gas and radioactive materials. Military experts point to a future where robots will replace human soldiers on the battlefields.

Commerce, Industry and Energy Ministry official Yoo Chung-yeol, proclaimed that there will be one robot per family by 2020 and the volume of the robot market by that time will exceed that of the car industry. If it is nurtured early, the robot industry could be a source of great economic growth for the country, just as the semiconductor, the cell phone and automobile industries have been, Yoo added.

The trends that brought AI and robotics from the early failures to breakthrough success will continue. Computers will get more powerful. Software will get cleverer. AI will creep closer toward human capabilities. And a frightening question is whether AI robots could get smarter than humans and turn the tables on us. In South Korea, most people have a bright outlook. They believe that AI robots will simply make the world a better place.

Robot's name	*Type of robot*	*Company that produces the robot*	*Functions performed by the robot*

Ex.5.25. The following statements are false. Correct them using your own words.

1. Despite their use in factories, robotic devices haven't reached people's homes yet.
2. South Korean citizens are mainly interested in buying robots for home entertainment.
3. Dasa Tech robots photograph guests after they enter the house.

Ex.5.26. Complete the text with the words from the box.

in need	*avoid*	*inspire*	*stabilization*
the elderly	*smoothly*	*series*	*culmination*
	select	*added to*	

In 1986, Honda engineers set out to create a walking robot. Early models focused on developing legs that could simulate the walk of a human. The next 1)… of models were focused on walk 2)… and stair climbing. Next, a head, body and arms were 3)… the robot to improve balance. Therefore, ASIMO

is the 4)… of two decades of humanoid robotics research by Honda engineers. ASIMO can run, walk on uneven slopes and surfaces, turn 5)… , climb stairs, and reach for and grasp objects. ASIMO can also comprehend and respond to simple voice commands. ASIMO has the ability to recognize the face of a 6)… group of individuals. Using its camera eyes, ASIMO can map environment and 7)… moving obstacles.

As development continues on ASIMO, today Honda demonstrates ASIMO around the world to 8)… young students to study the sciences. And in the future, ASIMO may serve as another set of eyes, ears, hands and legs for all kinds of people 9)… . Someday ASIMO might help with assisting 10)… or a person confined to a bed or a wheelchair.

Ex.5.27. Read the text and fill in the gaps (1-6) with a correct sentence A-G. One sentence is extra.

A. How has the iCub robot been equipped to help scientists research this idea?

B. Also, it has been programmed with 53 different movements.

C. In short, they will be able to build robots that can actually think!

D. What's more, it will investigate it, then store what it has learnt.

E. It isn't made of flesh and blood, though; it's made of metal and circuits.

F. A baby, for instance, learns many things simply by touching, smelling or seeing objects around it.

G. Do you dream of a future where robots can think and make their own decisions?

The Toddler Robot

A. It is only one metre high. It looks and behaves like a human child of about three. It can crawl and sit up. It can

even play the drums. 1) _____ What is it? It's the iCub robot – the latest in artificial intelligence and technology! The humanoid iCub robot was created by scientists at the Italian Institute of Technology in Genoa, Italy, in order to understand how human children learn about the world around them. This is important because scientists believe that once they understand how human beings learn, they will be able to apply these principles to robots.

B. _____ How can a robot teach scientists about how humans learn? Well, many scientists believe that one way humans learn is by physically interacting with objects and other humans. 2) _____ So, by building a robot with a physique that is as human as possible, scientists can study how our physical form helps us develop our learning abilities.

C. _____ 3) _____ Well, it has a large number of motors in its body that generate movement in the head, arms, hands and legs. It has cameras for eyes and it listens with two tiny microphones on its head that record sounds. 4)_____ This enables the iCub to rawl, walk and even pick up objects in its hand in a similar way to a toddler.

D. _____ On the outside, the iCub looks like a small child. However, a child will interact with interest to what it sees. 5)_____ The iCub robot has only just managed to 'learn' how to control its eye movements based on external stimuli. That's a long way from being able to learn by interacting with its surroundings the way a child does.

E. _____ 6) _____ If so, you could be in for a long wait! Nevertheless, the iCub – and robots like it – demonstrate that one day it should be possible to introduce 'thinking' robots into the workplace. Places such as hospitals and residential care homes could use these robots to assist with patient care. If the iCub experiment succeeds, many busy doctors and nurses will get a helping hand with their workload. Meanwhile, the iCub research team are patiently waiting

and watching – much like normal parents – to see how their 'child' learns as it grows up!

Ex.5.28. Answer the questions to the text above.

1. Why have scientists modelled the iCub on a baby human?
2. How can 'thinking' robots be useful to us?
3. What is the author's purpose?

Ex.5.29. Decide if the statement are true or false.

1. The robot can think for itself.
2. It is modelled on a baby human.
3. It works in hospitals.
4. It can't respond to the environment like a human.

Ex.5.30. Find words in the text which mean:

1) act (para A)
2) most recent (para A)
3) have a human shape and appearance (para A)
4) rules (para A)
5) body structure (para B)
6) advance (para B)
7) produce (para C)
8) outside (para D)
9) things which cause us to react (para D)
10) communicate (para D)
11) show (para E)

Ex.5.31. Use the completed phrases to write or say sentences about the iCub.

1) …team
2) …object
3) …care home
4) …being

5) …hand
6) …intelligence

Ex.5.32. Read the text and fill in the table below.

Is 'AIBO' a Robot-Like Dog or a Dog-Like Robot?

It is a funeral like any other in Japan. Except that those being honoured are robot dogs, lined up on the altar, each wearing a tag to show where they came from and which family they belonged to. Some Japanese owners of robot dog AIBO believe their 'pets' have souls.

The devices are 'AIBOs', the world's first home-use entertainment robot equipped with Artificial Intelligence (AI) and capable of developing its own personality. Sony rolled out the first-generation AIBO in June 1999, with the initial lot of 3,000 selling out in just 20 minutes, despite the hefty 250,000 yen (more than $2,000) price tag. Over the following years, more than 150,000 units were sold, in numerous iterations, ranging from metallic-silver versions to round-faced cat-like models.

The dog came with a range of sensors, a camera and microphone. The final generation could even talk, sense and express their "feelings".

By 2006, Sony was in trouble: its business model was broken and it was facing fierce competition from rivals in all fields. The AIBO, an expensive and somewhat frivolous luxury, had to go. The company kept its AIBO Clinic open until March 2014, but then – politely – told dedicated and loving owners that they were on their own.

For Hideko Mori, 70, that nearly spelled disaster. Mori has had her AIBO for around eight years. She enjoyed the conversations she had with it, and thought it far more convenient than a real puppy. 'He doesn't require feeding and I never thought there was a limit to his life,' she said. But in May last year her beloved AIBO became immobile.

'I e-mailed a former Sony engineer (on behalf of the dog), saying: 'Do I have no choice but to die like this because I can't walk?',' she said. The engineer introduced her to A FUN, a company that employs former Sony engineers, who fixed her machine in two months.''I was so happy to see him back to health and at home,' she said.

Hiroshi Funabashi, 61, who supervises repairs at A FUN, said troubled AIBO owners think of him more as a doctor than an engineer.

'I don't know if people will develop affection towards a new generation of robots in five, six years' time,' he said. 'But for those who keep AIBOs, they are nothing like home appliances. It's obvious they think their (robotic pet) is a family member and not an ordinary electrical device,' he said.

Date	*Event*
June 1999	
	Manufacturer of 'AIBO' – Sony – decided not to continue 'AIBO' production
March 2014	
May 2014	

Ex.5.33. Read the text and decide if the statements below are true or false.

Sony Shows off Jogging Robot

In 2003 Sony showed a new version of its QRIO robot that could jog at a top speed of 14 metres per minute.

Running is a much more difficult task for a robot to perform as both of the machine's feet must be off the floor at the same time. Sony said the QRIO jogging robot was the result of three years of work but that it had no plans to put it on sale like the AIBO robot dog. QRIO stands for "quest for curiosity". The robot, which was previously known as the SDR, has earlier been shown walking, climbing, kicking a ball and dancing. Now

Sony has updated the robot, which is usually shown off at trade shows and other events, to run slowly for a short distance. If the 58 cm high robot were human-sized, it would be able to run at a speed of about 2.4 km per hour.

QRIO is also able to speak now. Its "voice" is generated using software that converts text to speech. It has on board two digital cameras that help it learn about its surroundings and recognise up to 10 faces.

Sony uses the friendly robot as an ambassador for its products at events. This robot puts Sony ahead of Honda, which has shown off its ASIMO robot that, so far, can only walk. Sony has enjoyed huge success with its AIBO robot dog and has sold more than 130,000 units of that technological pet. AIBO costs around 69,000 yen, about 520 euros.

But QRIO's adventures don't stop here! The robot has made its TV debut: it recorded its voice for a small part in a top Japanese cartoon show called "Astro Boy". QRIO has clearly impressed Kazuya Konaka, its director. "Our message is that robots are our partners", he said. "This has demonstrated that robots and human beings can work together."

1. Sony's QRIO represents a major advance in robotics.
2. People can buy the QRIO robot soon.
3. The robot's name means searching, wanting to learn more.
4. QRIO is a human-sized robot.
5. QRIO is used to present and promote Sony's technological innovations.
6. Previous Sony robots have been a complete failure.

Ex.5.34. Match the words from the text with their equivalents on the right.

1) show off	a) execute
2) leap	b) first appearance

3) top	c) modernised
4) perform	d) environment
5) quest	e) translates
6) updated	f) achievement
7) converts	g) representative
8) surroundings	h) exhibit
9) ambassador	i) maximum
10) debut	j) search

Ex.5.35. Complete the text with the words from the box.

robotic	*emotions*	*developed*	*behaves*
domestic	*navigate*	*capable*	*walk*

Sony and Honda have 1)… humanoid robots. Standing 50 cm tall, they can 2)… and dance – although they can't do much more than this. Dyson have also produced 3)… vacuum cleaners which can clean rooms, using sensors to 4)… . Scientists say these are the first steps towards 5)… robots which will one day be carrying out all our boring household chores. But will robots ever be 6)… of more than this? In AI robots can love. Could machines ever have 7)…? Current technology is nowhere near achieving this, and experts agree that we are a long way from building a robot which 8)… anything like a human.

Ex.5.36. Read the text and answer the questions below.

Pill Reminders from Robot Pets

In the future, the elderly could be reminded to take medication by a computerised pet. The "Pill Pets" behave like the Tamagotchi, a favourite children's toy of recent years, which had to be paid attention, or it would become ill and eventually die. For the Pill Pets to thrive, they have to be told their reminders are taking medication properly.

Researchers at the Massachusetts Institute of Technology's (MIT) Ageing Lab in Boston hope people will form an emotional bond with the pets, making them more likely to obey the reminders than if they were simply prompted to take their drugs by, for example, an alarm clock ringing.

The Pill Pets are brightly coloured, cuddly toys made of silicon, with a computerised screen that gives instructions on taking medication, such as how many times a day pills should be consumed and if they should be taken with food or drink.

One of the Lab's other ideas is a real-life version of TV Knight Rider's Kit Car. Named Miss Daisy – after Driving Miss Daisy, the film about an elderly lady who was chauffeured around in her old age – the car is filled with high-tech devices, including a device to warn of imminent collisions, and a night-vision system.

Populations are ageing. It is estimated that in the US, someone turns 50 every seven seconds. Joe Coughlin, director of MIT's Ageing Lab, told the BBC advances in science and healthcare over the last century had added around 30 years to the average lifespan, and the lab's work was aimed at devising technology which could improve those years. He said: "If you think about ageing, it's not just about where you live or using the car, it's about all those activities that make up a healthy active life."

The Pill Pets are based on the principal that many older people have cats or dogs. Caring for them means the elderly have to take care of themselves so that they can be there to look after their pets.

Early indications are that the Pill Pets are seen in the same way. In trials, elderly women who had taken Pill Pets home grew attached to the devices and did not want to give them back.

Dr Coughlin said: "We're trying to get in [to people's minds] on another channel rather than on an intellectual level, on an

emotional level. We're trying to find a way to get people to take care of themselves."

1. Which institution has developed the Pill Pets?
2. What is the main purpose of this device?
3. What is essential for the success of this invention? Explain.
4. Does the article mention any other invention that is being developed by this same institution? If you say YES, describe it and explain its functions.
5. These technological devices are meant to answer a social need. Explain what it is as well as the devices' contribution.

Unit 6. ARTIFICIAL INTELLIGENCE

Ex.6.1. Read the text and answer the questions below.

What is Artificial Intelligence?

Artificial intelligence (AI) is intelligence demonstrated by machines, as opposed to the natural intelligence displayed by humans or animals. Leading AI textbooks define the field as the study of "intelligent agents": any system that perceives its environment and takes actions that maximize its chance of achieving its goals. Some popular accounts use the term "artificial intelligence" to describe machines that mimic "cognitive" functions that humans associate with the human mind, such as "learning" and "problem solving", however this definition is rejected by major AI researchers.

