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ПЕРЕДМОВА

Сучасний світ інформаційних технологій швидко розвивається, і знання англійської мови стає необхідністю для успішного пристосування до цих змін. Англійська мова – це не лише засіб спілкування, але й потужний інструмент у сучасному інформаційному світі. Для студентів комп'ютерних спеціальностей володіння англійською мовою стає ключовим фактором у досягненні успіху у своїй професійній кар'єрі.

Методичний посібник «Іноземна мова професійного спрямування для студентів комп’ютерних спеціальностей» створений з урахуванням специфіки професійної діяльності та містить матеріали, які допоможуть студентам вдосконалити свої мовні навички, а також опанувати термінологію та концепції, що є ключовими в комп'ютерних технологіях.

Посібник складається із трьох розділів. Перший розділ містить сучасні професійно-орієнтовані тексти та комплекс вправ, спрямованих на засвоєння нових лексичних одиниць-термінів, що ними оперують фахівці ІТ сфери у своїй професійній діяльності. Кожен урок першого розділу має вправи та ситуативні задачі для формування та розвитку навичок монологічного та діалогічного мовлення. У другому розділі подано основні граматичні теми англійської мови у формі теоретичного матеріалу, правил і таблиць, розроблено вправи для засвоєння категорій і формування граматичних навичок. Третій розділ складається із автентичних текстів професійного спрямування для позааудиторного читання та збагачення словникового запасу студента. Посібник можна використовувати як на практичних заняттях англійської мови, так і для самостійної роботи студентів.

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Part 1
Unit 1. Parts of the computer

Your vocabulary
to store – зберігати
to retrieve – видобувати (інформацію)
hardware – апаратне забезпечення
software – програмне забезпечення
input and output devices – пристрої вводу та виводу
instructions – команди
operating system – операційна система
application software – прикладна́ програ́ма або дода́ток — користувацька комп'ютерна програма, що дає змогу вирішувати конкретні прикладні задачі користувача
central processing unit – центральний процесор
hard disk – жорсткий диск
solid-state drive – твердотілий накопичувач
high-end chipsets – високопродуктивні мікросхеми
printed circuit board – друкована плата
to process – обробляти (інформацію)
to execute – виконувати
multi-core processors – багатоядерні процесори
to enhance – покращувати, збільшувати, підвищувати
simultaneously – одночасно
Graphics Processing Unit – графічний процесор
performance – продуктивність
time-consuming – довготривалий, часовитратний
to lead to – призводити до
visuals – графіка
high-end – високопродуктивний, високоякісний
Random Access Memory – оперативна пам'ять
volatile memory – енергозалежна пам'ять
to access v**. –** мати доступ до; **access** n. – доступ
key – основний

What is a Computer

A computer is a machine or an electronic device that **stores**, **retrieves**, and manipulates data. The components of a computer are classified into two categories, namely, **hardware** and **software**. The physical parts of a computer are called hardware. The processor, the **input and output devices** of a computer, for example, the keyboard, printer, mouse, monitor, speakers are part of its hardware. The set of **instructions**, and the programs installed on a computer constitute its software. The computer software can be classified into two categories, namely, the application software and the **operating system**. The **application software** instructs the computer

to perform specific tasks based on the input data. The operating system controls the integrated working of the various parts of the computer hardware.

What are the 5 Basic Parts of a Computer?

Every computer comprises 5 basic parts, namely, a motherboard, a **central processing unit**, a graphics processing unit, a random access memory, and a **hard disk or solid-state drive.** All the integrated chips and circuits are installed on the motherboards of computers.

Motherboard

The motherboard of a computer is the circuit board on which all the basic and **high-end chipsets** are installed. The motherboard is one of the main parts of a computer and is also known as the **printed circuit board**. It is present in all computer systems, be it general-purpose systems or expandable ones. The main electronic components of a computer such as its central processor, interface connectors, memory controllers are all integrated into the motherboard. The peripheral components, sound cards, hard drives, interface cards, network cards, video cards, and cards for extra USB slots, are attached to the motherboard.

CPU

CPU or the Central Processing Unit is among the basic parts of the computer and is often referred to as the brain of the computer. All the data provided to a computer is **processed** in the Central Processing Unit of the computer. The instructions given to a computer through various computer programs are **executed** in this processor. In microprocessors, the processing unit is contained in one integrated circuit chip. In the modern age of **multi-core processors**, one integrated circuit chip contains multiple CPUs. The multi-core processors **enhance** the performance of the computer systems. For example, with a multi-core processor, you can perform several tasks **simultaneously**, without any effect on the processor speed.

GPU

The **Graphics Processing Unit** is used as a co-processor to enhance the **performance** of the Central Processing Unit in engineering and scientific computing. It offloads some of the **time-consuming** parts of program codes, to improve the performance of the CPU. The Graphics Processing Unit boosts the CPU performance by providing a parallel processing **facility (можливість).** A GPU may contain hundreds of cores, whereas a CPU contains a maximum of 8 cores. The highly programmable feature of graphics chips **led to** the invention of the Graphics Processing Unit.

The graphic cards produce high-quality **visuals** like the ones in 3D images and video games. These graphics cards can render great visual effects when coupled with a **high-end** monitor. A graphics card comes with a processing unit, a cooling mechanism, connections to display devices, and a memory.

RAM

Random Access Memory or RAM refers to the **volatile memory** of a computer. It is referred to as the main memory of the computer. RAM is one of the main parts of a computer and it stores the **application programs**, operating system, and the data that is currently used. It takes a shorter time to read data from RAM and to write data in it. Therefore, the processor of a computer can **access** the data stored in the Random

Access Memory, in a short time. As stated above, RAM is volatile, that is, all the data stored in it is lost when we turn off the computer. So, every time we restart the computer the operating system along with the other programs is reloaded into RAM from the hard disk drive. Also, RAM can hold less data than a hard disk, so it can be stored in microchips. For example, RAM can hold 8 GB of data whereas a hard disk can hold 10 TB of data.

Storage

One of the basic parts of a computer is constituted by its storage components. The solid-state drive and the hard disk drive are the **key** storage components of a computer. The hard disk drive of a computer system stores data permanently. Therefore, even if you turn off the computer, the data stored in the hard disk drive will be saved. All the important data, software programs, and operating systems are stored in the hard disk drive of a computer. Hard disk drives are secondary storage devices.

Solid-state storage devices can store data continuously on **integrated circuit assemblies** (інтегровані друковані плати). The SSD's or solid-state devices contain semiconductor cells and store data on them. These storage drives run silently. The semiconductor cells can store 1 to 4 bits of data. These storage devices come with lower access times and lower **latency** (час очікування, затримка). SSD's facilitate better storage density, more reliability, and high data-transfer rates. Also, the solid-state drives are highly shock-resistant as compared to hard disk drives.

Ex.1. Choose correct word or phrase and fill in the gaps.

To retrieve, hardware, instructions, central processing unit, hard disk, to process, to enhance, time-consuming, high-end, access

1. Traditional computers based on transistors and silicon chips use binary code **…** information. 2. Only authorized personnel have **…** to the computer system. 3. Computers can instantly **…** millions of information bits. 4. A computer must have **…** in order to perform four types of operations. 5. Our sites currently use cookies **…** functionality, specifically language selection. 6. A **…** is the most important processor in a computer. 7. Security is an ongoing challenge for any IT department, but there are many different **…** and software platforms available to help. 8. The data were stored on a computer **…** for later analysis. 9. Intel has succeeded in producing **…** processors. 10. This method is not only costly, but requires comprehensive, **…** data interpretation.

Ex. 2. Answer the questions.

1. What is a computer? 2. What are the physical components of a computer called? 3. What is computer software? 4. What is the difference between application software and operating system? 5. What are the 5 Basic Parts of a Computer? 6. What is the function of a motherboard? 7. What is CPU and what functions does it perform? 8. What is a multi-core processor? 9. Describe the operation of a graphics processing unit. 9. What is RAM? Why RAM is volatile type of memory? 10. What are the key storage components of a computer? 11. What are main benefits of a SSD over HDD?

Ex. 3. Translate into Ukrainian.
hardware and software, input and output devices, set of instructions, application software, circuit board, general-purpose systems, USB slots, attached to the motherboard, modern age of multi-core processors, enhance the performance of the computer systems, perform several tasks simultaneously, application programs, key storage components of a computer, stores data permanently, to run silently, to contain semiconductor cells

1. Software itself is the set of instructions or programs that tell a computer what to do. 2. The machine allows multitasking without the need to buy extra hardware. 3. An operating system (OS) is system software that manages computer hardware and software resources, and provides common services for computer programs. 4. Web browsers like Firefox, and Google Chrome, as well as Microsoft Word and Excel, are examples of application software that is used on a personal computer or laptop. 5. The CPU interprets, processes and executes instructions, most often from the hardware and software programs running on the device. 6. A multi-core processor is a microprocessor on a single integrated circuit with two or more separate processing units, called cores, each of which reads and executes program instructions. 7. A graphics processing unit (GPU) is a specialized electronic circuit initially designed to accelerate computer graphics and image processing (either on a video card or embedded on the motherboards, mobile phones, personal computers, workstations, and game consoles). 8. In general, a dual-core processor does not benefit the hardcore gamer, as most PC games are not optimized for **multi-threaded** (багатопотоковий) processing. 9. Volatile memory is a type of memory that maintains its data only while the device is powered. 10. Volatile memory is a type of memory that maintains its data only while the device is powered.

Ex. 4. Render the following phrases into English.
електронний пристрій, який видобуває, зберігає та опрацьовує інформацію; апаратне забезпечення; пристрої вводу та виводу; прикладна́ програ́ма або дода́ток; твердотілий накопичувач; високопродуктивні мікросхеми; друкована плата; інтерфейсні роз'єми; дані опрацьовуються в центральному процесорі; підвищити продуктивність комп'ютера; відеокарта; відтворювати зображення високої якості; передавати графічні ефекти у поєднанні із високоякісним монітором; зчитувати дані; часовитратний; енергозалежна пам'ять; короткий час вибірки даних

Ex. 5. Translate sentences into English. Use key words in parenthesis.
1. Апаратна складова (**hardware**) – це комплекс технічних засобів, який включає пристрої опрацювання і зберігання даних, пристрої введення і виведення, засоби комунікацій. 2. Програмна складова (**software**) – це комплекс програм, які забезпечують реалізацію інформаційних процесів пристроями інформаційної системи. 3. Прикладне програмне забезпечення (**application software**) – частина

програмного забезпечення, що потребує безпосередньої взаємодії та забезпечує користувачеві розв`язання певної задачі. 4. Центральний процесор відповідає за те, щоб повідомити всім іншим компонентам комп'ютера, що робити, відповідно до інструкцій, наданих програмами, що працюють на цьому комп'ютері. 5. Твердотілий накопичувач **(SSD)** – комп'ютерний запам'ятовувальний пристрій на основі мікросхем пам'яті та контролера (control unit), що не містить рухомих механічних частин. 6. Багатоядерні процесори (**multi-core processors)** – це інтегральна схема, яка використовує два або більше окремих процесорів або ядер для обробки даних. 7. Графічний процесор, що знаходиться на відеокартах, – це спеціальний процесор, який може швидко виконувати команди для керування зображеннями та для їх відображення. 8. Графічний процесор корисний для машинного навчання, штучного інтелекту та інших завдань, що вимагають великої кількості складних обчислень. 9. Комп'ютерна графіка нині стала невід'ємною частиною майже будь-якої галузі людської діяльності. 10. Енергозалежна пам'ять (**volatile memory)** – це комп'ютерна пам'ять, яка потребує живлення для зберігання інформації. 11. Оперативна пам'ять, або ОЗП, – це енергозалежна мікросхема, яка використовується для зберігання даних різного типу. 12. Інтернет – це відкрита система, доступ до якої може отримати будь-хто, у кого є відповідні технічні можливості.

Ex. 6. Match phrases to form collocations.

1. install	a) processing unit
2. set	b) the program
3. central	c) processor
4. solid-state	d) the performance
5. multi-core	e) data
6. to run	f) on the motherboard
7. to enhance	g) internet
8. Random Access	h) Memory
9. to read	i) of instructions
10. to access	j) drive

Ex. 7. Fill in the text with correct nouns, verbs and prepositions.

Software

Software are 1) … that tell a computer what to do. Software comprises the entire set of programs, procedures, and routines associated with the operation of a computer system. The term was coined to differentiate these instructions from hardware – i.e., the 2) … components of a computer system. A set of instructions that directs a computer’s hardware to 3) … a task is called a program, or software program.

The two main types of software are system software and 4) … software. System software controls a computer’s internal functioning, mainly through an operating system, and also controls such 5) … as monitors, printers, and storage devices.

Application software, by contrast, directs the computer to 6) … commands given by the user and may be said to include any program that processes data for a user. Application software thus 7) … word processors, spreadsheets, database management, inventory and payroll programs, and many other "applications". A third software category is that of network software, which coordinates 8) … between the computers linked in a network.

Software is typically stored on an external long-term memory device, such as a hard drive. When the program is in use, the computer reads it from the storage device and temporarily places the instructions in 9) … access memory (RAM). The process of storing and then performing the instructions is called "running," or "executing," a program. By contrast, software programs and procedures that are 10) … stored in a computer's memory using a read-only (ROM) technology are called firmware, or "hard software."

1.	a) rules	b) regulations	c) instructions	d) laws
2.	a) mechanical	b) physical	c) electrical	d) natural
3.	a) perform	b) make	c) understand	d) limit
4.	a) addition	b) gadget	c) firmware	d) application
5.	a) parts	b) software	c) peripherals	d) applications
6.	a) execute	b) make	c) excuse	d) exercise
7.	a) indicates	b) excludes	c) performs	d) includes
8	a) conversation	b) talk	c) communication	d) commutation
9.	a) read-only	b) repeat	c) running	d) random
10.	a) temporally	b) permanently	c) shortly	d) briefly

Speaking.

Answer the following questions using vocabulary from this unit.

1. Do you use a computer very much? 2. When do you use a computer? 3. What do you use the computer for? 3. What was your impression when you used a computer the first time? 4. How did you learn to use a computer? 5. Have computers changed your life in any way (if yes, How?)? 6. Are computers used much in your country? 7. Do you think computers are useful in everyday life (how)? 8. Do you play computer games? 9. Do you think computers are perfect now, or do they still need to be improved?

Useful phrases and speech patterns

• I **use** a laptop **for watching** movies
• I **use** my laptop **for watching** movies
• I **use** a laptop **to watch** movies

It **comes in handy for** _____ (=to be convenient)
• watching movies
• coding

• preparing presentations
• surfing the Internet
• shopping online

I use /z/ it _+ noun____
for work for work stuff
for business for
personal use /s/
for educational purposes
for almost everything

Problems of using computers
Here are some ideas, phrases and language we can use to talk about the challenges of using computers.
They do exactly what you tell them, not what you want them to do!
They are so fragile and easy to break
The battery can run out too quickly
They often have compatibility issues, so I can't share Mac Pages with a Windows computer.
Insufficient storage space can be problematic
Glitches can be a problem
_____ can be a problem
____ can be problematic
Accessing a wifi network can be challenging
There is a threat from malware, viruses and cyberattacks

Unit 2. The processor

Text 1. Microprocessor

Microprocessor, any of a type of miniature electronic device that contains the arithmetic, logic, and **control circuitry** necessary to perform the functions of a digital computer's central processing unit. **In effect**, this kind of integrated circuit can interpret and execute program instructions as well as handle arithmetic operations.

In the early 1970s the introduction of **large-scale integration** (LSI)—which made it possible to pack thousands of transistors, diodes, and resistors onto a silicon chip less than 0.2 inch (5 mm) square—led to the development of the microprocessor. The first microprocessor was the Intel 4004, which was introduced in 1971. During the early 1980s very large-scale integration (VLSI) vastly increased the **circuit density** of microprocessors. In the 2010s a single VLSI circuit holds billions of electronic components on a chip identical in size to the LSI circuit.

The production of inexpensive microprocessors enabled computer engineers to develop microcomputers. Such computer systems are small but have enough computing power to perform many business, industrial, and scientific tasks. The microprocessor also permitted the development of so-called intelligent terminals, such

as **automatic teller machines** and **point-of-sale terminal**s employed in retail stores. The microprocessor also provides automatic control of industrial robots, surveying instruments, and various kinds of hospital equipment. It has brought about the computerization of a wide array of consumer products, including programmable microwave ovens, television sets, and electronic games. In addition, some automobiles feature microprocessor-controlled ignition and fuel systems designed to improve **performance** and fuel economy.

Ex.1. Answer the questions.

1. What is a microprocessor? What functions does it perform? 2. What has led to the development of the microprocessor? 3. What is a large-scale integration? 4. What technology increased the circuit density of microprocessors? 5. What triggered the development of microcomputers? 6. Why do you think the microprocessor also permitted the development of so-called intelligent terminals, such as automatic teller machines and point-of-sale terminals? 7. What devices a microprocessor can be used? 8. What is the most powerful microprocessor known today?

Your vocabulary

control circuitry – схема керування
in effect – власне, по-суті, фактично
large-scale integration – широка інтеграція, інтеграція високого рівня
circuit density – щільність компонування схем
automatic teller machine, ATM – банкомат
point-of-sale terminal – платіжний/касовий термінал
performance – продуктивність

Text 2. Microprocessor

Processors are found in many modern electronic devices, including PCs, smartphones, tablets, and other **handheld devices**. Their purpose is to receive input in the form of program instructions and **execute** trillions of calculations to provide the output that the user will **interface with**.

A processor includes an arithmetic logic and control unit (CU), which measures capability in terms of the following: Ability to process instructions at a given time. Maximum number of bits/instructions. Relative **clock speed**.

Every time that an operation is performed on a computer, such as when a file is changed or an application is open, the processor must **interpret** the operating system or software's instructions. Depending on its capabilities, the processing operations can be quicker or slower, and **have** a big **impact on** what is called the "processing speed" of the CPU.

Each processor is constituted of one or more individual processing units called "cores". Each core processes instructions from a single computing task at a certain speed, defined as "clock speed" and measured in gigahertz (GHz). Since increasing clock

speed beyond a certain point became technically too difficult, modern computers now have several processor cores (dual-core, quad-core, etc.). They work together to process instructions and **complete** multiple tasks at the same time.
Modern desktop and laptop computers now have a separate processor to handle **graphic rendering** and send output to the display monitor device. Since this processor, the GPU, is specifically designed for this task, computers can handle all applications that are especially **graphic-intensive** such as video games more efficiently.
A processor is made of four basic elements: the arithmetic logic unit (ALU), the **floating point unit** (FPU), registers, and the cache memories. The ALU and FPU carry basic and advanced arithmetic and logic operations on numbers, and then results are sent to the registers, which also store instructions. Caches are small and fast memories that store copies of data for frequent use, and act similarly to a random access memory (RAM).
The CPU **carries out** his operations through the three main steps of the instruction cycle: **fetch**, decode, and execute. Fetch: the CPU **retrieve**s instructions, usually from a RAM. Decode: a decoder converts the instruction into signals to the other components of the computer. Execute: the now decoded instructions are sent to each component so that the desired operation can be performed.

handheld devices – мобільні/кишенькові пристрої
to execute – виконувати
to interface with – взаємодіяти
arithmetic logic unit – арифметико-логічний пристрій
clock speed/rate – тактова частота
to interpret – виконувати програму в режимі інтерпретації
to have impact on – впливати на
to complete – виконувати
graphic rendering – графічна візуалізація, графічний рендерінг
graphic-intensive – графічно-інтенсивний
floating point unit – математи́чний співпроце́сор, модуль (блок) операцій з рухомою комою
fetch – виклик (даних або програм із пам'яті), вибірка (напр., команди або даних із пам'яті)
retrieve – отримувати, вибирати дані

Answer the questions.

1. What is the purpose of a microprocessor? 2. What does a microprocessor consists of? 3. What is the clock speed and what units it is measured in? 4. What is the “core” of a microprocessor and what functions it performs? 5. Why do modern computers have several processor cores? 6. Describe the operating principle of a processor.

Ex.2. Fill in the sentences with the correct word or phrase.

executes, handheld, in effect, graphic, on, introduced, handle, clock, with, cores

1. That deal might create, … **,** the world's most promising company. 2. Since we work with numbers so much in programming, learning how to … mathematical operations will be helpful for a lot of programming tasks. 3. The first microprocessor, the Intel 4004, was … in 1971. 4. … devices are designed to be extremely portable, and they can often fit in your hand. 5. This device needs to interface … different networks and operating systems and communications middleware. 6. A … speed of 3.5 GHz to 4.0 GHz is generally considered to be a good one for gaming. 7. This decision will have a disastrous impact … foreign policy. 8. An interpreter is a computer program that directly … instructions written in a programming or scripting language. 9. Each processor consists of one or more individual processing units called "…". 10. Modern desktop and laptop computers now have a separate processor to handle … rendering and send output to the display monitor device.

Ex. 3. Translate the phrases into Ukrainian.

to perform the functions, integrated circuit, interpret and execute program instructions, silicon chip, to develop microcomputers, to improve performance, handheld devices, have a big impact on, CPU retrieves instructions, to interface with, arithmetic logic unit, clock speed, graphic rendering, graphic-intensive, processing operations, complete multiple tasks at the same time

(work some of these phrases into sentences)

Ex. 4. Translate the following phrases into English.

інтегрована схема, керувати арифметичними операціями, призводити до розвитку, щільність компонування схем, платіжний термінал, обчислювальна потужність/спроможність, виконувати інженерні завдання, промислові роботи, широкий асортимент споживчих товарів, кишенькові пристрої, мати значний вплив на (суттєво впливати), графічна візуалізація (rendering), перетворення інструкції в сигнали, тактова частота

Ex. 5. Translate sentences into English.

1. Будь-який комп'ютер – це машина для обробки інформації, незважаючи на те, яку конкретну задачу він виконує. 2. Конструктивно, мікропроцесор виконується у вигляді однієї мікросхеми. 3. Компонентами мікропроцесора є регістри, арифметико-логічний пристрій, та блок керування. 4. Впровадження широкомасштабної інтеграції, яка дозволила розмістити тисячі транзисторів,

діодів і резисторів на кремнієвому чіпі. 5. Виробництво недорогих мікропроцесорів дозволило комп'ютерним інженерам розробити мікрокомп'ютери. 6. Мікропроцесор також дозволив розробити так звані інтелектуальні термінали, такі як банкомати та термінали в роздрібних магазинах. 7. Крім того, деякі автомобілі оснащені мікропроцесорними системами запалювання і паливними системами, призначеними для підвищення продуктивності та економії палива. 8. Процесори використовуються в багатьох сучасних електронних пристроях, включаючи ПК, смартфони, планшети та інші портативні пристрої. 9. Залежно від його можливостей, операції обробки можуть бути швидшими або повільнішими, і мають великий вплив на те, що називається "швидкістю обробки" процесора. 10. Кожне ядро обробляє інструкції однієї обчислювальної задачі з певною швидкістю, яка визначається як "тактова частота" і вимірюється в гігагерцах (ГГц). 11. Сучасні настільні комп'ютери та ноутбуки тепер мають окремий процесор для обробки графічного рендерингу та надсилання вихідних даних на пристрій відображення. 12. Процесор складається з чотирьох основних елементів: арифметико-логічний пристрій (ALU), пристрій з плаваючою комою (FPU), регістри та кеш-пам'ять. 13. Процесор виконує свої операції за допомогою трьох основних кроків циклу інструкцій: вибірка, декодування та виконання. 14. Оскільки збільшення тактової частоти понад певну межу стало технічно надто складним, сучасні комп'ютери тепер мають кілька процесорних ядер (двоядерні, чотирьохядерні тощо). 15. Intel - провідний американський бренд і виробник напівпровідникових комп'ютерних схем.

Ex. 6. Match phrases to form collocations.

1. in	a) to
2. to lead	b) devices
3. automatic teller	c) speed
4. to interface	d) chip
5. handheld	f) effect
6. clock	g) on
7. silicon	h) with
8. to have impact	i) machine

Ex. 7. Fill in the text with correct words.

The Intel Core i7-14700K is the workhorse CPU in the Intel's 14th generation launch **1) ….** , and like any good workhorse, it's going to be the one to do the heavy lifting for this generation of processors. Fortunately for Intel, the Core i7-14700K succeeds in keeping Raptor Lake Refresh from being completely forgettable.

Of all the chips **2) ….** on October 17, 2023, the Core i7-14700K is the only one to get a substantive spec upgrade over its predecessor as well as a slight cut in price to

just $409 (about £325/AU$595), which is $10 less than the Intel Core i7-13700K it replaces.

So what do you get for $10 less? Gen-on-gen, you don't get a whole lot of improvement (about 6% better performance overall compared to the 13700K), but that figure can be deceiving, since the Core i7-13700K was at the **3) ….** of our best processor list for a reason.

With the 13700K's performance being within striking distance of the Intel Core i9-13900K, that 6% improvement for the 14700K effectively closes the gap, putting the 14700K within just 3% of the 13900K overall, and even allowing it to pull ahead in average gaming **4) ….** , losing out to only the AMD Ryzen 7 7800X3D.

In terms **5) ….** productivity and general performance, the Core i7-14700K shines as well, going toe to toe with the best AMD processors like the AMD Ryzen 9 7950X and AMD Ryzen 9 7950X3D, giving it a very strong claim on being the best Intel processor for most people.

Given its excellent mix of performance and price, the Intel Core i7-14700K could very well be the last Intel chip of the LGA 1700 epoch that anyone should **6) ….** buying, especially if you're coming from a 12th-gen chip.

With the Core i9-13900K **7) ….** the Intel Core i9-12900K by as much as 25% in some workloads, someone coming off an i9-12900K or lower will find it hard to believe that an i7 could **8) ….** this well, but that's where we're at. And with the i7-14700K coming in about 30% cheaper than the Intel Core i9-14900K, while still managing to come remarkably close in terms of its performance, the Intel Core i7-14700K is the Raptor Lake Refresh chip to buy if you're going to buy one at all.

1	a) line-out	b) line-up	c) line-in	d) online
2	a) simulated	b) generated	c) lunched	d) launched
3	a) peak	b) top	c) tip	d) roof
4	a) structure	b) performance	c) immuned	d) high-end
5	a) on	b) in	c) of	d) about
6	a) review	b) consider	c) regard	d) relate
7	a) retrieving	b) maintaining	c) mastering	d) outperforming
8	a) display	b) perform	c) make	d) show

Ex. 8. Complete the sentences with correct words.

1. Processor constitutes the physical … of the entire computer system.

a) hands b) heart c) head d) lungs

2. In modern computers, the CPU is contained on an … circuit chip called a microprocessor.

a) advanced b) upgraded c) installed d) integrated

3. The control … of the central processing unit regulates and integrates the operations of the computer.

a) block b) unit c) device d) chip

4. The control unit selects and ... instructions from the main memory in proper sequence and interprets them so as to activate the other functional elements of the system at the appropriate moment to perform their respective operations.

a) blocks b) digs c) mines d) retrieves

5. Pentium contained two processors on a … chip and about 3.3 million transistors.

a) one b) unique c) isolated d) single

6. … processors help to control aircraft and industrial automation, and they are common in automobiles and in both large and small household appliances.

a) Implanted b) Outgrated c) Embedded d) Inserted

7. An arithmetic-logic unit is the part of a central processing unit that … arithmetic and logic operations on the operands in computer instruction words.

a) implements b) calculates c) carries out d) makes

8. On personal computers, the functions of a sound card are usually directly integrated into the … .

a) dashboard b) motherboard c) carries out d) makes

9. An organization's culture and style have an impact … a project's ability to meet its goals.

a) on b) in c) out d) at

10. Rendering or image … is the process of generating a photorealistic or non-photorealistic image from a 2D or 3D model by means of a computer program.

a) translation b) synthesis c) performance d) execution

Unit 3. Types of Computers

Text 1. Types of Computers

There are two bases on which we can define the types of computers. We will discuss the type of computers on the basis of size and **data handling** capabilities. We will discuss each type of computer **in detail**. Let's see first what are the types of computers. These are: Super Computer, Mainframe computer, Mini Computer, Workstation Computer, Personal Computer (PC), Server Computer, Analog Computer, Digital Computer, Hybrid Computer, Tablets and Smartphone **Supercomputer.** When we talk about speed, then the first name that comes to mind when thinking of computers is supercomputers. They are the biggest and fastest computers (**in terms of** speed of processing data). Supercomputers are designed such that they can process a huge **amount of** data, like processing trillions of instructions or data just in a second. This is because of the thousands of interconnected processors in supercomputers. It is basically used in scientific and engineering applications such as weather forecasting, scientific **simulations**, and nuclear energy research. It was first developed by Roger Cray in 1976.

Characteristics of Supercomputers. Supercomputers are the computers that are the fastest and they are also very expensive. It can calculate up to ten trillion individual calculations per second, this is also the reason which makes it even faster. It is used in the stock market or big organizations for managing the online currency world such as Bitcoin etc. It is used in scientific research areas for analyzing data obtained from exploring the solar system, satellites, etc.

Mainframe computer Mainframe computers are designed in such a way that they can support hundreds or thousands of users at the same time. It also supports multiple programs **simultaneously**. So, they can execute different processes simultaneously. All these features make the mainframe computer ideal for big organizations like banking, telecom sectors, etc., which process a high volume of data in general.

Characteristics of Mainframe Computers. It is also an expensive or costly computer. It has high **storage capacity** and great **performance**. It can process a huge amount of data (like data involved in the banking sector) very quickly. It runs smoothly for a long time and has a long life.

Minicomputer. Minicomputer is a medium size multiprocessing computer. In this type of computer, there are two or more processors, and it supports 4 to 200 users at one time. Minicomputer is similar to Microcontroller. Minicomputers are used in places like institutes or departments for different work like billing, accounting, inventory management, etc. It is smaller than a mainframe computer but larger **in comparison to** the microcomputer.

Characteristics of Minicomputer. Its weight is low. Because of its low weight, it is easy to carry anywhere. It is less expensive than a mainframe computer. It is fast.

Workstation Computer

A workstation computer is designed for technical or scientific applications. It consists of a fast microprocessor, with a large amount of RAM and a high-speed

graphic adapter. It is a single-user computer. It is generally used to perform a specific task with great **accuracy**.

Characteristics of Workstation Computer. It is expensive or high in cost. They are exclusively made for complex work purposes. It provides large storage capacity, better graphics, and a more powerful CPU when compared to a PC. It is also used to handle animation, data analysis, CAD, audio and video creation, and editing.

Your vocabulary

data handling – обробка інформації, робота з даними
in detail – детально
in terms of – в сенсі, стосовно, з точки зору, з огляду на
amount of – кількість, сума (вираз вживається з незлічувальними та абстрактними іменниками) **amount of** money, work, fuel, etc.
simulation – моделювання, імітація
simultaneously – одночасно
storage capacity – об'єм запам'ятовуючого пристрою
performance – продуктивність
in comparison to – у порівнянні з
accuracy – точність

Ex.1. Choose correct word or phrase to insert into the sentences.
in terms of, amount of , simulation, simultaneously, performance, accuracy, to manage, microprocessor, high-speed, execute

1. The biggest factor in your computer's … is the hard disk speed. 2. This laptop employs high-end Intel … . 3. The results from computer … demonstrate the effectiveness of the proposed method. 4. Our goods compete … product quality, reliability and above all variety. 5. The scientific supervisor questioned the … of his statement. 6. The network was broadcasting four games … across the country. 7. Your PC should have a … graphics processor to edit videos. 8. In computers, software provides information to a central processing unit (CPU) that … instructions and controls the operation of other hardware components. 9. Sequencing the code produces a huge … data. 10. Everyone should learn how to smartly … his/her time.

Ex. 2. Answer the questions.