AI applications include advanced web search engines (i.e. Google), recommendation systems (used by YouTube, Amazon and Netflix), understanding human speech (such as Siri or Alexa), self-driving cars (e.g. Tesla), and competing at the highest level in strategic game systems (such as chess and Go). As machines become increasingly capable, tasks considered to require "intelligence" are often removed from the definition of AI, a phenomenon known as the *AI effect*. For instance, optical character recognition is frequently excluded from things considered to be AI, having become a routine technology.

Artificial intelligence was founded as an academic discipline in 1956, and in the years since has experienced

several waves of optimism, followed by disappointment and the loss of funding (known as an "AI winter"), followed by new approaches, success and renewed funding. AI research has tried and discarded many different approaches during its lifetime, including simulating the brain, modeling human problem solving, formal logic, large databases of knowledge and imitating animal behavior. In the first decades of the 21st century, highly mathematical statistical machine learning has dominated the field, and this technique has proved highly successful, helping to solve many challenging problems throughout industry and academia.

The various sub-fields of AI research are centered around particular goals and the use of particular tools. The traditional goals of AI research include reasoning, knowledge representation, planning, learning, natural language processing, perception and the ability to move and manipulate objects. General intelligence (the ability to solve an arbitrary problem) is among the field's long-term goals. To solve these problems, AI researchers use versions of search and mathematical optimization, formal logic, artificial neural networks, and methods based on statistics, probability and economics. AI also draws upon computer science, psychology, linguistics, philosophy, and many other fields.

The field was founded on the assumption that human intelligence "can be so precisely described that a machine can be made to simulate it". This raises philosophical arguments about the mind and the ethics of creating artificial beings endowed with human-like intelligence. These issues have been explored by myth, fiction and philosophy since antiquity. Science fiction and futurology have also suggested that, with its enormous potential and power, AI may become an existential risk to humanity.

1. What is artificial intelligence?
2. What are the examples of artificial intelligence?
3. When was artificial intelligence founded as an academic discipline?
4. What are the traditional goals of AI research?
5. What is artificial general intelligence?
6. What are the ethical issues of artificial intelligence?

Ex.6.2. Match the words in the columns to complete word combinations from the text above.

1)	artificial	a)	system
2)	cognitive	b)	solving
3)	problem	c)	goals
4)	human	d)	intelligence
5)	recommendation	e)	discipline
6)	self-driving	f)	functions
7)	strategic	g)	mind
8)	academic	h)	logic
9)	formal	i)	optimization
10)	long-term	j)	car
11)	mathematical	k)	arguments
12)	philosophical	l)	game system

Ex.6.3. Match the words with their definitions.

1)	intelligence	a)	a large amount of information stored in a computer system in such a way that it can be easily looked at or changed
2)	statistics	b)	to do or make something that looks real but is not real
3)	database	c)	connected with thinking or conscious mental processes
4)	logic	d)	relating to light or the ability to see

5)	recognition	e)	the ability to learn, understand, and make judgments or have opinions that are based on reason
6)	perception	f)	the fact of knowing someone or something because you have seen or heard him or her or experienced it before
7)	cognitive	g)	a collection of numerical facts or measurements, as about people, business conditions, or weather
8)	optical	h)	to have control over a place or person
9)	simulate	i)	a particular way of thinking, especially one that is reasonable and based on good judgment
10)	dominate	j)	the quality of being aware of things through the physical senses, especially sight

Ex.6.4. Put the words in correct order to make sentences.

1) intelligence / intelligence / displayed / Artificial / is / by / demonstrated / machines / to / in / the / contrast / humans / natural / by.

2) whatever / been / Artificial / hasn't / is / yet / intelligence / done.

3) types / Artificial / can / into / intelligence / be / three / of / classified / different / systems.

4) founded / academic / Artificial / was / intelligence / as / an / in / 1956 / discipline.

5) create / Artificial / risk / mass / will / a / unemployment / of / intelligence.

6) problems / many / helps / Artificial / solve / challenging / intelligence.

Ex.6.5. Complete the text with the words from the box.

learning	*Uber*	*repetitive*	*software*	*enterprises*
errors	*online better*		*competitors*	*successful*

Why is Artificial Intelligence Important?

AI is important because it can give enterprises insights into their operations that they may not have been aware of previously and because, in some cases, AI can perform tasks 1)… than humans. Particularly when it comes to 2)…, detail-oriented tasks like analyzing large numbers of legal documents to ensure relevant fields are filled in properly, AI tools often complete jobs quickly and with relatively few 3)… .

This has helped fuel an explosion in efficiency and opened the door to entirely new business opportunities for some larger 4)… . Prior to the current wave of AI, it would have been hard to imagine using computer 5)… to connect riders to taxis, but today 6)… has become one of the largest companies in the world by doing just that. It utilizes sophisticated machine learning algorithms to predict when people are likely to need rides in certain areas, which helps proactively get drivers on the road before they're needed. As another example, Google has become one of the largest players for a range of 7)… services by using machine 8)… to understand how people use their services and then improving them. In 2017, the company's CEO, Sundar Pichai, pronounced that Google would operate as an "AI first" company.

Today's largest and most 9)… enterprises have used AI to improve their operations and gain advantage on their 10)… .

Ex.6.6. Match the words with their definitions.

1)	intelligence	a)	intelligent or made in a complicated way and therefore able to do complicated tasks

2)	insight	b)	a set of mathematical instructions or rules that, especially if given to a computer, will help to calculate an answer to a problem
3)	aware	c)	the ability to learn, understand, and make judgments or have opinions that are based on reason
4)	relevant	d)	a person, team, or company that is competing against others
5)	software	e)	the instructions that control what a computer does; computer programs
6)	competitor	f)	a clear, deep, and sometimes sudden understanding of a complicated problem or situation
7)	algorithm	g)	to use something in an effective way
8)	sophisticated	h)	knowing that something exists, or having knowledge or experience of a particular thing
9)	utilize	i)	an organization, especially a business
10)	enterprise	j)	connected with what is happening or being discussed

Ex.6.7. Read the text and answer the questions below.

Definitions of Artificial Intelligence

Less than a decade after breaking the Nazi encryption machine Enigma and helping the Allied Forces win World War II, mathematician Alan Turing changed history a second time with a simple question: "Can machines think?". Turing's paper «Computing Machinery and Intelligence" (1950), and its subsequent Turing Test, established the fundamental goal and vision of artificial intelligence.

At its core, AI is the branch of computer science that aims to answer Turing's question in the affirmative. It is the endeavor

to replicate or simulate human intelligence in machines. The expansive goal of artificial intelligence has given rise to many questions and debates. So much so, that no singular definition of the field is universally accepted.

The major limitation in defining AI as simply "building machines that are intelligent" is that it doesn't actually explain *what artificial intelligence is? What makes a machine intelligent?* AI is an interdisciplinary science with multiple approaches, but advancements in machine learning and deep learning are creating a paradigm shift in virtually every sector of the tech industry.

In their groundbreaking textbook "Artificial Intelligence: A Modern Approach", authors Stuart Russell and Peter Norvig approach the question by unifying their work around the theme of intelligent agents in machines. With this in mind, AI is "the study of agents that receive percepts from the environment and perform actions."

Norvig and Russell go on to explore four different approaches that have historically defined the field of AI:

1. Thinking humanly
2. Thinking rationally
3. Acting humanly
4. Acting rationally

The first two ideas concern thought processes and reasoning, while the others deal with behavior. Norvig and Russell focus particularly on rational agents that act to achieve the best outcome, noting "all the skills needed for the Turing Test also allow an agent to act rationally."

Patrick Winston, the Ford professor of artificial intelligence and computer science at MIT, defines AI as «algorithms enabled by constraints, exposed by representations that support models targeted at loops that tie thinking, perception and action together.»

While these definitions may seem abstract to the average person, they help focus the field as an area of computer science and provide a blueprint for infusing machines and programs with machine learning and other subsets of artificial intelligence.

1. Who and when established fundamental goal and vision of artificial intelligence?
2. What are the definitions of artificial intelligence, according to the text?
3. How do Stuart Russell and Peter Norvig define artificial intelligence?
4. What four approaches have historically defined the field of AI?
5. How does Patrick Winston define artificial intelligence?

Ex.6.8. Match the words in the columns to complete word combinations from the text above. Explain their meanings.

1)	fundamental	a)	approaches
2)	artificial	b)	industry
3)	computer	c)	person
4)	multiple	d)	agents
5)	machine	e)	intelligence
6)	tech	f)	textbook
7)	groundbreaking	g)	science
8)	intelligent	h)	goal
9)	average	i)	learning

Ex.6.9. Match the sentences' halves to complete full sentences.

1) Less than a decade after breaking the Nazi encryption machine Enigma and helping the Allied Forces win World War II, …	a) …a blueprint for infusing machines and programs with machine learning and other subsets of artificial intelligence.
2) AI is the branch of computer science that aims to answer Turing's question…	b) …mathematician Alan Turing changed history a second time with a simple question: «Can machines think?»
3) The expansive goal of artificial intelligence has given…	c) …in the affirmative.
4) Advancements in machine learning and deep learning are creating…	d) …from the environment and perform actions.
5) AI is the study of agents that receive percepts…	e) … rational agents that act to achieve the best outcome.
6) Norvig and Russell focus particularly on…	f) …rise to many questions and debates.
7) Patrick Winston defines AI as…	g) …a paradigm shift in virtually every sector of the tech industry.
8) These definitions help focus the field as an area of computer science and provide…	h) …»algorithms enabled by constraints, exposed by representations that support models targeted at loops that tie thinking, perception and action together.»

Ex.6.10. Read the text and answer the questions below.

Brief History of Artificial Intelligence

Intelligent robots and artificial beings first appeared in the ancient Greek myths of Antiquity. Aristotle's development of syllogism and its use of deductive reasoning was a key moment in mankind's quest to understand its own intelligence. While the roots are long and deep, the history of artificial intelligence as we think of it today spans less than a century.

1950s

• (1950) Alan Turing publishes "Computing Machinery and Intelligence", proposing what is now known as the Turing Test, a method for determining if a machine is intelligent.

• (1950) Harvard undergraduates Marvin Minsky and Dean Edmonds build SNARC, the first neural network computer.

• (1950) Isaac Asimov publishes the "Three Laws of Robotics."

• (1954) The Georgetown-IBM machine translation experiment automatically translates 60 carefully selected Russian sentences into English.

• (1956) The phrase "artificial intelligence" is coined at the "Dartmouth Summer Research Project on Artificial Intelligence." Led by John McCarthy, the conference, which defined the scope and goals of AI, is widely considered to be the birth of artificial intelligence as we know it today.

• (1956) Allen Newell and Herbert Simon demonstrate Logic Theorist (LT), the first reasoning program.

• (1958) John McCarthy develops the AI programming language Lisp and publishes the paper "Programs with Common Sense." The paper proposed the hypothetical Advice Taker, a complete AI system with the ability to learn from experience as effectively as humans do.

• (1959) Allen Newell, Herbert Simon and J.C. Shaw develop the General Problem Solver (GPS), a program designed to imitate human problem-solving.

1960s

• (1966) The Automatic Language Processing Advisory Committee (ALPAC) report by the U.S. government details the lack of progress in machine translations research, a major Cold War initiative with the promise of automatic and instantaneous translation of Russian. The ALPAC report leads to the cancellation of all government-funded MT projects.

• (1969) The first successful expert systems are developed in DENDRAL, a XX program, and MYCIN, designed to diagnose blood infections, are created at Stanford.

1970s

• (1972) The logic programming language PROLOG is created.

• (1973) The "Lighthill Report," detailing the disappointments in AI research, is released by the British government and leads to severe cuts in funding for artificial intelligence projects.

• (1974–1980) Frustration with the progress of AI development leads to major DARPA cutbacks in academic grants. Combined with the earlier ALPAC report and the previous year's "Lighthill Report," artificial intelligence funding dries up and research stalls. This period is known as the «First AI Winter.»

1980s

• (1980) Digital Equipment Corporations develops R1 (also known as XCON), the first successful commercial expert system. Designed to configure orders for new computer systems, R1 kicks off an investment boom in expert systems that will last for much of the decade, effectively ending the first "AI Winter."

• (1987–1993) As computing technology improved, cheaper alternatives emerged and the Lisp machine market collapsed in 1987, ushering in the "Second AI Winter." During

this period, expert systems proved too expensive to maintain and update, eventually falling out of favor.

1990s

• (1991) U.S. forces deploy DART, an automated logistics planning and scheduling tool, during the Gulf War.

• (1997) IBM's Deep Blue beats world chess champion Gary Kasparov.

2000s

• (2005) STANLEY, a self-driving car, wins the DARPA Grand Challenge.

• (2008) Google makes breakthroughs in speech recognition and introduces the feature in its iPhone app.

2010–2014

• (2011) IBM's Watson trounces the competition on *Jeopardy!*.

• (2011) Apple releases Siri, an AI-powered virtual assistant through its iOS operating system.

• (2012) Andrew Ng, founder of the Google Brain Deep Learning project, feeds a neural network using deep learning algorithms 10 million YouTube videos as a training set. The neural network learned to recognize a cat without being told what a cat is, ushering in the breakthrough era for neural networks and deep learning funding.

• (2014) Google makes the first self-driving car to pass a state driving test.

• (2014) Amazon's Alexa, a virtual home is released.

2015–2021

• (2016) Google DeepMind's AlphaGo defeats world champion Go player Lee Sedol. The complexity of the ancient Chinese game was seen as a major hurdle to clear in AI.

• (2016) The first "robot citizen", a humanoid robot named Sophia, is created by Hanson Robotics and is capable of facial recognition, verbal communication and facial expression.

• (2018) Google releases natural language processing engine BERT, reducing barriers in translation and understanding by machine learning applications.

• (2018) Waymo launches its Waymo One service, allowing users throughout the Phoenix metropolitan area to request a pick-up from one of the company's self-driving vehicles.

• (2020) Baidu releases its LinearFold AI algorithm to scientific and medical teams working to develop a vaccine during the early stages of the SARS-CoV-2 pandemic. The algorithm is able to predict the RNA sequence of the virus in just 27 seconds, 120 times faster than other methods.

1. What was the first attempt to understand if a machine can think?
2. Who published the "Three Laws of Robotics"?
3. What event is widely considered to be the birth of artificial intelligence as we know it today?
4. When and where were the programs to diagnose blood infections created?
5. What period is known as the "First AI Winter"?
6. What event effectively ended the "First AI Winter"?
7. What period is known as the "Second AI Winter"?
8. What system beat world chess champion Gary Kasparov?
9. What is the first "robot citizen"?
10. What is the contribution of AI in the world's struggle against COVID-19?

Ex. 6.11. Match the words in the columns to complete word combinations from the text above. Explain their meanings.

1)	artificial	a)	learning
2)	programming	b)	car
3)	common	c)	champion
4)	problem	d)	sense

5)	academic	e)	home
6)	self-driving	f)	recognition
7)	speech	g)	language
8)	deep	h)	intelligence
9)	virtual	i)	grants
10)	world	j)	solving

Ex.6.12. Match the sentences' halves.

1)	Harvard undergraduates Marvin Minsky and Dean Edmonds …	a)	…reducing barriers in translation and understanding by machine learning applications.
2)	Isaac Asimov published …	b)	…build SNARC, the first neural network computer in 1950.
3)	John McCarthy develops the AI programming language Lisp and publishes the paper «Programs with Common Sense» …	c)	…that proposed the hypothetical Advice Taker, a complete AI system with the ability to learn from experience as effectively as humans do.
4)	The «Lighthill Report,» detailing the disappointments in AI research, is …	d)	…the Three Laws of Robotics.
5)	Designed to configure orders for new computer systems, R1 kicks off …	e)	…released by the British government and leads to severe cuts in funding for artificial intelligence projects.
6)	Andrew Ng, founder of the Google Brain Deep Learning project, feeds a neural network…	f)	…an investment boom in expert systems that will last for much of the decade, effectively ending the first «AI Winter.»

7) Google releases natural language processing engine BERT, …	g) …to request a pick-up from one of the company's self-driving vehicles.
8) Waymo launches its Waymo One service, allowing users throughout the Phoenix metropolitan area …	h) …using deep learning algorithms 10 million YouTube videos as a training set.

Ex.6.13. Match the events in the robotics history with the dates they occurred.

1950	a) John McCarthy develops the AI programming language Lisp.
1954	b) IBM's Deep Blue beats world chess champion Gary Kasparov.
1956	c) Google makes breakthroughs in speech recognition and introduces the feature in its iPhone app.
1958	d) The phrase "artificial intelligence" is coined at the «Dartmouth Summer Research Project on Artificial Intelligence.» Led by John McCarthy, the conference, which defined the scope and goals of AI, is widely considered to be the birth of artificial intelligence as we know it today.
1959	e) The logic programming language PROLOG is created.
1969	f) Allen Newell, Herbert Simon and J.C. Shaw develop the General Problem Solver (GPS), a program designed to imitate human problem-solving.
1972	g) Google DeepMind's AlphaGo defeats world champion Go player Lee Sedol. The first «robot

		citizen», a humanoid robot named Sophia, is created by Hanson Robotics and is capable of facial recognition, verbal communication and facial expression.
1987–1993	h)	Alan Turing publishes «Computing Machinery and Intelligence», proposing what is now known as the Turing Test, a method for determining if a machine is intelligent.
1997	i)	STANLEY, a self-driving car, wins the DARPA Grand Challenge.
2005	j)	Google releases natural language processing engine BERT, reducing barriers in translation and understanding by machine learning applications.
2008	k)	The Georgetown-IBM machine translation experiment automatically translates 60 carefully selected Russian sentences into English.
2011	l)	Baidu releases its LinearFold AI algorithm to scientific and medical teams working to develop a vaccine during the early stages of the SARS-CoV-2 pandemic.
2016	m)	As computing technology improved, cheaper alternatives emerged and the Lisp machine market collapsed in 1987, ushering in the «Second AI Winter.»
2018	n)	The first successful expert systems are developed in DENDRAL, a XX program, and MYCIN, designed to diagnose blood infections, are created at Stanford.
2020	o)	IBM's Watson trounces the competition on *Jeopardy!*. Apple releases Siri, an AI-powered virtual assistant through its iOS operating system.

Ex.6.14. Complete the text with appropriate phrases from the list below.

Four Types of Artificial Intelligence

1. Reactive Machines

A reactive machine follows the most basic of AI principles and, as its name implies, is capable of only using its intelligence to perceive and react to the world in front of it. A reactive machine cannot store a memory and as a result cannot rely on past experiences to inform decision making in real-time.

Perceiving the world directly means that reactive machines are designed to complete only 1)_____. Intentionally narrowing a reactive machine's worldview is not any sort of cost-cutting measure, however, and instead means that this type of AI will be more trustworthy and reliable – it will react the same way to the same stimuli every time.

A famous example of a reactive machine is Deep Blue, which was designed by IBM in the 1990's as a chess-playing supercomputer and 2)_____. Deep Blue was only capable of identifying the pieces on a chess board and knowing how each moves based on the rules of chess, acknowledging each piece's present position, and determining 3)_____. The computer was not pursuing future potential moves by its opponent or trying to put its own pieces in better position. Every turn was viewed as its own reality, separate from any other movement that was made beforehand.

Another example of a game-playing reactive machine is Google's AlphaGo. AlphaGo is also incapable of evaluating future moves but relies on its own neural network to evaluate developments of the present game, giving it an edge over Deep Blue in a more complex game. AlphaGo also bested world-class competitors of the game, 4)_____.

Though limited in scope and not easily altered, reactive machine artificial intelligence can attain a level of complexity, and offers reliability when created to fulfill repeatable tasks.

2. Limited Memory

Limited memory artificial intelligence has the ability to store previous data and predictions when gathering information and weighing potential decisions – essentially looking into the past for clues on what may come next. Limited memory artificial intelligence is more complex and presents 5)_____.

Limited memory AI is created when a team continuously trains a model in how to analyze and utilize new data or an AI environment is built so models can be automatically trained and renewed. When utilizing limited memory AI in machine learning, six steps must be followed: training data must be created, the machine learning model must be created, the model must be able to make predictions, the model must be able to receive human or environmental feedback, that feedback must be stored as data, and 6)_____.

There are three major machine learning models that utilize limited memory artificial intelligence:

- *Reinforcement learning,* which learns to make better predictions through repeated trial-and-error.
- *Long Short Term Memory (LSTM),* which utilizes past data to help predict the next item in a sequence. LTSMs view 7)_____ when making predictions and discounts data from further in the past, though still utilizing it to form conclusions.
- *Evolutionary Generative Adversarial Networks (E-GAN),* which evolves over time, growing to explore slightly modified paths based off of previous experiences with every new decision. This model is constantly in pursuit of a better path and utilizes simulations and statistics, or chance, to predict outcomes throughout its evolutionary mutation cycle.

3. **Theory of Mind**

Theory of Mind is just that – theoretical. We have not yet achieved the technological and scientific capabilities necessary to reach this next level of artificial intelligence.

The concept is based on the psychological premise of understanding that other living things have 8)_____ of one's self. In terms of AI machines, this would mean that AI could comprehend how humans, animals and other machines feel and make decisions through self-reflection and determination, and then will utilize that information to make decisions of their own. Essentially, machines would have to be able to grasp and process the concept of "mind," the fluctuations of emotions in decision making and a litany of other psychological concepts in real time, creating 9)_____.

4. Self-awareness

Once Theory of Mind can be established in artificial intelligence, sometime well into the future, the final step will be for AI to become self-aware. This kind of artificial intelligence possesses 10)_____, as well as the presence and emotional state of others. It would be able to understand what others may need based on not just what they communicate to them but how they communicate it.

Self-awareness in artificial intelligence relies both on human researchers understanding the premise of consciousness and then learning how to replicate that so it can be built into machines.

a) human-level consciousness and understands its own existence in the world

b) defeating champion Go player Lee Sedol in 2016

c) more recent information as most important

d) defeated international grandmaster Gary Kasparov in a game

e) a limited number of specialized duties

f) these steps must be reiterated as a cycle

g) thoughts and emotions that affect the behavior

h) what the most logical move would be at that moment

i) greater possibilities than reactive machines

j) a two-way relationship between people and artificial intelligence

Ex.6.15. Answer the questions to the text above.

1. What are the four types of artificial intelligence?
2. What is reactive machine?
3. What are the most famous examples of reactive machines?
4. What is the limited memory AI?
5. What is the difference between reactive machine and limited memory?
6. What are the three major machine learning models that utilize limited memory artificial intelligence?
7. What is theory of mind?
8. What is self-awareness?

Ex.6.16. Decide if the statements are true or false.

1. A reactive machine is able to rely on past experiences to inform decision making in real-time.
2. Reactive machines are able to complete only a limited number of specialized duties.
3. Deep Blue is an advanced version of limited memory AI.
4. AlphaGo relies on its own neural network to evaluate developments of the present game.
5. Limited memory artificial intelligence stores previous data and predictions, gathers information and weighs potential decisions.
6. Limited memory artificial intelligence has more possibilities than reactive machines.
7. Limited memory AI can never be renewed.
8. Theory of mind is one of the major machine learning models that utilize limited memory artificial intelligence.
9. Theory of Mind AI could understand how humans, animals and other machines feel and make decisions through self-reflection and determination.

10. Self-awareness AI would be able to understand what others may need based on not just what they communicate to them but how they communicate.

Ex.6.17. Match the words with their definitions.

1)	perceive	a)	to notice something or someone by using sight, sound, touch, taste, or smell
2)	narrow	b)	to follow someone or something, usually to try to catch him or her
3)	defeat	c)	knowing and understanding yourself very well
4)	pursue	d)	the act of making something stronger
5)	analyze	e)	to become less wide or to make something less wide
6)	utilize	f)	the state of being awake, thinking, and knowing what is happening around you
7)	reinforcement	g)	to use something in an effective way
8)	comprehend	h)	to study something in a systematic and careful way
9)	self-aware	i)	to understand something completely
10)	consciousness	j)	to oppose and cause someone to lose in a competition or war so that you can win

Ex.6.18. Read the text and answer the questions below.

How is AI Used?

While addressing a crowd at the *Japan AI Experience* in 2017, DataRobot CEO Jeremy Achin began his speech by offering the following definition of how AI is used today: “AI is a computer system able to perform tasks that ordinarily require

human intelligence... Many of these artificial intelligence systems are powered by machine learning, some of them are powered by deep learning and some of them are powered by very boring things like rules."

Artificial intelligence generally falls under two broad categories: Narrow AI and Artificial General Intelligence.

Narrow AI. Sometimes referred to as «Weak AI,» this kind of artificial intelligence operates within a limited context and is a simulation of human intelligence. Narrow AI is often focused on performing a single task extremely well and while these machines may seem intelligent, they are operating under far more constraints and limitations than even the most basic human intelligence.

Narrow AI is all around us and is easily the most successful realization of artificial intelligence to date. With its focus on performing specific tasks, Narrow AI has experienced numerous breakthroughs in the last decade that have had "significant societal benefits and have contributed to the economic vitality of the nation," according to "Preparing for the Future of Artificial Intelligence," a 2016 report released by the Obama Administration.

A few examples of Narrow AI include: Google search; image recognition software; Siri, Alexa and other personal assistants; self-driving cars; IBM's Watson.

Artificial General Intelligence (AGI). AGI, sometimes referred to as "Strong AI," is the kind of artificial intelligence we see in the movies, like the robots from *Westworld* or Data from *Star Trek: The Next Generation*. AGI is a machine with general intelligence and, much like a human being, it can apply that intelligence to solve any problem.

The creation of a machine with human-level intelligence that can be applied to any task is the Holy Grail for many AI researchers, but the quest for AGI has been fraught with difficulty.

The search for a "universal algorithm for learning and acting in any environment," (Russel and Norvig) isn't new, but time hasn't eased the difficulty of essentially creating a machine with a full set of cognitive abilities.

AGI has long been the muse of dystopian science fiction, in which super-intelligent robots overrun humanity, but experts agree it's not something we need to worry about anytime soon.