1. Why are there many different types of computer systems? 2. When was the first supercomputer designed? 3. What tasks can supercomputer perform and which fields it is used in? 4. What are some basic characteristics of a mainframe computer? What are they designed for? 5. Why are mainframe computers so expensive? 6. What factors do you think influence the life of any computer? 7. What tasks are minicomputers best for? 8. Think of specifications for a minicomputer. 9. What is a workstation computer? 10. Provide characteristics of a workstation and explain what purposes it is mostly used for.

Ex. 3. Translate into Ukrainian.

data handling capabilities, discuss in detail, come to mind, data processing speed, huge amount of data, to support multiple programs simultaneously, to process a high volume of data, to run smoothly, medium size multiprocessing computer, high storage capacity, great performance, designed for technical or scientific applications, with great accuracy, made for complex work purposes, computer simulation of global warming

Ex. 4. Render the following phrases into English.

працювати з великим об’ємом даних, більш детально надати інформацію, виконати великий об’єм роботи, спадати на думку, одночасно виконувати тисячі команд за лічені секунди, моделювання виробничого процесу, об’єм запам’ятовуючого пристрою, висока продуктивність, висока точність, призначений для виконання складних завдань, обробляти великі масиви даних

Ex. 5. Translate sentences into English.

1. Уміння працювати з великими об’ємами даних, аналітично мислити, вільно володіти англійською мовою – основні вимоги до кандидатів на посаду адміністратора. 2. Принцип роботи взаємодії штучного інтелекту з актуаторами детально описаний в наступному розділі. 3. Нова система інтернету речей набагато надійніша, ефективніша і продуктивніша. 4. З точки зору якості, це, безсумнівно, кращий продукт. 5. Пам'ятайте, що у нас була обмежена кількість часу, щоб завершити цей проект. 6. Завдання нашої команди дослідити за допомогою моделювання процесу виробництва як можна зменшити енерговитрати і одночасно підвищити якість і продуктивність нового приладу. 7. Робочі станції призначенні для вирішення складних інженерних завдань. 8. Результати дослідження нової моделі виявилися не дуже точними. 9. Ми поговоримо про типи комп'ютерів з точки зору їх розміру, продуктивності та можливостей обробки даних. 10. У порівнянні з типовим мейнфреймним комп'ютером, міні-комп'ютери були невеликими (приблизно з невеликий стіл) і дешевими (вартістю кілька десятків тисяч доларів).

Ex. 6. Match phrases to form collocations.

1. to discuss	a) of production process
2. in terms of	b) instructions
3. simulation	c) complex engineering tasks
4. amount	d) measurement
5. to process	e) in detail
6. accuracy of	f) processor
7. designed for	g) of work
8. high-speed	h) energy efficiency

Ex. 7. Fill in the text with correct nouns, verbs and prepositions.

Workstation, a high-performance computer system that is basically 1) … for a single user and has advanced graphics capabilities, large storage capacity, and a powerful central processing unit. A workstation is more capable than a personal computer (PC) but is less 2) … than a server (which can manage a large network of peripheral PCs or workstations and 3) … immense data-processing and reporting tasks). The term workstation was also sometimes ascribed to dumb terminals (i.e., those without any processing capacity) that were connected to mainframe computers.

Their raw processing power allows 4) … workstations to accommodate high-resolution or three-dimensional graphic interfaces, sophisticated multitask software, and advanced abilities to communicate with other computers. Workstations are used primarily to 5) … computationally intensive scientific and engineering tasks. They have also found favour in some complex financial and business 6) … . In addition, high-end workstations often serve a network of attached "client" PCs, which use resident tools and applications to 7) … and manipulate data stored on the workstation.

The chief delineation between PCs and workstations has traditionally been the latter's advanced graphics and data-processing capabilities. But the advanced graphic interfaces and powerful 8) …. of high-end PCs can make them barely distinguishable from low-end workstations.

1	a) worked	b) designed	c) challenged	d) done
2	a) simulated	b) advanced	c) automated	d) generated
3	a) ensure	b) handle	c) integrate	d) incorporate
4	a) low-end	b) high-protected	c) immuned	d) high-end
5	a) perform	b) make	c) operate	d) redo
6	a) checks	b) threats	c) applications	d) relations
7	a) retrieve	b) maintain	c) automate	d) access
8	a) displays	b) microprocessors	c) printers	d) HDDs

Ex. 8. Complete the sentences with correct words.

1. A mainframe computer is a powerful computer used primarily by large organizations for critical applications like bulk data … .

a) working b) processing c) operation d) going

2. Neural networks implies a new way of … data.

a) corrupting b) offering c) operation d) handling

3. Research findings should be discussed in … .

a) advance b) detail c) deep d) the while

4. He thought of everything … money.

a) in terms of b) in detail of c) in advance d) in the while of

5. Nowadays any computer is able to handle huge …. of data.

a) mass b) deals c) amount d) figure

6. Computer … is the process of mathematical modelling, performed on a computer, which is designed to predict the behavior of, or the outcome of, a real-world or physical system.

a) processing b) running c) advancement d) simulation

7. Minicomputers were used for scientific and engineering computations, business transaction processing, file handling, and database… .

a) extraction b) control c) management d) simulation

8. Supercomputers have wide … in areas involving engineering or scientific research.

a) speed b) application c) management d) simulation

9. To make simulation of galaxy formation they need high- … minicomputers with multiprocessing capability.

a) speed b) resolution c) force d) performance

10. The mainframes computers have high-performance and can be used for intensive … of operations that cannot be done by normal computers.

a) speed b) solution c) processing d) performance

Ex. 9. Fill in the text with correct nouns, verbs and prepositions.

Personal Computer (PC)

Personal Computers is also known as a microcomputer. It is basically a general-purpose computer 1) … for individual use. It 2) … of a microprocessor as a central processing unit(CPU), memory, input unit, and output unit. This kind of computer is suitable for personal work such as making an **assignment**, watching a movie, etc.

Server Computer

Server Computers are computers that are combined data and programs. Electronic data and applications are stored and shared in the server computer. The working of a server computer is that it does not solve a bigger problem like a supercomputer but it solves many smaller similar ones. Examples of server computer are like Wikipedia, as when users put a 3) … for any page, it finds what the user is looking for and sends it to the user.

Digital Computer

Digital computers are designed in such a way that they can easily perform calculations and logical operations 4) … high speed. It takes raw data as input and processes it with programs stored in its memory to 5) … the final output. It only understands the binary input 0 and 1, so the **raw input data** is 6) … to 0 and 1 by the computer and then it is processed by the computer to produce the result or final output. All modern computers, like laptops, desktops including smartphones are digital computers.

Hybrid Computer

As the name suggests hybrid, which means made by combining two different things. Similarly, the hybrid computer is a **combination** of both analog and digital computers. Hybrid computers are fast like analog computers and have memory and accuracy like digital computers. So, it has the 7) … to process both **continuous and discrete data**. For working when it accepts analog signals as input then it converts them into digital form before processing the input data. So, it is widely used in specialized applications where both analog and digital data are required to be 8) … . A

processor which is used in petrol pumps that converts the measurements of fuel flow into quantity and price is an example of a hybrid computer.

1	a) worked	b) designed	c) challenged	d) done
2	a) makes	b) compiles	c) consists	d) generates
3	a) reply	b) response	c) asking	d) request
4	a) at	b) in	c) on	d) out of
5	a) perform	b) produce	c) operate	d) manufacture
6	a) converted	b) inverted	c) combined	d) related
7	a) possibility	b) power	c) ability	d) accessibility
8	a) made	b) done	c) printed	d) processed

Unit 4. Computers in our life.

Computers in our life.

Computers play an important role in our everyday life. Let's see the uses of computers in various **field**s and why the computer is important in our life.

Today, the computer is **indispensable**, and its presence has become very important and necessary in our daily life, and it has become easier for us to do many operations and activities.

A computer is an electronic device that receives information and data, automatically stores it and **retrieve**s it at any time, and uses it in a useful manner. The computer **convert**s different types of numbers and solves **intractable** mathematical **equation**s very quickly and with high **accuracy**. That is why we need a clean PC build.

The computer was invented in the second half of the twentieth century and now it has become the **backbone of life**.

Some operations before the invention of the computer were very difficult, including searches and doing some arithmetic tasks. In 1642 AD, the calculator was invented to **facilitate** arithmetic operations such as addition, **subtraction**, and other arithmetic operations.

The computer has been able to invade the lives of individuals in a large way, and it is used in all areas of their lives, and based on this great position that it has enjoyed, the manufacturers have been interested in producing many shapes and types for it **in line with** the user's need, including the mobile device, office devices, and others.

Computer use is common in homes, institutions, businesses, and education, it is also an integral part of the services, entertainment, and other sectors.

Your vocabulary

Field (галузь, сфера діяльності) … **in a/the** ~ There has been no solid research in this field. | **outside a/sb's** ~ I can't answer that? I'm afraid it's outside my field (= outside the subject I am studying/know sth about). | ~ of now working in the field of computer science

Indispensable – незамінний, … absolutely | almost, virtually ~ Written sources are considered virtually indispensable for today's history teaching. These drugs are almost indispensable in the fight against the disease.

Retrieve – (отримувати доступ, відновлювати (інфор.), видобувати інформацію. ~ to get stored information from a computer. E.g. Computers are used to store and retrieve information efficiently.

retrieve data/information I finally managed to retrieve the deleted data

retrieve a record/image/file, etc. The search is designed to retrieve all the records WorldCat has for a particular book.

Convert – змінювати, перетворювати. What's the formula for converting pounds into kilograms? The signal will be converted into digital code.

Intractable – які важко розв'язати/вирішити, неконтрольований. We are facing an intractable problem.

Equation – рівняння. In the equation 3x - 3 = 15, x = 6.

Accuracy – точність. It is possible to predict the outcome with reasonable accuracy. **improve, increase** ~ We are hoping **to improve** the **accuracy** of our forecasts. | **check, confirm, test | ensure** ~ Great care is taken **to ensure the accuracy** of research data. | **to doubt, question** ~ Many people began **to question the accuracy** of his statement.

backbone of life – основа життя, сутність життя. Carbon is the chemical backbone of life on Earth. To succeed in life, you need three things: a wishbone, a backbone and a funny bone. (Reba McEntire) Infrastructure is the backbone of economic growth.

to facilitate – полегшувати, сприяти. Both centers are electronically linked to facilitate communication. Bodybuilders use mental imaging to facilitate their physical development. Her rise to power was facilitated by her influential friends.

subtraction – віднімання. The purpose is to reinforce the basic operations of addition, subtraction, multiplication and division.

in line with – згідно з, у відповідності з/до. The company's results are in line with stock market expectations. In line with our normal policies, he will be suspended for four games.

Ex.1. Choose correct word or phrase to insert into the sentences.

Indispensable, accuracy, line, backbone, facilitate, retrieve, convert, backbone, intractable

1. This book is an … resource for researchers. 2. Despite the challenges she faced, she had the … to keep going and never give up on her dreams. 3. My actions are in … with my words. 4. Introverts take longer to … information, longer to marshal their ideas and thoughts, and longer to respond to the demands of the world around them. 5. Both groups faced … problems where resources were inadequate and no satisfactory solution was visible. 6. You must do it right, because your staff are the … of your business. 7. He challenged the … of the research results. 8. The new software will … the data entry process. 9. It is important, however, that we now … words into action.

Ex. 2. Answer the questions.

1. What is a computer? 2. Why is it indispensable? 3. When was computer invented? 4. What device was invented in 1642? 5. What does the phrase “computers have invaded our lives” infer?

Ex. 3. Translate into Ukrainian.

in the field of IT, outside the field of view of researchers, indispensable source, retrieve lost data, to convert 2D content into 3D, to ensure accuracy, backbone of a strong developing team, to facilitate new development, to stand in line with national interests (work these phrases into sentences of your own)

Ex. 4. Render the following phrases into English.

сприяти розумінню, відповідно до мети і цілей компанії, основа операційної системи, ставити під сумнів точність результатів, перетворювати в цифрову форму, видобувати резервну копію, одна із галузей інформаційних технологій, розв’язати рівняння, незамінне джерело знань
(work these phrases into sentences of your own)

Ex. 5. Translate sentences into English. Use key words in parenthesis.

1. Вирішення таких проблем не в моїй компетенції. (field) 2. Сьогодні системи штучного інтелекту все більше і більше використовуються в різних галузях IT. (field) 3. Нам нарешті вдалося відновити втрачені файли. (to retrieve) 4. Знання потрібно “конвертувати” в реальні досягнення. (to convert) 5. Це рішення (технологія) дає можливість миттєво друкувати скріншоти та конвертувати їх в інші розширення. (to convert) 6. Для того щоб отримати точні результати, вам необхідно правильно розв’язати рівняння. (equation) 7. Наполегливість, сумлінна праця і наявність мети – основа будь-якого успіху. (backbone) 8. Використання цього модуля сприятиме швидшому обміну даними. (to facilitate) 9. Команда IT розробників створила систему штучного інтелекту, який відповідає потребам компанії. (to be in line with) 10. Продукт-менеджер визначив (to identify) які невирішувані проблеми стоять на шляху реалізації нового проекту. (intractable problem)

Ex. 6. Match phrases to form collocations.

1) in the field of	a) advanced technologies
2) to retrieve	b) miles into kilometers
3) to convert	c) equations
4) accurate	d) AI (artificial intelligence)
5) backbone	e) the development of a project
6) to facilitate	f) result

7) in line with	g) accidentally deleted files
8) to solve	h) of friendly relationship

Ex. 7. Fill in the text with correct nouns, verbs and prepositions.

Some of the fields where computers are used.

Transportation: The computer is used in transportation, where the routes of transportation lines are controlled, as well as **1)** … travel tickets via the computer and recently via the Internet, and booking international airline tickets anywhere in the world via the Internet.

The computer is used to control transportation, determine the take-off and direction of aircraft, and store information about workers in the **2)** … of transportation.

The industry: Computer uses are widespread in the industry, as most companies today have a wide **3)** … of uses for computers, and factories have become highly dependent **4)** … the operation of machines to ensure a high level of quality.

The use of computers in the industry has been a great **5)** … , as it is used as a means to allocate industrial resources more efficiently, as well as as a means to reach a larger group of potential customers. As a result, IT jobs have flourished as the industry relies **6)** … computers for its daily operations.

Entertainment: Computers are among the best sources of entertainment because they **7)** … a wide range of options related to entertainment and entertainment. Through the computer, you can listen **8)** … music, watch some movies and videos, and talk and chat with your friends.

Today, everything related **9)** … daily life can be done with a few simple clicks, where breakfast can be ordered online, newspapers can also be read, and work from home can be done comfortably with the help of a laptop.

1	a) suggesting	b) offering	c) booking	d) reserving
2	a) garden	b) field	c) office	d) department
3	a) numbers	b) amount	c) results	d) range
4	a) on	b) in	c) at	d) of
5	a) problem	b) deal	c) explosion	d) necessity
6	a) in	b) on	c) at	d) about
7	a) suggest	b) ignore	c) offer	d) drive
8	a) to	b) in	c) –	d) for
9	a) in	b) to	c) about	d) with

Speaking.

Answer the following questions using vocabulary from this unit.

1. When was the first time you used a computer. What did you use it for? 2. What would your life be like without computers? 3. What do you usually use a computer for? 4. How did computers change the way we live, study and work?

Text 2. The Use of Computers.

The computer is used in several areas of our lives, including the following:

Education: The use of computers in the field of education is one of its most important **benefits** in daily human life. It is one of the most important educational **tools** used by teachers and students.

The computer is used in the field of education in schools and universities, where **hard disks** and magnetic disks are used to explain the lessons, and drawings and films are used **to deliver** information to students, as well as the students retain the information in order to retrieve it at a later time.

The computer has restructured the education system. Schools, colleges, and almost all educational institutions use at least one computer each semester, and many colleges and universities **offer** online degrees to students.

Many schools and colleges around the world are now using computer and Internet technologies to teach students digitally and creatively, as the use of the computer in the classroom unleashes creativity and imagination among students. Through computer programs, you can learn more deeply and more accurately, such as: drawing tools, spreadsheets, music, video lectures, and PowerPoint presentations.

This has led to the creation of new models of work in the field of education, such as: small classes, smart classrooms, and digital classrooms.

The Internet: The computer is used to access the Internet, and the Internet is used as a means of communication between people in all countries of the world.

With the help of the Internet you **keep in touch** with your friends and family, computers provide this to you easily, and the Internet is also used **to search for** information. You just have to type a word in the search engine and open many pages to provide all the information about the specific word, and you can also watch movies, videos, and news on computers connected to the Internet.

Communication: Computers are one of the main tools that allow communication between people regardless of their location, as the computer has become an effective communication tool that brings together family members, relatives, and friends, and allows **job interviews** to be conducted virtually. This is done by connecting the computer to the Internet, and then using some programs and tools to conduct Internet communications, whether visual or even audio.

A computer connected to the Internet allows the use of various social media such as Facebook, Twitter, and others. These means allow users to interact with each other by sharing photos, videos, and other activities.

The computer is also used to organize phone lines, pay phone bills, and control the purity of voice calls.

Business: The business sector is one of the most important sectors in which the computer is used, due to the numerous and important services it provides for employers or workers.

Through the computer, many different actions can be performed, such as conducting online sales, transferring funds between accounts, completing large account operations, and other institutional work that requires speed and accuracy.

The computer also provides business companies with the ability to create economic **forecast** plans based on some of the data it is provided with. In addition, corporate computers provide protection for their data and information from **theft** or vandalism.

When a user **surfs** the browser, there is a passing of information between the server and the user's PC. It should be encrypted with modern encryption standards. It is therefore necessary to have an **SSL certificate** to secure online transactions.

The use of computers in business has made it easier to find employees. This is done through some specialized social media such as LinkedIn.

The computer has also made it easier **to manage** the company's employee records through specialized programs, as well as to prepare the company's budget, tax forms, and others.

Your vocabulary

benefit – користь, вигода, перевага; отримати вигоду, користь
tool – інструмент, засіб
hard disk (hard disk drive (HDD)) – жорсткий диск
to deliver – доставляти, постачати; **to deliver** information – доносити/надавати інформацію
to offer – пропонувати; пропозиція
keep in touch – залишатися на зв'язку, підтримувати зв'язок
to search for – шукати
job interview – співбесіда на роботу, співбесіда з роботодавцем
forecast – прогноз; прогнозувати
theft – крадіжка, злодійство
to surf the web – переглядати веб-сторніки
SSL certificate – Secure Sockets Layer – рівень захищених сокетів
to manage – керувати, вести (записи, облік, eg**. to manage** records)

Ex.1. Fill in the sentences with the correct word or phrase.

Benefit, to benefit, tool, to deliver, to keep in touch, to search for, job interview, forecast, identity theft, to surf, to manage

1. Your mailbox probably contains lots of information that would be used for … . 2. Real-time systems help … criminals. 3. The priest … a passionate sermon/speech against war. 4. Jen and I never … after college. 5. The discovery of oil brought many … to the town. 6. He was dressed as though he was going to a … . 7. I think these sales … are unrealistic, considering how slow sales are at present. 8. I usually … the Internet to gather information for my research study. 9. When you have a job as well as children to look after, you have to learn how … your time. 10. I feel that I have … greatly from her wisdom. 11. We believe the new law will be an effective … in fighting poverty.

Ex. 2. Translate the phrases into Ukrainian.

enjoy the benefits, to benefit from any positive decision, effective tool, virtual and physical hard disk, to deliver expectations, unexpected offer, two devices stay in touch, search for useful method, to be invited for a job interview, identity theft, to manage small group of developers
(work some of these phrases into sentences)

Ex. 3. Translate the following phrases into English.

переваги процесора останнього покоління, вміло розпоряджатися своїм часом, викрадення персональних даних, успішно пройти співбесіду з роботодавцем, шукати відповідь в інтернеті, оптимістичний прогноз, цікава пропозиція, ефективний засіб боротьби із кіберзагрозами, залишатись на зв'язку із старими друзями, виправдати сподівання, замінити жорсткий диск

Ex. 4. Translate sentences into English. Use key words in parenthesis.

1. Використання графічної карти нового покоління значно покращить продуктивність роботи цього ПК. 2. Toshiba є основним виробником 2,5- і 1,8-дюймових вінчестерів для ноутбуків. 3. Програма дозволяє керувати треками/аудіозаписами за допомогою жестів. 4. Крадіжка особистих даних – це, наприклад, коли хтось використовує кредитну картку іншої особи для здійснення несанкціонованих транзакцій. 5. Твердотілий накопичувач (SSD solid-state drive) зможе забезпечити (deliver) високу швидкість, надійність та енергоефективність. 6. Співбесіда — це можливість справити перше враження на рекрутера і дізнатися більше про компанію та умови роботи. 7. Впродовж наступних десятиліть прогнозують інтенсивний розвиток систем штучного інтелекту в різних галузях діяльності людини. 8. На шляху до успіху є багато кроків, один з яких — навчитися організовувати (to manage) свій час. 9. Голова громади зробив оптимістичний прогноз щодо використання систем інтернету речей в інфраструктурі міста. 10. Оновлення обладнання, яке автоматично перевіряє весь трафік що надходить до мережі, є одним із ефективних засобів (tool) боротьби із кіберзагрозами. 11. Два із десяти комп'ютерів потребують заміни жорстких дисків. 12. У відділ боротьби з кіберзлочинністю поступила цікава пропозиція від анонімної особи.

Ex. 5. Choose correct word.

1) Some critics say that only wealthy people will … the tax cuts.

a) respect from	b) stay down	c) benefit from	d) pay from

2) The Internet has become an important research… .

a) engine	b) tool	c) team	d) market

3) The jury is expected to … a verdict later today.

a) speak	b) say	c) retell	d) deliver

4) I was … a position at a bank, but I turned it down.

a) suggested	b) offered	c) given	d) asked for

5) Experts … that the economy will slow in the coming months.

a) forecast	b) recognize	c) manage	d) search

6) The company is holding … for several new jobs.

a) benefits	b) holidays	c) interviews	d) money

7) The … of the jewelry and other valuables was immediately reported to the police.

a) delivery	b) offer	c) foecast	d) theft

8) When she … the department, we never missed a deadline.

a) ruined	b) managed	c) offered	d) missed

9) A … is an electro-mechanical data storage device that stores and retrieves digital data using magnetic storage.

a) flash drive	b) CPU	c) hard disk	d) graphics card

10) You can protect your privacy and identity as you … the web.

a) surf	b) look for	c) download	d) search for

Ex. 6. Fill in the text with correct nouns, verbs and prepositions.

Some of the fields where computers are used.

Transportation: The computer is used in transportation, where the routes of transportation lines are controlled, as well as booking travel tickets via the computer and recently via the Internet, and booking international airline tickets anywhere in the world via the Internet.

The computer is used to control transportation, determine the take-off and direction of aircraft, and 1) … information about workers in the field of transportation.

The industry: Computer uses are widespread in the industry, as most companies today have a wide 2) … of uses for computers, and factories have become highly dependent on the operation of machines to 3) … a high level of quality.

The use of computers in the industry has been a great necessity, as it is used as a means to allocate industrial resources more efficiently, as well as as a means to reach a larger group of potential customers. As a result, IT jobs have flourished as the industry relies 4) … computers for its daily operations.

Entertainment: Computers are among the best sources of entertainment because they 5) … a wide range of options related to entertainment. Through the computer, you can listen to music, watch some movies and videos, and talk and chat with your friends.

Today, everything 6) … daily life can be done with a few simple clicks, where breakfast can be ordered online, newspapers can also be read, and work from home can be done comfortably with the help of a laptop.

Engineering and military: Both the engineering and military 7) … are broad areas of computer use. The computer helps accomplish many operations, including:

The computer 8) … special programs for advanced engineering drawing, such as the design of buildings, structures, ships, planes, city planning, and design through 2D and 3D graphics.

The computer is used in the field of military industries and to control them through computerized control systems that control missile launches, military communications, military planning operations, and smart weapons.

Security systems: The computer is used in various electronic protection systems, such as surveillance cameras, which are widely used in private and government facilities in order to 9) … the movement of goods and people in these areas.

Some types of computers, particularly those built with facial recognition and fingerprint, have also contributed to reducing the possibility of 10) … fraud.

1	a) upload	b) store	c) compromise	d) download
2	a) row	b) spectrum	c) limits	d) range
3	a) change	b) commit	c) ensure	d) intercept
4	a) on	b) in	c) at	d) out of
5	a) suggest	b) offer	c) reveal	d) manage
6	a) responsible for	b) related to	c) committed to	d) irrelevant to
7	a) zones	b) positions	c) fields	d) plants
8	a relates	b) suggests	c) uses	d) provides
9	a) organize	b) monitor	c) occupy	d) forcast
10	a) authority	b) password	c) money	d) identity

Unit 5. Cyber Security

Your bocabulary

practice – діяльність, спосіб, метод
malicious – зловмисний, шкідливий
to apply in – застосовувати у, в
intruder – зломщик, порушник
targeted attacker – цілеспрямований/свідомий зломщик, нападник
opportunistic – ненавмисний, випадковий
malware – ПЗ для злому, хакерське ПЗ
compromised application – інфікована/зламана програма
to deploy – встановлювати, впроваджувати, використовувати
data assets – інформаційні активи
to fall back on – повертатися до, вдаватися до
to operate – працювати, функціонувати
unpredictable – непередбачуваний

accidentally – випадково
to introduce a virus – занести вірус, впровадити вірус
suspicious – підозрілий

WHAT IS CYBER SECURITY?

Cyber security is the practice of defending computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks. It's also known as information technology security or electronic information security. The term applies in a variety of contexts, from business to mobile computing, and can be divided into a few common categories.

Network security is the practice of securing a computer network from intruders, whether targeted attackers or opportunistic malware.

Application security focuses on keeping software and devices free of threats. A compromised application could provide access to the data its designed to protect. Successful security begins in the design stage, well before a program or device is deployed.

Information security protects the integrity and privacy of data, both in storage and in transit.

Operational security includes the processes and decisions for handling and protecting data assets. The permissions users have when accessing a network and the procedures that determine how and where data may be stored or shared all fall under this umbrella.

Disaster recovery and business continuity define how an organization responds to a cyber-security incident or any other event that causes the loss of operations or data. Disaster recovery policies dictate how the organization restores its operations and information to return to the same operating capacity as before the event. Business continuity is the plan the organization falls back on while trying to operate without certain resources.

End-user education addresses the most unpredictable cyber-security factor: people. Anyone can accidentally introduce a virus to an otherwise secure system by failing to follow good security practices. Teaching users to delete suspicious email attachments, not plug in unidentified USB drives, and various other important lessons is vital for the security of any organization.

Ex. 1. Answer the following questions.

1. What cyber security is all about? 2. What categories does cyber security fall into? 3. What is application security? 4. What is operational security? 5. In what cases is a business continuity plan applied? 6. What is end-user education?

Ex. 2. Match terms with their definitions.

1. malicious	a) feeling doubt or no trust in someone or something
2. intruder	b) someone who enters a place without permission in order to commit a crime

3. to handle	c) intended to cause damage to a computer system, or to steal private information from a computer system
4. to share	d) an event, esp. one that is either unpleasant or unusual
5. suspicious	e) software or computer programs which are designed to damage other people's computers and prevent them from working normally
6. incident	f) to distribute on the Internet
7. recovery	g) a process in which a situation improves after a difficult period
8. malware	h) to operate or control something that could be difficult or dangerous

Ex. 3. Find words with similar meaning.

1. practice	a) to concentrate on
2. malicious	b) by mistake
3. intruder	c) to manage, to deal with
4. to focus on	d) important
5. threat	e) ill-natured, evil
6. accidentally	f) risk
7. to handle	g) activity
8. vital	h) trespasser, invader

Ex. 4. Find words with opposite meaning.

1. security	a) undoubted
2. common	b) to attack
3. to protect	c) inessential
4. to recover	d) intentionally
5. suspicious	e) known, familiar
6. accidentally	f) danger
7. vital	g) to damage
8. unidentified	h) individual

Ex. 5. Fill in the blanks with correct words.

1) A Denial of Service (DoS) attack is a … attempt to affect a website or an application.
a) hazardous b) malicious c) lucky d) vital
2. Data … is the practice of protecting digital information from unauthorized access, corruption or theft.
a) spread b) operation c) security d) stealing
3. A … file is essentially a file that has become damaged and refuses to open properly.

a) destroyed b) ruined c) restored d) corrupted
4. Many operating systems include tools to … damaged files.
a) back up b) recover c) reuse d) remodel
5. He … the virus into every computer he could get his hands on.
a) launched b) ran c) introduced d) released
6. DDoS attacks are now more … and damaging than ever, crippling websites, shutting down operations, and costing millions of dollars in downtime, customer support and brand damage, according to Neustar.
a) reliable b) accidental c) suspicious d) unpredictable
7. Additionally, knowing how to … a computer confidently inevitably helps children for their future endeavors in schools, such as essay writing and research skills.
a) operate b) crash c) design d) play
8. … deleted files from computer hard disk will go to the Recycle bin folder.
a) Maliciously b) Vitally c) Accidentally d) Commonly
9. You should never click … links, download files from unsafe websites, or run email attachments from unknown sources.
a) hyper b) suspicious c) familiar d) malicious
10. A security … is a malicious act that aims to corrupt or steal data or disrupt an organization's systems or the entire organization.
a) defense b) threat c) alarm d) problem

Internet addiction

A new survey suggests that people who ***use*** the Internet too much may have mental health problems. The survey said that people who are ***addicted*** to the Internet have problems in life if they cannot get online regularly. The survey is from McMaster University in Canada. Researchers looked at the Internet ***habits*** of 254 students and then looked at the students' general mental health. Thirty-three of the students were addicted to the Internet. The researchers said another 107 students had problems because of their Internet use. These ***included*** depression, anxiety, impulsiveness and inattention. A professor said we still know little about the dangers of Internet addiction and need to do more research into it.

The lead researcher in the study, professor Michael Van Ameringen, explained what kind of problems he found with students. He said: "We found that [students addicted to the Internet] had significantly more trouble ***dealing with*** their day-to-day activities, including life at home, at work or school and in social settings." Professor Van Ameringen added: "[People] with Internet addiction also had significantly higher amounts of depression and anxiety symptoms, problems with planning and [problems with] time management." The professor said we needed to find out just how big the problem of Internet addiction is. He also said we needed to find out if mental health problems caused Internet addiction.

Ex. 6. CHAT: In pairs / groups, talk about these topics or words from the article. What will the article say about them? What can you say about these words and your life?

survey / Internet / mental health / problems / regularly / habits / depression / professor / addicted / activities / trouble / planning / time management / find out

Have a chat about the topics you liked. Change topics and partners frequently.

Ex. 7. **INTERNET:** Students A strongly believe the Internet is more bad than good; Students B strongly believe the Internet is more good than bad. Change partners again and talk about your conversations.

Ex. 8. MENTAL HEALTH: Spend one minute writing down all of the different words you associate with the term "mental health". Share your words with your partner(s) and talk about them. Together, put the words into different categories.

Ex. 9. PROBLEMS: Rank these with your partner. Put the biggest problems with the Internet at the top. Change partners often and share your rankings.

cyber-bullying
identity theft
sleeping difficulties
online gambling
phishing
lack of exercise
traffic accidents
no conversation

Ex. 10. TRUE / FALSE: Read the headline. Guess if a-h below are true (T) or false (F).

1. A survey says people should not use the Internet. T / F
2. The survey said Internet addicts needed to get online regularly. T / F
3. Researchers questioned over 2,540 people in their study. T / F
4. A professor said we know a lot about Internet addiction. T / F
5. The professor said addicts had no problem with day-to-day activities. T / F
6. Internet addicts suffer from depression more than non-addicts. T / F
7. Internet addicts find it more difficult to manage their time. T / F
8. We need to know if mental health problems create Internet addiction. T / F

Ex. 11. SYNONYM MATCH: Match the following synonyms from the article.