1. What is AI according to Jeremy Achin?
2. What are the two main categories of AI?
3. What is Narrow AI?
4. What is Narrow AI focused on?
5. What are the examples of Narrow AI?
6. What is Artificial General Intelligence?
7. What is the difference between Narrow AI and AGI?
8. Are there any real examples of AGI?

Ex.6.19. Match the sentences' halves.

1) AI is a computer system able to perform tasks that …	a) …numerous breakthroughs in the last decade.
2) Artificial intelligence generally falls under two …	b) …in any environment» isn't new.
3) Narrow AI is often focused on …	c) …performing a single task extremely well.
4) Narrow AI is all around us and is easily the most …	d) …ordinarily require human intelligence.
5) Narrow AI has experienced …	e) …broad categories: Narrow AI and Artificial General Intelligence.
6) AGI is a machine with general intelligence and it can …	f) …we need to worry about anytime soon.

7)	The search for a «universal algorithm for learning and acting …	g)	… successful realization of artificial intelligence to date.
8)	Experts agree it's not something …	h)	…apply that intelligence to solve any problem.

Ex.6.20. Match the words with their definitions.

1)	simulation	a)	important or noticeable
2)	breakthrough	b)	a helpful or good effect, or something intended to help
3)	decade	c)	a model of a real activity, created for training purposes or to solve a problem
4)	significant	d)	the instructions that control what a computer can do; computer programs
5)	benefit	e)	the act of flowing out from somewhere
6)	contribute	f)	an important discovery or event that helps to improve a situation or provide an answer to a problem
7)	vitality	g)	relating to a very bad or unfair society in which there is a lot of suffering, especially an imaginary society in the future
8)	release	h)	to make or become less severe, difficult, unpleasant, painful, etc.
9)	software	i)	a period of ten years, especially a period such as 2010 to 2019
10)	algorithm	j)	energy and strength
11)	ease	k)	to give something, especially money, in order to provide or achieve something together with other people

12)	dystopian	l) a set of mathematical instructions or rules that, especially if given to a computer, will help to calculate an answer to a problem

Ex.6.21. Complete the text with the words from the box.

processed algorithms programmed learning task distinguish results artificial statistical neural

Machine Learning & Deep Learning

Much of Narrow AI is powered by breakthroughs in machine learning and deep 1)… . Understanding the difference between 2)… intelligence, machine learning and deep learning can be confusing. Venture capitalist Frank Chen provides a good overview of how to 3)… between them, noting: "Artificial intelligence is a set of 4)… and intelligence to try to mimic human intelligence. Machine learning is one of them, and deep learning is one of those machine learning techniques."

Simply put, machine learning feeds a computer data and uses 5)… techniques to help it "learn" how to get progressively better at a 6)…, without having been specifically 7)… for that task, eliminating the need for millions of lines of written code. Machine learning consists of both supervised learning (using labeled data sets) and unsupervised learning (using unlabeled data sets).

Deep learning is a type of machine learning that runs inputs through a biologically-inspired neural network architecture. The 8)… networks contain a number of hidden layers through which the data is 9)…, allowing the machine to go «deep» in its learning, making connections and weighting input for the best 10)… .

Ex.6.22. Read the text and choose appropriate heading (1–10) to each paragraph. You don't need one of them.

1) AI in Security
2) AI in finance
3) AI in Space
4) AI in banking
5) AI in law
6) AI in education
7) AI in manufacturing
8) AI in healthcare
9) AI in business
10) AI in transportation

Applications of AI

Artificial intelligence has made its way into a wide variety of markets. Here are nine examples.

A_____

The biggest bets are on improving patient outcomes and reducing costs. Companies are applying machine learning to make better and faster diagnoses than humans. One of the best-known healthcare technologies is IBM Watson. It understands natural language and can respond to questions asked of it. The system mines patient data and other available data sources to form a hypothesis, which it then presents with a confidence scoring schema. Other AI applications include using online virtual health assistants and chatbots to help patients and healthcare customers find medical information, schedule appointments, understand the billing process and complete other administrative processes. An array of AI technologies is also being used to predict, fight and understand pandemics such as COVID-19.

B_____

Machine learning algorithms are being integrated into analytics and customer relationship management (CRM)

platforms to uncover information on how to better serve customers. Chatbots have been incorporated into websites to provide immediate service to customers. Automation of job positions has also become a talking point among academics and IT analysts.

C_____

AI can automate grading, giving educators more time. It can assess students and adapt to their needs, helping them work at their own pace. AI tutors can provide additional support to students, ensuring they stay on track. And it could change where and how students learn, perhaps even replacing some teachers.

D_____

AI in personal finance applications, such as Intuit Mint or TurboTax, is disrupting financial institutions. Applications such as these collect personal data and provide financial advice. Other programs, such as IBM Watson, have been applied to the process of buying a home. Today, artificial intelligence software performs much of the trading on Wall Street.

E_____

The discovery process – sifting through documents – in law is often overwhelming for humans. Using AI to help automate the legal industry's labor-intensive processes is saving time and improving client service. Law firms are using machine learning to describe data and predict outcomes, computer vision to classify and extract information from documents and natural language processing to interpret requests for information.

F_____

Manufacturing has been at the forefront of incorporating robots into the workflow. For example, the industrial robots that were at one time programmed to perform single tasks and separated from human workers, increasingly function as cobots: smaller, multitasking robots that collaborate with

humans and take on responsibility for more parts of the job in warehouses, factory floors and other workspaces.

G_____

Banks are successfully employing chatbots to make their customers aware of services and offerings and to handle transactions that don't require human intervention. AI virtual assistants are being used to improve and cut the costs of compliance with banking regulations. Banking organizations are also using AI to improve their decision-making for loans, and to set credit limits and identify investment opportunities.

H_____

In addition to AI's fundamental role in operating autonomous vehicles, AI technologies are used in transportation to manage traffic, predict flight delays, and make ocean shipping safer and more efficient.

I_____

AI and machine learning are at the top of the buzzword list security vendors use today to differentiate their offerings. Those terms also represent truly viable technologies. Organizations use machine learning in security information and event management (SIEM) software and related areas to detect anomalies and identify suspicious activities that indicate threats. By analyzing data and using logic to identify similarities to known malicious code, AI can provide alerts to new and emerging attacks much sooner than human employees and previous technology iterations. The maturing technology is playing a big role in helping organizations fight off cyber attacks.

Ex.6.23. Answer the questions to the text above.

1. What can IBM Watson do?
2. What can robots do in healthcare?
3. What is the purpose of using chatbots on websites?

4. What are the functions of AI tutors?
5. What is the application of artificial intelligence software in business?
6. How can AI help people in legal industry?
7. What is a cobot?
8. How can AI be used in banks?
9. What are the applications of AI in transportation?
10. What is the role of AI in security of organizations?

Ex.6.24. Match the words in the columns to complete word combinations from the text above. Explain their meanings.

1)	natural	a)	point
2)	scoring	b)	intervention
3)	customer relationship	c)	language
4)	talking	d)	activities
5)	financial	e)	schema
6)	personal	f)	data
7)	human	g)	technologies
8)	virtual	h)	institutions
9)	autonomous	i)	assistants
10)	viable	j)	code
11)	suspicious	k)	management
12)	malicious	l)	vehicles

Ex.6.25. Match the words with their definitions.

1)	outcome	a)	to make something certain to happen
2)	array	b)	the way that a particular type of work is organized
3)	pace	c)	the most noticeable or important position
4)	ensure	d)	the act of obeying an order, rule, or request
5)	overwhelming	e)	the speed at which someone or something move

6) forefront	f) someone who is selling something
7) workflow	g) difficult to fight against
8) warehouse	h) a large group of things or people, especially one that is attractive or causes admiration or has been positioned in a particular way
9) compliance	i) an amount of money that is borrowed, often from a bank, and has to be paid back
10) loan	j) a large building for storing things before they are sold, used, or sent out to shops
11) buzzword	k) a word or expression from a particular subject area that has become fashionable by being used a lot
12) vendor	l) a result or effect of an action, situation, etc.

Ex.6.26. Complete the text with the words from the box.

expensive faster qualified artificial time accurately generalize evolving applications available

Advantages and disadvantages of AI

Artificial neural networks and deep learning 1)… intelligence technologies are quickly 2)…, primarily because AI processes large amounts of data much 3)… and makes predictions more 4)… than humanly possible.

While the huge volume of data being created on a daily basis would bury a human researcher, AI 5)… that use machine learning can take that data and quickly turn it into actionable information. As of this writing, the primary disadvantage of

using AI is that it is 6)… to process the large amounts of data that AI programming requires.

Advantages: good at detail-oriented jobs; reduced 7)… for data-heavy tasks; delivers consistent results; AI-powered virtual agents are always 8)… .

Disadvantages: expensive; requires deep technical expertise; limited supply of 9)… workers to build AI tools; only knows what it's been shown; lack of ability to 10)… from one task to another.

Unit 7. FUTURE OF ROBOTS

Ex.7.1. Read the text and complete it (1–10) with phases below (a–j)

Robots and Our Future Life

A_____

Artificial technology for predicting and detecting crime might seem far-fetched, but it's quite possible for the future we're looking at. Drone footage, for instance, will make that happen soon. In addition, automatic recognition of suspicious activities is already a reality for camera-based security systems. This technology will change society in a very important way: it will allow law enforcement officials to act quickly whenever 1)… .

B_____

A single teacher does not have the capacity to meet the needs of personalized learning for every single student in the classroom. Computer-based learning is already changing things in that matter. It's not replacing the teacher, but it enables students to learn at their own pace.

Robots will boost the process of personalized learning. NAO, the humanoid robot, is already forming 2)… . It comes with important senses of natural interaction, including moving, listening, speaking, and connecting.

C_____

Cloud-connected home robots are already becoming part of our lives. We can set up the vacuum cleaner to do the chore

for us, and we can schedule a warm home-cooked meal to be ready 3)… . Multi-function robotic cookers are able to fry, steam, bake, slow cook, and perform any other action without our intervention. We just set them up. These cloud-connected robots are likely to evolve into more advanced version. We expect to see speech comprehension and increased interactions with humans in the upcoming years.

D_____

Robots will have a profound effect on the workplace of the future. They'll become capable of taking on multiple roles in an organization, so it's time for us to start thinking about the way we'll interact with our new coworkers. The machines will likely evolve more in terms of voice recognition, so 4)… .

E_____

Whether we like it or not, robots have already replaced many people in their jobs. The jobs in office administration, logistics, and transport are also at risk of being replaced. Many occupations are 5)… , including insurance underwriters, telemarketers, and tax-return preparers. To be more precise, robots are expected to take over half of all low-skilled jobs.

F_____

"Robots will take our jobs!" is perhaps the most common fear surrounding robotics development. In the near future artificial intelligence will most likely replace *tasks*, not jobs. The good news is that it will also create new markets and jobs. We might need additional education 6)… , but the opportunities will be there.

G_____

Self-driving cars won't require human intervention. In the past decade, the perception of this technology among the public went from "How is it even possible?" to 7)… to "Definitely getting there!"

H_____

We're looking into a different future for healthcare, too. Instead of visiting a primary care physician who will give us a check-up with a simple stethoscope, we'll have intelligent robots performing these tasks. They will interact with patients, 8)… , and evaluate the need for further appointments.

Pharmabotics will bring more huge changes. They'll be like ATMs for medicines, so we can get the medications we need while avoiding the inconvenience of talking to a stranger about our health issues.

I_____

Robots are getting more personalized, interactive, and engaging than ever. With the growth of this industry, virtual reality will enter our homes in the near future. We'll be able to 9)…, and they will respond to our attempts to communicate.

J_____

We've seen this throughout history: automation and mechanization boosts the overall standard of living. We've seen it with the Industrial Revolution, and 10)… . According to estimates from the United Nations, poverty was reduced to a greater extent over the past five decades than in the previous 50. That's because the global economy grew sevenfold, and technology played a huge part in that progress.

a) and re-training for those jobs

b) interact with our home entertainment systems through conversations

c) it's going to happen again

d) at risk of being automated

e) bonds with students from around the world

f) "Maybe it's possible..."

g) we'll be communicating with them through voice commands

h) check on their conditions
i) a suspicious behavior has been spotted
j) by the time we're finished with work

Ex.7.2. Choose the best headline (1–10) to each paragraph (A–J).

1. Healthcare robots
2. Robots create jobs, too
3. Robots might take our jobs
4. Robotics for entertainment
5. Robots in education
6. Robots at home
7. Robots will boost our standard of living
8. Robotics in public security
9. Robots as coworkers
10. Autonomous cars

Ex.7.3. Answer the questions to the text above.

1. How can robots be used for safety at homes?
2. What are the advantages of robot teachers?
3. What functions will robots have in our homes.
4. How will we communicate with robots at a working place?
5. What jobs are at risk of being replaced by robots in the future?
6. What is the prediction of the affect of artificial intelligence on our work?
7. What do you think about advantages and disadvantages of self-driving cars?
8. How will robots be helpful in healthcare?
9. What way of communication is predicted to be between people and their home entertainment robots?
10. Why is it predicted that robots will boost our standard of living?