1. **survey**	a. considerably
2. **problems**	b. described
3. **regularly**	c. hazards
4. **general**	d. difficulties
5. **dangers**	e. signs
6. **explained**	f. study

7. **significantly**	g. discover
8. **symptoms**	h. frequently
9. **find out**	i. led to
10. **caused**	j. usual

Ex. 12. PHRASE MATCH: (Sometimes more than one choice is possible.)

1. people who use the Internet	a. online regularly
2. have problems in life if they cannot get	b. and inattention
3. looked at the students' general	c. day activities
4. These included depression, anxiety, impulsiveness	d. Internet addiction
5. need to do more research	e. too much
6. explained what kind of problems	f. mental health
7. trouble dealing with their day-to-	g. he found
8. significantly higher amounts	h. into it
9. find out just how big the problem of Internet addiction	i. of depression
10. find out if mental health problems caused	j. is

Ex. 13. Put these words into the spaces in the paragraph below.

habits
addicted
anxiety
suggests
mental
dangers
regularly
another

A new survey (1) _____ that people who use the Internet too much may have mental health problems. The survey said that people who are (2) _____ to the Internet have problems in life if they cannot get online (3) _____. The survey is from McMaster University in Canada. Researchers looked at the Internet (4) _____ of 254 students and then looked at the students' general (5) _____ health. Thirty-three of the students were addicted to the Internet. The researchers said (6) _____ 107 students had problems because of their Internet use. These included depression, (7) _____, impulsiveness and inattention. A professor said we still know little about the (8) _____ of Internet addiction and need to do more research into it.

Put these words into the spaces in the paragraph below.
problems
higher
lead
out
activities
big
dealing
anxiety

The (9) _____ researcher in the study, professor Michael Van Ameringen, explained what kind of (10) _____ he found with students. He said: "We found that [students addicted to the Internet] had significantly more trouble (11) _____ with their day-to-day (12) _____, including life at home, at work or school and in social settings." Professor Van Ameringen added: "[People] with Internet addiction also had significantly (13) _____ amounts of depression and (14) _____ symptoms, problems with planning and [problems with] time management." The professor said we needed to find out just how (15) _____ the problem of Internet addiction is. He also said we needed to find (16) _____ if mental health problems caused Internet addiction.

Ex. 14. Role play.

Role A —Phishing

You think phishing is the biggest problem regarding the Internet. Tell the others three reasons why. Tell them why their problems aren't as big. Also, tell the others which is the least dangerous of these (and why): lack of exercise, traffic accidents or no conversation.

Role B —Lack of exercise

You think lack of exercise is the biggest problem regarding the Internet. Tell the others three reasons why. Tell them why their problems aren't as big. Also, tell the others which is the least dangerous of these (and why): phishing, traffic accidents or no conversation.

Role C —Traffic accidents

You think accidents on the road is the biggest problem regarding the Internet. Tell the others three reasons why. Tell them why their problems aren't as big. Also, tell the others which is the least dangerous of these (and why): lack of exercise, phishing or no conversation.

Role D —No conversation

You think no conversation is the biggest problem regarding the Internet. Tell the others three reasons why. Tell them why their problems aren't as big. Also, tell the others which is the least dangerous of these (and why): lack of exercise, traffic accidents or phishing.

Ex 15. Discussion - Internet addiction sign of mental health problems

STUDENT A's QUESTIONS (Do not show these to student B)

1. What did you think when you read the headline?
2. What springs to mind when you hear the word 'Internet'?
3. How important is the Internet to you?
4. What do you think about what you read?
5. What would life be like without the Internet?
6. Are you addicted to the Internet?
7. How can we help people with an Internet addiction?
8. Are you addicted if you check social media while on the toilet?
9. Are people who browse the Internet while walking addicted?
10. Who is the most Internet-crazy person you know?

STUDENT B's QUESTIONS (Do not show these to student A)

11. Did you like reading this article? Why/not?
12. Will everyone be addicted to the Internet in the future?
13. What is wrong with spending a long time online?
14. Is being online better than being with people?
15. How might Internet addicts have problems with day-to-day life?
16. What are the signs of being addicted to the Internet?
17. How long will people spend online in the future?
18. How dangerous is Internet addiction for children?
19. How might the Internet help people with depression?
20. What questions would you like to ask an Internet addict?

Useful phrases for discussions

Giving your opinion

In my opinion/view .... If you ask me .... As far as I can see/I'm concerned .... It seems to me that .... I have the/a feeling that .... I think/feel/reckon/believe .... Well, I'd say .... If you want my opinion .... You can take it from me that .... First of all/To start with I'd like to point out ... What we have to decide is .... There can be no doubt that .... It's a fact that .... Nobody will deny that .... The way/As I see it Everyone knows .... Let me put it this/another way .... Let's get this clear (first) .... Sorry to interrupt you, but .... The point I'm trying to make is .... Personally (speaking) I think

.... I'm absolutely convinced that .... My view/point of view is that .... The way I look at/see it is this What I actually meant was ....

Giving an explanation

Look, it's like this: What I mean is .... The reason for this is .... The main problem is .... Just let me explain .... Well, the reason is .... Well, the thing is .... Above all we must keep in mind that ....

Agreeing with an opinion

I (quite) agree. I agree completely/entirely. I couldn't agree (with you) more. I entirely/completely agree with you on that. That's true/right. That's just it. Quite/Exactly/Precisely/Right/Certainly/Definitely. You're quite/so right. I think so, too. I don't think so either. That's just my feeling/opinion. That's just how I see it/feel about it, too. That's a very good/important point. You've got a good point there. Yes, of course/definitely/absolutely Marvelous. That's exactly what I mean/say. Yes, that's obvious. That's exactly how I see it. That's what I think How very true. So do I/So am I Yes, indeed. I'm all in favor of what you've been saying.

Polite disagreement

I disagree (with you), I'm afraid. No, I really can't agree, I'm afraid. I don't quite agree there. I'm not so certain/at all sure if that's true/correct I'm not (quite) so sure (really). I'm sorry I can't agree. Do you really think so/believe that? I'm not convinced that .... Well, that's one way of looking at it, (but) Well, I have my doubts about that You can't really mean that. You don't really mean that, do you? I wouldn't say so. I don't think so. I don't think you're right/that's right. Surely you don't mean that? I don't want to argue with you, but .... I can't go all the way with you on that point. Are you seriously suggesting that ...? I have my problems with what you're saying

Strong disagreement

I doubt that very much I think you got that wrong Don't you dare say so! You're pulling my leg! On the contrary! That doesn't convince me at all. You're contradicting yourself. I've never heard of such a thing. You're wrong, you know. You can't be serious! It's not like that at all! That's not correct You're contradicting yourself You don't understand. I'm afraid, I don't think you quite understand. I don't think so, really! That's not fair! That's out of the question I can't believe that I'm afraid I can't accept your view, that .... Do you really think that's a good idea? I'm afraid, I can't agree with you there Well, you would, wouldn't you? Really? Don't be silly/stupid! How stupid can you get? What a silly/stupid thing to say! That's (simply) not true! I don't think, you can say .... Surely you're not serious, are you? I doubt it/that very much You can't be serious! Oh, come on, think about what you've just said! I doubt if ... I've got my doubts about that. I don't agree with you at all. I

disagree entirely/completely. Oh, come on, you must be joking/kidding! That's out of the question That's not how I see it It's not as simple as that! That's no excuse I believe you're mistaken That doesn't make sense to me Let's be sensible about this You're hopeless/wrong You won't listen to reason I think you got that wrong I'm not impressed For heaven's sake! Well that's one way of looking at it, but

Ex. 16.

A new survey (1) ____ that people who use the Internet too much may have mental health problems. The survey said that people who are addicted (2) ____ the Internet have problems in life if they cannot get online (3) ____. The survey is from McMaster University in Canada. Researchers looked at the Internet habits of 254 students and then looked at the students' (4) ____ mental health. Thirty-three of the students were addicted to the Internet. The researchers said (5) ____ 107 students had problems because of their Internet use. These included depression, anxiety, impulsiveness and inattention. A professor said we still know (6) ____ about the dangers of Internet addiction and need to do more research into it.

The (7) ____ researcher in the study, professor Michael Van Ameringen, explained what kind of problems he found with students. He said: "We found that [students addicted to the Internet] had significantly (8) ____ trouble dealing with their day-to-day activities, including life at home, at work or school and (9) ____ social settings." Professor Van Ameringen added: "[People] with Internet addiction also had significantly (10) ____ amounts of depression and anxiety symptoms, problems with planning and [problems with] time (11) ____." The professor said we needed to find out (12) ____ how big the problem of Internet addiction is. He also said we needed to find out if mental health problems caused Internet addiction.

Which of these words go in the above text?

1. (a) suggestion (b) suggestive (c) suggest (d) suggest

2. (a) to (b) at (c) of (d) on

3. (a) regularly (b) regular (c) regulate (d) regulatory

4. (a) general (b) generally (c) generals (d) generalise

5. (a) other (b) the other (c) others (d) another

6. (a) few (b) tiny (c) small (d) little

7. (a) lead (b) steel (c) iron (d) gold

8. (a) mostly (b) much (c) many (d) more

9. (a) in (b) to (c) by (d) on

10. (a) height (b) higher (c) highs (d) highest

11. (a) manage (b) management (c) manages (d) manager

12. (a) just (b) justly (c) adjust (d) gest

Ex. 17. Put the words in the right order

1. much the People Internet who too use .
2. the Internet have problems in life People who are addicted to .
3. at 254 the students Internet Researchers habits looked of .
4. of use students because Internet 107 problems their Another had .
5. about of We little dangers addiction know the Internet still .
6. he what found kind with of students problems Explained .
7. day-to-day activities More trouble dealing with their .
8. and Significantly amounts depression anxiety higher of .
9. just how big the problem of Internet addiction is Find out .
10. mental addiction health Find problems out caused if Internet .

Ex. 18. Choose the correct word.

A *new / newly* survey suggests that people who use the Internet too *many / much* may have mental health *problems / problematic*. The survey said that people who are addicted to the Internet have problems *on / in* life if they cannot get online *regular / regularly*. The survey is from McMaster University in Canada. Researchers looked at the Internet *habits / habitat* of 254 students and then looked at the students' *generally / general* mental health. Thirty-three of the students were *addiction / addicted* to the Internet. The researchers said another 107 students had problems because *of / for* their Internet use. These included depression, anxiety, impulsiveness and inattention. A professor said we still *know / known* little about the dangers of Internet addiction and need to do more research into it.

The lead researcher in the study, professor Michael Van Ameringen, *explained / explanation* what kind of problems he found with students. He said: "We found that [students addicted to the Internet] *had / did* significantly more trouble *deals / dealing* with their day-to-day *active / activities*, including life at home, at work or school and in *socially / social* settings." Professor Van Ameringen added: "[People] with Internet addiction also had *significance / significantly* higher amounts of depression and *anxiety / anxious* symptoms, problems with planning and [problems with] *times / time* management." The professor said we needed to find out *just / justice* how big the problem of Internet addiction is. He also said we needed to find out if mental health problems *causes / caused* Internet addiction.

Talk about the connection between each pair of words in italics, and why the correct word is correct.

CASE STUDY I: WIRELESS HACKING FOR HIRE

Her First Engagement

Makoto had done her *fair share* (левову частку) of infrastructure assessments in the past, and she had managed to "borrow" Wi-Fi from neighbors and unsuspecting businesses in her travels. This was the first time she had been asked to perform a wireless (дистанційно) assessment for a client, however. She knew the timing couldn't be worse—it was the middle of the winter, and the site she was supposed to visit was a remote location known for its legendary snow storms. Although the weather wasn't going to be peachy (чудова) while she was there, she did her homework to determine the best days to avoid getting snowed in. She also planned all her equipment needs ahead of time and packed the wireless gear (оснащення) she thought she might need: an array of wireless cards, long-range directional antennas, (направлена антена великого радіусу дії) and a netbook with an Atheros-based wireless card. She also brought along a GPS (Система глобального позиціонування) unit in case she got lost and a cigarette lighter power adapter to keep her laptop alive while war driving. All that gear earned her suspicious stares from airport security as she went through the security check, but she managed to get onto her flight without too much hassle. When she arrived at the hotel the night before the assessment, she asked the front desk (реєстратура) how long it would take to get to her destination in the morning. She'd never been in the area before and had no idea if there would be any traffic. Better to know ahead of time (завчасно), especially with it being winter and any possible road closures.

A Parking Lot Approach

As usual, Makoto arrived at the site a bit early. When she pulled up to the location, she realized it was a sprawling (що простягався в різні боки) shipping and receiving facility (пункт, термінал) of large warehouses with trucks coming in and going out. However, with the different names on the sides of the trucks as well as the many entrances, she concluded that most likely multiple businesses used this site. She made a mental note that she had to make absolutely sure any wireless networks she planned to assess actually belonged to the client, not to one of the neighboring businesses.

Before she went in, she decided to determine what she could detect from the outside. She parked in the facility's lot and opened her laptop. She first searched for wireless networks using the built-in Windows tools. She knew active scanning was a pretty limited approach, and anyone with passing knowledge of wireless assessments (діагностика,тестування мережі) would put their wireless card into monitor mode. However, she felt active scanning was representative of some random person off the

street trying to see if any wireless networks were open, so maybe she would gain useful information. She picked up a few wireless networks—some “defaults” and some with cryptic names that used a combination of WEP and WPA. She wasn’t sure if they belonged to the client or the neighboring businesses, so she simply took note of what she could see and moved on.

Next she performed a more thorough outside test. Makoto plugged in her external Atheros-based wireless card and attached a high-gain directional antenna(антенна с высоким коэффициентом направленного действия). She booted off a preprepared BackTrack Linux USB key (флешка) and put the wireless card into monitor mode. She fired up (активізувати) airodump-ng, part of the Aircrack-ng suite of tools, and pointed the antenna at the part of the facility owned by the client. Because the antenna was directional, many of the other wireless networks that she detected earlier did not show up. However, a new wireless network showed up, this time with a hidden SSID(ідентифікатор мережі) . It was protected by WEP, and she could see the data count (кількість трафіку/переданих пакетів) gradually going up. But, without confirming that it belonged to the client, she decided to only take note of it for now. While she kept the antenna pointed to the building, someone came and got something out of the car parked next to her. She could tell that he was trying to be sneaky (він намагався підкрастися) and pretend not to be checking out the person in the car with a laptop and an antenna pointed at a building. She smiled to herself but was glad that she had her site contact’s information handy if that person alerted security—or even worse the authorities. Enough for outdoor reconnaissance (розвідка), she thought, it was time to meet the site contact (контактна особа пункту). Her contact was the site manager, who had been removed from the information security team sponsoring (що замовила) this project. He said he knew she was here, as someone came to him earlier and said there was a suspicious-looking person in the parking lot with a laptop and antenna. He was actually happy to hear that the employees were alert.

The Robot Invasion

First, she did a walkthrough of the facilities with the site manager as an escort. She took her little netbook with an Atheros-based mini PCI wireless card set in monitor mode to look for any wireless access points. As these satellite offices were far from the reach of corporate (основного) headquarters, the existence of wireless access points was one of the things the information security project sponsor was interested in. Part of Motoko’s activities was to catalog (зафіксувати) which access points existed, if any, and to see if any unauthorized wireless access points (rogue шахрайські APs) had been installed. The site manager informed Makoto that they had no wireless here; it was only a shipping and receiving station with minimal IT infrastructure (or so he thought).

She walked around with the site manager inside the large shipping and receiving floor. It was a veritable (справжній) menagerie (звіринець, клітка) of automated robots

moving palettes of goods around, as well as people driving small forklifts, loading and unloading goods into trucks parked at the service bay. Except for a small office attached to the warehouse, the site manager was right in that there appeared to be little IT infrastructure involved. As she walked around, she still saw the "hidden" wireless signal that she discovered from outside with her high-gain antenna. The signal was particularly strong using only the built-in antenna in her netbook, so she was fairly certain it originated from somewhere in this warehouse.

In fact, as she walked around with Kismet (детектор) running, she noticed the signal strength fluctuate. The signal was stronger inside the large plant area than it was in the office, contrary to where she thought a wireless router might be located. As she walked around, she noticed the robots that were moving palettes. The robots never seemed to bump into each other, so she deduced they were being controlled by something. She also noticed that every time they picked up and dropped off a palette of goods, the robot scanned a large barcode on the side of the palette and the device beeped. The same thing happened whenever one of the forklift drivers picked up a palette and moved it into a waiting truck. They would scan the palette with a handheld device.

Could the robots and the barcode scanners be communicating over some type of wireless network, possibly the WEP-protected wireless signal she saw? Looking around further, she noticed a large box attached to the rafters (балка) of the warehouse. Some conduit (кабель) seemed to be running from it, so she thought that maybe it was the source of the wireless signal. Attaching her high-gain wireless card and directional antenna, she pointed it around the room and saw the signal jumped considerably when pointed directly at the box (or somewhere around it due to the dispersion of signal from the antennas probably built into the box). She determined that the signal might be coming from there.

With a reasonable degree of confidence that the hidden AP was owned by the client and not the next door neighbor, she then decided it was time to see what she could do. The instructions from the client were to try to penetrate whatever wireless infrastructure she found and see what she could do while on the network. Using the aforementioned Aircrack-ng toolkit, she put her wireless card into monitor mode, performed a fake authentication against the hidden AP, and started performing packet injection. She noticed that every time one of the robots or forklift drivers scanned a palette, the data counter for that wireless network would increment збільшуватися). She concluded that these robots and handheld scanners must be using the wireless network to communicate and track the inventory. That gave her enough useable data to reply back to the router to generate more IVs (Initialization vector Ініціалізаційний вектор) via ARP injection.

It only took ten minutes or so to crack the WEP key, a testament to how little protection WEP provided. After associating with the access point with her PC using the key, she received an IP via DHCP. She was now on the network that the robots and scanners

used. But what could she do? If the robots in this shipping station were scanning some type of barcode on each of the palettes, perhaps that information was being tracked somewhere. Maybe these machines were talking to a backend server. She wrote a little script to ping (протестувати,прозондувати) each of the IPs in her subnet. After some replies and a few port scans, she realized she was on the same network segment as the inventory server that all the automated machines were talking to! She decided it was beyond the scope of the project to try to penetrate into the server, so the screenshots she took of being able to reach it was enough to prove she could penetrate it from the wireless network segment. What's more, she did some simple network discovery and saw that she could also access the internal domain controllers within the enterprise and even access the servers located in different regions of the world!

Final Wrap-Up

She spoke again to the site manager after connecting to and poking around the wireless infrastructure. She explained that the robots and the handheld scanners connected back to a backend inventory system via a wireless connection, and that she was able to associate with the access point after she cracked the WEP key. He explained that the inventory system that Makoto had compromised was installed about five years ago, probably before more recent encryption methods were used, and he had no idea that it communicated over standard 802.11; to him and everyone else with a computer in the office, it never looked like there was any wireless infrastructure (мережеве обладнання) . What's worse is that, although Makoto did this while she was in the office, there's no reason she couldn't have done it sitting down the street with a high-powered antenna pointing at the building. And no one would have known.

Pre-text exercise.

1.	GPS	a) Wired Equivalent Privacy	I) кишеньковий комп'ютер
2.	PDA	b) Service Set Identifier	II) універсальна послідовна шина
3.	WEP	c) personal digital assistant	III) система глобального позиціонування
4.	WPA	d) Universal Serial Bus	IV) один з протоколів безпеки, що використовується для захисту бездротових мереж
5.	SSID	e) Global Positioning System	V) ідентифікатор зони обслуговування (мережі)

6.	USB	f) Wi-Fi Protected Access	VI) алгоритм для захисту бездротових мереж

Answer the following questions.

1. What task was Makoto assigned to perform? 2. Where was the target site located. 3. What gear did the assignee decided to take along? 4. What did Makoto get to keep her laptop alive while war driving? 5. How was Makoto approached at the airport formality check? Did she get into the flight

without too much problem? 6. What sort of business was the assessor supposed to perform wireless monitoring? 7. Where did Makoto parked her car? 8. What was Makoto's first step in carrying out her assessment? Was it much helpful? 9. What was the next thing she did? 10. Do you think the client's wireless network was well protected or not? (what if you apply contemporary criteria?) 11. Who spotted Makoto? (Can you state that she was caught red-handed?) 12. Who was Makoto's contact?

Ex 1. Match related words or word combinations.

1. fair share	a) set, kit
2. unsuspecting	b) wireless net security check
3. gear	c) integrated
4. array	d) unsuspicious, unaware
5. ahead of time	e) to start up
6. built-in	f) to activate
7. wireless assessment	g) a great deal of, plenty of, a lot of
8. to boot off	h) worker, staff member
9. to fire up	i) equipment and supplies
10. employee	j) beforehand

Ex 2. Match English words with their Ukrainian definitions.

1. assessment	a) з'ясувати
2. to determine	b) розвідка
3. gear	c) підозрілий
4. array	d) приєднувати

5. suspicious	e) активізувати
6. destination	f) завантажувати, запускати
7. To monitor	g) ноутбук
8. To attach	h) оцінювання, аудит, діагностика
9. To boot off	i) продовжувати
10. Thumbdrive	j) слідкувати, стежити, здійснювати радіоперехват
11. To fire up	k) працівник
12. reconnaissance	l) оснащення
13. laptop	m) флешка
14. employee	n) набір, комплект
15. To move on	o) пункт призначення

Work ten of the words into sentences of your own.

Unit 6. Internet of things

Your vocabulary
operations – діяльність та функціонування компанії
vehicle – транспортний засіб (сухопутний)
to embed – вбудовувати, інтегрувати в, у
to range from … to – (коливатися, починатися) від … до
RFID-enabled clothing – чіп радіочастотної ідентифікації інтегрований в одяг
to envision – уявляти, малювати у своїй уяві
traffic patterns – схема руху ТЗ, режим руху
tracking – відслідковування
application – використання, застосування
humidity – вологість
machine performance – продуктивність машини
bottom line – практичний результат, найважливіший аспект
to resolve issues – вирішувати проблеми
downtime – простій, зупинка виробничого процесу
uptime – безперервний виробничий процес
data-driven – оснований на даних
to gain insights – зрозуміти суть, вникати
sustainability – раціональність, ефективність
experiences – (тут) можливості

Text 1. What is internet of things?

(Taken from: https://www.ibm.com/topics/internet-of-things)

*Learn about how the Internet of Things is enabling businesses to monitor, manage and automate their **operations** more efficiently and with more control.*

The Internet of Things (IoT) refers to a network of physical devices, **vehicles**, appliances and other physical objects that are **embedded** with sensors, software and

network connectivity that allows them to collect and share data. These devices — also known as "smart objects" — can **range from** simple "smart home" devices like smart thermostats, **to** wearables like smartwatches and **RFID-enabled clothing**, to complex industrial machinery and transportation systems. Technologists are even **envisioning** entire "smart cities" predicated on IoT technologies.

IoT enables these smart devices to communicate with each other and with other internet-enabled devices, like smartphones and gateways, creating a vast network of interconnected devices that can exchange data and perform a variety of tasks autonomously. This can include everything from monitoring environmental conditions in farms, to managing **traffic patterns** with smart cars and other smart automotive devices, to controlling machines and processes in factories, to **tracking** inventory and shipments in warehouses.

The potential **applications** of IoT are vast and varied, and its impact is already being felt across a wide range of industries, including manufacturing, transportation, healthcare and agriculture. As the number of internet-connected devices continues to grow, IoT is likely to play an increasingly important role in shaping our world and transforming the way we live, work and interact with each other.

In an enterprise context, IoT devices are used to monitor a wide range of parameters such as temperature, **humidity**, air quality, energy consumption and **machine performance**. This data can be analyzed in real time to identify patterns, trends and anomalies that can help businesses optimize their operations and improve their **bottom line**.

Why is IoT important? IoT is important for business for several reasons. Here are the core benefits of IoT:

Improved efficiency. By using IoT devices to automate and optimize processes, businesses can improve efficiency and productivity. For example, IoT sensors can be used to monitor equipment performance and detect or even **resolve** potential **issues** before they cause **downtime**, reducing maintenance costs and improving **uptime**.

Data-driven decision-making. IoT devices generate vast amounts of data that can be used to make better-informed business decisions and new business models. By analyzing this data, businesses can **gain insights** into customer behavior, market trends and operational performance, allowing them to make more informed decisions about strategy, product development and resource allocation.

Cost-savings. By reducing manual processes and automating repetitive tasks, IoT can help businesses reduce costs and improve profitability. For example, IoT devices can be used to monitor energy usage and optimize consumption, reducing energy costs and improving **sustainability.**

Enhanced customer experience. By using IoT technology to gather data about customer behavior, businesses can create more personalized and engaging **experiences** for their customers. For example, retailers can use IoT sensors to track customer movements in stores and deliver personalized offers based on their behavior.

EX. 1. Answer the following questions

1. What does the Internet of Things refer to? 2. Think of some smart devices. 3. Why do technologists envision entire smart cities? 4. How does IoT operate in real life?

Provide some examples from the text and your experience. 5. Where IoT can be used and how it may be beneficial? 6. Why is IoT important? 7. How can IoT improve efficiency and productivity? Give your arguments and examples. 8. How may can be used to make better-informed business decisions and new business models? Provide your examples. 9. Why IoT can reduce production costs and improve profitability of a business? 10. How can IoT enhance customers' experience?

EX. 2. Translate the following phrases into Ukrainian.

embedded with sensors, software and network connectivity, to collect and share data, **RFID-enabled clothing,** complex industrial machinery, to communicate with each other, internet-enabled devices, a vast network of interconnected devices, to manage traffic patterns, to track shipments in warehouses, internet-connected devices, to improve efficiency and productivity, reducing manual processes

EX. 3. Translate the following phrases into English.

Інтегровані датчики, мережеві підключення, збирати та обмінюватися даними, створювати широку мережу, контролювати/відстежувати метеорологічні умови, вплив технологій інтернету речей, виявляти потенційні проблеми, прийняття рішень на основі аналізу даних, розуміти суть, зменшити енерговитрати, збирати дані, індивідуальні пропозиції.

EX. 4. Match words with their definitions.

1. application	a) integrated
2. to gain insights into	b) Radio Frequency IDentification
3. embedded	c) the fundamental and most important factor
4. network connectivity	d) time during which a machine, especially a computer, is out of action or unavailable for use
5. RFID	e) a device used to connect two different networks
6. gateway	f) time during which a machine, especially a computer, is in operation
7. bottom line	g) to get accurate and deep understanding of smth
8. downtime	h) a way in which something can be used for a particular purpose
9. uptime	i) connection of various parts of a network to one another
10. tracking	j) the act or process of following something or someone

EX. 5. Match words with similar meaning.

1. to embed	a) to solve problems
2. software	b) suspension
3. to envision	c) program
4. to resolve issues	d) possibilities
5. downtime	e) to stay in touch

6. impact	f) to integrate
7. to communicate	g) influence
8. experiences	h) to predict

EX. 6. Find English equivalences for the following words:

1. мережеві підключення	a) embedded sensors
2. інтегровані датчики	b) personalized offers
3. широка мережа	c) to enhance
4. розуміти суть	d) to reduce energy consumption
5. індивідуальні пропозиції	e) experiences
6. зменшити енерговитрати	f) sustainability
7. зупинка виробничого процесу	g) network connectivity
8. раціональність, ефективність	h) downtime
9. збільшити, розширити	i) vast network
10. можливості	j) to gain insights

EX. 7. Fill in the blanks with correct words.

1. An IoT ecosystem consists of web-enabled smart devices that use … systems.
a) deployed b) uploaded c) embedded d) downloaded

2. IoT … machines to complete tedious tasks without human intervention.
a) forbids b) enables c) limits d) reduces

3. Companies can automate processes, … labor costs, cut down on waste and improve service delivery.
a) simplify b) increase c) maximize d) reduce

4. IoT is one of the most important technologies and it continues to … as more businesses realize the potential of connected devices to keep them competitive.
a) fall down b) advance c) retreat d) retard

5. Sensors can … data on rainfall, humidity, temperature and soil content and IoT can help automate farming techniques.
a) collect b) share c) generate d) replicate

6. Sensors, for example, can … events or changes within structural buildings, bridges and other infrastructure that could potentially compromise safety.
a) develop b) produce c) monitor d) make

7. A home automation business can use IoT to monitor and … mechanical and electrical systems in a building.
a) maintain b) do c) block d) manipulate

8. Automation is possible when sensors and actuators work to … issues without human intervention.

a) decide b) resolve c) calculate d) accumulate

9. To make sense of the vast amounts of data … by IoT devices, businesses need to use advanced analytics tools to extract insights and identify patterns.
a) generated b) duplicated c) extended d) compiled

10. Industrial IoT devices can be used in manufacturing to monitor machine… , detect equipment failures and optimize production processes.
a) life b) technology c) performance d) tool

11. In the transportation industry, IoT devices can be used to monitor vehicle performance, optimize routes and … shipments.
a) load b) download c) track d) pack

12. Many IoT devices are vulnerable to hackers and other cyber threats, which can … the security and privacy of sensitive data.
a) optimize b) compromise c) improve d) protect

EX.8. Fill in the text with correct words.

How should businesses approach IoT?

Managing IoT devices can be a complex and 1) … task, but there are several best practices that businesses can follow to ensure that their IoT devices are secure, reliable and optimized for performance. Here are some tips for managing IoT devices:

Plan your IoT strategy: Before deploying any IoT devices, businesses should have a clear 2) … of their objectives, use cases and desired outcomes. This can help them choose the right devices, IoT platforms and technologies, and 3) … that their IoT strategy is aligned with their business goals.

Choose secure IoT products: Security is a critical consideration for IoT solutions, as they can be 4) … to cyber attacks. Businesses should choose devices that are designed with security 5) … and implement appropriate security systems, such as encryption, authentication and access controls.

Monitor and maintain devices: IoT devices need to be monitored and maintained regularly to ensure that they are performing optimally and are not vulnerable to security 6) … . This can involve monitoring device health and performance, updating firmware and software and conducting regular security audits and predictive 7) … .

Manage data effectively: IoT devices generate vast amounts of real-world data, which can be challenging to 8) … and analyze. Businesses should have a clear data management strategy in place, including data storage, analysis and visualization, to ensure that they can extract meaningful insights from the data generated by their IoT devices.

Build an ecosystem: IoT devices are often part of a larger ecosystem that includes other devices, platforms and technologies. Businesses should have a clear understanding of this ecosystem and ensure that their IoT devices can 9) … effectively with other systems and technologies.

1	a) useless	b) easy	c) challenging	d) limited
2	a) simulation	b) understanding	c) automation	d) generation
3	a) ensure	b) see	c) integrate	d) incorporate
4	a) vulnerable	b) protected	c) immune	d) increased
5	a) in heart	b) in head	c) in hand	d) in mind
6	a) checks	b) threats	c) drawbacks	d) controls
7	a) performance	b) maintenance	c) automation	d) identification
8	a) compromise	b) manage	c) understand	d) predict
9	a) play	b) work	c) downgrade	d) integrate

EX. 9. Discussion.

1) Why is IoT important? IoT can be important for businesses for several reasons. Think of them and come up with examples to support your ideas.

2) Think of the technologies that make IoT possible. Provide real-life examples to ground your opinion. Here are some technologies which can make Iot possible: ***Sensors and actuators***: Sensors are devices that can detect changes in the environment, such as temperature, humidity, light, motion or pressure. Actuators are devices that can cause physical changes in the environment, such as opening or closing a valve or turning on a motor. These devices are at the heart of IoT, as they allow machines and devices to interact with the physical world. Automation is possible when sensors and actuators work to resolve issues without human intervention.