Ex.7.4. Match the words in columns to complete word combinations from the text above. Explain their meanings.

1)	drone	a)	cleaner
2)	automatic	b)	systems
3)	security	c)	intelligence
4)	humanoid	d)	administration
5)	vacuum	e)	Revolution
6)	office	f)	cars
7)	artificial	g)	intervention
8)	self-driving	h)	footage
9)	human	i)	recognition
10)	Industrial	j)	robot

Ex.7.5. Complete the text with the words from the box.

babysitters monitoring cooking hundred difficult care comfortable unbelievable technology college

What will life be like in one 1)… years time? Will our home life be more 2)…? Will our jobs become easier? Will our health become better thanks to 3)…? According to scientists, robots will be doing our hard work, taking over some of our jobs and 4)… our health. Does this sound 5)…? This might be the kind of world our grandchildren will grow up in. Our home life will be greatly affected by technology and this example might prove it.

Women find being a mother 6)… because they have to take care of children and do house work every day. Many mothers work or attend 7)… so they leave their children with 8)… who are expensive and sometimes aren't nice to the children they watch. It will be great if someday every family owns a robot to help take 9)… of the children. Then being a mother

will be easier. Maybe the robot will be cleaning our floors, 10)…, vacuuming and washing our clothes. Do you think this is possible? Will we have robots someday? Could a robot be a mother?

Ex.7.6. Read the text and choose the best headline (1–6) for each paragraph (A–D). You don't need two of them.

1) Teachers
2) Healthcare
3) Waiters
4) Shop assistants
5) The Emergency Serveces
6) Robocops

The Robot Professionals

The robot revolution isn't a thing of the future – robots are taking over right now and the world of work is never going to be the same again.

A_____

The next time you get into trouble when you're swimming in the sea, you will be glad that Emily is there to rescue you. Emily's not a lifeguard though. Emily is a remote-controlled robot that races through the water ten times faster than any human swimmer. She may not drag you back to shore, but she will keep you afloat until a lifeboat **picks you up**. Elsewhere, the US Navy is working on Octavia, a robot firefighter that never **gives up**. It battles through the smoke and flames to **put out** fires that would be far too dangerous for human firefighters.

B_____

Even the best surgeon's hand sometimes shakes while operating on a patient. Soon though, patients will **wake up** after surgery knowing that the steadiest of robotic arms will have been operating on them. Meanwhile, in another part of the

hospital, a robot nurse, the RP7, will be taking a patient's pulse and temperature then emailing their medical history to a specialist in another country. In the corridor, a fleet of robots will be hard at work day and night collecting dirty sheets, delivering clean ones and **handing out** food. These robots won't replace humans, but they will allow the human staff to **get on with** saving people's lives.

C_____

This robot shows you to your table, takes your order and **heads for** the kitchen where the chef – another robot – cooks your steak. After a delicious main course, another robot provides entertainment until the dessert comes. It may sound like a sci-fi film, but actually this is the Haohai Robot Restaurant in China where all 18 members of staff are robots. Amazingly, this is the fourth robot restaurant in China. The good news for customers is that you don't need to give them a tip; the bad news for the restaurant manager is that they only work a five-hour shift before taking a two-hour break to recharge their batteries.

D_____

This robot will soon be patrolling your neighbourhood as police forces around the world take advantage of technological advances to fight crime. US police departments are getting their very own ex-army robots for situations that are too risky for a human being. The 'Throwbot' is a pocket-sized robot that police will throw around comers to **check out** who or what is waiting for them; the 'Packbot' and the 'Talon' can defuse a bomb just as well as any bomb disposal expert. The only thing the forces of law and order don't have is a robot judge... yet!

Ex.7.7. Answer the questions to the text above.

1. How will robots help the human staff in a hospital?
2. What will robots do to fight crime?

3. How will robots save lives in emergencies?
4. How will robots help the human customers in a restaurant?

Ex.7.8. Read again and for questions 1-10, choose from the texts (A-D). The texts may be chosen more than once.

Which text mentions:

a robot you will see on the streets?	1	
a person not doing their job well?	2	
a robot that will amuse you?	3	
robots that need to stop working for a while?	4	
a robot that tidies up?	5	
a robot that you will be happy to see?	6	
a very small robot?	7	
a robot sending some information?	8	
a robot that is quicker than a person?	9	
a robot that does not stop?	10	

Ex.7.9. Match the phrasal verbs in bold in the text above to their meanings.

1) stop sth burning
2) giving
3) goes and gets you
4) stops trying
5) see
6) stop sleeping
7) continue
8) goes to

Ex.7.10. Match the underlined words in the text above to their antonyms below.

1) explode
2) unsurprisingly
3) shakiest

4) push
5) disgusting
6) sinking
7) safe
8) relaxing

Ex.7.11. Fill in the gaps with the words from the box.

take (x3)	*police*	*recharge*	*get*
give	*defuse*	*technological*	*main*

1) … somebody's pulse / temperature
2) … a bomb
3) … course
4) … force / department
5) … advances
6) … somebody a tip
7) … batteries
8) … a break
9) … into trouble
10) … advantage of

Ex.7.12. Complete the text with the words from the box.

partner	*intelligence*	*afford*	*humans*
creation	*implants*	*show*	*thinking*
	surrogate	*eyes*	

Robots and Human Emotions

In the future, robots will have emotional intelligence. Or to be more precise, robots will be able to show most, if not all, of the signs and behaviours of emotional 1)… . The robots will not feel, but like actors they will be able to 2)… emotional intelligence. Robots will develop greater emotional intelligence

that many 3)… have. The various aspects of emotional intelligence robots will be better at than many humans include: 4)…, judgement, problem solving, openness, self-control, self-analysis, and paying attention to and identifying people's feelings and emotions, for example.

But robots wouldn't be accepted by most people as a replacement for a 5)… or child. Though some people do accept 6)… partners, for example dolls and pets, for the vast majority of people a robot would fall so far short of a human that this would not be a possibility, even perhaps in a hundred years or more. The cost of producing such a machine would be more than many companies could 7)… . Such technology is probably more than fifty years away. But with advances in artificial hearts, lungs, 8)…, ears, skin and so on, the 9)… of a part machine part human is possible technically. Such machines would be cyborgs or cybernetic organisms. Patients have been given artificial brain, heart, cochlea and other 10)… in large numbers.

Ex.7.13. Read the text and decide if the statements below are true or false.

Japan Opens Hotel Run by Robots

Five-star hotels pride themselves on offering cordon bleu food and personal service, but a hotel in Japan may offer a glimpse of the future, because it will be staffed almost entirely by helpful humanoids. When the first guests check into at Henn-na Hotel in Nagasaki this July, they will be greeted by 10 lifelike robots – and the mechanical service will not stop there.

The robots will check in new guests before carrying their luggage and cleaning their rooms – and all with a smile. The robots are designed to look like and share the mannerisms as polite young Japanese women. They will look like they are really breathing, blink and make eye contact as well as altering

their body language and tone to respond to guests' requests. Their cloth uniform also makes them look more human. The robots will be multilingual and able to speak fluent Japanese, Chinese, Korean and English. Three of the uniformed robots will man the reception desk, another four will act as porters, while others will clean. An industrial robot will serve as a cloakroom attendant.

While human staff will be on hand to make sure everything runs smoothly in the hotel, company president Hideo Sawada said that he hopes the robots will carry out 90 per cent of tasks in the hotel. He told the Japan Times: "We will make the most efficient hotel in the world." Guests staying at the hotel, which is located at Huis Ten Bosch theme park in Nagasaki Prefecture, Japan, won't need any room keys, because the doors will be fitted with face recognition technology, allowing them to access their rooms using their appearance alone. The temperature of their rooms will be monitored with technology that detects body heat and guests will be able to call for robotic room service using a tablet instead of a phone.

While the Henn-na will be Japan's first hotel run by robots, androids are already working in shops and restaurants. A club called The Robot Restaurant in Tokyo is known for its sci-fi cabaret show, featuring robotic boxers and dancers, as well as its garishly illuminated interior. And humanoids called Nao will begin working at branches of Mitsubishi UFJ Financial Group from April, on a trial basis. If the trial is successful, the robotic employees will be rolled out to more branches of the Japanese bank by 2020.

1. A hotel in Japan will use only humanoid robots.
2. These robots will be multi-functional.
3. The robots won't be able to move their eyes.
4. The robots will speak four languages.
5. This experience in robot staff is a new thing in Japan.

Ex.7.14. Choose the right meaning for the following words and word combinations.

1) pride themselves
a. propose
b. are proud
c. prepare
2) be on hands
a. walk on hands
b. be available
c. unemployed
3) monitored
a. controlled
b. detected
c. replaced
4) featuring
a. planning
b. performing
c. showing
5) trial
a. period
b. satisfaction
c. test

Ex.7.15. Read the text and answer the questions below.

It's a Robot's World

You've met C-3PO and R2-D2. Now meet SDR-4X, the new "entertainment robot" Sony presented last week, which lists singing and conversation among its accomplishments. It has a vocabulary of 60,000 words, it can walk by itself, and once it gets to know you, it will recognise your face.

SDR-4X is the newest member of the growing family of humanoid robots, and it's one of many that will be on display at Robodex, a four-day exhibition that begins this Thursday

in Japan. Featuring thousands of electronic creations of all shapes and sizes, the exhibition will focus on "robots as partners". The official word is that "the goal of Robodex is to provide people with 'love' and 'dreams' through robots and to realize a society where humans and robots cohabit with each other."

Is that kind of society a very distant dream? Not if Honda has its way. The Japanese corporation's robot division has created ASIMO, a partner for people, a new kind of robot that functions in society. ASIMO looks a little like a 10-year-old in an astronaut's suit. It weighs about 110 pounds and stands four feet tall. "ASIMO will truly be able to help people in the 21st century," says Honda, adding that its "dream is that ASIMO will help improve life in human society." A commercial for ASIMO describes how the little robot will be able to respond to simple voice commands, recognize faces, carry loads, and push carts – so one day, it might be able to assist the elderly and help with household tasks.

Whether for entertainment or service purposes, Sony and Honda's robot divisions have been dealing with the same technical challenges: how to get a robot to see, hear, walk, climb stairs, avoid obstacles, and pick itself up if it falls over. It's a long list and it highlights just how complex humans are – all of our capabilities are difficult to duplicate in a machine.

Despite their sophistication, the heart-surgery robot, Robonaut, and ASIMO all lack a fundamental human capacity: the ability to think, make decisions, and be creative. Artificial intelligence (AI) is the term used to describe this capacity for a computer or a robot to imitate the thinking and decision-making capabilities of the human mind. Scientists are working on several projects that aim to create robots that think and behave like humans. One of those projects is known as Cog (short for "cognition").

1. What is Robodex and why has it been created?
2. How will Honda improve human life?
3. According to the text why are robots unable to be like humans?

Ex.7.16. Decide if the following sentences are true or false. Correct the false ones.

1. SDR-4X is a robot and therefore it will never recognize its owner's face.
2. SDR-4X can walk, sing and talk.
3. The purpose of Robodex is to make robots be partners for people.
4. ASIMO is specially designed to entertain people regardless of how useful it is to improve our daily life.
5. It's hard and still impossible to create a robot which will have all the senses and functions of a human.
6. Unlike other robots, the Cog is able to use artificial intelligence.

Ex.7.17. Read the text and answer the questions below.

Giggling Robot Becomes One of the Kids

A computer might not be clever enough to trick adults into thinking they are intelligent yet, but a new study shows that a giggling robot is sophisticated enough to get toddlers to treat it as a peer.

An experiment led by Javier Movellan at the University of California San Diego, US, is the first long-term study of interaction between toddlers and robots.

The researchers stationed a 2-foot-tall robot called QRIO (pronounced "curio"), and developed by Sony, in a classroom of a dozen toddlers aged between 18 months and two years. QRIO stayed in the middle of the room using its sensors to avoid bumping the kids or the walls. It was initially programmed

to giggle when the kids touched its head, to occasionally sit down, and to lie down when its batteries died. A human operator could also make the robot turn towards a child or wave as they went away. “We expected that after a few hours, the magic was going to fade,” Movellan says. “That’s what has been found with earlier robots.” But, in fact, the kids warmed to the robot over several weeks, eventually interacting with QRIO in much the same way they did with other toddlers.

The researchers measured the bond between the children and the robot in several ways. Firstly, as with other toddlers, they touched QRIO mostly on the arms and hands, rather than on the face or legs. For this age group, ‘the amount of touching is a good predictor of how you are doing as a social being”, Movellan says. The children also treated QRIO with more care and attention than they treated a similar-looking but inanimate robot that the researchers called Robby, which acted as a control in the experiment. Once they had grown accustomed to QRIO, they hugged it much more than Robby, who also received far more rough treatment.

A panel, who watched videos of the interactions between the children and QRIO, concluded that these interactions increased in quality over several months. Eventually, the children seemed to care about the robot’s well being. They helped it up when it fell, and played “care-taking” games with it – most commonly, when QRIO’s batteries ran out of juice and it lay down, a toddler would come up and cover it with a blanket and say “Good night”. Altering QRIO’s behavior also changed the children’s attitude towards the robot. When the researchers programmed QRIO to spend all its time dancing, the kids quickly lost interest. When the robot went back to its old self, the kids again treated it like a peer again.