Connectivity technologies: To transmit IoT data from sensors and actuators to the cloud, IoT devices need to be connected to the internet. There are several connectivity technologies used in IoT, including Wi-Fi, Bluetooth, cellular, Zigbee and LoRaWAN.

Cloud computing: The cloud is where the vast amounts of data generated by IoT devices are stored, processed and analyzed. Cloud computing platforms provide the infrastructure and tools needed to store and analyze this data, as well as to build and deploy IoT applications.

Big data analytics: To make sense of the vast amounts of data generated by IoT devices, businesses need to use advanced analytics tools to extract insights and identify patterns. These tools can include machine learning algorithms, data visualization tools and predictive analytics models.

Security and privacy technologies: As IoT deployments become more widespread, IoT security and privacy become increasingly important. Technologies such as encryption, access controls and intrusion detection systems are used to protect IoT devices and the data they generate from cyber threats.

3) Provide examples of IoT applications. *(health care, manufacturing, retail, agriculture, transportation etc.)*

4) IoT offers many benefits, but it also poses several risks and challenges. Think of some risks and challenges of IoT.

5) How do you see the future of IoT?

Useful phrases for discussions

Giving your opinion

In my opinion/view .... If you ask me .... As far as I can see/I'm concerned .... It seems to me that .... I have the/a feeling that .... I think/feel/reckon/believe .... Well, I'd say .... If you want my opinion .... You can take it from me that .... First of all/To start with I'd like to point out ... What we have to decide is .... There can be no doubt that .... It's a fact that .... Nobody will deny that .... The way/As I see it Everyone knows .... Let me put it this/another way .... Let's get this clear (first) .... Sorry to interrupt you, but .... The point I'm trying to make is .... Personally (speaking) I think .... I'm absolutely convinced that .... My view/point of view is that .... The way I look at/see it is this What I actually meant was ....

Giving an explanation

Look, it's like this: What I mean is .... The reason for this is .... The main problem is .... Just let me explain .... Well, the reason is .... Well, the thing is .... Above all we must keep in mind that ....

Agreeing with an opinion

I (quite) agree. I agree completely/entirely. I couldn't agree (with you) more. I entirely/completely agree with you on that. That's true/right. That's just it. Quite/Exactly/Precisely/Right/Certainly/Definitely. You're quite/so right. I think so, too. I don't think so either. That's just my feeling/opinion. That's just how I see it/feel about it, too. That's a very good/important point. You've got a good point there. Yes, of course/definitely/absolutely Marvelous. That's exactly what I mean/say. Yes, that's obvious. That's exactly how I see it. That's what I think How very true. So do I/So am I Yes, indeed. I'm all in favor of what you've been saying.

Polite disagreement

I disagree (with you), I'm afraid. No, I really can't agree, I'm afraid. I don't quite agree there. I'm not so certain/at all sure if that's true/correct I'm not (quite) so sure (really). I'm sorry I can't agree. Do you really think so/believe that? I'm not convinced that .... Well, that's one way of looking at it, (but) Well, I have my doubts about that You can't really mean that. You don't really mean that, do you? I wouldn't say so. I don't think so. I don't think you're right/that's right. Surely you don't mean that? I don't want to argue with you, but .... I can't go all the way with you on that point. Are you seriously suggesting that ...? I have my problems with what you're saying.

Text 2.

EX 1. TRUE / FALSE: Read the headline. Guess if a-h below are true (T) or false (F).

a. A tech expert said we will never be ready for the Internet of Things. T / F
b. The Internet of Things will bring big changes to our life. T / F
c. In the next 10 years, over 25 billion devices will be connected online. T / F
d. A fridge will be able to re-order supplies that are running low. T / F
e. The Internet of Things has infrastructure obstacles to overcome. T / F
f. We have enough data storage facilities for the Internet of Things. T / F
g. There will be little that is unexpected from the Internet of Things. T / F
h. The Internet of Things will not throw up any concerns about privacy. T / F

The Internet of Things

A top technology analyst has warned that the world might not yet be ready for what is called the Internet of Things. This is the next stage of the digital and technological revolution. It will greatly transform our lives via the interconnectedness of all the devices, services and appliances we use in our daily life. The technology research company Gartner predicts that by 2020, nearly 26 billion devices will be on the Internet of Things. All of these things will communicate with each other to make even simple decisions, like ordering a new carton of milk, a seamless experience. The fridge will simply contact the delivery service when it senses stocks need replenishing, and hey presto – no need to go shopping.

The ComputerWorld magazine says that while the Internet of Things has, "the potential to drive fundamental economic and social change," there are "serious obstacles" to ensuring the infrastructure of this technological revolution is in place in time. These include the building of new data storage centres, data storage and management and data security. Gib Sorebo, a cyber-security expert, warns of the unforeseen. He says "the law of unintended consequences" on the Internet could pose problems with the explosion in the number of connected devices. He predicts that privacy will become a primary concern because of the huge number of things in our daily life that will be connected to the Internet.

EX 2. SYNONYM MATCH: Match the following synonyms from the text.

1. warned	a) refilling
2. stage	b) smooth
3. greatly	c) ability
4. seamless	d) step
5. replenishing	e) propel
6. potential	f) key
7. drive	g) cautioned
8. unforeseen	h) enormous
9. primary	i) unexpected
10. huge	j) considerably

EX.3. PHRASE MATCH: (Sometimes more than one choice is possible.)

1. the next	a) devices
2. 26 billion	b) need replenishing
3. a seamless	c) storage
4. when it senses stocks	d) of things
5. hey	e) consequences
6. serious	f) experience
7. data	g) a primary concern
8. unintended	h) presto
9. privacy will become	i) stage
10. the huge number	j) obstacles

EX. 4. Multiple Choice

1. What did an analyst warn we might not be ready for?
a) new Internet bugs b) the Internet of Things c) the thing that will replace the Internet d) new websites

2. What will the Internet of things change considerably?
a) websites b) the cost of being online c) our lives d) data traffic

3. How many devices will be on the Internet by 2020?
a) exactly 26 billion b) just over 26 billion c) around 26 billion d) just under 26 billion

4. What kind of experience did the article say there could be?
a) a digital one b) a seamless one c) a crazy one d) a steaming one

5. What would be eliminated if our fridge took over ordering milk?
a) shopping b) dairy farms c) cows d) the middle man

6. What is the name of the magazine mentioned in the second paragraph?
a) Computer World b) World Computer c) Computer First d) Internet Things

7. What is in the way of ensuring the infrastructure is in place?
a) viruses b) hackers c) firewalls d) obstacles

8. Who is Gib Sorebo?
a) a data processor b) a CEO c) a cyber-security expert d) a hacker
9. What did a cyber-security expert warn of?
a) security b) chaos c) explosions d) the unforeseen

10. What did the cyber-security expert predict would be a major worry?
a) headaches b) privacy c) bandwidth d) password protection

Discussion

EX.5. What are the pros and cons of these things being connected to the Internet?

	Possible uses	pros	cons
Your fridge			
Your car			
Your watch			
Your shoes			
Your sofa			
Your garden			

EX. 6. PROBLEMS: Rank these with your partner. Put the biggest problem from digital connectivity at the top.

• Privacy, • Internet costs, • Less control of life, • Laziness • Machine-made mistakes • Loss of jobs • Machines taking over • Hackers

EX. 7. Discuss the following questions.
1) What would life be like without the Internet? 2) What do you think is the most useful thing about the Internet? 3) What technological revolutions do you think will happen? 4) What are the bad things about devices being interconnected? 5) Is it better to order milk yourself or let a computer do it? 6) Will we need workers in the future? 7) How good would it be to have no need for shopping? 8) What economic and social changes could the Internet of Things bring? 9) What bad things could the Internet of Things bring? 10) What are your favourite devices and why? 11) Would you like your life to be controlled by connected devices? 12) How concerned are you about privacy on the Internet? 13) What do you think of the idea of our brain being connected to the Internet? 14) What questions would you like to ask an Internet expert?

Unit 7. Artificial intelligence

Your vocabulary
application - застосування
to scramble - поспішати
to require – вимагати (потребувати)
to ingest – (тут) поглинати
correlation – взаємозв'язок, співвідношення
to acquire – отримувати, набувати
actionable – актуальний, практичний, корисний
reasoning – обґрунтування, логічне мислення
to fine-tune – вдосконалювати, точно налаштовувати,
rules-based systems – експертні системи (побудовані на основі продукційних правил)
lead generation – формування бази даних потенційних клієнтів
detail-oriented – скрупульозний, відповідальний
relevant – відповідний, актуальний
to give insights into – давати уявлення/розуміння про
to fuel – сприяти, викликати, давати поштовх
to outpace – випереджати
to underpin – лежати в основі
language processing – розпізнавання, обробка і синтез мови

What is artificial intelligence (AI)?

Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific ***application***s of AI include expert systems, natural language processing, speech recognition and machine vision.

How does AI work?

As the hype around AI has accelerated, vendors have been ***scrambling*** to promote how their products and services use it. Often, what they refer to as AI is simply a component of the technology, such as machine learning. AI ***require***s a foundation of

specialized hardware and software for writing and training machine learning algorithms. No single programming language is synonymous with AI, but Python, R, Java, C++ and Julia have features popular with AI developers.

In general, AI systems work by ***ingesting*** large amounts of labeled training data, analyzing the data for ***correlations*** and patterns, and using these patterns to make predictions about future states. In this way, a chatbot that is fed examples of text can learn to generate lifelike exchanges with people, or an image recognition tool can learn to identify and describe objects in images by reviewing millions of examples. New, rapidly improving generative AI techniques can create realistic text, images, music and other media.

AI programming focuses on cognitive skills that include the following:

Learning. This aspect of AI programming focuses on ***acquiring*** data and creating rules for how to turn it into ***actionable*** information. The rules, which are called algorithms, provide computing devices with step-by-step instructions for how to complete a specific task.

Reasoning. This aspect of AI programming focuses on choosing the right algorithm to reach a desired outcome.

Self-correction. This aspect of AI programming is designed to continually ***fine-tune*** algorithms and ensure they provide the most accurate results possible.

Creativity. This aspect of AI uses neural networks, ***rules-based systems***, statistical methods and other AI techniques to generate new images, new text, new music and new ideas.

Why is artificial intelligence important?

AI is important for its potential to change how we live, work and play. It has been effectively used in business to automate tasks done by humans, including customer service work, ***lead generation***, fraud detection and quality control. In a number of areas, AI can perform tasks much better than humans. Particularly when it comes to repetitive, ***detail-oriented*** tasks, such as analyzing large numbers of legal documents to ensure ***relevant*** fields are filled in properly, AI tools often complete jobs quickly and with relatively few errors. Because of the massive data sets it can process, AI can also ***give*** enterprises ***insights into*** their operations they might not have been aware of. The rapidly expanding population of generative AI tools will be important in fields ranging from education and marketing to product design.

Indeed, advances in AI techniques have not only helped ***fuel*** an explosion in efficiency, but opened the door to entirely new business opportunities for some larger enterprises. Prior to the current wave of AI, it would have been hard to imagine using computer software to connect riders to taxis, but Uber has become a Fortune 500 company by doing just that.

AI has become central to many of today's largest and most successful companies, including Alphabet, Apple, Microsoft and Meta, where AI technologies are used to improve operations and ***outpace*** competitors. At Alphabet subsidiary Google, for example, AI is central to its search engine, Waymo's self-driving cars and Google Brain, which invented the transformer neural network architecture that ***underpins*** the recent breakthroughs in natural ***language processing***.

EX 1. Answer the questions.

1. What is AI and what do specific applications of AI include? 2. What did sellers started doing as AI kept on advancing? 3. What programming languages are used in AI? 4. How does an AI operate in general? 5. Name cognitive skills that AI focuses on. 6. How is AI used in business? 7. What type of tasks can AI perform? 8. Where is AI used at Alphabet Inc?

EX.2. Match words with their definitions.

1. application 2. to require 3. to acquire 4. reasoning 5. relevant 6. to give insights into 7. to fuel 8. to outpace 9. to underpin 10. detail-oriented	a) correct or suitable for a particular purpose b) very interested in and paying a lot of attention to details c) to need something or make something necessary d) to give support, strength, or a basic structure to something e) a way in which something can be used for a particular purpose f) to move or develop faster than someone or something else g) to get or obtain something h) the process of thinking about something in order to make a decision i) to provide power to something j) to gain accurate and deep understanding of smth.

EX.3. Find words with similar meaning.

1. application 2. to require 3. to acquire 4. reasoning 5. relevant 6. to give insights into 7. to fuel 8. to outpace 9. to underpin 10. detail-oriented	a) to clarify b) to outperform c) to demand d) thorough e) use f) to obtain g) to power, to boost h) significant i) argumentation j) to support

EX.4. Choose the best word to complete the sentences.

1. I went to the meeting armed with the … facts and figures.

a) insignificant	b) relevant	c) unimportant	d) vital

2. The company has completely … its rivals in the market.

a) lost	b) aided	c) gave up	d) outpaced

3. Physicists hope they will … into the strong nuclear force that binds atoms together.

a) fall	b) give insight	c) break	d) go

4. This technique has found many ... in improving the quality of manufacturing processes.

a) rivals	b) applications	c) drawbacks	d) feedbacks

5. He also … the habit of taking risks.

a) required	b) followed	c) acquired	d) lagged behind

6. This huge amount of resources is not only needed … their export-oriented economy.

a) recall	b) ban	c) exchange	d) to fuel

7. These new products are part of a line-up that will … the company's recovery.

a) underpin	b) give insight	c) understand	d) outpace

8. The successful candidate must be… , hard-working and a team player.

a) retail-oriented	b) object-oriented	c) disoriented	d) detail-oriented

9. Greenpeace works … awareness of the dangers that threaten our planet today.

a) to require	b) to promote	c) to give up	d) fall behind

10. We hope … some new ideas at the meeting.

a) to generate	b) to settle	c) to solve	d) to design

11. Many companies use this approach when it … to innovation.

a) arrives	b) gets	c) goes	d) comes

12. These chips … data seven times faster using 95 percent less power than traditional means.

a) play	b) outperform	c) process	d) underpin

13. This game … total concentration.

a) acquires	b) does	c) takes	d) requires

What are the advantages of AI?

Artificial neural networks and deep learning AI technologies are quickly evolving, primarily because AI can **1) …** large amounts of data much faster and make predictions more accurately than humanly possible.

While the huge volume of data created on a daily basis would bury a human researcher, AI applications using machine learning can take that data and quickly turn it into **2) …** information. A primary disadvantage of AI is that it is expensive to process the large amounts of data AI programming requires. As AI techniques are **3) …** into more products and services, organizations must also be attuned to AI's potential to create biased and discriminatory systems, intentionally or inadvertently. **Advantages of AI.** The following are some advantages of AI.

Good at detail-oriented jobs. AI has proven to be as good or better than doctors at diagnosing certain cancers, including breast cancer and melanoma.

Reduced time for data-heavy tasks. AI is widely used in data-heavy industries, including banking and securities, pharma and insurance, to **4) …** the time it takes to analyze big data sets. Financial services, for example, routinely use AI to process loan applications and **5) …** fraud.

Saves labor and **6) …** productivity. An example here is the use of warehouse **7) …** , which grew during the pandemic and is expected to increase with the integration of AI and machine learning.

Delivers consistent results. The best AI translation **8) …** deliver high levels of consistency, offering even small businesses the ability to reach customers in their native language.

Can improve customer satisfaction through personalization. AI can personalize content, messaging, ads, recommendations and websites to individual customers.

AI-powered virtual agents are always **9) …** . AI programs do not need to sleep or take breaks, providing 24/7 service.

1	a) develop	b) underpin	c) process	d) limit
2	a) useless	b) actionable	c) irrelevant	d) first-hand
3	a) injected	b) scrambled	c) fine-tuned	d) incorporated
4	a) extend	b) reduce	c) change	d) increase
5	a) defect	b) require	c) underpin	d) detect
6	a) outpaces	b) increases	c) decreases	d) acquires
7	a) degradation	b) simulation	c) automation	d) personnel
8	a) tools	b) employees	c) services	d) bureaus
9	a) occupied	b) limited	c) available	d) required

Text 2. Artificial Intelligence

The increasing ubiquity of artificial intelligence in our lives is creating waves in academia. Three universities in Australia have adopted what seems like a landmark policy. The three institutions are allowing students to use AI when taking assessments, albeit under strict conditions. Professor Romy Lawson said: "Instead of banning students from using such programs, we aim to assist academic staff and students to use digital tools to support learning." The Internet abounds with AI text generators. These can be used to create essays that look authentic enough to fool examiners. The content created by these AI tools evade detection by even the smartest of anti-plagiarism tools.

Artificial Intelligence is posing huge challenges to exam integrity. It is the biggest disruptor since calculators were allowed into maths tests. The latest quandary for educators comes from a language processing chatbox called ChatGPT. This can produce highly authentic human-like content on any subject in seconds. It has sparked fears that students will use it to write essays. The University of South Australia's Dr Vitomir Kovanovic said teachers needed to embrace AI. He said: "You cannot stop it. The alternative is the Middle Ages – going to pen and paper." He added that universities needed to change with the times. He said: "It's like having a driving school, but teaching people how to ride horses."

Paragraph 1

1.ubiquity	a. Doing something big and different to make people think, wonder, worry...
2.creating waves	b. Exist in large numbers or amounts.
3.landmark	c. The practice of taking someone else's work or ideas and passing them off as one's own.

4.abound	d. An event or discovery marking an important stage or turning point in something.
5.authentic	e. Escape or avoid someone or something.
6.evade	f. The fact of appearing everywhere or of being very common.
7.plagiarism	g. Of undisputed origin and not a copy; genuine.

Paragraph 2

8. posing	h. The condition of being honest and incorruptible.
9. integrity	i. A company or technology that causes huge change in an industry or market by means of innovation.
10.disruptor	j. Of one or more things available as another possibility or choice.
11.quandary	k. Provided the stimulus for an event or process.
12.sparked	l. A state of confusion or uncertainty over what to do in a difficult situation.
13.embrace	m. Presenting or being a problem or danger.
14.alternative	n. Accept a belief, theory, or change willingly and enthusiastically.

1. TRUE / FALSE: Read the headline. Guess if 1-8 below are true (T) or false (F).

1. Australian universities have developed A.I. using sound waves. **T / F**
2. Three Australian universities want to support students with digital tools. **T / F**
3. The article says there are one of two AI text generators online. **T / F**
4. The article says chatboxes cannot outsmart anti-plagiarism tools. **T / F**
5. The last huge change in exams was using calculators in maths tests. **T / F**
6. It takes ChatGPT just minutes to create authentic-looking tests. **T / F**
7. A professor said it is possible to stop AI. **T / F**
8. A professor likened paper tests to driving schools teaching horse riding. **T / F**

2. SYNONYM MATCH/ PHRASE MATCH

1. ubiquity	a) genuine
2. landmark	b) other possibility
3. abounds	c) unmasking
4. authentic	d) constituting
5. detection	e) dilemma
6. posing	f) turning point
7. quandary	g) adopt
8. sparked	
9. embrace	

10. alternative	h) ever-presence i) proliferates j) prompted

3. PHRASE MATCH: (Sometimes more than one choice is possible.)

1. biquity of artificial intelligence 2. adopted what seems like a landmark 3. The Internet abounds with AI text 4. essays that look authentic enough 5. evade detection by even the smartest of 6. Artificial Intelligence is posing 7. The latest 8. It has sparked 9. Dr Vitomir Kovanovic said teachers needed 10. universities needed to change	a. generators b. with the times c. anti-plagiarism tools d. quandary for educators e. huge challenges f. in our lives g. fears h. to embrace AI i. to fool examiners j. policy

Put these words into the spaces in the paragraph below.

Albeit, authentic, ubiquity, evade, digital, landmark, banning, generators

The increasing (1) _____ of artificial intelligence in our lives is creating waves in academia. Three universities in Australia have adopted what seems like a (2) _____ policy. The three institutions are allowing students to use AI when taking assessments, (3) _____ under strict conditions. Professor Romy Lawson said: "Instead of (4) _____ students from using such programs, we aim to assist academic staff and students to use (5) _____ tools to support learning." The Internet abounds with AI text (6) _____. These can be used to create essays that look (7) _____ enough to fool examiners. The content created by these AI tools (8) _____ detection by even the smartest of anti-plagiarism tools.

Put these words into the spaces in the paragraph below.

Horses, quandary, alternative, sparked, times, posing, embrace, authentic

Artificial Intelligence is (9) _____ huge challenges to exam integrity. It is the biggest disruptor since calculators were allowed into maths tests. The latest (10) _____ for educators comes from a language processing chatbox called ChatGPT. This can produce highly (11) _____ human-like content on any subject in seconds. It has (12) _____ fears that students will use it to write essays. The University of South Australia's Dr Vitomir Kovanovic said teachers needed to (13) _____ AI. He said: "You cannot stop it. The (14) _____ is the Middle Ages - going to pen and paper." He added that universities needed to change with the (15)

_____. He said: "It's like having a driving school, but teaching people how to ride (16) _____."

Choose correct option

1) The increasing ubiquity of artificial intelligence in our lives _____
   a. is creating weaves
   b. is creating waves
   c. is creating waives
   d. is creating ways
2) universities in Australia have adopted what seems like _____
   a. a landmark politic
   b. a benchmark policing
   c. a landmark policy
   d. a trademark policy
3) allowing students to use AI when taking assessments, albeit _____
   a. asunder strict conditions
   b. udder strict conditions
   c. ender strict conditions
   d. under strict conditions
4) we aim to assist academic staff and students to _____
   a. use digital stools
   b. use digit tall tools
   c. use digital tools
   d. use digit taut awls
5) These can be used to create essays that look authentic enough _____
   a. to fool examiners
   b. two fool examiners
   c. through fool examiners
   d. tooth all examiners
6) Artificial Intelligence is posing huge challenges _____
   a. to eggs and integrity
   b. to exam integrated
   c. two exams integrity
   d. to exam integrity
7) This can produce highly authentic human-like content on any _____
   a. object in seconds
   b. inject in seconds
   c. subjecting seconds
   d. subject in seconds
8) South Australia's Dr Vitomir Kovanovic said teachers needed _____
   a. to embarrass AI
   b. to embrace AI
   c. to emboss AI
   d. to embers AI
9) The alternative is the Middle Ages - going to _____

a. pen and paper
b. pen and quill
c. pen and parchment
d. pen and manuscript

10) He said: "It's like having a driving school, but teaching people how _____."
a. to ride hearses
b. to ride horsies
c. to ride horses
d. to ride houses

Comprehension questions

1. What does the article say A.I. is creating in academia?
2. How many universities are allowing AI is assessments?
3. Under what kind of conditions will exams be taken using AI?
4. Who does the article say AI text generators can fool?
5. What does the article say AI tools can outsmart?
6. What is artificial intelligence posing huge challenges for?
7. What was the last big disruptor in exams?
8. How long does it take ChatGPT to create authentic-looking texts?
9. Where did a professor say we would return to if we didn't accept AI?
10. Who did a professor say needed to change with the times?

Multiple choice quiz

1) What does the article say A.I. is creating in academia?
a) articles
b) a mess
c) waves
d) milestones
2) How many universities are allowing AI is assessments?
a) three
b) eight
c) 20
d) dozens
3) Under what kind of conditions will exams be taken using AI?
a) fair conditions
b) strict conditions
c) supervised conditions
d) good conditions
4) Who does the article say AI text generators can fool?
a) anyone and everyone
b) students
c) fools
d) examiners
5) What does the article say AI tools can outsmart?
a) super-computers

b) geniuses
c) anti-plagiarism tools
d) top professors
6) What is artificial intelligence posing huge challenges for?
a) the Internet
b) exam integrity
c) education
d) grades
7) What was the last big disruptor in exams?
a) digital clocks
b) the pen
c) bubble sheets
d) calculators
8) How long does it take ChatGPT to create authentic-looking texts?
a) nanoseconds
b) seconds
c) milliseconds
d) minutes
9) Where did a professor say we would return to if we didn't accept AI?
a) the dark ages
b) the Middle Ages
c) the Stone Age
d) prehistoric times
10) Who did a professor say needed to change with the times?
a) universities
b) students
c) professors
d) web designers

Speaking

STUDENT A's QUESTIONS (Do not show these to student B)

1. What did you think when you read the headline?
2. What images are in your mind when you hear the word 'intelligence'?
3. What do you think of tests and assessments?
4. How good were you at taking tests?
5. What do you think of artificial intelligence?
6. What dangers does AI present to tests?
7. Should universities ban students from using AI?
8. What is artificial intelligence good for?
9. What are your favourite digital tools?
10. What do you think of plagiarism?

STUDENT B's QUESTIONS (Do not show these to student A)

11. Did you like reading this article? Why/not?
12. What do you think of when you hear the word 'assessments'?

13. What do you think about what you read?
14. Did you ever see students cheating in exams?
15. Should calculators be allowed in exams?
16. What do you know about the new chatbox ChatGPT?
17. How good are you at writing essays?
18. Should all tests be pen-and-paper tests?
19. What do you know about the Middle Ages?
20. What questions would you like to ask the researchers?

Unit 8. Extented reality

Your vocabulary
extended reality (XR) – розширена реальність
umbrella term – загальне поняття, широкий термін
immersive – імерсивний (одночасний вплив на людину за допомогою декількох каналів сприйняття) Імерсивні технології — технології повного або часткового занурення у віртуальний світ або різні види змішання реальної і віртуальної реальності. Імерсивні технології також називають технологіями розширеної реальності. До їх списку входить віртуальна і доповнена реальність, а також 360 °-відео (Вікіпедія)
augmented reality – доповнена реальність
to blend – змішувати
immersive experience – відчуття присутності, ефект занурення
to reveal – розкривати, виявляти
augmented reality (AR) – доповнена реальність
to overlay – накладати
to enhance – підсилювати, покращувати, розширювати
simulated – змодельований
HoloLens – окуляри змішаної реальності

Extended Reality Technology [1]

Imagine what it might be like to live and work in our world in 2030 and beyond. Perhaps, thanks to advancements in **extended reality** (XR), an **umbrella term** used to describe **immersive** technologies that can merge the physical and virtual worlds, you might be able to shop for a new home anywhere in the world as if you were actually on-site or head to lunch in some faraway land. By 2022, the XR market is expected to reach $209 billion, which is eight times what it is today. This tremendous growth could mean the realities of our 2030 lives are beyond our imagination's ability to grasp.

What is extended reality (XR)?

XR is an emerging umbrella term for all the immersive technologies. The ones we already have today—**augmented reality** (AR), virtual reality (VR), and mixed reality (MR) plus those that are still to be created. All immersive technologies extend the reality we experience by either **blend**ing the virtual and "real" worlds or by creating a fully **immersive experience**. Recent research **reveal**ed that more than 60% of

respondents believed XR will be **mainstream** in the next five years. To get a better picture of XR, let's review each of the existing technologies that exist today.

Augmented reality (AR)

In augmented reality, virtual information and objects are **overlaid** on the real world. This experience **enhance**s the real world with digital details such as images, text, and animation. You can access the experience through AR glasses or via screens, tablets, and smartphones. This means users are not isolated from the real world and can still interact and see what's going on in front of them. The most well-known examples of AR are the Pokémon GO game that overlays digital creatures onto the real world or Snapchat filters that put digital objects such as hats or glasses onto your head.

Virtual reality (VR)

In contrast to augmented reality, in a virtual reality experience, users are fully immersed in a **simulated** digital environment. Individuals must put on a VR headset or head-mounted display to get a 360 -degree view of an artificial world that fools their brain into believing they are, e.g., walking on the moon, swimming under the ocean or stepped into whatever new world the VR developers created. The gaming and entertainment industry were early adopters of this technology; however, companies in several industries such as healthcare, construction, engineering, the military, and more are finding VR to be very useful.

Mixed reality (MR)

In mixed reality, digital and real-world objects co-exist and can interact with one another in real-time. This is the latest immersive technology and is sometimes referred to as hybrid reality. It requires an MR headset and a lot more processing power than VR or AR. Microsoft's **HoloLens** is a great example that, e.g., allows you to place digital objects into the room you are standing in and give you the ability to spin it around or interact with the digital object in any way possible. Companies are exploring ways they can put mixed reality to work to solve problems, support initiatives, and make their businesses better.

Challenges of XR

Those developing XR technologies are battling with some of the challenges to mainstream adoption. First, XR technologies collect and process huge amounts of very detailed and personal data about what you do, what you look at, and even your emotions at any given time, which has to be protected.

In addition, the cost of implementing the technology needs to come down; otherwise, many companies will be unable to invest in it. It is essential that the wearable devices that allow a full XR experience are fashionable and comfortable as well as always connected, intelligent, and immersive. There are significant technical and hardware issues to solve that include but are not limited to the display, power and thermal, motion tracking, connectivity and common illumination—where virtual objects in a real world are indistinguishable from real objects especially as lighting shifts.

As each day passes, we are one step closer to solving these issues so that we will see many more mainstream applications of all XR technologies over the coming years.

[1] Bernard Marr, https://www.forbes.com/sites/bernardmarr/2019/08/12/what-is-extended-reality-technology-a-simple-explanation-for-anyone/?sh=322c55b72498

Ex.1. Choose correct word or phrase and fill in the gaps.

Simulation, immersive, benefited, encounter, to blend, interact, simulators, to experience

1. Users can experience MR environments through a headset, phone or tablet, and can … with digital objects by moving them around or placing them in the physical world. 2. Consumers worldwide are purchasing AIOs (all-in-one) … XR, from immersive gaming to remote learning to virtual training. 3. MR utilizes both AR and VR … the physical and digital worlds. 4. Manufacturing has also … from Extended Reality. 5. VR training allows learners to develop their skills and … true-to-life scenarios without facing real-world risk. 6. VR refers to a computer-created … in which users can enter a three-dimensional world, using devices such as glasses and gloves equipped with sensors. 7. VR began in the federal sector, where it was used to train people in flight … . 8. Mixed reality is the most advanced … technology, as it combines the best of virtual reality and augmented reality, which offers a more complete experience.

Ex. 2. Answer the questions

1. What is extended reality? 2. Can people imagine in terms of how our life will look like in 2030? 3. What does the term immersive technology mean? 4. What immersive technologies are known today? Which one/ones have you tried? 5. How is augmented reality (AR) generated? 6. What gadgets are used to experience AR? 7. Think of examples for AR and its possible applications. 8. Where and what can VR be used for? 9. What does concept mixed reality (MR) mean? 10. Provide examples of MR applications. 11. Think of advantages and disadvantages of XR nowadays.

Ex. 3. Translate into Ukrainian.

advancements in extended reality, immersive technologies, merge the physical and virtual worlds, faraway land, blending the virtual and “real” worlds, immersive experience, virtual information and objects are overlaid on the real world, simulated digital environment, digital and real-world objects co-exist and can interact with one another in real-time, cost of implementing the technology needs to come down, significant technical and hardware issues, mainstream applications

Ex. 4. Render the following phrases into English.

об’єднати фізичний та віртуальний світ, віддалений регіон, поза межами нашої уяви, новий узагальнюючий термін, розширювати реальність, яку ми сприймаємо, занурюватися у змодельоване цифрове середовище, штучний світ, який обманює їхній мозок, цифрові та реальні об'єкти співіснують

Ex. 5. Translate sentences into English. Use key words in parenthesis.