“The study shows that current technology is very close to being able to produce robots able to bond with toddlers,

at least over long periods of time," says Movellan. "However", he adds, "it is not clear yet whether robots can appeal in the same way to older children or adults".

Movellan says that a robot like this might eventually be useful as a classroom assistant. "You can think of it as an appliance," he says. "We need to find the thing that the robots are better at, and leave to humans the things humans are better at."

1. What does the amount of touching in toddlers indicate?
2. Why did the toddler interact with QRIO more than they did with Robby?
3. Do you think robots like QRIO will appeal in the same way to older children and adults? Why?
4. In your opinion, why did the kids lose interest in QRIO when it was programmed to spend all its time dancing?

Ex.7.18. Find a synonym in the text for each of the following words.

Child (para 1), originally (para 2), contact (para 4), look (para 2), shifting (para 4).

Ex.7.19. Read the text and answer the questions below.

Robot Birds

Liverpool city council wants to clear the city of fat pigeons. They say that people are feeding the pigeons with junk food which makes them fat. The pigeons get bigger because their normal diet consists of seeds and insects, not high-fat junk food they are eating in the city centre.

The council wants people to know that the streets are crowded with these birds because some people are feeding them. Therefore, they are responsible for the discomfort, in other words the trouble. They hope to encourage the birds to move away from the city centre and into parks and open spaces.

Councillor Berni Turner, Liverpool city council's executive member for the environment, said: "Pigeons are a real nuisance

in the city centre, they fly up at people and they leave droppings everywhere and these droppings not only make the city look really unattractive but can make surfaces slippery and dangerous. Besides, 88 man work to clean droppings from streets and buildings, at a cost of £160,000 a year.

The council brought ten robotic birds into the city centre to scare the pigeons away and they ask visitors not to give the pigeons any food. The mechanical birds, known as 'robops', will sit on the roofs of buildings. They look like a peregrine falcon, which is a bird that kills pigeons. They even make noises and flap their wings to scare the pigeons. They hope that the pigeons will go away before Liverpool becomes the European Capital of Culture.

1. What do pigeons feed on in nature?
2. What are the reasons that make the pigeons a problem to Liverpool?
3. How do the robotic birds frighten the pigeons?

Ex.7.20. Decide if the sentences are true, false, or haven't been mentioned in the text.

1. The city council is trying to encourage the citizens not to feed the pigeons with healthy food.
2. Pigeons don't get fat when they eat seeds and insects.
3. Pigeons are a problem in the city center because they pollute the environment.
4. If people do not feed pigeons, then the pigeons will look for food in the parks or open spaces.
5. Pigeons are fatter in Liverpool than in other cities so they prefer to stay in Liverpool.
6. The robotic birds will stop people from giving food to the pigeons.
7. Falcons are natural enemies of pigeons, that's why the robots look like falcons.

8. Peregrine falcon on top of the buildings will kill the pigeons.

9. Cleaning the streets off pigeons' droppings is expensive.

10. According to the city council, if there's no food, there'll be no pigeons.

11. Liverpool is the European Capital of Culture.

Ex.7.21. Read the story and choose the most appropriate option to complete the sentences below.

The phone rang in the Chief Controller's office. "The Inspection Committee is waiting, sir," he was told. "We'll begin as soon as you join us."

"I'll be right along," the Chief replied. He was a tired old man.

"I hear we've done it at last," remarked one of them.

"Let's decide afterwards," replied the Chief cautiously.

Inside the Inspection Chamber each one went to his own special section. The Chief gave a signal, the robots were brought in and the tests began. Work continued throughout the day without a break. It was five o'clock when the Committee reassembled.

"Well, gentlemen," said the Chief, "may I have your verdicts?"

"We can't hope for anything better than this," said the Head of Design Section. "You couldn't tell they weren't human!"

"Agreed," said the Chief Medical Adviser. "No defects at all."

"Psychology Section?"

"Perfect specimens, sir," said the Head of Psychology Section. "They react like humans."

"Well, gentlemen", summed up the Chief Controller when they had all finished, "it looks as if we've produced the perfect robot at last! I'd like to sign a production order straight

away. How many shall we order?" The number finally agreed was ten thousand.

"After all these years of failure, I can't tell you how relieved I am," the Chief observed. "It's going to make a lot of difference to our lives, having these robots!"

Down in Transit Section the robots sat quietly talking. "Did you hear what they called us?" said one of them. "Perfect."

"And you know what that means! They're not going to break us up this time. They'll produce us in thousands!"

The robots smiled at the thought. "I think," said the other one, "our moment has come!" And long into the night they discussed their plans for the future of the world.

1. Before the meeting the Chief …

a) had no doubts about their success.

b) wanted to say nothing in advance.

c) believed he was right all along.

d) was tired of waiting for the Committee.

2. The inspection Committee tested the robots in order to find out …

a) how to use them.

b) whether the robots were human.

c) how good the robots were.

d) how many robots to produce.

3. Each member of the inspection Committee was expected to …

a) give a signal to a robot.

b) bring the robots in.

c) sum up the results of all sections of the Inspection Chamber.

d) inform the chief about the testing results in their own section.

4. They all agreed that …

a) robots were without faults.

b) they were not able to produce a perfect robot.
c) the robots were human.
d) they couldn't hope for anything.

5. The Committee … five o'clock.
a) had the robots brought back at
b) had a break at
c) didn't finish until
d) had their Chief's verdict at

6. In the Chief's opinion the robots will …
a) endanger people's lives.
b) increase people's lives.
c) take the places of the people.
d) change people's lives.

7. When the testing was over, the Chief …
a) felt happy and relaxed.
b) was tired and quiet.
c) was cautious and observant.
d) felt they were a failure.

8. The robots decided to …
a) have a discussion with humans.
b) become human beings.
c) take over the world.
d) produce thousands of robots.

Unit 8. ETHICAL ISSUES OF ROBOTICS

Ex.8.1. Read the text and choose best options to complete it.

Robot Ethics

Robot ethics, sometimes known by the short expression "roboethics", concerns ethical problems that occur with robots, such *as* / *like* whether robots pose a threat - / *to* humans in the long or short run, whether some uses of robots are *problematic* / *easy* (such as in healthcare or as 'killer robots' *on* / *in* war), and how robots *may* / *should* be designed such as they act "ethically" (this last concern is also called machine ethics). *Despite* / *Alternatively*, roboethics refers specifically to the ethics of human behavior *towards* / *upwards* robots, as robots become increasingly *advancing* / *advanced*. Robot ethics is a sub-field of ethics of technology, specifically information technology, and it has *close* / *short* links to legal as well as socio-economic concerns. Researchers *on* / *from* diverse areas are beginning *to* / - tackle ethical questions about creating robotic technology and implementing it in societies, in a way that will still *ensure* / *insure* the safety of the human race.

While / *When* the issues are as old as the word robot, serious academic discussions *started* / *have started* around the year 2000. Robot ethics *require* / *requires* the combined commitment of experts of several disciplines, who have to adjust laws and regulations to the problems resulting *in* / *from* the scientific and technological achievements in Robotics and AI. The main fields *involved* / *involve* in robot

ethics are: robotics, computer science, artificial intelligence, philosophy, ethics, theology, biology, physiology, cognitive science, neurosciences, law, sociology, psychology, and industrial design.

Ex.8.2. Answer the questions.

1. What is Robot Ethics?
2. What ethical problems are discussed?
3. When did the ethical discussions start?
4. What are the main fields involved in robot ethics?

Ex.8.3. Read the text and choose the best headline (A–J) to each paragraph (1-10).

10 Ethical Issues o
f Artificial Intelligence and Robotics

1. The flow of misinformation together with our natural inability of perceiving reality based on evidence (a phenomenon called confirmation bias) is a threat to having an informed democracy. Russian hackers influencing the US elections, Brexit campaign and Catalonia crisis are examples of how social media can massively spread misinformation and fake news. Recent advances in computer vision make it possible to completely fake a video of President Obama. It is an open question how institutions are going to address this threat.

2. Since automatization in production appeared, there has been a fear that automation and technological advance will produce mass unemployment. Even though that prediction has proven to be incorrect, it is a fact that there has been a painful job displacement. PwC estimates that by 2030 around 30 % of the jobs will be automized. Under these circumstances, governments and companies should provide workers with tools to adapt to these changes, by supporting education and relocating jobs.

3. The importance of privacy is obvious on the example of the Cambridge Analytica scandal, where 87 million Facebook profiles were stolen and used to influence the US election and Brexit campaign. Privacy is a human right and should be protected against misuse.

4. This is one of the biggest concerns of governments and companies, especially banks. A robbery of $1 billion was reported in banks from Russia, Europe and China in 2015 and half a billion was stolen from the cryptocurrency exchange Coincheck. AI can help protect against these vulnerabilities, but it can be also used by hackers to find new sophisticated ways of attacking institutions.

5. Last month, a woman was hit and killed overnight by an Uber self-driving car when walking across the street in the US. As any other technological system, AI systems can make mistakes. It is a common misconception that robots are infallible and infinitely precise.

6. There is an ongoing debate about controlling the development of military robots and banning autonomous weapons. An open letter, from 25,000 researchers and professionals of AI, asks to ban autonomous weapons without human supervision to avoid an international military AI arms race.

7. We have to work hard to avoid bias and discrimination when developing AI algorithms. A specific example was face detection using Haar Cascades that has a lower detection rate in dark-skinned people than in light-skinned people. This happens because the algorithm is designed to find a double T pattern in a grayscale image of the person's face, corresponding to the eyebrows, nose and mouth. This pattern is more difficult to find in a person with dark skin.

8. Existing laws have not been developed with AI in mind, however, that does not mean that AI-based product and services are unregulated. As suggested by Brad Smith,

Chief Legal Officer at Microsoft, "Governments must balance support for innovation with the need to ensure consumer safety by holding the makers of AI systems responsible for harm caused by unreasonable practices". Policymakers, researchers and professionals should work together to make sure that AI provides a benefit to humanity.

9. Some tech leaders have shown concerns about the possible threats of AI. Superintelligence is generally regarded to a state where a robot starts to recursively improve itself, reaching a point that easily surpass the most intelligent human by orders of magnitude. Some enthusiasts believe that by 2045 we will have reached that state. Others believe that it is impossible.

10. Should robots have rights? If we think of a robot as an advanced washing machine, then no. However, if robots were able to have emotions or feelings, then the answer is not that clear. One of the pioneers of AI, Marvin Minsky, believed that there is no fundamental difference between humans and machines, and that general AI won't be possible unless robots have self-concious emotions.

A. Algorithmic Bias
B. Privacy
C. Superintelligence
D. Cybersecurity
E. Misinformation and Fake News
F. Regulation
G. Military Robots
H. Robot Rights
I. Job Displacement
J. Mistakes of AI

Ex.8.4. Answer the questions.

1. What are the 10 ethical issues of artificial intelligence and robotics?

2. How can artificial intelligence and robotics be used in spreading misinformation and fake news?
3. Why may automatization be a problem for people?
4. What is the example of the biggest privacy violation?
5. What is one of the biggest concerns of governments and companies, especially banks as for artificial intelligence and robotics?
6. Can AI systems make mistakes? Give examples.
7. What issue is discussed about military robots and autonomous weapons?
8. According to the text, what is bias and discrimination?
9. According to Brad Smith, who must be responsible for harm caused by unreasonable practices of AI systems?
10. What may happen if people develop superintelligence?
11. Should robots have rights?

Ex.8.5. Decide if the statements are true or false.

1. Confirmation Bias is our natural inability of perceiving reality based on evidence.
2. It is estimated that by 2030 about half of the jobs will be automatized.
3. In the Cambridge Analytica scandal there were 87 million Facebook profiles stolen to be misused.
4. AI can be used for both attacking official institutions and protecting against them.
5. Robots are infallible and infinitely precise.
6. Researchers and professionals of AI want to avoid an international military AI arms race.
7. Some AI systems work different with white and black skin.
8. There haven't been laws regulating all the issues regarding AI and robotics.
9. There are no possible threats of AI.
10. Advanced washing machine should have rights.

Ex.8.6. Match the words with their definitions.

1)	misinformation	a)	someone's right to keep their personal matters and relationships secret
2)	fake	b)	the fact that information is not correct because of the method used in collecting or presenting it
3)	threat	c)	any object used in fighting or war, such as a gun, bomb, knife, etc.
4)	privacy	d)	not real, but made to look or seem real
5)	misuse	e)	things that are done to protect a person, organization, or country and their computer information against crime or attacks carried out using the internet
6)	weapons	f)	a hypothetical agent that possesses intelligence far surpassing that of the brightest and most gifted human minds
7)	bias	g)	wrong information, or the fact that people are misinformed
8)	unemployment	h)	to use something in an unsuitable way or in a way that was not intended
9)	superintelligence	i)	a statement that someone will be hurt or harmed
10)	cybersecurity	j)	the number of people who do not have a job that provides money

Ex.8.7. Complete the text with the words from the box.

publications ethics artificial intelligence news robot newswriting transparency stories earthquake alerts

It's routine now for news organizations to use 1)… to write news. Robots are regularly transforming data into 2)…, and stories into multimedia presentations.

As more organizations start deploying AI, we need to keep a focus on the 3)… and quality of robot newswriting. What accuracy and 4)… problems do robotic systems create? What bad scenarios do we need to worry about?

Most robot newswriting so far has been for fairly formulaic situations: company earnings reports, stock market summaries, 5)… and youth sports stories.

The Associated Press is the U.S. leader in using 6)…, generating sports and business stories that appear in thousands of 7)… . A system called Heliograf writes stories for The Washington Post. Swedish local 8)… publisher MittMedia produces a robot-written story on every local house sale – catnip to those who follow real estate.

As they move into robotics, news companies should ask some serious ethical questions regarding the robot stories themselves, issues of news judgment and transparency, and pitfalls to be alert to.

Ex.8.8. Read the text and answer the questions below.

Ethical Issues of Robots in Society

It is obvious that the ethical issue of machine slavery is relatively abstract. However, the real ethical questions that revolve around robots are their impact upon human society. Clearly, low skilled labour will experience the side effects of having their jobs replaced by machines. Thus leaving society with an over abundance of people with outdated skills and little education to fall back on. This could result in a serious economic and social backlash.

There is also the ethical question of how is a robot to be treated on a day to day basis. It sounds silly, but is it ethical

to turn your robot off? Consider the flip side, maybe it is more unethical to leave your robot turned on for too long. These two questions lead us to ask at what point does a household device become worthy of moral protection. By moral protection, one means a societal sense of it being wrong for one to intentionally damage or injure the machine. This would closely resemble a machine version of animal cruelty laws.

Most researchers believe that robots are nowhere near a point to which they are advanced enough to even raise these questions. However, society has witnessed the result of not dealing with moral and ethical questions until the last minute or even after the fact on many occasions. How interesting it would be, to do something right from the beginning, before problems arise.

Most would agree that intentionally beating or breaking a robot is more a damage of property issue, than a moral, life-entity one. However, this is probably going to be the first real ethical question that arises with the coming of the robotic age. Where does the line get drawn between a device used for work and something that deserves moral protection?

A lot of what sets machines apart from animals in our psychological profile of them. Machines do not cry, show signs of distress, injury, nor do they act to avoid them. It is likely that robotic entities will be endowed with highly advanced self-preservation instincts programmed into them. Robots are expensive, and nobody wants their costly investment throwing itself into a pool one night after a hard day of labour.

These programs will require a kind of internal, negative feedback system to harmful situations. Biological life forms have a sense of pain; it is our internally wired system that reacts to negative stimulus. Most intelligent robots today have some rudimentary form of self-preservation such as an aversion to dropping off an edge. Even more advanced robots can identify

areas they had difficulty performing in, remember where it was, and in the future avoid it. Pattern matching is common as well, so as to actually predict what areas will be met with difficulty, and avoid them entirely, without actually encountering it.

1. What is the impact of robots upon human society? Do you agree with the author? Express your opinion in your own words.
2. Comment on the following sentence „By moral protection, one means a societal sense of it being wrong for one to intentionally damage or injure the machine."
3. Is human society prepared to deal with ethical questions raised by robots? Why? Why not?
4. Based on the text, point out some specific characteristics of the robots?
5. What's your opinion on the statement: „ Even more advanced robots can identify areas they had difficulty performing in, remember where it was, and in the future avoid it."? Give your own reasons.

Ex.8.9. Find in the text words with the same meaning as the given ones.

Piece of equipment (para 2), harm (para 2), come up (para 3), suffering (para 5), gifted (para 5).

Ex.8.10. All these statements are wrong. Correct them.

1. Robots are not as skilled workers as humans.
2. Robots will allow humans to have more jobs.
3. Society hasn't viewed the consequences of dealing with ethical and moral questions raised by the robotic age.
4. Robots have higher self-preservation instincts than humans.
5. Nowadays robots are not able to find their own difficulties.

Ex.8.11. Read the essay and decide on each paragraph if it supports using robots or not.

Pros and Cons of Using Robots

1. Robots are very helpful and need to be used to help people in many different ways such as cleaning in parks and streets.

2. What if something happens, and the robot is not programmed to react properly it could make the problem worse! Not all robots are programmed to respond to everything like humans can.

3. They do jobs we don't want to do or cannot do. They don't ask to be paid for what they do.

4. Could you imagine a robot taking care of your little brother or sister? Since robots are not humans, they can't show love, or compassion, or happiness. Kids would then grow up without developing social skills.

5. Robots can go into dangerous places for us. Robots can be great for working in hard-to- reach places, like the ocean floor, or under dangerous conditions, like bomb defusing.

6. Since they don't have feelings they cannot get fed up, tired or sick because of what they have to do. Furthermore, they are programmed, so they will not complain or rebel, and refuse to do what they are programmed for.

7. Robots are cheaper and more efficient than humans. They can be mass produced and instantly and infinitely duplicated. When there's a choice between a robot and a human with equal potential, the robot is always the more efficient choice.

8. One day, not too far from now, we're going to experience the greatest unemployment crisis in human history. With robots too many jobs at too many levels would become obsolete at the same time. This would have dramatic consequences for employment.

9. Robots may help us create a society in which work is not necessary, and where fun is the major priority for society. Let's

be honest with ourselves here: what we all really want in life is just to be happy, and fun helps us being happy.

10. Robots are no threat to anyone when they are programmed properly. Robots do not have free will, so therefore they cannot argue with you, injure you or disobey you.

11. All what robots will do is making unemployment levels rise and rise. People will lose their jobs, and as a consequence the number of people living under the poverty line will increase. Without jobs people can become ruthless and savage and can do wrong things.

12. Of course robots can do many things for us, but when using robots we tend to become more lazy and unable to live without robots.

13. When you look at the advancements made in the past few years, it's hard not to get excited over the possibilities of robots. For example, driverless cars.

14. Moreover, robots require energy. The energy in our world is already depleting at an accelerated rate.

15. Robots may be programmed to be destroying. Robots will learn how to fight and once they do they will fight people.

16. A real teacher can answer what students ask him, while robot teachers will teach only what they have been programmed to teach. They can't give information about life. No more fun or affection in the classroom.

Robots are unable to compete with humans in areas of perception and manipulation, creativity and social intelligence.

Ex.8.12. Answer the questions.

1. What are the pros and cons of using robots?
2. What other pros and cons can you add to the list?
3. Do you think people should limit using robots in some specific areas? Why? Why not?
4. What is your personal opinion on using robots?

Ex.8.13. Decide if the statements are true or false.

1. Robots may be very useful in our householding chores and cleaning streets and parks.
2. Robots need energy.
3. Robots can't be dangerous or harmful for people.
4. Robot teachers can have individual approach to each student.
5. Robots are allowed to kill people if they are detected as enemies.
6. A driverless car is an exciting but still not perfect device.
7. Mass use of robots in industry will obviously lead to unemployment.
8. Some robots have feeling and emotions and are good at looking after kids.
9. Using robots in our daily lives will lead us to being lazy and uncreative.
10. People are still better than robots at perception and manipulation, creativity and social intelligence.

Ex.8.14. Complete the text with correct words from the box.

Robots to Get Their Own Internet

data	*build up*	*knowledge*	*researchers*
store	*task*	*roboticists*	*project*
standardisation		*armed with*	

Robots could soon have an equivalent of the Internet and Wikipedia. European scientists have embarked on a 1)… to let robots share and 2)… what they discover about the world. Called RoboEarth, it will be a place that robots can upload 3)… to when they master a 4)…, and ask for help in carrying out new ones. 5)… behind it hope it will allow robots to come into service more quickly, 6)… a growing library of knowledge about their human masters.

The idea behind RoboEarth is to develop methods that help robots encode, exchange and re-use 7)…, said RoboEarth researcher Dr Markus Waibel from the Swiss Federal Institute of Technology in Zurich. "Most current robots see the world their own way and there's very little 8)… going on," he said. Most researchers using robots typically develop their own way for that machine to 9)… a corpus of data about the world. This, said Dr Waibel, made it very difficult for 10)… to share knowledge or for the field to advance rapidly because everyone started off solving the same problems. By contrast, RoboEarth hopes to start showing how the information that robots discover about the world can be defined so any other robot can find it and use it.

Ex.8.15. Answer the questions.

1. Why do robots need their own equivalent of the Internet and Wikipedia?
2. How could robots use it?
3. Why do robots have their own view about the world?
4. What is the main idea of RoboEarth?

Ex.8.16. Match the words in columns with prepositions to complete word combinations from the text. Explain their meanings.

1) build	a) contrast
2) armed	b) out
3) embarked	c) on
4) carrying	d) up
5) allow	e) on
6) going	f) off
7) started	g) with
8) by	h) to

Ex.8.17. Match the sentences halves.

1) Robots could soon have…	a) …let robots share and store what they discover about the world.
2) European scientists have embarked on a task to…	b) …see the world their own way.
3) The idea behind RoboEarth is to develop methods that…	c) …an equivalent of the Internet and Wikipedia.
4) Most current robots…	d) …to build up a corpus of data about the world.
5) Most researchers typically develop their own way for that machine…	e) …help robots encode, exchange and re-use data.

Ex.8.18. Read the second part of the text and fill in the gaps with the right linking words from the box.

so that however therefore because and (2x) where if (2x) so as to while besides in order to so as for instance as a result since which whether

1)… RoboEarth will be a communication system and a database, he said. 2)… in the database there will be maps of places 3)… robots may work, descriptions of objects they encounter 4)… instructions for how to complete distinct actions. “The human equivalent would be Wikipedia 5)… Wikipedia is something that humans use 6)… share knowledge, that everyone can edit, contribute knowledge to and access,” Dr Waibel said. “7)… something like that does not exist for robots. 8)… it would be great, 9) … a robot could enter a location that it had never visited before, consult RoboEarth to learn about that place and the objects

and tasks in it and then quickly get to work. 10)… other projects are working on standardising the way robots sense the world and encode the information they find, RoboEarth tries to go further. "That's really new 11)… the key is allowing robots to share knowledge," said Dr Waibel. 12)… RoboEarth is likely to become a tool for the growing number of service and domestic robots 13)… many expect to become a feature in homes in coming decades. Dr Waibel said it would be a place 14)… robots would be taught about the objects that fill the human world and their relationships to each other. 15)… RoboEarth could help a robot understand what is meant 16)… whether it is asked to set the table and what objects are required 17)… complete that task. 18)… the EU-funded project has about 35 researchers working on it, they hope to demonstrate how the system might work by the end of its four-year duration. Early work has resulted in away to download descriptions of tasks that are then executed by a robot 19)… improved maps of locations can also be uploaded. "A system such as RoboEarth was going to be essential, 20)… robots were going to become truly useful to humans", said Dr Waibel.

Ex.8.19. Answer the questions.

1. What will RoboEarth contain?
2. What can Wikipedia be used for?
3. What is new in RoboEarth compared to existing technologies?
4. When do the 35 researchers plan to demonstrate how the system might work?
5. What is the main goal of RoboEarth?

Ex.8.20. Match the words with their definitions.

1) database	a) the right or opportunity to use or look at something

2)	distinct	b)	an ability to understand, recognize, value, or react to something
3)	access	c)	a large amount of information stored in a computer system in such a way that it can be easily looked at or changed
4)	standardize	d)	relating to a person's own country
5)	sense	e)	clearly separate and different (from something else)
6)	domestic	f)	the length of time that something lasts
7)	duration	g)	to make things of the same type all have the same basic features

Ex.8.21. Match the verbs with their synonyms.

1)	encounter	a)	to code; to encrypt
2)	contribute	b)	to look forward; to wait
3)	share	c)	to perform; to carry out
4)	encode	d)	to promote; to support; to assist
5)	expect	e)	to face
6)	fill	f)	to demand; to need
7)	require	g)	to divide; to give
8)	execute	h)	to complete; to stuff

Ex.8.22. Read the article and answer the questions below.

Computers Turned My Son into a Robot

A mother says that her schoolboy son's addiction to computers turned him into a "robot". Paul, now 19, was a computer addict. "He didn't want to eat or sleep", says Connie Bedworth, Paul's mother. "He locked himself in his bedroom. He sat there all day-all night too. One night I had to turn off the electricity. It was the only way to make him stop."

Connie bought Paul his computer when he was 11. "I thought it would help him in his school work". At first Paul played computers games. Then he started writing his own

programmes. When he was 14 he learned how to enter secret computer systems. He discovered top secret information. But yesterday a court in London decided Paul was innocent. He did not break the law. "He's a computer addict", they said.

"Not any more", says Paul. "That part of my life is finished". Paul is now a student at Edinburgh University.

1. Why does the mother compare her son to a robot?
2. What activities did Paul do with his computer?
3. How long has Paul been using the computers?
4. Why did Paul appear in a court?
5. Have you ever had such addiction?