1. Розширена реальність з'явилася завдяки інтенсивному розвитку імерсивних технологій. 2. Імерсивні технології здатні розширити межі реальності завдяки злиттю реального та віртуального світів. 3. Розробники вважають що розширена реальність стане мейнстрімом (основною технологією) у найближчі 10 років. 4. Щоб краще зрозуміти сутність XR, потрібно знати як працюють технології що входять до її складу. 5. В доповненій реальності будь-яка інформація чи предмети накладаються на реальний світ. 6. Віртуальна реальність – ілюзія дійсності, створювана за допомогою комп'ютерних систем, які забезпечують зорові, звукові та інші **відчуття** (experiences). 7. Кімнати віртуальної реальності – спеціально обладнане середовище, де створене комп'ютером зображення повністю транслюється на його стіни завдяки дисплеям чи проекторам. 8. Рукавиці віртуальної реальності – дозволяють відслідковувати положення рук і пальців, щоб симулювати маніпуляції з віртуальними об'єктами, ніби вони справжні. 9. VR використовується для моделювання складної чи небезпечної діяльності, наприклад, керування транспортом, хірургічних операцій, тощо. 10. Змішана реальність – злиття реальних і віртуальних світів для створення нових середовищ і візуалізації, де фізичні та цифрові об'єкти співіснують і взаємодіють в режимі реального часу. 11. Хірургічні та ультразвукові моделювання використовуються як тренувальні вправи для фахівців в галузі охорони здоров'я. 12. Моделі дають можливість отримати інтуїтивне розуміння точного продукту в режимі реального розміру та конструкції деталей, які дозволяють більш уважно розглянути деталі інтер'єру.

Ex. 6. Match phrases to form collocations.

1. immersive	a) business knowledge
2. to reveal	b) virtual and real worlds
3. to enhance	c) world
4. simulated	d) experience
5. digital	e) technology
6. to blend	f) one's brain
7. to fool	g) secrets
8. mainstream	h) environment

Ex. 7. Fill in the text with correct nouns, verbs and prepositions.

What is virtual reality?

Virtual reality is a **1)** … 3D environment that enables users to explore and interact with a virtual surrounding in a way that approximates reality, as it is perceived through the users' senses. The environment is created with computer hardware and software, although users might also need **2)** … devices such as helmets or goggles to interact

with the environment. The more deeply users can **3)** … themselves in a VR environment -- and block out their physical surroundings -- the more they are able to suspend their belief and accept it as real, even if it is fantastical in nature.
The VR industry still has far to go before realizing its vision of a totally immersive environment that **4)** … users to engage multiple sensations in a way that approximates reality. However, the technology has come a long way in providing realistic sensory engagement and shows promise for business use in a number of industries.

VR systems can vary significantly from one to the next, depending on their purpose and the technology used, although they generally fall **5)** … one of the following three categories:

Non-immersive. This type of VR typically refers to a 3D simulated environment that's accessed through a computer screen. The environment might also **6)** … sound, depending on the program. The user has some control over the virtual environment using a keyboard, mouse or other device, but the environment does not directly **7)** … with the user. A video game is a good example of non-immersive VR, as is a website that enables a user to design a room's decor.
Semi-immersive. This type of VR offers a partial virtual experience that's accessed through a computer screen or some type of glasses or headset. It focuses primarily **8)** … the visual 3D aspect of virtual reality and does not incorporate physical movement in the way that full immersion does. A common example of semi-immersive VR is the flight simulator, which is used by airlines and militaries to **9)** … their pilots.
Fully immersive. This type of VR **10)** … the greatest level of virtual reality, completely immersing the user in the simulated 3D world. It incorporates sight, sound and, in some cases, touch. There have even been some experiments with the **11)** … of smell. Users wear special equipment such as helmets, goggles or gloves and are able to fully interact with the environment. The environment might also incorporate such equipment as treadmills or stationary bicycles to provide users with the **12)** … of moving through the 3D space. Fully immersive VR technology is a field still in its infancy, but it has made important inroads into the gaming industry and to some extent the healthcare industry, and it's generating a great deal of interest in others.

1	a) stimulated	b) simulated	c) challenged	d) limited
2	a) to dress	b) to try on	c) to wear	d) to put in
3	a) dive	b) see	c) observe	d) immerse
4	a) provides	b) enables	c) immunes	d) increases
5	a) onto	b) to	c) in	d) into
6	a) generate	b) make	c) limit	d) control
7	a) face	b) play	c) interact	d) identify
8	a) about	b) on	c) in	d) at
9	a) study	b) work	c) train	d) integrate
10	a) studies	b) gets	c) trains	d) delivers
11	a) extraction	b) addition	c) illusion	d) delivery
12	a) knowledge	b) understanding	c) experience	d) insight

Part 2
Grammar reference and exercises

Simple Tenses.

***Present Simple*.** **V_1, (he, she, it) – V_1+s(es)**

e.g. I report. **but** He report**s**. I don't report. He **does**n't report**.** How often do you report?

How often **does** he report?

Випадки вживання:

1.

а) дія, що відбувається постійно, регулярно, часто (із прислівниками: **always, often, frequently, seldom, rarely, as a rule, usually, never** тощо):
Usually computer science specialism students have 3 or 4 practical classes a day. He never cuts classes.

б) для вираження дії або властивості, які характеризують підмет постійно або у теперішній період часу:
Our dean speaks English quite well. His son already goes to school.

в) для вираження закономірностей, загальних положень; при формулюванні правил, законів, формул (особл. в точних науках)
The Earth rotates around its axis. Light travels at different speeds in different media. Bisector is the line that cuts (bisects) an angle into two equal parts.

2. для вираження майбутньої дії:

а) розклад руху транспорту, початку занять, сеансів тощо:
Amsterdam train leaves at 21:35. Classes start at 8 a.m at our university.

б) у підрядних реченнях умови і часу після сполучників **if, provided (that), providing; when, after, before, till, until, as soon as**
You will be allowed to the laboratory, provided (that) you have protective outfit.
I'll help you, as soon as I have spare moment.

в) з дієсловами, що позначають рух (to, come, to go, to leave, to move, to arrive etc.)
Tomorrow the delegation leaves for Lviv. They come next week.

г) під час презентації, доповіді, лекції, коли повідомляємо слухачам про що йтиметься у наступних частинах, розділах тощо:
*In the next chapter, I first outline a framework developed on the results of investigation. In the following two chapters, I argue that this problem cannot be solved **along these lines**. (i.e. by using/applying these techniques)*

3. У заголовках газет, журналів, а також коли посилаємось на твердження відомих науковців, вчених замість минулого простого (Past Simple) чи теперішнього доконаного (Present Perfect):
Mayer inaugurates resort center. I. Newton states that, if an object experiences no net force, then its velocity is constant.

4. Із дієсловами сприйняття, з дієсловами, що виражають емоційні, розумові стани **(to hear, to see, to know, to realize, to understand, to recognize, to believe, to suppose, to need, to desire, to love, to like, to appreciate, to please, to prefer, to hate, to dislike, to care, to surprise etc.)** замість теперішнього тривалого часу (Present Continuous).
I think you haven't got the case. We hear the sound inside the room.

Past Simple **V_2 (V+ed)**
I work**ed** really hard. I **did**n't work really hard. Where **did** you work so hard?

Випадки вживання:
1. дія, що відбулася у минулому (з прислівниками часу**: yesterday, the day before yesterday;** словоспол. із числівником **last week/month/year та ago – 5 minutes ago, week ago, year ago).**
I came across the vice rector at the admissions office yesterday. My neighbour graduated from the university 2 years ago.

2. послідовні дії у минулому:
Laboratory assistant entered the lab, aired the room and got down to work.

Future Simple **shall (I, we), will + V_1**
He **will look** through the paper ASAP. He **won't look** through the paper. **Will** he **look** through the paper ASAP?

Випадки вживання:
1. дія, що відбудеться у майбутньому; ряд послідовних дій у майбутньому
I'll tell you correct answers, as soon as I have the last paper.

2. після дієслів **to be sure, to hope, to think, to expect, to suppose,** для вираження майбутньої дії:
I expect you will come to the lecture in good time. I hope (student A) will tell us the truth about fundamental physical quantities.

Practice

Ex. 1. Put the verbs in parentheses into the correct tense form.

1. A.S. Popov (to pay) much attention to the works of Hertz who (to prove) by experiments the existence of electromagnetic waves. 2. In the next chapter I briefly (to consider) major results of our research. 3. I suppose you (to help) me with the investigation. 4. The term algorithm (to refer) to a rule or a set of rules that are precise.

5. Pul'uj's works (to draw) attention in many countries. 6. A.-H. Becquerel, while experimenting in 1896 with fluorescence produced by X-rays, (to discover) that uranium salts (to emit) a type of radiation able to blacken photographic plates. 7. The earliest known working telescopes (to appear) in 1608 and are credited to Hans Lippershey. 8. The spring term/semester (to end) in mid-June at our university. 9. Years passed and S. Korolyov's rare talents (to develop) and (to mature). 10. Supersonics is an important branch of aerodynamics, (to concern) phenomena that arise when the velocity of a solid body exceeds the speed of sound in the medium in which it is travelling. 11. Computer Science (to deal) with the design of computer systems and applications, both hardware and software. 12. I (to run) the program, as soon as I (to scan) it. 13. What significant discoveries (to take) place on the threshold of the millenniums that have altered our ways of life? 14. Scientists (to begin) to study plasma in 1920. 15. He (to publish) scientific articles twice a year. 16. Lecture on Astronomy (to start) in 5 minutes. 17. We (to give) you a definite answer in/within 3 working days.

Ex. 2. Translate the following sentences into English.

1. Делегація прибуває завтра. 2. Післязавтра у вас 2 практичних заняття з фізики і одна лекція із вступу до спеціальності. 3. Кампус нашого університету складається із 10 навчальних корпусів, 3 гуртожитків, наукової бібліотеки, їдальні…. 4. Якщо метал нагріти – він розшириться. 5. Четверте заняття розпочинається рівно о 13:00. 6. Студенти-іноземці, зрештою як і наші студенти, часто пропускають заняття без поважних причин. 7. Післявчора у спорткомплексі «Політехнік» відбулися збори трудового колективу. 8. Ви часто робите поспішні висновки. 9. У наступному розділі ми розглянемо практичні застосування методів, про які вже йшла мова раніше. 10. У 1977 р. я з відзнакою закінчив університет. 11. У водному середовищі швидкість світла зменшується. 12. Згідно з рівнянням Дж. К. Максвелла, електромагнітна хвиля поширюється у вакуумі з фіксованою швидкістю. 13. Світло потрапляє до людського ока через зіницю. 14. У наступному розділі ми детальніше розглянемо ефект Допплера. 15. Нам сказали, що свинець поглинає рентгенівські промені. 16. У 1894 р. М. Моор створив лампу, у якій використовувався азот і вуглекислий газ, що випромінювали рожево-біле світло. 17. Сподіваюся, що наступного разу Вам все-таки вдасться провести це дослідження і отримати вірні результати.

Continuous Tenses (be + V+ing)

	Present	**Past**	**Future**	**V+ing**
I	**am**	**was**	**shall be/will be**	work**ing**
You	**are**	**were**	**will be**	work**ing**
He, she, it	**is**	**was**	**will be**	work**ing**
We	**are**	**were**	**shall be/will be**	work**ing**

You	**are**	**were**	**will be**	work**ing**
they	**are**	**were**	**will be**	work**ing**

Present Continuous

- ***дія, що відбувається в момент мовлення*** (**now, right now, at the moment**):

e.g. We are testing the new device at the moment.

- ***з дієсловами, що позначають рух (to go, to come, to move, to arrive, to leave, to start etc):***

e.g. Tomorrow I am leaving for the beautiful city of Budapest.

- **словосполучення *to be going to* у формі Present Continuous виражає плани і наміри на майбутнє**

e.g. Anyway, I am going to submit application for post-graduate studies.

- **з прислівниками always, constantly для вираження дії, що регулярно повторюється і викликає роздратування , докір:**

e.g. You are always missing my classes.

- ***замість Future Continuous у підрядних реченнях умови і часу після сполучників if, when, after, till, until, before etc.:***

e.g. If he is carrying the experiment when you come, don't interrupt him.

Past Continuous

- **дія, що тривала в певний проміжок/момент часу у минулому (at that moment, at that time, at 8 a.m. yesterday etc.).**

e.g. We were reading for the exam all day long yesterday.

- **якщо одна минула дія перериває іншу минулу дію, то дія, що переривається завжди виражається минулим тривалим часом**

e.g. When I came into the room, they were still arguing about nothing.

- **дія, що визначалася конкретними часовими рамками:**

e.g. Technicians were desperately trying to repair the engine from 5 till 6 p.m.

Future Continuous

- **дія, що відбуватиметься в певний період часу у майбутньому (або у певний проміжок часу у майбутньому)**

e.g. I'll be reading for the exam all day long tomorrow.

Practice

Ex. 1. Translate into English.

1. Вчора увесь день я працював над розробкою навчальної програми із дисципліни «Вступ до спеціальності». 2. В даний момент інженер досліджує діелектричні властивості ізоляційних матеріалів. 3. Сьогодні ми обговорюватимемо (збираємося обговорити) вплив внутрішніх і зовнішніх факторів на розвиток промисловості в нашому регіоні. 4. Коли я увійшов до актового залу, делегати конференції все ще обговорювали спільне бачення наукових проблем. 5. Ректорат університету збирається ввести ряд ініціатив стосовно збільшення набору студентів-іноземців. 6. Чому Ви постійно пропускаєте заняття з математики? 7. Я гадаю, що завтра у цей час він знову працюватиме з документацією. 8. Ми збираємось відкрити ряд нових спеціальностей. 9. Вчора, коли я прийшов на засідання кафедри, питання щодо залучення іноземних інвестицій вже розглянули, а власне з проблем покращення ефективності навчання доповідав доцент Смоляк П.М.. 10. Завтра о 13:00 представники факультетів будуть вирішувати ряд важливих й актуальних проблем.

Ex. 2. Fill in the blanks with appropriate words.

1. TNTU university … is increasingly becoming multinational.
a) academics b) campus c) buildings d) community

2. Students of our university … vast variety of extracurricular activities.
a) group in b) come in c) engage in d) go in

3. The primary purpose of … is to improve student performance.
a) valuing b) estimation c) assessment d) diagnosis

4. Post-graduate students … around 12 percent of all student body.
a) consist of b) constitute c) comprise d) correspond

5. Applicants should … their applications to the Admissions Office in due time.
a) transmit b) address c) submit d) commit

6. You should nominate referees who can provide academic … of your academic ability and suitability for your chosen programme of study.
a) report b) performance c) cability d) assessment

7. Admission to the university is highly … .

a) strict b) competitive c) recommended d) corrupted

8. In Great Britain … are exclusively state-funded.
a) governmental schools b) public schools c) private schools d) grammar schools

9. At the University of Leiden (The Netherlands), it takes four to five years …a bachelor's degree.
a) to clear b) to run c) to complete d) finish

10. In 2009 Ternopil Ivan Pul'uj National Technical University … 21 among higher educational institutions in Ukraine.
a) ranked b) took place c) occupied d) came

Ex. 3. Render the words in brackets into English.

1. At TNTU, undergraduate students study specialized subjects (поглиблено і на високому рівні). 2. Our academics apply (найпередовіші методи викладання) in training both national and international students. 3. In the second year at the university students (проходять практику на підприємствах) relating to their specific field of study. 4. While (зовнішнє оцінювання) is at the core of education policies, educational research has tackled problems about their usefulness, limitations and risks. 5. In Australia the degree (присуджується) to students who have achieved a higher level of performance in the fourth year. 6. Applications should be submitted to (приймальну комісію університету) before June 21st. 7. Please (надсилайте характеристики/рекомендації) to 'The Board of Graduate Studies' and make sure you sign and date the reference. 8. All schools in UK are required to follow the (державної національної програми навчання) , which is made up of twelve subjects. 9. A (державна школа) is for the most part a school whose budget comes from public sector funds. 10. Each school has its own (правила прийому) and may set certain criteria for admissions, such as giving priority to brothers/sisters of children already at the school; proximity to the school may also be used, but living close to a school does not guarantee them a place. 11. (Плата за навчання) vary for international students and for undergraduate students in business, engineering, nursing, pharmacy, and medicine. 12. Syllabi in English Language should (відповідати вимогам) Common European Framework of References for Languages.

Ex 3. Translate into English

1. В той час, коли я готувався до екзамену, мій сусід по кімнаті перекладав важкий текст з англійської на українську. 2. І. Пулюй зробив вагомий внесок у розвиток світової науки, а також і популяризував українську культуру в Європі. 3. Коли я прийшов в деканат декан і заступник декана (про щось) сперечалися. 4. Чим займалися студенти, коли Ви увійшли до лекційної аудиторії? 5. В даний момент лаборант проводить хімічний експеримент з небезпечними реагентами у лабораторії №2. 6. Коли я переглядав офіційний сайт ТНТУ ім. І. Пулюя, я

натрапив на цікаву інформацію про співробітництво з іноземними партнерами. 7. Ми збираємось обговорити цю другорядну проблему дещо пізніше. 8. У типовому британському університеті навчається від 6 до12 тис. студентів. 9. Технічний університет у багатьох аспектах відрізняється від інших університетів нашого міста. 10. Минулого року багато студентів не склало вступних іспитів («провалилося» на вступних іспитах). 11. Екзамен складається із кількох тестових завдань. 12. Зараз викладач *робить перекличку*. (to call the register) . 13. Ви постійно списуєте на підсумкових модулях. 14. Вчора я увесь вечір розмовляв зі своїм *науковим керівником*. (research supervisor – Br.E., research advisor – Am.E.)

Perfect Tenses

(have + V3)

Present Perfect. I **have** just complet**ed** my task. Our co-worker **has** never **been** abroad.

Past Perfect. Before 1998 nobody **had** visit**ed** this island.

Future Perfect. I think I **shall have begun** the experiment, before you come back.

Present Perfect.

- Дія, що відбулася у минулому, але своїм результатом пов'язана із теперішнім часом (Present Perfect як правило вживається без зазначення часу виконання дії, тому, що в центрі уваги є результат дії, а не час її перебігу, часто з прислівниками: **never, ever, already, yet, not yet, so far, just, recently, lately**);
  e.g. *I have lost my debit card. I can't find it anywhere. You have done too many mistakes in your work. Olya says, she has read all of the books that appear in the recommended reference list of literature. What problems have you had with you IPhone 5 so far? Have you ever been in a laboratory before?*
- Дія, що розпочалася в минулому і все ще триває (з прийменниками since, for); або замість Present Perfect Continuous з дієсловами, що у тривалих часах не вживаються;
  e.g. *We have lived in the same house for ten years. I have known him since 1998.*
- Дія, що відбулася в період/проміжок часу, який ще досі триває:
  e.g. *I haven't seen Petro this morning. (it is still morning). I have already had four cups of coffee today (perhaps I shall have some more today or before today is finished)*

Past Perfect.

- Дія, що вже відбулася до певного моменту у минулому або завершилася раніше іншої минулої дії:
  e.g. *He had sent the reply before January 1st. When I came into the office, all employees had already gone.*

Future Perfect.

- Дія, що відбудеться до конкретно зазначеного моменту у майбутньому; дія, що завершиться раніше іншої майбутньої дії:

  e.g. He will have tested the new device by 3 p.m. tomorrow. I shall have finished my home assignment by the time you come.

Exercise 1. Translate the following sentences into English.

1. Я ще не подав документів для поступлення до університету. 2. Студент не здав екзамену до встановленого кінцевого терміну, тому він залишиться без стипендії. 3. Ви коли-небудь проводили такі експерименти? 4. Скільки завдань ви виконали від початку заняття? 5. Ми знайомі з 1991 р. 6. Які важливі зміни відбулися у Вашому житті відколи Вам виповнилося 25 років? 7. Поки група Міллера розпочне свій експеримент, ми вже матимемо свої перші результати. 8. Технології, про які ти говориш, науковці вже почали використовувати задовго до початку 21 століття. 9. Я думаю, що відправлю електронне повідомлення до того, як ти повернешся. 10. Насправді ви неправильно зрозуміли мою думку/позицію. 11. Після того як студенти здадуть усі екзамени, у них буде літня практика.12. Наша група ще не отримала студентських квитків. 13. Реакція (хімічна) завершилася так швидко як і розпочалася. 14. Перед тим як студенти почали виконувати завдання, викладач попросив усіх вимкнути мобільні телефони. 15. Однак вже до 2006 р. ціни на навчання зросли вдвічі. 16. Протягом минулого літа я побував у Парижі кілька разів.

Ex. 2. Past Simple vs Present Perfect. Translate into English taking into consideration time aspect and character of the actions.

1.Розробляючи прилад нового покоління, інженери взяли до уваги усі переваги і недоліки попередньої моделі. 2. З 2005 р. доцент Н. прийняв участь у 10 міжнародних і 7 всеукраїнських наукових конференціях. 3. Викладач щойно повідомив студентові, що той не недопущений до екзамену. 4. Ми вже місяць не проводили опитувань. 5. Минулого тижня ми підрахували наші витрати. 6. Я ніколи ще не бачив такого дива. 7. Ти зустрічався сьогодні з професором? Він дуже хоче тебе бачити. 8. За життя В. Вернадський написав велику кількість наукових праць. 9. Коли викладач увійшов до аудиторії, то побачив, що усі студенти порозходилися. 10. Коли розпочався експеримент?

Ex. 3. Translate the following sentences into English

I. 1. Як правило (студенти)-старшокурсники працюють над індивідуальними проектами. 2. Коли мій сусід навчався в університеті, він працював над

індивідуальним проектом. 3. Післязавтра я розпочну роботу над важливим науковим проектом.

II. 1. Зараз я працюю над складним проектом. 2. Вчора увесь день ми працювали над проектом. 3. Завтра в цей час він працюватиме над своїм проектом.

III. 1. Я вже завершив роботу над проектом. 2. Я встиг завершити свій науковий проект, перед тим як одружився. 3. Я вважаю, що завершу проект до кінця наступного року.

Ex. 4. Translate the following sentences into English

1. Перед тим як інженер випробовує новий пристрій, він завжди ретельно перевіряє роботу усіх вимірювальних приладів. 2. Перед тим як інженер випробував новий пристрій, він ретельно перевірив роботу усіх вимірювальних приладів 3. Науковий керівник запитав скільки експериментів я вже провів. 4. Повідомте нам результати дослідження як тільки ви їх отримаєте. 5. Мій товариш провалився на вступному іспиті. 6. У скількох конференція Ви взяли участь? 7. На сьогоднішній день комісія розглянула 20 заяв. 8. В якому році ти закінчив університет? 8. Я вже прочитав цю книгу. 9. Мій одногрупник читав цей роман коли навчався в школі. 10. Ми вже обговорили це питання. 11. Ми обговорювали це питання минулого тижня. 12. Ми докладемо багато зусиль для того, щоб завершити проект вчасно. 13. Зателефонуй мені пізніше, тому що зараз у мене заняття. 14. Якщо у мене вихідний, то, як правило, я проводжу його з родиною. 15. Заступник декана по виховній роботі буде проводити співбесіду зі студентами – іноземцями завтра з 12:00 по 13:00. 16. Збільшення кількості безробітних, як правило призводить до соціальної напруженості і росту злочинності. 17. Ми Вам надішлемо детальний аналіз/розбір роботи, як тільки розглянемо її. 18. Прем'єр міністр повідомив, що ціна на нафту зросте на 10 відсотків.19. Зараз я роздумую над зауваженнями, які дав мені науковий керівник. 20. Коли я повернувся, колеги все ще сперечалися як найкраще вирішити проблему.

Test. Active voice

1. Joseph Rotblat … part in the development of the first nuclear bomb during World War II.
a) take
b) took
c) has taken
d) will take

2. The computer … the fastest growing technology since the beginning of human history.
a) has been

b) have been
c) had been
d) will be

3. New techniques in agriculture … food in future.
a) will provide
b) provide
c) was providing
d) have provided

4. Scientists usually … technical problems better than ordinary people.
a) understands
b) are understanding
c) understand
d) understood

5. When we entered the conference hall, they …. the necessity of research.
a) are discussing
b) discuss
c) has discussed
d) were discussing

6. Many designers of radar … the atom before the war.
a) was exploring
b) explored
c) has explored
d) explores

7. Scientists sometimes … many problems in research.
a) face
b) faced
c) will face
d) had faced

8. I … in the laboratory yesterday.
a) will work
b) was working
c) worked
d) has worked

9. Modern distance education … around at least since the 1840s.
a) was

b) were
c) will be
d) has been

10. Nowadays science and technology gradually … an integral part of society.
a) are becoming
b) became
c) will become
d) had become

11. When a scientist conducts a research, he … the unknown.
a) had explored
b) explores
c) explored
d) will explore

12. Technology usually … people to complete more tasks in less time.
a) allowing
b) have allowed
c) allows
d) will allow

13. Our research … years of work in future.
a) takes
b) is taking
c) has taken
d) will take

14. The inventions of the transistor in the 1940s and the microprocessor in the early 1970s … the way for the personal computer.
a) opened
b) had opened
c) will open
d) opens

15. I … the information in the Internet at 2 o'clock yesterday.
a) has looked for
b) was looking for
c) looked for
d) will look for

16. At present the specialists of Research and Development department … a number of installations.
a) tests
b) are testing
c) had tested
d) tested

17. Research in industrial chemistry … a lot of materials up to now.
a) creates
b) will create
c) has created
d) had created

18. There … many developments in satellite technology for these years.
a) is
b) was
c) has been
d) have been

19. Many ancient civilizations … astronomical information long ago.
a) collected
b) will collect
c) have collected
d) are collecting

20. Some scientists believe that by the end of this century our life … completely digitized.
a) was
b) shall be
c) will have been
d) has been

21. At present many computer specialists … to create fifth-generation computers.
a) have worked
b) are working
c) worked
d) will work

22. Scientists … on atomic power for some time, before they invented the bomb.
a) was working
b) has worked
c) will work

d) had worked

23. At this time tomorrow morning they … the possibilities to begin a new project.
a) shall discuss
b) are discussing
c) will be discussing
d) have discussed

24. Since the Web was first introduced, the number of sites and search engines ... at an unbelievable rate.
a) have grown
b) is growing
c) shall grow
d) grow

25. Research scientists … on an interesting problem for obtaining power from atom now.
a) are working
b) has worked
c) worked
d) have work

26. The speaker just … the role of genetics in the development of medical science.
a) mentioned
b) has mentioned
c) mentions
d) have mentioned

27. They … these results last year.
a) received
b) has received
c) receive
d) receives

28. They always … to use the most efficient methods of research.
a) tries
b) try
c) has tried
d) was trying

29. He … his device a week ago.
a) was improving

b) had improved
c) improved
d) improves

30. He … his device before they examined the properties of the materials.
a) improves
b) will improve
c) has improved
d) had improved

31. Newton … the law of gravity in 1666.
a) establishes
b) had established
c) has established
d) established

32. Newton … his law of gravity by 1670.
a) have established
b) had established
c) establishes
d) will establish

33. My friend had prepared his report before we … to you.
a) spoke
b) are speaking
c) had spoken
d) have spoken

34. He … his report yesterday.
a) is preparing
b) prepares
c) prepared
d) had prepared

35. He … results of his research a month ago.
a) was publishing
b) have published
c) publishes
d) published

36. My friend already … the results of his discovery.
a) had published

b) has published
c) publishes
d) was publishing

37. He … the article before you spoke to me.
a) had translated
b) has translated
c) translates
d) is translating

38. He … the article by the time you come.
a) was translating
b) translates
c) will have translated
d) has translated

39 The explorers will have conducted a study of the Artic before the winter ….
a) has come
b) had come
c) came
d) comes

40. The scientists … plasma since the late 1920s.
a) have studied
b) has studied
c) study
d) was studying

41. The scientists … this problem before first plasma was produced.
a) didn't studied
b) hadn't studied
c) isn't studying
d) aren't studying

42. We just … the analysis of the mixture.
a) has finished
b) finishing
c) finished
d) have finished

43. Phosphorus … in the dark.
a) have shined

b) were shined
c) shines
d) shining

44. In 1669 the alchemist Hennig Brandt … phosphorus.
a) discovers
b) had discovered
c) discovered
d) will discover

45. The students usually … to the shop to practice mechanics.
a) go
b) goes
c) went
d) gone

46. We usually … thermometers to measure temperatures.
a) have used
b) uses
c) use
d) used

47. Scientists rarely … research outside the laboratory.
a) are conducting
b) had conducted
c) will conduct
d) conduct

48. As a rule a skilled engineer … Higher Mathematics.
a) shall know
b) knows
c) had known
d) known

49. Science and engineering sometimes … synthetic materials in the development of electronic instruments.
a) uses
b) use
c) is using
d) have used

50. Sometimes scientific inventions … fatal results.

a) is having
b) will have
c) has
d) have

A Noun

Особливості вживання у множині деяких іменників, що закінчуються на –s можна поділити на такі групи:

- іменники, що мають форму множини, але вживаються лише в однині:
  news, measles (кір), physics, linguistics, acoustics, mathematics, politics, statistics etc. (якщо подані іменники виступають в ролі підмета, то з дієсловом-присудком узгоджуються в однині: Politics **is**n't interesting for me. This branch of physics **is** difficult to understand)
- іменники, що мають форму множини, але вживаються в однині і множині
  gasworks (газовий завод), golf-links (поле для гри в гольф), headquarters (штаб, головний офіс), series (ряд, серія), species (вид, рід, порода), means (засіб, спосіб)
  Letters are the most common means of communication. Other means are telegram, telephone, telex, fax, e-mail, radio, television, newspapers, etc.
- іменники, що мають форму множини і вживаються тільки у множині. До таких іменників належать назви речей, предметів, що складаються із двох однакових частин:

binoculars – бінокль	***shorts – шорти***
braces – підтяжки	***tights – колготи***
glasses – окуляри	***pincers – щипці, кліщі***
pants, trousers – штани	***pliers – обценьки***
scales – ваги	***scissors – ножиці***

- слід відрізняти за значенням іменники, що мають тільки одну форму множини, від омонімічних іменників, що вживаються в однині і множині:

Іменники, що мають форми однини і множини		**Іменники, що мають тільки множину**
A clolour – колір –	colours	colours – прапори
A force – сила –	forces	forces – армія
A custom – звичай –	customs	customs – мито, митниця
A draught – протяг –	draughts	draughts – шашки
A glass – шклянка –	glasses	glasses – окуляри
A minute – хвилина –	minutes	minutes – протокол
A damage – пошкодження –	damages	damages – збитки

Множина літер і сполучників, що вживаються у значенні іменника

- якщо літера або сполучник вживаються як окреме слово у значенні іменника, то вони утворюють множину додаванням **s** з апострофом **('s):** His **k's** look like **h's.** His speech was full of **if's** and **but's**.

Множина збірних іменників

- деякі збірні іменники мають тільки форму однини і у функції підмета узгоджуються із дієсловом-присудком в однині: **peasantry (селянство) , aristocracy, bourgeoisie (буржуазія)**: Ukrainian peasantry hopes for state subsidies.
- деякі збірні іменники мають тільки форму однини, а у ролі підмета узгоджуються з дієсловом-присудком як в однині, так і в множині: **clergy (духовенство), gentry (дворянство), youth (молодь): The youth** of today **is/are** trying to adapt **itself/themselves** to rapidly changing circumstances.
- інші збірні іменники **cattle, people, police, vermin (шкідники)** мають форму однини, а в ролі підмета узгоджуються із дієсловом-присудком у множині: These people are waiting for their passports. Vermin are harmful animals or insects. Іменник **people** у значенні **нація, народ, раса** має форму однини і множини: Indigenous peoples are ethnic minorities who have been marginalized as their historical territories became part of a state. A people has its own tradition.