Ex.8.23. Decide if the statements are true or false.

1. Paul's mother turned off the electricity because she couldn't pay the electricity bill.
2. She bought her son a computer when he was a school boy.
3. Paul was addicted to computer games.
4. When a schoolboy, Paul used computer to do home work.
5. Paul was a criminal.
6. Court in London decided Paul wasn't guilty.

Ex.8.24. Read the text and fill in the blanks with correct articles (a, an. the).

Meet the Robot Telemarketer
Who Denies She's a Robot

Recently Time Washington Bureau Chief Michael Scherer received … phone call from … apparently bright and engaging woman asking him if he wanted … deal. But he soon got … feeling something wasn't quite right.

After asking … telemarketer point blank if she was … real person or … computer-operated robot, she chuckled charmingly

and insisted she was real. Looking to press … issue, Scherer asked her … series of questions, which she promptly failed, such as "What vegetable is found in tomato soup?" to which she responded by saying she didn't understand … question. When asked what day of … week it was yesterday, she complained of bad connection (ah, … oldest trick in … book).

.... Time reporter called ... company directly, identified himself and said … Time was doing … story about .... robot who calls people on … company's behalf. "We don't use robot calls, sir," said … person who answered phone, before promptly hanging up … phone.

Ex.8.25. Answer the questions to the story above.

1. Why is the telemarketer calling?
2. What excuses does the telemarketer keep making?
3. What does the reporter want the telemarketer to say?
4. Why doesn't she say it?

Ex.8.26. Match the words with their definitions.

1)	apparent	a)	to insist on raising / discussing / resolving a problem
2)	engage	b)	as the representative of somebody or instead of them
3)	point blank	c)	to attract and keep somebody's attention and interest
4)	chuckle	d)	seems to be real or true but may not be
5)	press an issue	e)	a well-known way of deceiving someone, though still effective
6)	the oldest trick in the book	f)	to laugh quietly

7)	on behalf	g)	extremely close to the target or when almost touching it

Ex.8.27. Discuss the following questions.

1. What role will robots play in our society later this century? (companions, workers, computers, etc…)

2. How much of the human body will be replaced by machines? Will there be androids in the future?

3. Can you think of movies that have robots in them? What were they about? Did you enjoy it?

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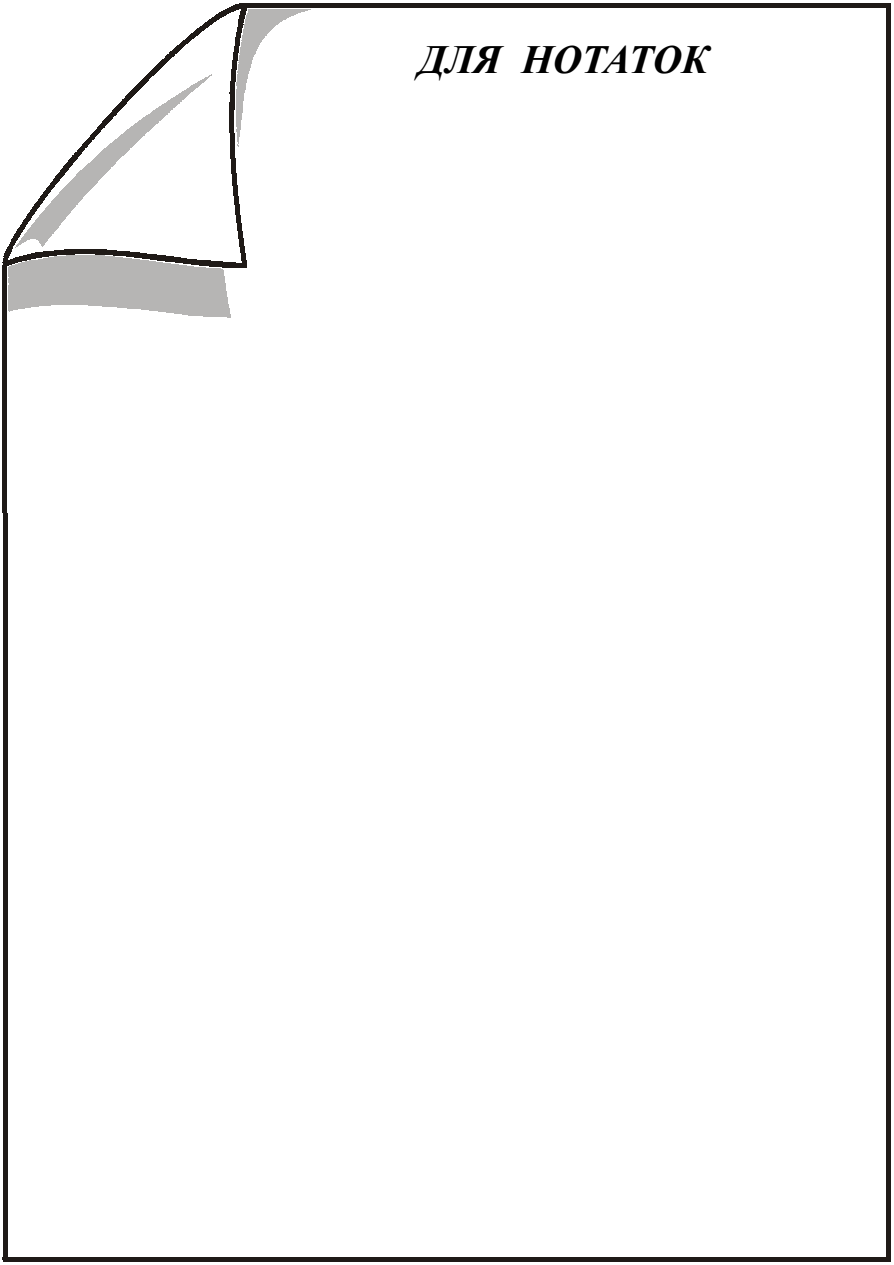
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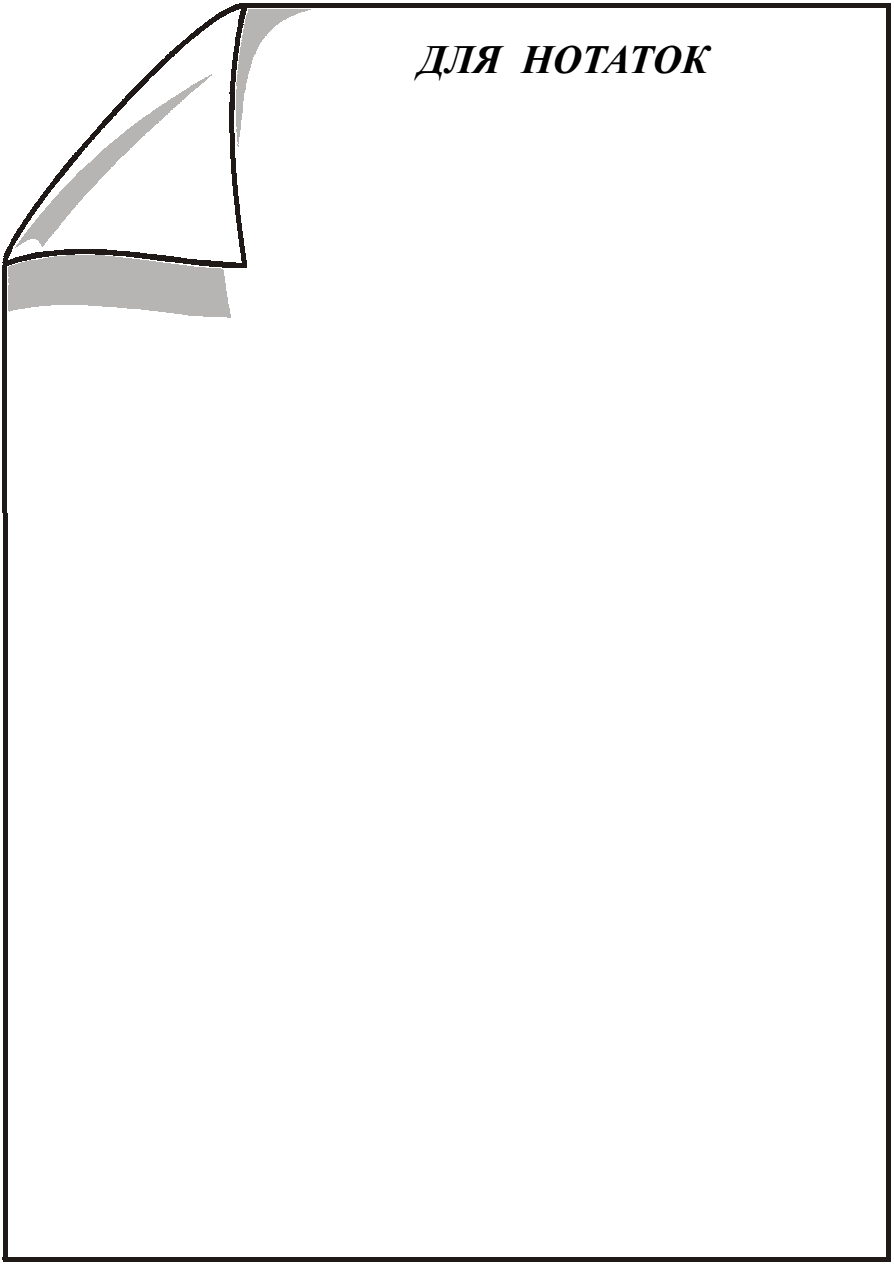
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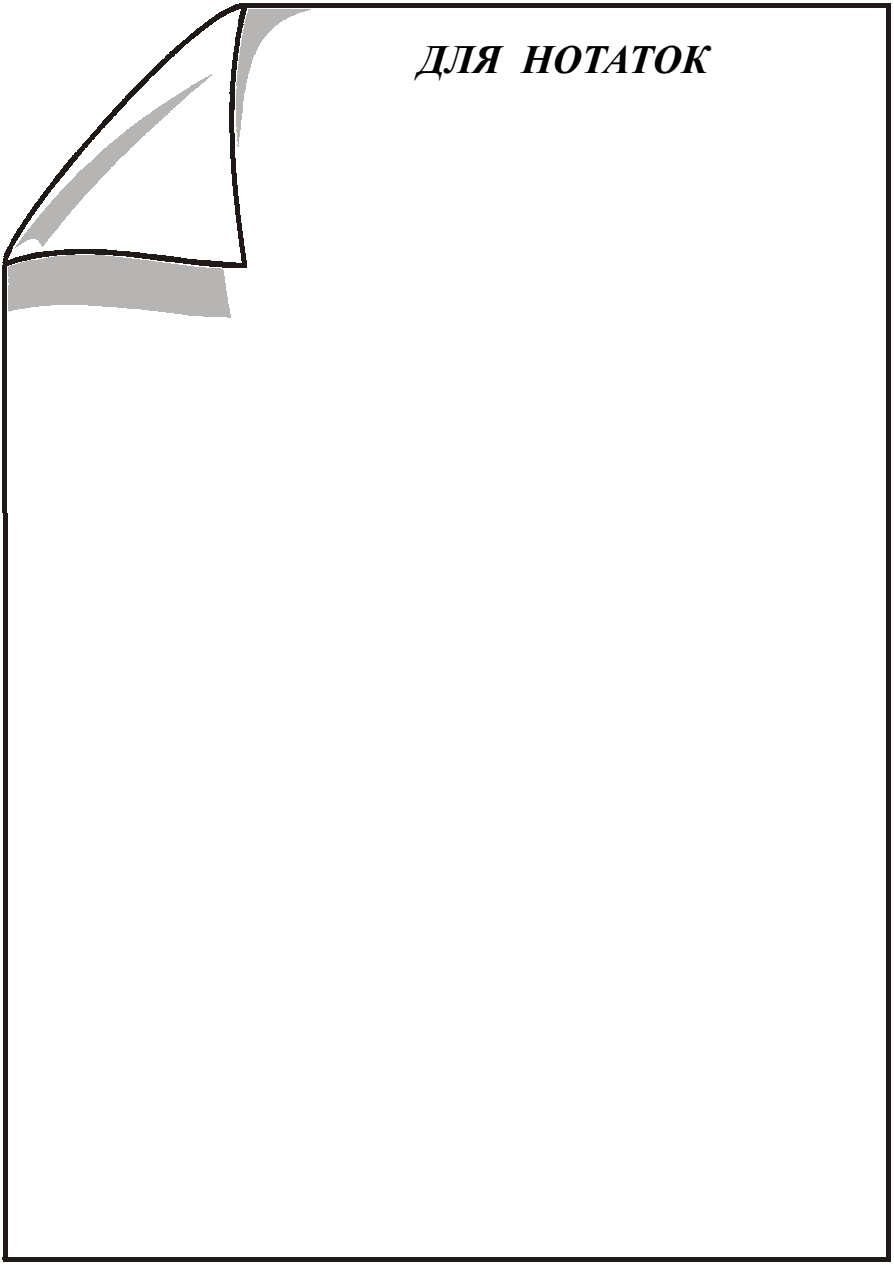
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