- Іменники, що означають групу людей як певний колектив, мають форму однини і множини:

a family	сім'я	families
a group	група	groups
a crew	екіпаж, бригада	crews
a committee	комітет	committees
a delegation	делегація	delegations
a government	уряд	governments
a team	команда	teams
a board	правління, рада	boards
a staff	штат працівників	staffs

Особливість цих іменників полягає в тому, що вони можуть означати:
А) групу людей як одне ціле, як один колектив і у ролі підмета узгоджуватися з дієсловом-присудком в однині: *Our team plays better on its own ground. His family is well-known in the town.*

Б) окремих членів колективу і у ролі підмета узгоджуватися з дієсловом-присудком в множині: *The team are resting now. (Команда зараз відпочиває (тобто відпочиває кожен член команди)).*

Ex. 1. Translate the following sentence into English.
1. Відсутність новин – теж новина. 2. Газета – один із ефективних засобів масової інформації. 3. Професор Массачусетського технологічного інституту О'Браєн проведе серію лекцій про впровадження новітніх інформаційних технологій в медицину. 4. Бінокль – це хороший оптичний прилад і засіб спостереження за метеоритами, траєкторія яких перетинається із орбітою Землі. 5. Цього року заробітки (надходження, earnings) від експорту послуг знизилися на 10%. 6.

Природні ресурси – це однорідні складові природи, що є елементами екосистеми і придатні для задоволення певних потреб людини. 7. Стежте за тим, щоб у рівняннях були чітко написані плюси та ікси. 8. У вашій презентації, в основному, переважали такі слова і вирази як «скажімо так», «тобто», «ну» та інші слова-паразити (filler-words). 9. If if's and but's were candy and nuts (try to translate this proverb). 10. Ці люди чекають на результати вступних випробувань. 11. кожна нація має свої звичаї і традиції. 12. Знімальній групі часто доводиться вести репортаж із «гарячих» місць. 13. Команда науковців зараз обговорює стратегію подальших досліджень. 14. Сучасна молодь, окрім аквапарків, 3D кінопалаців, ресторанів, нічних клубів, барів, розважальних центрів, пейнтбольних клубів, інтернет кафе, казино, саун, не має більше куди піти і чим зайнятися.

Test. NOUNS

1. The row of … to your right contains all the books you may need while preparing for your exam.

a) shelves
b) shelfs
c) shelf
d) shelfes

2. My … diploma paper is almost finished, but he still has some problems to solve.

a) class-mate
b) class-mate's
c) class-mates'
d) class-mates's

3. How many … do you usually have?

a) class
b) class's
c) class'
d) classes

4. Many famous researchers sacrificed their … in the name of science.

a) lifes
b) life
c) lives
d) life's

5. Many … ask difficult questions during the examination to find out how well the students are prepared.

a) teacher
b) teachers
c) teacher's

d) teacheres

6. Have your … already submitted their course papers?
a) class-mates
b) classes-mates
c) class'-mates
d) class-mate

7. Numerous … inventions were recognized only after their death.
a) scientists
b) scientists'
c) scientist's
d) scientists's

8. There are career … that seem difficult at first, but in the end they turn out to be the most rewarding.
a) paths
b) path
c) path's
d) pathes

9. I usually try to follow my … advice when studying for my exams.
a) teacher
b) teacher'
c) teachers's
d) teacher's

10. Good … of mathematics is a key to success in many branches of research.
a) knowledges
b) knowledge's
c) knowledge
d) knowledges'

11. In this book you can find a lot of interesting … to use in your diploma paper.
a) informations
b) information
c) informatia
d) informationes

12. Famous … are often laughed at by their contemporaries.
a) inventors
b) inventor
c) inventories
d) inventors'

13. Your … in this field of study is impressing; I think you really deserve this scholarship.
a) progresses
b) progress’
c) progresses’
d) progress

14. The … of your research paper are good, but you should work more on its structure.
a) contents
b) contentes
c) content
d) contents’

15. A lot of … is needed to make hydroelectric power stations work.
a) waters
b) water
c) water’s
d) waters’

16. It was a common mistake found in almost all … works by the teacher.
a) students’
b) students’s
c) studentes
d) student’

17. Young specialists usually have low ….
a) wage
b) wagees
c) wages
d) wages’

18. I have a great … , according to the results of entrance exams I am admitted to the university!
a) new
b) new’s
c) newes
d) news

19. … all over the world experience difficulties in the times of economic crises.
a) Industry
b) Industrys
c) Industries
d) Industrees

20. Usual … policy is to grant scholarships to good students.
a) universities's
b) universities'
c) universitys
d) university'

21. One of the … in this room hasn't passed the last test.
a) student
b) students
c) student's
d) studentes

22. I am sure John can lead this scientific project; he is the … for the job!
a) man
b) men
c) mans
d) mens

23. A … absence can seriously influence your semester grade.
a) months
b) month
c) month's
d) monthes

24. Technology has always been a male field, but today more and more … appear to compete for jobs in the field of engineering.
a) woman
b) women
c) womens
d) womanes

25. This … losses are considerable; the production levels grow lower every year.
a) branch
b) branches
c) branch'
d) branch's

26. Talk to Mr. Johnson, he can give you a lot of useful … on how to write scientific papers.
a) advice
b) advices
c) advicees
d) advice's

27. Have you considered many … before deciding to enter this one?

a) university
b) universitys
c) universities
d) university's

28. … is said to be difficult, but I find it rather exciting.
a) Physic
b) Physices
c) Physics
d) Physic's

29. … are set up in order to enable scientists to test their inventions.
a) Laboratories
b) Laboratorys
c) Laboratory
d) Laboratory's

30. I always forget to return … textbook to the library, I should really do it tomorrow.
a) Jack
b) Jack's
c) Jacks
d) Jacks'

31. Unfortunately many students dislike studying by …
a) themself
b) themselfs
c) themselve
d) themselves

32. A … students have signed up for this lecture, because it is given by a famous professor.
a) dozen
b) dozens
c) dozenes
d) dozen's

33. … industry needs sound modernization in order to be able to compete at the international market.
a) Ukraine's
b) Ukraines
c) Ukraine
d) Ukraines'

34. One of the … we chose this subject is that it is very promising as far as the future development of technology is concerned.
a) reasons
b) reason
c) reasones
d) reasons'

35. The tuition fee for your university studies is a lot of …, you should make as much use of it as possible.
a) moneys
b) money
c) moneies
d) money's

36. In many … engineering profession is passed on from one generation to another.
a) family
b) familys
c) families
d) family's

37. Jack's project is considered the best among this … scientific projects.
a) year
b) year's
c) years
d) yeares

38. According to the scientists, the … orbit should be increased to diminish the increasing brightness of the Sun.
a) Earth
b) Earths
c) Earthes
d) Earth's

39. Western … constantly increase the financing of their research projects.
a) country
b) countries
c) countrys
d) countrees

40. The … proposals are intended to support scientific research in our country.
a) government's
b) governments
c) governmentes
d) governmentes'

41. Have you heard about this … works before? He is said to be one of the most talented researchers in this field.
a) professor
b) professors
c) professor's
d) professors'

42. We are working on an integrated diploma paper and the only thing that we still have to do is to unite the two … into one work.
a) halfs
b) half
c) halves
d) halvs

43. The … at the scientific competitions are usually very strict.
a) jury
b) jurys
c) jurees
d) juries

44. Mechanics is one of the most important engineering ….
a) specialty
b) specialties
c) specialty'
d) specialties'

45. Many … hypotheses are disproved when tested in the laboratories.
a) researcherses
b) researchers's
c) researchers'
d) researcher'

46. Industrial designers create attractive looking … in order to increase sales.
a) good
b) goods
c) good's
d) goods'

47. It takes many … and even years before the newly invented mechanism can be produced.
a) months
b) month
c) monthes
d) month's

48. How can you describe this … contents?
a) articles'
b) articles’s
c) article’s
d) article’

49. Many talented … participated in this competition but only three of them won grants.
a) scientists
b) scientist
c) scientistes
d) scientist’s

50. Some … present here are already working on their next thesis.
a) doctor of philosophies
b) doctors of philosophy
c) doctors of philosophies
d) doctor of philosophies’

Conditionals

тип	**Характер і час перебігу дії**	**Підрядне речення If clause,**	**Головне речення Main/result clause**
0	дія реальна, закономірна, описує загальновідомі факти, загальні істини, закони природи	Present Simple (Continuous/Perfect)	Present Simple
1	дія реальна, характеризує можливі, ймовірні ситуації у майбутньому	Present Simple (Continuous/Perfect)	Future Simple can, may(might)
2	дія напівреальна або нереальна, описує малоймовірні, нереальні ситуації у теперішньому і майбутньому	Past Simple Past Continuous	would + simple form (would complete) could, might
3	нереальна дія, яка могла б за певних умов відбутися у минулому, але не відбулася	Past Perfect	would + perfect form (would completed) could/might+perfect form

Examples:

0. If I have enough time, I watch evening TV news once in a while.
1. If I have enough time, I will watch evening TV news later on tonight.
2. If I had enough time, I would watch evening TV news now or later on.

3. If I had had enough time, I would have watched evening TV news yesterday.

More examples:
0. When you fly budget airline, you have to pay for your drinks and snacks. If unemployment is rising, people tend to stay in their present jobs. When I'm concentrating, please don't make so much noise. When I've finished an article, I always ask Kate to read it through. It's bad luck if the groom sees the bride before the wedding! Ice melts if it is heated. If I am driving, I never answer my cell phone. If you drop an apple, it falls.
1. What will you do if you miss the plane? If you drop that glass, it might break. If he's feeling better, he'll come. If she hasn't heard the bad news yet, I'll tell her. If you want better grades, you must work harder.
2. If I had more time, I would help you. If she were happy in her job, she wouldn't be looking for another one. If I was the President, I would reduce taxes. If I spoke to him directly, I might be able to persuade him.
3. If I had worked harder, I would have passed my exam. If we had known you were coming, we would have organized a meeting. If I studied harder, I could/might have passed my exam. If I had paid more attention in class, I would have understood the lesson.

- If I were you/her/him, I would+simple: (На твоєму/вашому/її/його місці я би …)

If I were you, I would apply some other methods. If I were him, would take another try.

- Інколи ***if*** можна упускати, однак змінюється порядок слів у підрядному реченні:

Were I you, I would take it easy. Had I known, I would have told you. Should anyone call, please take the message. Should you start the engine, the indicator light must go off. Should you need my advice, contact me anytime.

- Інколи ***if*** можна замінити схожими за змістом виразами: assuming (that), on condition (that), provided (that), providing (that), supposing (that), unless, in case of

  Assuming I can get all my homework done in time, you can use my computer this afternoon. "Supposing you couldn't find a parking space in town, would you park in a private car park?" – "Yes, I would. Providing I wasn't going to be too long". You could have gone through Minsk, provided you have obtained a visa in advance. Unless the directors increased sales, we would have to close this shop. In case of fire, leave the room. I need painkillers, in case I am in severe pain.

- I wish I (past simple) – виражає нездійсненне бажання у теперішньому/майбутньому часі (якби тільки) I wish I had better command of English. Does he wish he lived in Chicago?

- I wish I (past perfect – нездійсненне бажання стосовно минулого часу
  I wished I had stayed in France a little bit longer. I wish I had passed that exam.

Ex. 1. Translate the following sentences into English.

1. Якби у мене була така друга можливість, я б скористався нею. 2. Якби ви були уважнішим на занятті, то б знали відповідь на це запитання. 3. Якби мій одногрупник провів більше часу з підручниками, то він звичайно б здав свій екзамен. 4. Якщо ти не скористаєшся цією нагодою, то другої (в тебе) може не бути. 5. Якщо ви залишитесь ще на декілька днів, то зможете прийняти участь у семінарі присвяченому проблемам захисту довкілля. 6. Якби Ви були студентом денної форми навчання, ми б запропонували Вам широкий вибір цікавих програм практики на літній період. 7. Якщо ми укладемо договір і підпишемо низку угод з нашими іноземними партнерами, то отримаємо перевагу над нашими конкурентами. 8. Якщо ви звершите проект вчасно (в термін), то отримаєте премію. 9. Якщо б хтось телефонував, передайте, що я на засіданні ради факультету. 10. Якби ти застосував найсучасніші методи, що їх використали наші колеги-іноземці, то б отримав точніші результати. 11. На вашому місці я б не дуже довіряв інформації з Інтернет ресурсів. 12. На яку висоту підніметься тіло, якщо його кинути вгору з такою ж самою швидкістю з поверхні Місяця? 13. Якщо у мене вихідний, я зазвичай його проводжу із сім'єю. 14. Тіло масою 2 кг падає з висоти 5 м і занурюється в сніг на 50 см. Знайдіть середню силу опору снігу, якщо середня сила опору повітря 4 Н. 15. Якби то подав заявку вчасно, тебе б запросили на співбесіду.

Ex. 2. Translate the following sentences into English.

1. На Вашому місці я б порадився з куратором. 2. Якщо раптом у Вас виникнуть запитання стосовно нашої співпраці – звертайтесь в Міжнародний відділ. 3. Ви не будете допущені до екзамену, поки не наберете 45 балів (unless). 4. В цю лабораторію не можна заходити, якщо у вас немає спеціального дозволу (unless). 5. Думаю, що ознайомче заняття можна провести в аудиторії 22. Якщо ж слухачів буде більше ніж ми сподівалися, то можна перейти в лекційну залу. 6. Якби староста групи повідомив, що студентські квитки потрібно було забрати (отримати) особисто, то ми б, звичайно, зробили це. 7. Якщо ви успішно складете усі екзамени, то літні канікули у вас швидше. 8. Якщо студент вчасно здає індивідуальне завдання, то отримує додаткові 5 балів. 9. Ви не зможете продовжувати курс, якщо не наберете N балів. 10. Ви зможете відповідати на запитання поки не закінчиться час на його виконання. 11. Ти б мені допоміг із написанням резюме? – Я б допоміг, якщо б міг, але не можу. 12. На твоєму місці я б не гаяв часу, а одразу б почав доводити дисертацію/курсову/дипломну до кінцевого варіанту.

CONDITIONALS TEST

1. If the engineer had been informed of the results before, he … you to repeat the test.
a) would have allowed
b) would allow
c) will allow
d) allow

2. If the students … more careful, they wouldn't have broken the new apparatus.
a) were
b) have been
c) had been
d) are

3. If the books on that subject … available in our library, I would be able to make a good report.
a) were
b) are
c) have been
d) had been

4. If they … all the necessary equipment, they will be able to carry out their experiment.
a) will receive
b) received
c) receive
d) have received

5. It … impossible to send up sputniks unless the laws governing the motion of planets had been studied.
a) will be
b) would have been
c) would be
d) were

6. If all the people of the world … the atoms in a drop of water, they would not be able to finish their work even in ten thousand years.
a) counted
b) have counted
c) will count
d) should count

7. .If the air molecules … stationary, we should expect the smoke particles to be stationary too.
a) are
b) were

c) have been
d) was

8. We won't have the necessary skills to deliver R&D if we … more students to study Aerospace technology.
a) don't encourage
b) didn't encourage
c) doesn't encourage
d) will not encourage

9. I think there will be many changes to the design before it … manufactured.
a) is
b) was
c) will be
d) were

10. Unless we have more skilled software engineers, we … problems developing new programs.
a) have
b) had
c) will have
d) would have

11. Unless the aircraft … a slower approach, there will be too much noise.
a) made
b) makes
c) will make
d) would make

12. If safety measures …, the accident would never have happened.
a) were followed
b) will be followed
c) will follow
d) had been followed

13. If rubber is cooled to -200° C, it … brittle and will break.
a) became
b) will become
c) becomes
d) would become

14. If all vehicles were fitted with a catalytic converter, there … less pollution.

a) would be
b) will be

c) were
d) would have been

15. If we had known the weather was going to be this bad, we … the start of the project.
a) will delay
b) delayed
c) would have delayed
d) would delay

16. If your report dealt with urgent problems of engineering, you … a diploma.
a) will be awarded
b) would be awarded
c) would have been awarded
d) awarded

17. If one knows the dimensions of the body he … easily its volume.
a) would have calculated
b) would calculate
c) will calculate
d) calculated

18. If we … some work, we can do the job faster.
a) will outsource
b) would outsource
c) outsourced
d) outsource

19. If we … the cheaper materials, we won't meet the specs.
a) would use
b) use
c) will use
d) used

20. If graduates maintained close contacts with leading research institutions, they ... modern methods of scientific research.
a) learned
b) will learn
c) would learn
d) would have learned

21. If he … the specific heat and the weight of the substance, he would have calculated its thermal capacity.

a) knew
b) know

c) knowed
d) had known

22. .If there were no sunshine, the world would … no sources of power for running machinery.
a) have
b) had
c) have had
d) had had

23. If the problem of this kind was so absurd, the men of science … take such deep interest in its solution.
a) would not
b) was not
c) will not
d) were not

24. If the researches … reliable information on the subject, they would have proved their hypothesis.
a) possessed
b) would possess
c) had possessed
d) will possess

25. If people realize the environmental advantages of modern vehicles they … happy to finance their implementation.
a) be
b) will be
c) are
d) is

26. If you bend or stretch the material it … back to its original shape.
a) go
b) went
c) was going
d) will go

27. If you don't close the valve, the system….
a) overheated
b) had overheated
c) will overheat
d) would overheat

28. If you … my advice it would never have happened.
a) had followed

b) followed
c) will follow
d) follows

29. If the students … harder they would be able to participate in the international conferences.
a) studies
b) study
c) will study
d) studied

30. If you showed better results you … for a scholarship.
a) would apply
b) apply
c) applied
d) will aply

31. If we … good results, the reinforced plastics will be used in this car.
a) obtained
b) obtains
c) obtain
d) have obtained

32. You … better results if you work hard next term.
a) achieve
b) will achieve
c) achieved
d) achieves

33. If students … to become academics and perhaps teach in a university, then they will work for a higher degree, a Doctor of Philosophy (PhD).
a) wished
b) wishes
c) would wish
d) wish

34. You … more opportunities to get an interesting job if you took part in the research activity.
a) would have
b) will have
c) had
d) have

35. If I … enough money, I would buy a high-performance computer.
a) have

b) will have
c) had
d) had had

36. If you … the Internet, you will have access to the latest news.
a) joined
b) join
c) will join
d) joins

37. If you had been at the lecture, you … a lot about modern production technologies.
a) will learn
b) learned
c) would learn
d) would have learned

38. If I … Java Script, I would have got that job.
a) knew
b) had known
c) know
d) will know

39. If you participate in the work of student society, you … in your future career.
a) succeed
b) would succeed
c) will succeed
d) succeeded

40. If there … not programming languages, communication with computers would be impossible.
a) were
b) is
c) will be
d) are

41. If you hadn't forgotten the password, you … so much time yesterday.
a) will spend
b) spend
c) spent
d) wouldn't have spent

42. If I have spare time in summer, I … some foreign language.
a) would learn
b) will learn

c) would have learnt
d) learned

43. If you … the paper in time, you will get a “poor” mark.
a) didn’t submit
b) don’t submit
c) won’t submit
d) hadn’t submitted

44. If you paid more attention to this subject at school, you … with ease at the university.
a) will learn
b) learn
c) would learn
d) learned

45. If we … more accurate method in this experiment yesterday, we would have obtained better results.
a) used
b) had used
c) will use
d) use

46. You could answer the questions better if you … more thoroughly.
a) prepared
b) prepare
c) had prepared
d) will prepare

47. It would be convenient if special machines … available.
a) is
b) were
c) will be
d) had been

48. The students … more satisfied with the course if it had been illustrated with the videos.
a) would be
b) will be
c) be
d) would have been

49. Students will be awarded diplomas when they … their education.
a) completed
b) complete

c) completes
d) would complete

50. If you … to get a Master degree, you have to pass an English exam.
a) want
b) wanted
c) will want
d) wants

The Passive Voice

	Simple			Continuous			Perfect			Main verb
	present	*past*	*future*	*present*	*past*	*f*	*present*	*past*	*future*	
I	am	was	will be	am being	was being	-	have been	had been	will have been	asked
You	are	were	will be	are being	were being	-	have been	had been	will have been	asked
He, she, it	is	was	will be	is being	was being	-	has been	had been	will have been	asked
We	are	were	will be	are being	were being	-	have been	had been	will have been	asked
You	are	were	will be	are being	were being	-	have been	had been	will have been	asked
They	are	were	will be	are being	were being	-	have been	had been	will have been	asked

	ACTIVE			PASSIVE			
Present Simple	A student	**does**	his home task.	The home task	**is**	**done**	by a student.
Present Contin.	A student	**is doing**	his home task.	The home task	**is being**	**done**	by a student.
Present Perfect	A student	**has done**	his home task.	The home task	**has been**	**done**	by a student.
Past Simple	A student	**did**	his home task.	The home task	**was**	**done**	by a student.

Past Contin.	A student	**was doing**	his home task.		The home task	**was being**	**done**	by a student.	
Past Perfect	A student	**had done**	his home task.		The home task	**had been**	**done**	by a student.	
Future Simple	A student	**will do**	his home task.		The home task	**will be**	**done**	by a student.	
Future Perfect	A student	**will have done**	his home task.		The home task	**will have been**	**done**	by a student.	

Ex. 1. Translate the following sentences into English.

1. Ці прилади виготовлені в Китаї. 2. Робоча програма з дисципліни «Основи макроекономіки» була затверджена на засіданні кафедри 23 травня 2012 р. 3. Новий корпус буде збудовано до 2015 р. 4. Розклад екзаменів ще не складено. 5. На екзамені мені ставили багато додаткових запитань. 6. Англійською мовою розмовляють в усьому світі. 7. Приблизно 120 туристів відвідують Музей Ван Гога щодня. 8. Коли я повернувся у зал засідань, питання щодо отримання подвійних дипломів все ще обговорювали. 9. Коли депутат прокнувся, закон вже прийняли. 10. Скільки студентів зараховані на денну форму навчання? 11. Коли ми прибули в аеропорт, то дізналися, що рейс було скасовано.

Test. PASSIVE VOICE

1. By 8 o'clock all the experiments … .
a) will have been conducted
b) will have been conduct
c) will have being conducted
d) will have been conducting

2. The majority of valves … with tiny transistors already.
a) have been replace
b) have been replaced
c) had been replaced
d) have be replaced

3. By the middle of the 19th century about 60 elements … .
a) has been discovered
b) have been discovered
c) had been discovered
d) will have been discovered

4. A further progress … in microwave systems recently.
a) have been made
b) had been made
c) has been make
d) has been made

5. New equipment … in our shop when the designer returned to the plan.
a) had been installed
b) has been installed
c) have been installed
d) had be installed

6. By the end of the next week all the experiments … by the students.
a) shall have been conducted
b) will have been conducted
c) have been conducted
d) had been conducted

7. By the end of the year a large variety of semiconductor devices … .
a) shall have been produced
b) have been produced
c) will have been produced
d) has been produced

8. Heat is radiated by the Sun to the Earth, but the land, the sea, and the air … differently by this radiation.
a) affected
b) affect
c) are affecting
d) are affected

9. The positive particle in the nucleus … the name of the “proton”.
a) was given
b) given
c) were given
d) giving

10. We … a number of experiments illustrating the presence of high-energy particles in the cosmic radiation.
a) was shown
b) were shown
c) has shown
d) shown

11. The scientists of the world … with the problem of interplanetary flights.
a) confronts
b) is confronted
c) are confronted
d) are confront

12. The modern scientific forecasts of weather … upon.
a) was be fully relied
b) can be fully rely
c) can to be fully relied
d) can be fully relied

13. Light … of as some factor that is capable of affecting the eye.
a) may be thought
b) may to be thought
c) may be think
d) may been thought

14. The neutron … by a magnetic field.
a) are completely unaffected
b) is completely unaffected
c) is completely unaffecting
d) are completely unaffecting

15. The theory which K.Tsiolkovsky arrived at … on experimental work.
a) were based
b) will base
c) was based
d) base

16. We live at the bottom of an ocean of air, and our lives … by the change and movement of this gas.
a) is constantly influenced
b) are constantly influence
c) are constantly influenceing
d) are constantly influenced

17. This valve seat is made of cast iron; it … with a powder of many elements.
a) is being alloyed
b) are being alloyed
c) is being alloying
d) is be alloyed

18. Lasers … also widely … in drilling the diamonds employed as dies for drawing wire.
a) are used
b) are used
c) is used
d) has used

19. The liquid … then … by a jet of covering gas.

a) is removing
b) are removed
c) is removed
d) are removing

20. The molten material … above the outer surface by the pressure of the super-heated vapor.
a) are lifted
b) is lifting
c) lifted
d) is lifted

21. It is expected that the results of our research … in chemical industry in the future.
a) will be applied
b) be applied
c) is applied
d) are applied

22. This problem … in the nearest future.
a) be solved
b) will be solved
c) will solved
d) will solve

23. He found that this effect … by some unknown subatomic particles.
a) has been caused
b) have been caused
c) had been caused
d) has been causing

24. In the nearest future the electricity … mainly from solar energy.
a) is generated
b) are generated
c) was generated
d) will be generated

25. Hydroelectric stations … on several stations now.
a) are being built
b) is being built
c) was being built
d) were being built

26. He … in computers since his childhood.
a) has been interested
b) were interested

c) have been interested
d) is interested

27. The positive results … until a more powerful apparatus was installed.
a) hasn't been obtained
b) hadn't been obtained
c) wasn't obtained
d) weren't obtained

28. The explanation of these strange facts … yet.
a) haven't been furnished
b) weren't furnished
c) hasn't been furnished
d) have furnished

29. He … a very interesting job at the institute.
a) are offered
b) were offered
c) will offered
d) has been offered

30. All necessary information … in the computer.
a) are being stored
b) is being stored
c) are stored
d) were stored

31. What substance … to the solution?
a) are added
b) be added
c) must be added
d) must added

32. The problem of the future of human civilization on the Earth … by the scientists throughout the world.
a) are being steadily researched
b) is being steadily researched
c) being steadily researched
d) is being steadily research

33. In general, organic coatings … for protecting structures and machines.
a) is used
b) are used
c) are use
d) are using

34. The new plastics … as insulators in electrical and electronic circuits.
a) will be mainly used
b) will be mainly use
c) will have used
d) will use

35. Polymers … for different purposes and new applications are being constantly developed.
a) are now been used
b) are now be used
c) is now being used
d) are now being used

36. Today plastics … to replace metals for certain applications.
a) have been use
b) has been used
c) have been used
d) had been used

37. When the engineers returned to the plant a year later new advanced technological processes … for producing synthetic leather.
a) have been used
b) has been used
c) had used
d) had been used

38. Many operations which were formerly performed by skilled workers … by computers.
a) are now being performed
b) are now perform
c) is now being performed
d) are now been performed

39. The translation from one language into another … by the computers.
a) will soon been performed
b) will soon be performed
c) will soon be perform
d) will soon being perform

40. When you return all mathematical calculations … by means of the electronic computing machine.
a) will have been performed
b) will have been perform
c) will had been performed

d) has been performed

41. At present a great number of transistors … by our industry.
a) is produced
b) are being produced
c) is being produced
d) were being produced

42. The process of separating metals from their ores … for a long time.
a) were being used
b) was being use
c) being used
d) was being used

43. Plastic metals … for home construction for a long time
a) was being used
b) were being used
c) will being used
d) were being use

44. Video card ... into your computer to make the graphics more pleasurable to the eye.
a) is inserted
b) is insert
c) are inserted
d) inserted

45. Ram means small pieces of hardware that … to help increase speed and performance.
a) can be upgraded
b) can to be upgraded
c) can being upgraded
d) can upgraded

46. Students speak much of the new device which … for measuring pressure.
a) is use
b) used
c) are used
d) is used

47. Much research work in pure and applied science … in our new laboratory during the next semester.
a) will been carried out
b) will carried out
c) will be carried out
d) will be carry out

48. Our new physical laboratory … next week.
a) will been opened
b) were be opened
c) will be opened
d) will be open

49. Our new physical laboratory … for conducting scientific experiments including physical and chemical processes.
a) is fit up
b) is fitted up
c) are fitted up
d) were fitted up

50. The application of scientific principles in testing and analyses … in the laboratory.
a) are studied
b) is studied
c) have studied
d) is study

Final test

1. If you have any ideas or suggestions, please feel free to … them … and they'll be given our full consideration.

a) set … aback	b) put … forward	c) put … for	d) draw … out

2. I intend to … a series of experiments.

a) carry out	b) carry on	c) carry in	d) carry off

3. The International Commission of Inquiry into the 1932–1933 Famine in Ukraine was … in 1984 and was initiated by the World Congress of Free Ukrainians to study and investigate the 1932-1933 Famine in Ukraine.

a) set on	b) set in	c) set out	d) set up

4. You can only … an assignment once, so make sure it is the final copy.

a) transmit	b) submit	c) commit	d) remit

5. Many articles have been published … of global warming.

a) in the subject	b) of the subject	c) on the object	d) on the subject

6. The article … the problem of light pollution.

a) addresses	b) deals	c) conceals	d) has

7. She has a remarkably good … Japanese

a) knowing	b) speaking	c) command of	d) reputation of

8. Please … your statement with reasonable and powerful arguments.

a) report	b) support	c) develop	d) assess

9. Low birth rate may … the decrease in the number of applicants to higher educational establishments in Ukraine.

a) tell for	b) speak for	c) account for	d) report for

10. My father-in-law, a beemaster, … a series of experiments investigating how bees communicate.

a) set in	b) set out	c) set up	d) set for

11. The book … the number of studies carried out during the 2000s.

a) is based on	b) is set up on	c) is based in	d) biased on

12. Prof. Wichtig delivered a lecture … globalization.

a) on the problem of	b) on the theme about	c) on the topic about	d) on the issue of

13. The speaker … to the fact that the economy started to improve.

a) drew intention	b) pulled attention	c) captured attention	d) drew attention

14. The … this paper is to investigate the properties and behaviour of this material under severe artic conditions.

a) aid of	b) scope of	c) aim of	d) summary of

15. After years of hard research work he managed to develop his own theory … .

a) at the end	b) finally	c) lastly	d) at last

16. First, I outline the scope of the problem, then I provide a brief review of the latest studies, and, … , I deal with the problem applying different methods and techniques. In the end I draw a conclusion on the results obtained.

a) at last	b) lastly	c) lately	d) recently

17. Your argument lacks… .

a) heavy evidence	b) hard evidence	c) strict facts	d) severe evidence

18. Under no circumstances … be allowed to defer the submission of their graduation theses longer than one month.

a) students will	b) students' will	c) will students	d) will students'

19. Both Dragomanov and Ilnytskyi studied the problem. The … wrote a book; the … published three papers.

a) one, … two	b) former, … later	c) first, … last	d)former, … latter

20. The political arguments concerning emigration movement are … of this essay.

a) beyond imagination	b) beyond the scope	c) behind the scope	d)below the scope

TASK 2. Choose the correct variant.

1. Joseph Rotblat … part in the development of the first nuclear bomb during World War II.
a) takes
b) took
c) has taken
d) will take

2. Scientists usually … technical problems better than ordinary people.
a) understands
b) will understand
c) understand
d) understood

3. Agricultural machines are used … crops.
a) cultivate
b) to have cultivated
c) for cultivating
d) to cultivating

4. The trial run of a new automated production line is expected … in September.
a) to hold
b) to be held
c) be held
d) to have been held

5. Many revolutionary technologies … by the end of the 21st century.
a) have developed
b) had been developed
c) developed
d) will be developing

6. "… you ever … with this type of machines?"
"Unfortunately, I don't have any previous experience."

a) had … worked
b) has … worked
c) have … worked
d) will … work

7. I …any scientific articles since I graduated from the university, but I find this one really interesting.
a) hasn't read
b) didn't read
c) haven't read
d) hadn't read

8. This technology … any practical application so far, but we find it very promising in terms of hardware production.
a) will not have
b) don't have
c) hasn't had
d) didn't have

9. This method is highly efficient, but that one is even ….
a) better
b) the gooder
c) the best
d) good

10. The more aluminium bends, the … it breaks.
a) the quickest
b) quicker
c) the most quicker
d) the more quicker

11. Nanotechnology … lately become one of the fastest developing areas of research.
a) has
b) is
c) are
d) was

12. As part of cultural evolution, science … be allowed to develop freely.
a) must
b) had to
c) was able
d) might

13. FORTRAN was one of the first programming languages in which the programmer does not … deal with 0s and 1s.

a) had
b) have to
c) have
d) may

14. You … send an e-mail unless you are connected to the Internet.
a) may not
b) cannot
c) must not
d) should not

15. “Where was Alex yesterday?” – “Have no idea; he … in the library”
a) must have been
b) might have been
c) can be
d) might be

16. You … my advice. Why didn’t you do so?
a) should follow
b) have to
c) should have followed
d) could have followed

17. My brother admitted that he … fix the engine himself.
a) can’t
b) hadn’t
c) couldn't
d) may not

18. He said that the equipment necessary for his further research … in two days.
a) will be delivered
b) is to be delivered
c) would be delivered
d) will have been delivered

19. He knew that metals … electricity.
a) conduct
b) conducted
c) will conduct
d) has conducted

20. The student couldn’t do his research on the subject he was interested in, as a similar work … a year before.
a) is written
b) wrote

c) would be written
d) had been written

21. If all the people of the world … the atoms in a drop of water, they would not be able to finish their work even in ten thousand years.
a) counted
b) have counted
c) will count
d) should count

22. Unless we have more skilled software engineers, we … problems in developing new programs.
a) have
b) had
c) will have
d) would have

23. If safety measures …, the accident would never have happened.
a) were followed
b) will be followed
c) will follow
d) had been followed

24. If you don't close the valve, the system….
a) overheated
b) had overheated
c) will overheat
d) would overheat

25. If you had been on the lecture, you … a lot about modern production technologies.
a) will learn
b) learned
c) would learn
d) would have learned

26. Many famous researchers sacrificed their … in the name of science.
a) lifes
b) life
c) lives
d) life's

27. Numerous … inventions were recognized only after their death.
a) scientists

b) scientists’
c) scientist’s
d) scientists’s

28. Good … of mathematics is a key to success in many branches of research.
a) knowledges
b) knowledge’s
c) knowledge
d) knowledges’

29. I have a great … , according to the results of entrance exams I am admitted to the university!
a) new
b) new’s
c) newes
d) news

30. Industrial designers create attractive looking … in order to increase sales.
a) good
b) goods
c) good’s
d) goods’

31. He found that this effect … by some unknown subatomic particles.
a) has been caused
b) have been caused
c) had been caused
d) has been causing

32. I can’t come to the meeting without … .
a) invited
b) been invited
c) being invited
d) be invited

33. I seem … the invitation card. I have been looking for it for hours.
a) to misplace
b) to have misplace
c) to have been misplaced
d) to have misplaced

34. I got used … alone.
a) of working
b) to working
c) in working

d) at working

35. This may result … the distorted vision.
a) in obtaining
b) in obtain
c) on obtaining
d) at obtaining

Part III. Home reading.

DNA Computing

What is DNA Computing?

DNA computing is a modern area of science that recognizes biomolecules as fundamental elements of electronic devices. This is related to several other areas including chemistry, software engineering, cell genetics, physics, and mathematics. Computing with biological molecules, rather than conventional silicon chips. While its conceptual history stretches back to the early 1950s, the principle of computing with molecules was only understood scientifically in 1994, when Leonard Adleman illustrated the answer of a small aspect of a very well-known problem in combinatorics utilizing standard molecular biology methods in the lab. Since this study, curiosity in DNA computing has significantly increased, and now it's a best-established research field. Leonard Adleman demonstrated how a statistical problem can be solved with molecules.

How will the computer with DNA work?

Scientists have discovered a new material to create the next generation of computer chips they require. Hundreds of thousands of natural powerful computers, like your body, reside within living things. DNA (deoxyribonucleic acid) molecules, the component from which our genes are produced, can generate data several times greater than the most efficient human-built computing devices … The reason for this enthusiasm was that DNA molecules are inexpensive, fairly simple to manufacture, and versatile. There's no limitation to the capacity that DNA computation can potentially have as power is increased more and more compounds you add to the equation but unlike silicon transistors that can conduct a single rational item at a time, these DNA structures can potentially conduct as much of the operations at a time as possible to resolve an issue and do everything all at once …… For a long period of time scientists have been aware that DNA could be used to store data. Compared to standard devices DNA computers take a radically different approach to fixing the issues. "Modern electronic processors have to choose a route to follow when they come to a T-junction, while a DNA computer doesn't have to decide because it reproduces itself through follow both directions at the same moment. Complex mathematical problems have been already solved with DNA molecules. Though still in its development, DNA computers will be able to hold billions of times greater data than your personal computer. The researchers use genetic material to create nano-computers that could take the place of machines based on silicon over the next decade.

The experiments and Success of DNA Computers.

Scientists have created a new form of DNA device that operates in living organisms, potentially opening the way for a separate system that can pick out infected cells from some very healthy cells. The machine operates on a mechanism called RNA interference (RNAi), one where small RNA molecules inhibit the development of protein by a gene. The Adleman DNA computer ‘s achievement is evidence that DNA could be used to analyse complex math equations. This initial DNA machine is very far from intimidating computers built on silicone in terms of efficiency, nevertheless. Computer scientists at Davis and Caltech University of California have formulated DNA molecules that can be self-assembled into frameworks by using six-bit inputs to effectively run their own programme. Microsoft also has a programming language for DNA computing which will help make DNA computing functional once bio-processor technology is progressing to the stage that it can operate more sophisticated algorithms. In addition, Microsoft plans to incorporate DNA computing into its cloud services by 2020, and to aggressively build DNA storage space to incorporate into its cloud computing. The Adleman DNA machine very easily produced a collection of potential responses, but it required Adleman days to limit down the options. The objective of the area of DNA computing is to establish a system that can operate independently of human intervention. It will take several years for the DNA computer components to evolve logic gates and biochips into a functional, feasible DNA device. Scientists believe that if such a computer is ever designed it would be more lightweight, reliable and powerful than today’s computers.

Advantages of DNA based Computer.

The process starts with the use of DNA by allocating DNA strands to cities on a chart and to linkages among cities. The city strands are to link with the interactions and shape strands consisting of paths via the various cities. The strands are then arranged in such a way that only the proper number of cities are related. Carry out hundreds of thousands of tasks at the same time. DNA computers’ massively parallel computational power can give them the ability to seek solvable approaches to otherwise difficult issues, and possibly speed up massive, but otherwise possible to solve, polynomial-time problems commonly used to increase few procedures. There is “still the risk that a few of the strands would include the same city twice,” so the DNA is carried through filtration; each filter collects only DNA comprising a certain segment (each section representing a region). A further advantage of this method to DNA is that it operates in “parallel,” concurrently analysing all potential scenarios. It thus enables large parallel investigations to be conducted and a full set of possible solutions to be produced. DNA can contain more information than a trillion CDs in a cubic centimetre, thereby allowing it to accommodate vast quantities of working memory adequately. The DNA machine also has very low power consumption, and if it is mounted within the cell this would not need much energy to work and its energy-efficiency is much more than a thousand times that of a PC. While still in its infancy, machines with DNA are able to store billions of times more data than a personal computer. The DNA strands that the filters survive reflect all alternative avenues through the cities.

The future of DNA computing.

The interaction of chemists, biologists, mathematicians and software engineers to recognize and model essential biological processes and algorithms occurring inside cells makes DNA computing so fascinating. CONVENTIONAL machines perform linear calculations (that is, assume tasks one at a time). Nevertheless, parallel DNA computational power could tackle math problems in hours which would take many years for electronic computers. The DNA machine is in the very initial phases of development, however, there are actually many areas in active usage (or underactive technologies). Technically, classical DNA computing techniques have already been applied in real-life problems: breaking the Data Encryption Standard, DES. While this task has already been resolved using traditional techniques in a far shorter time than proposed by DNA methods, the DNA models are far more versatile, efficient, and cost-effective. A machine composed of DNA and enzymes was developed by Israeli researchers.

Supercomputer

Supercomputer, any of a class of extremely powerful computers. The term is commonly applied to the fastest high-performance systems available at any given time. Such computers have been used primarily for scientific and engineering work requiring exceedingly high-speed computations. Common applications for supercomputers include testing mathematical models for complex physical phenomena or designs, such as climate and weather, evolution of the cosmos, nuclear weapons and reactors, new chemical compounds (especially for pharmaceutical purposes), and cryptology. As the cost of supercomputing declined in the 1990s, more businesses began to use supercomputers for market research and other business-related models.

Distinguishing features Supercomputers have certain distinguishing features. Unlike conventional computers, they usually have more than one CPU (central processing unit), which contains circuits for interpreting program instructions and executing arithmetic and logic operations in proper sequence. The use of several CPUs to achieve high computational rates is necessitated by the physical limits of circuit technology. Electronic signals cannot travel faster than the speed of light, which thus constitutes a fundamental speed limit for signal transmission and circuit switching. This limit has almost been reached, owing to miniaturization of circuit components, dramatic reduction in the length of wires connecting circuit boards, and innovation in cooling techniques (e.g., in various supercomputer systems, processor and memory circuits are immersed in a cryogenic fluid to achieve the low temperatures at which they operate fastest). Rapid retrieval of stored data and instructions is required to support the extremely high computational speed of CPUs. Therefore, most supercomputers have a very large storage capacity, as well as a very fast input/output capability.

Still another distinguishing characteristic of supercomputers is their use of vector arithmetic—i.e., they are able to operate on pairs of lists of numbers rather than on mere pairs of numbers. For example, a typical supercomputer can multiply a list of hourly wage rates for a group of factory workers by a list of hours worked by members

of that group to produce a list of dollars earned by each worker in roughly the same time that it takes a regular computer to calculate the amount earned by just one worker.

Supercomputers were originally used in applications related to national security, including nuclear weapons design and cryptography. Today they are also routinely employed by the aerospace, petroleum, and automotive industries. In addition, supercomputers have found wide application in areas involving engineering or scientific research, as, for example, in studies of the structure of subatomic particles and of the origin and nature of the universe. Supercomputers have become an indispensable tool in weather forecasting: predictions are now based on numerical models. As the cost of supercomputers declined, their use spread to the world of online gaming. In particular, the 5th through 10th fastest Chinese supercomputers in 2007 were owned by a company with online rights in China to the electronic game World of Warcraft, which sometimes had more than a million people playing together in the same gaming world.

Historical development

Although early supercomputers were built by various companies, one individual, Seymour Cray, really defined the product almost from the start. Cray joined a computer company called Engineering Research Associates (ERA) in 1951. When ERA was taken over by Remington Rand, Inc. (which later merged with other companies to become Unisys Corporation), Cray left with ERA's founder, William Norris, to start Control Data Corporation (CDC) in 1957. By that time Remington Rand's UNIVAC line of computers and IBM had divided up most of the market for business computers, and, rather than challenge their extensive sales and support structures, CDC sought to capture the small but lucrative market for fast scientific computers. The Cray-designed CDC 1604 was one of the first computers to replace vacuum tubes with transistors and was quite popular in scientific laboratories. IBM responded by building its own scientific computer, the IBM 7030—commonly known as Stretch—in 1961. However, IBM, which had been slow to adopt the transistor, found few purchasers for its tube-transistor hybrid, regardless of its speed, and temporarily withdrew from the supercomputer field after a staggering loss, for the time, of $20 million. In 1964 Cray's CDC 6600 replaced Stretch as the fastest computer on Earth; it could execute three million floating-point operations per second (FLOPS), and the term supercomputer was soon coined to describe it.

Cray left CDC to start Cray Research, Inc., in 1972 and moved on again in 1989 to form Cray Computer Corporation. Each time he moved on, his former company continued producing supercomputers based on his designs.

Cray was deeply involved in every aspect of creating the computers that his companies built. In particular, he was a genius at the dense packaging of the electronic components that make up a computer. By clever design he cut the distances signals had to travel, thereby speeding up the machines. He always strove to create the fastest possible computer for the scientific market, always programmed in the scientific programming language of choice (FORTRAN), and always optimized the machines for demanding scientific applications—e.g., differential equations, matrix manipulations, fluid dynamics, seismic analysis, and linear programming.

Among Cray's pioneering achievements was the Cray-1, introduced in 1976, which was the first successful implementation of vector processing (meaning, as discussed above, it could operate on pairs of lists of numbers rather than on mere pairs of numbers). Cray was also one of the pioneers of dividing complex computations among multiple processors, a design known as "multiprocessing." One of the first machines to use multiprocessing was the Cray X-MP, introduced in 1982, which linked two Cray-1 computers in parallel to triple their individual performance. In 1985 the Cray-2, a four-processor computer, became the first machine to exceed one billion FLOPS.

While Cray used expensive state-of-the-art custom processors and liquid immersion cooling systems to achieve his speed records, a revolutionary new approach was about to emerge. W. Daniel Hillis, a graduate student at the Massachusetts Institute of Technology, had a remarkable new idea about how to overcome the bottleneck imposed by having the CPU direct the computations between all the processors. Hillis saw that he could eliminate the bottleneck by eliminating the all-controlling CPU in favour of decentralized, or distributed, controls. In 1983 Hillis cofounded the Thinking Machines Corporation to design, build, and market such multiprocessor computers. In 1985 the first of his Connection Machines, the CM-1 (quickly replaced by its more commercial successor, the CM-2), was introduced. The CM-1 utilized an astonishing 65,536 inexpensive one-bit processors, grouped 16 to a chip (for a total of 4,096 chips), to achieve several billion FLOPS for some calculations—roughly comparable to Cray's fastest supercomputer.

Hillis had originally been inspired by the way that the brain uses a complex network of simple neurons (a neural network) to achieve high-level computations. In fact, an early goal of these machines involved solving a problem in artificial intelligence, face-pattern recognition. By assigning each pixel of a picture to a separate processor, Hillis spread the computational load, but this introduced the problem of communication between the processors. The network topology that he developed to facilitate processor communication was a 12-dimensional "hypercube"—i.e., each chip was directly linked to 12 other chips. These machines quickly became known as massively parallel computers. Besides opening the way for new multiprocessor architectures, Hillis's machines showed how common, or commodity, processors could be used to achieve supercomputer results.

Another common artificial intelligence application for multiprocessing was chess. For instance, in 1988 HiTech, built at Carnegie Mellon University, Pittsburgh, Pa., used 64 custom processors (one for each square on the chessboard) to become the first computer to defeat a grandmaster in a match. In February 1996 IBM's Deep Blue, using 192 custom-enhanced RS/6000 processors, was the first computer to defeat a world champion, Garry Kasparov, in a "slow" game. It was then assigned to predict the weather in Atlanta, Ga., during the 1996 Summer Olympic Games. Its successor (now with 256 custom chess processors) defeated Kasparov in a six-game return match in May 1997.

As always, however, the principal application for supercomputing was military. With the signing of the Comprehensive Test Ban Treaty by the United States in 1996, the need for an alternative certification program for the country's aging nuclear

stockpile led the Department of Energy to fund the Accelerated Strategic Computing Initiative (ASCI). The goal of the project was to achieve by 2004 a computer capable of simulating nuclear tests—a feat requiring a machine capable of executing 100 trillion FLOPS (100 TFLOPS; the fastest extant computer at the time was the Cray T3E, capable of 150 billion FLOPS). ASCI Red, built at Sandia National Laboratories in Albuquerque, N.M., with the Intel Corporation, was the first to achieve 1 TFLOPS. Using 9,072 standard Pentium Pro processors, it reached 1.8 TFLOPS in December 1996 and was fully operational by June 1997.

While the massively multiprocessing approach prevailed in the United States, in Japan the NEC Corporation returned to the older approach of custom designing the computer chip—for its Earth Simulator, which surprised many computer scientists by debuting in first place on the industry's TOP500 supercomputer speed list in 2002. It did not hold this position for long, however, as in 2004 a prototype of IBM's Blue Gene/L, with 8,192 processing nodes, reached a speed of about 36 TFLOPS, just exceeding the speed of the Earth Simulator. Following two doublings in the number of its processors, the ASCI Blue Gene/L, installed in 2005 at Sandia National Laboratories in Livermore, Calif., became the first machine to pass the coveted 100 TFLOPS mark, with a speed of about 135 TFLOPS. Other Blue Gene/L machines, with similar architectures, held many of the top spots on successive TOP500 lists. With regular improvements, the ASCI Blue Gene/L reached a speed in excess of 500 TFLOPS in 2007. These IBM supercomputers are also noteworthy for the choice of operating system, Linux, and IBM's support for the development of open source applications.

The first computer to exceed 1,000 TFLOPS, or 1 petaflop, was built by IBM in 2008. Known as Roadrunner, for New Mexico's state bird, the machine was first tested at IBM's facilities in New York, where it achieved the milestone, prior to being disassembled for shipment to the Los Alamos National Laboratory in New Mexico. The test version employed 6,948 dual-core Opteron microchips from Advanced Micro Devices (AMD) and 12,960 of IBM's Cell Broadband Engines (first developed for use in the Sony Computer Entertainment PlayStation 3 video system). The Cell processor was designed especially for handling the intensive mathematical calculations needed to handle the virtual reality simulation engines in electronic games—a process quite analogous to the calculations needed by scientific researchers running their mathematical models.

Such progress in computing placed researchers on or past the verge of being able, for the first time, to do computer simulations based on first-principle physics—not merely simplified models. This in turn raised prospects for breakthroughs in such areas as meteorology and global climate analysis, pharmaceutical and medical design, new materials, and aerospace engineering. The greatest impediment for realizing the full potential of supercomputers remains the immense effort required to write programs in such a way that different aspects of a problem can be operated on simultaneously by as many different processors as possible. Even managing this in the case of less than a dozen processors, as are commonly used in modern personal computers, has resisted any simple solution, though IBM's open source initiative, with support from various academic and corporate partners, made progress in the 1990s and 2000s.

Intel

Intel is a leading American brand and manufacturer of semiconductor computer circuits. It is headquartered in Santa Clara, California. The company's name comes from "integrated electronics."

Intel was founded in July 1968 by American engineers Robert Noyce and Gordon Moore. Unlike the archetypal Silicon Valley start-up business with its fabled origins in a youthful founder's garage, Intel opened its doors with $2.5 million in funding arranged by Arthur Rock, the American financier who coined the term venture capitalist. Intel's founders were experienced, middle-aged technologists who had established reputations. Noyce was the coinventor in 1959 of the silicon integrated circuit when he was general manager of Fairchild Semiconductor, a division of Fairchild Camera and Instrument. Moore was the head of research and development at Fairchild Semiconductor. Immediately after founding Intel, Noyce and Moore recruited other Fairchild employees, including Hungarian-born American businessman Andrew Grove. Noyce, Moore, and Grove served as chairman and chief executive officer (CEO) in succession during the first three decades of the company's history.

Early products

Intel's initial products were memory chips, including the world's first metal oxide semiconductor, the 1101, which did not sell well. However, its sibling, the 1103, a one-kilobit dynamic random-access memory (DRAM) chip, was successful and the first chip to store a significant amount of information. It was purchased first by the American technology company Honeywell Incorporated in 1970 to replace the core memory technology in its computers. Because DRAMs were cheaper and used less power than core memory, they quickly became the standard memory devices in computers worldwide.

Following its DRAM success, Intel became a public company in 1971. That same year Intel introduced the erasable programmable read-only memory (EPROM) chip, which was the company's most successful product line until 1985. Also in 1971 Intel engineers Ted Hoff, Federico Faggin, and Stan Mazor invented a general-purpose four-bit microprocessor and one of the first single-chip microprocessors, the 4004, under contract to the Japanese calculator manufacturer Nippon Calculating Machine Corporation, which let Intel retain all rights to the technology.

Not all of Intel's early endeavours were successful. In 1972 management decided to enter the growing digital watch market by purchasing Microma. But Intel had no real understanding of consumers and sold the watchmaking company in 1978 at a loss of $15 million. In 1974 Intel controlled 82.9 percent of the DRAM chip market, but, with the rise of foreign semiconductor companies, the company's market share dipped to 1.3 percent by 1984. By that time, however, Intel had shifted from memory chips and become focused on its microprocessor business: in 1972 it produced the 8008, an eight-

bit central processing unit (CPU); the 8080, which was 10 times faster than the 8008, came two years later; and in 1978 the company built its first 16-bit microprocessor, the 8086.

n 1981 the American computer manufacturer International Business Machines (IBM) chose Intel's 16-bit 8088 to be the CPU in its first mass-produced personal computer (PC). Intel also provided its microprocessors to other manufacturers that made PC "clones" that were compatible with IBM's product. The IBM PC and its clones ignited the demand for desktop and portable computers. IBM had contracted with a small firm in Redmond, Washington, Microsoft Corporation, to provide the disk operating system (DOS) for its PC. Eventually Microsoft supplied its Windows operating system to IBM PCs, which, with a combination of Windows software and Intel chips, were dubbed "Wintel" machines and have dominated the market since their inception.

Of the many microprocessors Intel has produced, perhaps the most important was the 80386, a 32-bit chip released in 1985 that started the company's commitment to make all future microprocessors backward-compatible with previous CPUs. Application developers and PC owners could then be assured that software that worked on older Intel machines would run on the newest models.

Cyberattack and cyberdefense

Despite its increasing prominence, there are many challenges for both attackers and defenders engaging in cyberwar. Cyberattackers must overcome cyberdefenses, and both sides must contend with a rapid offense-defense cycle. Nevertheless, the offense dominates in cyberspace because any defense must contend with attacks on large networks that are inherently vulnerable and run by fallible human users. In order to be effective in a cyberattack, the perpetrator has to succeed only once, whereas the defender must be successful over and over again.

Another challenge of cyberwar is the difficulty of distinguishing between lawful combatants and civilian noncombatants. One of the significant characteristics of cyberspace is the low cost of entry for anyone wishing to use it. As a result, it can be employed by anyone who can master its tools. The implications of this openness for cyberwar are that civilians, equipped with the appropriate software, are capable of mounting and participating in cyberattacks against state agencies, nongovernmental organizations, and individual targets. The legal status of such individuals, under the laws of armed conflict and the Geneva Conventions, is unclear, presenting additional difficulty for those prosecuting and defending against cyberwar. The cyberattacks against Estonia and Georgia are examples of this challenge: it is alleged that most, if not all, of those participating in the attacks were civilians perhaps motivated by nationalist fervour.

Perhaps the greatest challenge for states defending against cyberattacks is the anonymity of cyberspace. Mention is made above of the low cost of entry into cyberspace; another major attribute is the ease with which anyone using the right tools can mask his identity, location, and motive. For example, there is little solid evidence

linking the Russian government to the Estonia and Georgia cyberattacks, and so one can only speculate as to what motivated the attackers if they did not act directly on orders from Moscow. Such easy anonymity has profound implications for states or agencies seeking to respond to—and deter—cyberwar attacks. If the identity, location, and motivation of an attack cannot be established, it becomes very difficult to deter such an attack, and using offensive cybercapabilities in retaliation carries a strong and often unacceptable risk that the wrong target will face reprisal.

Despite these challenges, defending against cyberwar has become a priority for many nations and their militaries. Key features of any major cyberdefense structure include firewalls to filter network traffic, encryption of data, tools to prevent and detect network intruders, physical security of equipment and facilities, and training and monitoring of network users. A growing number of modern militaries are creating units specifically designed to defend against the escalating threat of cyberwar. For example, in the United States, the Twenty-fourth Air Force has been set up to defend Air Force networks. Similarly, the U.S. Navy has formed the Fleet Cyber Command, part of the recommissioned Tenth Fleet, in order to protect its networks. Both of these commands are directly under U.S. Cyber Command, based at Fort Meade, Md., which is charged with conducting all U.S. military cyberoperations. In the United Kingdom the Government Communications Headquarters (GCHQ) created a Cyber Security Operations Centre (CSOC) in September 2009, and France set up its Network and Information Security Agency in July 2009.

Finally, while the present focus is on defending against cyberattacks, the use of offensive cybercapabilities is also being considered. There are legal, ethical, and operational implications in the use of such capabilities stemming from many of the challenges mentioned above. Hence, in many Western countries such capabilities are proscribed extensively by law and are alleged to be the preserve of intelligence agencies such as the National Security Agency (NSA) in the United States and GCHQ in the United Kingdom. In China, where the legal, ethical, and operational implications differ (or at least appear to), it is believed that organizations such as the General Staff Department Third and Fourth Departments, at least six Technical Reconnaissance Bureaus, and a number of People's Liberation Army (PLA) Information Warfare Militia Units are all charged with cyberdefense, attack, and espionage. Similarly, it is thought that in Russia both the Federal Security Service (FSB) and the Ministry of Defense are the lead agencies for cyberwar activities.

The controversy over Pegasus spyware highlights the ethical implications of these developing cybercapabilities. Although the creator of Pegasus, the Israeli cyber-intelligence firm NSO Group (founded in 2010), claims its product is sold exclusively to government security and law enforcement agencies and only for the purpose of aiding rescue operations and battling criminals, such as money launderers, sex- and drug-traffickers, and terrorists, the spyware has been used to track politicians, government leaders, human rights activists, dissidents, and journalists. It was even used to track Saudi journalist and U.S. resident Jamal Khashoggi months before his murder and dismemberment by Saudi agents in October 2018.

Stuxnet

Stuxnet, a computer worm, discovered in June 2010, that was specifically written to take over certain programmable industrial control systems and cause the equipment run by those systems to malfunction, all the while feeding false data to the systems monitors indicating the equipment to be running as intended.

As analyzed by computer security experts around the world, Stuxnet targeted certain “supervisory control and data acquisition” (SCADA) systems manufactured by the German electrical company Siemens AG that control machinery employed in power plants and similar installations. More specifically, the worm targeted only Siemens SCADA systems that were used in conjunction with frequency-converter drives, devices that control the speed of industrial motors, and even then only drives that were made by certain manufacturers in Finland and Iran and were programmed to run motors at very specific high speeds. This combination indicated to analysts that the likely target of Stuxnet was nuclear installations in Iran—either a uranium-enrichment plant at Naṭanz or a nuclear reactor at Būshehr or both—a conclusion supported by data showing that, of the approximately 100,000 computers infected by Stuxnet by the end of 2010, more than 60 percent were located in Iran.

The worm was found to have been circulating since at least mid-2009, and indeed in the latter part of that year at the Naṭanz plant an unusually large number of centrifuges (machines that concentrate uranium by spinning at very high speeds) were taken out of operation and replaced. The Iranian nuclear program, which most foreign governments believed was working to produce nuclear weapons, continued to suffer technical difficulties even after discovery of the worm.

Speculation then centred on where the worm may have originated. Many analysts pointed to the United States and Israel as two countries whose assessments of the threat of Iranian nuclear weapons had long been particularly severe and whose expertise in engineering and computer science would certainly have enabled them to plan and launch such a cyber attack. Officials of both countries refused to discuss the issue. Meanwhile, the Iranian government declared that a foreign virus had infected computers at certain nuclear facilities but had caused only minor problems. The consensus among experts was that Iran’s problems were far from minor; some speculated that the country’s nuclear program may have suffered a serious setback.

Though it was impossible to verify that the Stuxnet worm had caused those difficulties, it became clear to cybersecurity experts that Iran had suffered an attack by what may have been the most sophisticated piece of malware ever written. By taking over and disrupting industrial processes in a significant sector of a sovereign state, Stuxnet was a truly offensive cyber weapon, a significant escalation in the growing capability and willingness of states and state-sponsored groups to engage in cyber war.

Malware

Malware, malicious computer program, or “malicious software,” such as viruses, trojans, spyware, and worms. Malware typically infects a personal computer (PC) through e-mail, Web sites, or attached hardware devices. Mobile malware, including

spyware and ransomware, attacks smartphones and tablets, often through text messages and mobile apps.

Malware may be used to take over PCs, turning them into zombie computers that may form part of a "botnet" used to send out spam or perform denial of service attacks on Web sites. In addition, malware has been used to distribute pornography and unlicensed software. Owners of infected PCs often become aware of a problem only as their machines become progressively slower or they find unidentifiable software that cannot be removed.

Rootkits are one of the worst forms of malware. Their name comes from the fact that they infect the "root-level" of a computer's hard drive, making them impossible to remove without completely erasing the drives. In efforts to curb copyright infringement, some computer software makers and music companies secretly install detection software on users' machines. For example, it was revealed in 2005 that the Sony Corporation had been secretly installing rootkits as its music CDs were loaded into PCs. The rootkit was discovered because of the way that it collected information on users' PCs and sent the data back to Sony. The revelation turned into a public relations disaster, which forced the company to abandon the practice. The practice of monitoring users' data, with or without installing rootkits, continues in the software industry.

The evolution of malware reached a new milestone in 2010, when the Stuxnet worm proliferated on computers around the world. Characterized as "weaponized software" by security experts, Stuxnet exploited four separate vulnerabilities in the Windows operating system to achieve administrator-level control over specialized industrial networks created by Siemens AG. By attacking these supervisory control and data acquisition (SCADA) systems, Stuxnet was able to cause industrial processes to behave in a manner inconsistent with their original programming, thus crossing the line between cyberspace and the "real world." While Stuxnet's intended target remained a matter of debate, the worm demonstrated that SCADA systems, which provide the backbone for such critical infrastructure sites as nuclear power plants and electrical grid substations, could be subverted by malicious code.

Another development in 2010 was the founding of the Israeli cyber-intelligence firm NSO Group for eavesdropping on mobile phones and harvesting their data. Its chief spyware, Pegasus, has been highly controversial, used to track politicians, government leaders, human rights activists, dissidents, and journalists. Although NSO Group claims its product is sold exclusively to government security and law enforcement agencies and only for the purpose of aiding rescue operations and battling criminals, such as money launderers, sex- and drug-traffickers, and terrorists, the spyware was used in 2018 by the Saudi Arabian government to track Saudi journalist and U.S. resident Jamal Khashoggi. Months before Khashoggi's murder and dismemberment by Saudi agents in October 2018, Pegasus had been attached to the phone of Khashoggi's wife. Facebook (now Meta Platforms) sued NSO Group under the United States Computer Fraud and Abuse Act in 2019, and two years later, Apple also sued. U.S. President Joseph Biden blacklisted the company in 2021, making it illegal for U.S. firms to sell technology to NSO Group.

Four steps to get the most value from your IoT data.

The IoT journey has evolved over the last several years. But it is definitely a journey. Let's look at the four steps every organization needs to master to truly realize value from their IoT efforts.

Step 1: Gather data

Step 1 begins with the basics: IoT data. Or more precisely, gathering the data from your devices into a usable format. When IoT first came on the scene, we were fascinated with what we could do in our homes. We discovered we could connect things – like our light bulbs – to the Internet of Things. And we could use that connectivity to turn them off and on. A cool technology, and those early connections generated a lot of hype. But to what end?

That's why, step 1 begins with the basics: IoT data. Or more precisely, gathering the data from your devices into a usable format.

Step 2: Visualize patterns

As the technology matured, so did the expectations of businesses. That's why, as the market developed, the focus shifted from instrumenting data to visualizing it.

Let's take that connected light bulb in step 1 and move it into a large retail business. If all you did was turn the many light bulbs on and off via their sensors, then yes, that's convenient. But is it useful? Or to put it another way – is it useful enough to warrant transforming all of your facilities with instrumented light bulbs? What's more interesting – and useful – is what a connected light bulb can tell us about the way it is being used. Those insights show you energy usage. They help the retail owner manage energy consumption and understand where and how to save money and resources. For example, perhaps there are areas that don't have to be lit at certain times. Or you discover that on especially sunny days, you can dim your lights by 10 percent and still keep the same level of brightness. Once you begin to understand the patterns in your data, then apply the value to your business, you're making the most of step 2.

Step 3: Advance to analytics

The next step in the IoT journey focuses on making data even smarter through analytics.

Analytics allows you to couple real-time, IoT device data with existing, longer-term and historic information. It's a more complete picture of what's happening with your devices and in your environment. It also allows you to spot patterns and make predictions, and adopt new practices that proactively avert risk and avoid potential problems.

To illustrate, let's change the example from connected bulbs to more sophisticated manufacturing machines. Periodically, one of these machines fail when the torque of that machine spikes. But only sometimes. This is where analytics can help you play detective to solve the problem. In reviewing your other data, you discover that your temperature sensors record a spike two hours prior to the variance with torque. When those two things happen, your machines are 80 percent more likely to fail. Now, with information from multiple sources, you can more confidently predict the particular combination of factors that cause problems. That, in turn,

enables you take more proactive measure to keep machines up and running, reducing downtime and increasing productivity.

Step 4: Infuse with Artificial Intelligence

The fourth step on the IoT journey focuses on using Artificial Intelligence to do even more with your data. Even with a refined use case on how IoT can help your business, you'll still have too much data, especially as you combine data sets. It's easy to become overwhelmed, so that's where AI comes in. Machine learning will help you clean up the data you have, distil it down to the most relevant pieces, and find the seemingly desperate data sets that actually matter.

With those efforts, you'll find even more synergy within your data. It also helps identify what data should be used and what should be thrown out, because all data is not equal. As you refine the process, you'll be able to do more sophisticated tasks like forecast models, apply predictive maintenance and anomaly detection. In other words, you gain the right, rich context that helps make sense of what you are seeing. You'll also be able to solve problems more easily and perhaps even identify new opportunities and business models.

How to choose your platform

Remember, your IoT journey isn't a single thing you do. Infusing IoT into your business truly is a journey. And it's definitely worth the effort!

History of Internet of Things

The main concept of a network of smart devices was discussed as early as 1982, with a modified Coca-Cola vending machine at Carnegie Mellon University becoming the first ARPANET-connected appliance, able to report its inventory and whether newly loaded drinks were cold or not. Mark Weiser's 1991 paper on ubiquitous computing, "The Computer of the 21st Century", as well as academic venues such as UbiComp and PerCom produced the contemporary vision of the IOT. In 1994, Reza Raji described the concept in *IEEE Spectrum* as "[moving] small packets of data to a large set of nodes, so as to integrate and automate everything from home appliances to entire factories". Between 1993 and 1997, several companies proposed solutions like Microsoft's at Work or Novell's NEST. The field gained momentum when Bill Joy envisioned device-to-device communication as a part of his "Six Webs" framework, presented at the World Economic Forum at Davos in 1999.

The concept of the "Internet of things" and the term itself, first appeared in a speech by Peter T. Lewis, to the Congressional Black Caucus Foundation 15th Annual Legislative Weekend in Washington, D.C., published in September 1985. According to Lewis, "The Internet of Things, or IoT, is the integration of people, processes and technology with connectable devices and sensors to enable remote monitoring, status, manipulation and evaluation of trends of such devices."

The term "Internet of things" was coined independently by Kevin Ashton of Procter & Gamble, later of MIT's Auto-ID Center, in 1999, though he prefers the phrase "Internet *for* things". At that point, he viewed radio-frequency identification (RFID) as essential to the Internet of things, which would allow computers to manage all individual things. The main theme of the Internet of things is to embed short-range mobile transceivers in various gadgets and daily necessities to

enable new forms of communication between people and things, and between things themselves.

In 2004 Cornelius "Pete" Peterson, CEO of NetSilicon, predicted that, "The next era of information technology will be dominated by [IoT] devices, and networked devices will ultimately gain in popularity and significance to the extent that they will far exceed the number of networked computers and workstations." Peterson believed that medical devices and industrial controls would become dominant applications of the technology.

Defining the Internet of things as "simply the point in time when more 'things or objects' were connected to the Internet than people", Cisco Systems estimated that the IoT was "born" between 2008 and 2009, with the things/people ratio growing from 0.08 in 2003 to 1.84 in 2010.

Examples of IoT in Real Life

1. Home Automation. Home automation is one of the best examples of IoT. Smart homes or IoT-based home automation systems are becoming popular day by day. In a smart home, consumer electronic gadgets such as lights, fans, air-conditioners, etc. can be connected to each other via the internet. This interconnection enables the user to operate these devices from a distance. A smart home is capable of lighting control, energy management, expansion, and remote access. Currently, this application of IoT is not utilized at a large scale because the installation cost is too high, which makes it difficult for a majority of people to afford it. However, home automation holds quite a promising future.

2. Wearable Health Monitors. Wearable health monitors are both captivating and useful. They include smart clothes, smart wristwear, and medical wearables that provide us with high-quality health services. They are designed to track activities such as pulse rate, step count, heart rate, etc. This data is recorded and can be sent to the doctors for detailed fitness analysis. These IoT based smart wearable devices are influencing our lifestyles a lot. Apart from performing these basic operations, they can also raise an alarm and send an alert in case of a medical emergency such as an asthma attack, seizures, etc.

3. Disaster Management. IoT helps in the prediction and management of natural disasters. For instance, take the example of forest fires. To avoid the chaos and destruction caused by a forest fire, various sensors can be installed around the boundaries of the forests. These sensors continuously monitor the temperature and carbon content in the region. A detailed report is regularly sent to a common monitoring hub. In case of a forest fire, an alert is sent to the control room, police station, and fire brigade. Therefore, IoT helps in staying prepared and respond swiftly in case of emergency.

4. Biometric Security Systems. A lot of security agencies make use of biometric systems to mark daily attendance, allow access to the authorized personnel only, and other related services. Advanced security, data communication, and minimized human intervention are some of the features of IoT being utilized in this sector. Biometric technology makes use of fingerprint, voice, eye, and face recognition. The reliability

of IoT based security systems is higher than the manual or automated approach. The devices used in biometric security systems are interlinked to each other and possess the ability to dump the data after every usage to the host computer. This scanned data is stored for future use, and the useful information is retrieved as per requirement.

5. Smart Cars

IoT can be used to connect cars with each other in order to exchange information like location, speed, and dynamics. An estimate shows that by 2020, there will be 24 billion connected cars in the world. We use IoT in our daily life without even realizing its presence. For example, while finding the shortest route, while driving semi-automatic smart cars, etc. IoT is also used in vehicle repair and maintenance. It does not only remind the customer about the regular servicing date but also assists the consumer in repair and maintenance by providing proper guidance.

6. Process Automation

In the manufacturing industry, performing reoccurring tasks, such as label wrapping, packaging, etc., manually is difficult and is prone to human errors; therefore, automation comes into play. For instance, take the example of a cold drink manufacturing industry. Here, manufacturing machines and conveyor belts are required to be interconnected in order to share information, status, and data. This interconnection is IoT dependent. The status of the manufactured product and the machine health report is sent to the manufacturer at regular intervals in order to identify the faults in advance. An IoT equipped industry is advantageous as it elevates the production speed and maintains the uniform quality of the product throughout the production. It also helps to make the workplace more efficient and safe by reducing human error.

7. Farming

Due to climate change and water crisis, farmers go through a lot of troubles such as crop flattening, soil erosion, drought, etc. These problems can be easily suppressed by using IoT based farming system. For example, the IoT based irrigation system makes use of a number of sensors to monitor the moisture content of the soil. If the moisture level drops below a certain range, it automatically turns on the irrigation pump. Other than this, IoT also helps farmers to examine soil health. Before planning to farm a new batch of crops, a farmer needs to recover the soil nutrients. The IoT enriched software allows the user or the farmer to select the best nutrient restoring crops. It also helps in sensing the requirement of fertilizer and numerous other farming needs.

Multiple AI models help robots execute complex plans more transparently

A multimodal system uses models trained on language, vision, and action data to help robots develop and execute plans for household, construction, and manufacturing tasks.

Your daily to-do list is likely pretty straightforward: wash the dishes, buy groceries, and other minutiae. It’s unlikely you wrote out “pick up the first dirty dish,” or “wash that plate with a sponge,” because each of these miniature steps within the

chore feels intuitive. While we can routinely complete each step without much thought, a robot requires a complex plan that involves more detailed outlines.

MIT's Improbable AI Lab, a group within the Computer Science and Artificial Intelligence Laboratory (CSAIL), has offered these machines a helping hand with a new multimodal framework: Compositional Foundation Models for Hierarchical Planning (HiP), which develops detailed, feasible plans with the expertise of three different foundation models. Like OpenAI's GPT-4, the foundation model that ChatGPT and Bing Chat were built upon, these foundation models are trained on massive quantities of data for applications like generating images, translating text, and robotics.

Unlike RT2 and other multimodal models that are trained on paired vision, language, and action data, HiP uses three different foundation models each trained on different data modalities. Each foundation model captures a different part of the decision-making process and then works together when it's time to make decisions. HiP removes the need for access to paired vision, language, and action data, which is difficult to obtain. HiP also makes the reasoning process more transparent.

What's considered a daily chore for a human can be a robot's "long-horizon goal" — an overarching objective that involves completing many smaller steps first — requiring sufficient data to plan, understand, and execute objectives. While computer vision researchers have attempted to build monolithic foundation models for this problem, pairing language, visual, and action data is expensive. Instead, HiP represents a different, multimodal recipe: a trio that cheaply incorporates linguistic, physical, and environmental intelligence into a robot.

"Foundation models do not have to be monolithic," says NVIDIA AI researcher Jim Fan, who was not involved in the paper. "This work decomposes the complex task of embodied agent planning into three constituent models: a language reasoner, a visual world model, and an action planner. It makes a difficult decision-making problem more tractable and transparent."

The team believes that their system could help these machines accomplish household chores, such as putting away a book or placing a bowl in the dishwasher. Additionally, HiP could assist with multistep construction and manufacturing tasks, like stacking and placing different materials in specific sequences.

Evaluating HiP

The CSAIL team tested HiP's acuity on three manipulation tasks, outperforming comparable frameworks. The system reasoned by developing intelligent plans that adapt to new information.

First, the researchers requested that it stack different-colored blocks on each other and then place others nearby. The catch: Some of the correct colors weren't present, so

the robot had to place white blocks in a color bowl to paint them. HiP often adjusted to these changes accurately, especially compared to state-of-the-art task planning systems like Transformer BC and Action Diffuser, by adjusting its plans to stack and place each square as needed.

Another test: arranging objects such as candy and a hammer in a brown box while ignoring other items. Some of the objects it needed to move were dirty, so HiP adjusted its plans to place them in a cleaning box, and then into the brown container. In a third demonstration, the bot was able to ignore unnecessary objects to complete kitchen sub-goals such as opening a microwave, clearing a kettle out of the way, and turning on a light. Some of the prompted steps had already been completed, so the robot adapted by skipping those directions.

A three-pronged hierarchy

HiP's three-pronged planning process operates as a hierarchy, with the ability to pre-train each of its components on different sets of data, including information outside of robotics. At the bottom of that order is a large language model (LLM), which starts to ideate by capturing all the symbolic information needed and developing an abstract task plan. Applying the common sense knowledge it finds on the internet, the model breaks its objective into sub-goals. For example, "making a cup of tea" turns into "filling a pot with water," "boiling the pot," and the subsequent actions required.

"All we want to do is take existing pre-trained models and have them successfully interface with each other," says Anurag Ajay, a PhD student in the MIT Department of Electrical Engineering and Computer Science (EECS) and a CSAIL affiliate. "Instead of pushing for one model to do everything, we combine multiple ones that leverage different modalities of internet data. When used in tandem, they help with robotic decision-making and can potentially aid with tasks in homes, factories, and construction sites."

These models also need some form of "eyes" to understand the environment they're operating in and correctly execute each sub-goal. The team used a large video diffusion model to augment the initial planning completed by the LLM, which collects geometric and physical information about the world from footage on the internet. In turn, the video model generates an observation trajectory plan, refining the LLM's outline to incorporate new physical knowledge.

This process, known as iterative refinement, allows HiP to reason about its ideas, taking in feedback at each stage to generate a more practical outline. The flow of feedback is similar to writing an article, where an author may send their draft to an editor, and with those revisions incorporated in, the publisher reviews for any last changes and finalizes.

In this case, the top of the hierarchy is an egocentric action model, or a sequence of first-person images that infer which actions should take place based on its surroundings. During this stage, the observation plan from the video model is mapped over the space visible to the robot, helping the machine decide how to execute each task within the long-horizon goal. If a robot uses HiP to make tea, this means it will

have mapped out exactly where the pot, sink, and other key visual elements are, and begin completing each sub-goal.

Still, the multimodal work is limited by the lack of high-quality video foundation models. Once available, they could interface with HiP's small-scale video models to further enhance visual sequence prediction and robot action generation. A higher-quality version would also reduce the current data requirements of the video models.

That being said, the CSAIL team's approach only used a tiny bit of data overall. Moreover, HiP was cheap to train and demonstrated the potential of using readily available foundation models to complete long-horizon tasks. "What Anurag has demonstrated is proof-of-concept of how we can take models trained on separate tasks and data modalities and combine them into models for robotic planning. In the future, HiP could be augmented with pre-trained models that can process touch and sound to make better plans," says senior author Pulkit Agrawal, MIT assistant professor in EECS and director of the Improbable AI Lab. The group is also considering applying HiP to solving real-world long-horizon tasks in robotics.

Ajay and Agrawal are lead authors on a paper describing the work. They are joined by MIT professors and CSAIL principal investigators Tommi Jaakkola, Joshua Tenenbaum, and Leslie Pack Kaelbling; CSAIL research affiliate and MIT-IBM AI Lab research manager Akash Srivastava; graduate students Seungwook Han and Yilun Du '19; former postdoc Abhishek Gupta, who is now assistant professor at University of Washington; and former graduate student Shuang Li PhD '23.

The team's work was supported, in part, by the National Science Foundation, the U.S. Defense Advanced Research Projects Agency, the U.S. Army Research Office, the U.S. Office of Naval Research Multidisciplinary University Research Initiatives, and the MIT-IBM Watson AI Lab. Their findings were presented at the 2023 Conference on Neural Information Processing Systems (NeurIPS).

(By Alex Shipps | MIT CSAIL. Publication Date:January 8, 2024)

What does the future hold for generative AI?

Rodney Brooks, co-founder of iRobot, kicks off an MIT symposium on the promise and potential pitfalls of increasingly powerful AI tools like ChatGPT.

Speaking at the "Generative AI: Shaping the Future" symposium on Nov. 28, the kickoff event of MIT's Generative AI Week, keynote speaker and iRobot co-founder Rodney Brooks warned attendees against uncritically overestimating the capabilities of this emerging technology, which underpins increasingly powerful tools like OpenAI's ChatGPT and Google's Bard.

"Hype leads to hubris, and hubris leads to conceit, and conceit leads to failure," cautioned Brooks, who is also a professor emeritus at MIT, a former director of the Computer Science and Artificial Intelligence Laboratory (CSAIL), and founder of Robust.AI.

"No one technology has ever surpassed everything else," he added.

The symposium, which drew hundreds of attendees from academia and industry to the Institute's Kresge Auditorium, was laced with messages of hope about the opportunities generative AI offers for making the world a better place, including

through art and creativity, interspersed with cautionary tales about what could go wrong if these AI tools are not developed responsibly.

Generative AI is a term to describe machine-learning models that learn to generate new material that looks like the data they were trained on. These models have exhibited some incredible capabilities, such as the ability to produce human-like creative writing, translate languages, generate functional computer code, or craft realistic images from text prompts.

In her opening remarks to launch the symposium, MIT President Sally Kornbluth highlighted several projects faculty and students have undertaken to use generative AI to make a positive impact in the world. For example, the work of the Axim Collaborative, an online education initiative launched by MIT and Harvard, includes exploring the educational aspects of generative AI to help underserved students.

The Institute also recently announced seed grants for 27 interdisciplinary faculty research projects centered on how AI will transform people's lives across society.

In hosting Generative AI Week, MIT hopes to not only showcase this type of innovation, but also generate "collaborative collisions" among attendees, Kornbluth said.

Collaboration involving academics, policymakers, and industry will be critical if we are to safely integrate a rapidly evolving technology like generative AI in ways that are humane and help humans solve problems, she told the audience.

"I honestly cannot think of a challenge more closely aligned with MIT's mission. It is a profound responsibility, but I have every confidence that we can face it, if we face it head on and if we face it as a community," she said.

While generative AI holds the potential to help solve some of the planet's most pressing problems, the emergence of these powerful machine learning models has blurred the distinction between science fiction and reality, said CSAIL Director Daniela Rus in her opening remarks. It is no longer a question of whether we can make machines that produce new content, she said, but how we can use these tools to enhance businesses and ensure sustainability.

"Today, we will discuss the possibility of a future where generative AI does not just exist as a technological marvel, but stands as a source of hope and a force for good," said Rus, who is also the Andrew and Erna Viterbi Professor in the Department of Electrical Engineering and Computer Science.

But before the discussion dove deeply into the capabilities of generative AI, attendees were first asked to ponder their humanity, as MIT Professor Joshua Bennett read an original poem.

Bennett, a professor in the MIT Literature Section and Distinguished Chair of the Humanities, was asked to write a poem about what it means to be human, and drew inspiration from his daughter, who was born three weeks ago.

The poem told of his experiences as a boy watching Star Trek with his father and touched on the importance of passing traditions down to the next generation.

In his keynote remarks, Brooks set out to unpack some of the deep, scientific questions surrounding generative AI, as well as explore what the technology can tell us about ourselves.

To begin, he sought to dispel some of the mystery swirling around generative AI tools like ChatGPT by explaining the basics of how this large language model works. ChatGPT, for instance, generates text one word at a time by determining what the next word should be in the context of what it has already written. While a human might write a story by thinking about entire phrases, ChatGPT only focuses on the next word, Brooks explained.

ChatGPT 3.5 is built on a machine-learning model that has 175 billion parameters and has been exposed to billions of pages of text on the web during training. (The newest iteration, ChatGPT 4, is even larger.) It learns correlations between words in this massive corpus of text and uses this knowledge to propose what word might come next when given a prompt.

The model has demonstrated some incredible capabilities, such as the ability to write a sonnet about robots in the style of Shakespeare's famous Sonnet 18. During his talk, Brooks showcased the sonnet he asked ChatGPT to write side-by-side with his own sonnet.

But while researchers still don't fully understand exactly how these models work, Brooks assured the audience that generative AI's seemingly incredible capabilities are not magic, and it doesn't mean these models can do anything.

His biggest fears about generative AI don't revolve around models that could someday surpass human intelligence. Rather, he is most worried about researchers who may throw away decades of excellent work that was nearing a breakthrough, just to jump on shiny new advancements in generative AI; venture capital firms that blindly swarm toward technologies that can yield the highest margins; or the possibility that a whole generation of engineers will forget about other forms of software and AI.

At the end of the day, those who believe generative AI can solve the world's problems and those who believe it will only generate new problems have at least one thing in common: Both groups tend to overestimate the technology, he said.

"What is the conceit with generative AI? The conceit is that it is somehow going to lead to artificial general intelligence. By itself, it is not," Brooks said.

Following Brooks' presentation, a group of MIT faculty spoke about their work using generative AI and participated in a panel discussion about future advances, important but underexplored research topics, and the challenges of AI regulation and policy.

The panel consisted of Jacob Andreas, an associate professor in the MIT Department of Electrical Engineering and Computer Science (EECS) and a member of CSAIL; Antonio Torralba, the Delta Electronics Professor of EECS and a member of CSAIL; Ev Fedorenko, an associate professor of brain and cognitive sciences and an investigator at the McGovern Institute for Brain Research at MIT; and Armando Solar-Lezama, a Distinguished Professor of Computing and associate director of CSAIL. It was moderated by William T. Freeman, the Thomas and Gerd Perkins Professor of EECS and a member of CSAIL.

The panelists discussed several potential future research directions around generative AI, including the possibility of integrating perceptual systems, drawing on human senses like touch and smell, rather than focusing primarily on language and images. The researchers also spoke about the importance of engaging with

policymakers and the public to ensure generative AI tools are produced and deployed responsibly.

“One of the big risks with generative AI today is the risk of digital snake oil. There is a big risk of a lot of products going out that claim to do miraculous things but in the long run could be very harmful,” Solar-Lezama said.

The morning session concluded with an excerpt from the 1925 science fiction novel “Metropolis,” read by senior Joy Ma, a physics and theater arts major, followed by a roundtable discussion on the future of generative AI. The discussion included Joshua Tenenbaum, a professor in the Department of Brain and Cognitive Sciences and a member of CSAIL; Dina Katabi, the Thuan and Nicole Pham Professor in EECS and a principal investigator in CSAIL and the MIT Jameel Clinic; and Max Tegmark, professor of physics; and was moderated by Daniela Rus.

One focus of the discussion was the possibility of developing generative AI models that can go beyond what we can do as humans, such as tools that can sense someone’s emotions by using electromagnetic signals to understand how a person’s breathing and heart rate are changing.

But one key to integrating AI like this into the real world safely is to ensure that we can trust it, Tegmark said. If we know an AI tool will meet the specifications we insist on, then “we no longer have to be afraid of building really powerful systems that go out and do things for us in the world,” he said.

AI copilot enhances human precision for safer aviation

Designed to ensure safer skies, “Air-Guardian” blends human intuition with machine precision, creating a more symbiotic relationship between pilot and aircraft.

Imagine you're in an airplane with two pilots, one human and one computer. Both have their “hands” on the controllers, but they're always looking out for different things. If they're both paying attention to the same thing, the human gets to steer. But if the human gets distracted or misses something, the computer quickly takes over.

Meet the Air-Guardian, a system developed by researchers at the MIT Computer Science and Artificial Intelligence Laboratory (CSAIL). As modern pilots grapple with an onslaught of information from multiple monitors, especially during critical moments, Air-Guardian acts as a proactive copilot; a partnership between human and machine, rooted in understanding attention.

But how does it determine attention, exactly? For humans, it uses eye-tracking, and for the neural system, it relies on something called "saliency maps," which pinpoint where attention is directed. The maps serve as visual guides highlighting key regions within an image, aiding in grasping and deciphering the behavior of intricate algorithms. Air-Guardian identifies early signs of potential risks through these attention markers, instead of only intervening during safety breaches like traditional autopilot systems.

The broader implications of this system reach beyond aviation. Similar cooperative control mechanisms could one day be used in cars, drones, and a wider spectrum of robotics.

"An exciting feature of our method is its differentiability," says MIT CSAIL postdoc Lianhao Yin, a lead author on a new paper about Air-Guardian. "Our cooperative layer and the entire end-to-end process can be trained. We specifically chose the causal continuous-depth neural network model because of its dynamic features in mapping attention. Another unique aspect is adaptability. The Air-Guardian system isn't rigid; it can be adjusted based on the situation's demands, ensuring a balanced partnership between human and machine."

In field tests, both the pilot and the system made decisions based on the same raw images when navigating to the target waypoint. Air-Guardian's success was gauged based on the cumulative rewards earned during flight and shorter path to the waypoint. The guardian reduced the risk level of flights and increased the success rate of navigating to target points.

"This system represents the innovative approach of human-centric AI-enabled aviation," adds Ramin Hasani, MIT CSAIL research affiliate and inventor of liquid neural networks. "Our use of liquid neural networks provides a dynamic, adaptive approach, ensuring that the AI doesn't merely replace human judgment but complements it, leading to enhanced safety and collaboration in the skies."

The true strength of Air-Guardian is its foundational technology. Using an optimization-based cooperative layer using visual attention from humans and machine, and liquid closed-form continuous-time neural networks (CfC) known for its prowess in deciphering cause-and-effect relationships, it analyzes incoming images for vital information. Complementing this is the VisualBackProp algorithm, which identifies the system's focal points within an image, ensuring clear understanding of its attention maps.

For future mass adoption, there's a need to refine the human-machine interface. Feedback suggests an indicator, like a bar, might be more intuitive to signify when the guardian system takes control.

Air-Guardian heralds a new age of safer skies, offering a reliable safety net for those moments when human attention wavers.

"The Air-Guardian system highlights the synergy between human expertise and machine learning, furthering the objective of using machine learning to augment pilots in challenging scenarios and reduce operational errors," says Daniela Rus, the Andrew (1956) and Erna Viterbi Professor of Electrical Engineering and Computer Science at MIT, director of CSAIL, and senior author on the paper.

"One of the most interesting outcomes of using a visual attention metric in this work is the potential for allowing earlier interventions and greater interpretability by human pilots," says Stephanie Gil, assistant professor of computer science at Harvard University, who was not involved in the work. "This showcases a great example of how AI can be used to work with a human, lowering the barrier for achieving trust by using natural communication mechanisms between the human and the AI system."

This research was partially funded by the U.S. Air Force (USAF) Research Laboratory, the USAF Artificial Intelligence Accelerator, the Boeing Co., and the Office of Naval Research. The findings don't necessarily reflect the views of the U.S. government or the USAF.

Extended Reality: Immersing into the Future of Manufacturing

In recent years, the industrial landscape has witnessed a remarkable transformation driven by cutting-edge technologies. Among these, extended reality (XR) technology has emerged as a key catalyst for innovation, offering a spectrum of benefits that redefine the way industries operate. XR, encompassing virtual reality (VR), augmented reality (AR), and mixed reality (MR), has demonstrated its potential to revolutionize various facets of industrial processes, fostering enhanced efficiency, safety, and collaboration.

Apple and Meta have been leading the charge in the development of XR technology, with both companies announcing new XR headsets in June 2023. The Meta Quest 3 released in October, boasting mixed reality capabilities and powerful technical specifications. Apple's own headset promises extensive AR and MR capabilities aimed largely at professional use in the workplace. As more and more companies continue to develop top-of-the-line hardware, the manufacturing industry needs to adapt and find ways to take advantage of these developments.

One of the primary advantages of XR in the industrial space lies in its ability to revolutionize training and skill development. Traditional training methods often fall short when it comes to providing hands-on experience, particularly in high-risk environments. XR enables immersive training scenarios, allowing workers to simulate complex tasks and procedures in a safe and controlled virtual environment. This not only enhances the skills of the workforce but also minimizes the risks associated with learning on the job.

Maintenance and repairs are integral components of industrial operations, and any downtime can result in significant financial losses. XR facilitates remote assistance through AR applications, enabling on-site technicians to collaborate with experts located elsewhere. Using AR, technicians can overlay digital information onto physical equipment, providing real-time guidance and diagnostics. This accelerates troubleshooting processes, reduces downtime, and ultimately contributes to substantial cost savings.

XR offers a dynamic platform that enables engineers, designers, and manufacturers to collaboratively visualize and iterate on product designs in a virtual environment, fostering enhanced creativity and innovation. Through VR, teams can simulate and analyze the entire product lifecycle, from conceptualization to production, identifying potential issues and refining designs before physical prototypes are created. AR, on the other hand, integrates virtual elements into the real-world environment, allowing workers on the manufacturing floor to access real-time information, assembly instructions, and maintenance guidelines, improving efficiency and reducing errors.

The igusGO app is one such example of AR for product development, allowing users to see where various igus products could be implemented within an application. This technology minimizes the need for physical prototypes, accelerates prototyping cycles, and ultimately streamlines the entire product development process.

XR technology plays a pivotal role in streamlining complex workflows and enhancing overall operational efficiency. In manufacturing, for instance, AR applications can overlay digital information onto physical production lines, offering real-time data on performance metrics, quality control, and equipment status. AR apps

can even be used to overlay life-size digital machines over a physical space to assist with floor planning. This level of transparency allows for quicker decision-making, proactive problem-solving, and optimization of processes.

The globalized nature of modern industries often requires collaboration among geographically dispersed teams. XR technology facilitates seamless remote collaboration by providing immersive communication channels. Whether through virtual meetings, shared AR workspaces, or holographic conferencing, XR fosters effective communication and collaboration, eliminating the barriers imposed by physical distances.

An unparalleled advantage of VR technology in particular lies in its capacity to unite individuals from diverse locations within a shared virtual space. This is why igus has developed the "iguverse," an industrial metaverse platform for users across the globe to share ideas, concepts, and insights. Customers can also speak with igus experts for assistance in choosing products, performing maintenance and repairs, or optimizing designs.

Ensuring the safety of workers is a paramount concern in industrial settings. XR technology contributes to safety by creating realistic simulations for training purposes, enabling employees to practice emergency procedures in a controlled virtual environment. Additionally, AR applications can provide real-time safety information, such as hazard warnings and equipment status, directly in the field of vision, minimizing the risk of accidents and enhancing overall workplace safety.

As industries continue to navigate the complexities of a rapidly evolving technological landscape, the adoption of Extended Reality technology emerges as a strategic imperative. The transformative benefits, ranging from improved training and maintenance procedures to increased operational efficiency and enhanced safety protocols, position XR as a powerful tool for innovation in the industrial sector.

Mixed reality: a new approach to building

While companies like the former Oculus (today Meta) or HTC with its Vibe headset went down the virtual reality road, an innovative technology that has not gained mainstream status despite its potential, Microsoft chose another approach with its mixed reality HoloLens glasses, i.e., the overlapping of interactive holograms with the real world as their background. Together with augmented reality, the applications of this innovative technology have proved to be much more successful in the professional domain, especially in healthcare, where it assists surgeons in non-invasive operations, or in the business sector, where it helps with the on-site maintenance of machinery while providing hands-free assistance in real time.

Construction is another field ripe for the new features of mixed reality, also based on the HoloLens hardware. This time, it is an innovative software developed by a company called Fologram that enables the construction of complex structures like curved walls. Although 3D printing and robotics have gradually replaced manpower, there are still many tasks that require human intervention.

For instance, if a complex wall —because of its organic structure or curved shape— needs to be erected, the process can be costly and time-consuming. Currently, the bricklayers need to follow a plan and rectify any errors on the go. Let's

imagine, however, that the worker is equipped with a pair of mixed reality glassed that show a hologram with the exact position of each brick. While the successive layers are put into place, the software projects the variations in the angle of each one, which speeds up the process and minimizes human errors.

That is the simple but efficient concept behind Fologram. The results speak for themselves, two bricklayers need less than seven hours to erect a curved wall that, with traditional methods, would have required two weeks' worth of work and many rectifications. Moreover, paired with this software, the mixed reality glasses provide a powerful training tool for new workers, guiding them step by step throughout the process.

Finally, the value proposition of this technological project goes beyond the physical and virtual environments, as it will also enable man-machine communication within the 4.0 industry world and the Internet of Things. Thus, in a work site with a 3D printer, the operator would be able to specify each required element and even work without plans, as the software will be assessing the load paths on the spot.

What is the difference between mixed reality and augmented reality?

Even though almost everyone is acquainted with how a virtual reality headset works, that is, by creating an entirely digital reality, there are subtler differences between augmented reality (AR) and mixed reality (MR). The former overlaps holograms without interacting with physical reality. The usual example of this technology would be the projection of virtual screens providing information to the user while also seeing the physical space, such as the Google Glass hardware tried to achieve before its untimely death.

The latter, however, combines virtual reality and augmented reality to enhance interactivity by introducing virtual objects in the physical reality and the other way round, as well as allowing to manipulate them like physical objects, i.e., a 3D projected chair would disappear if there is another piece of furniture hiding it from view. If we came closer, we could lift it and place it somewhere else in the room. Eventually, virtual, augmented and mixed reality will come together in single multifunction devices

The Future Of Virtual Reality (VR)

You might think you've experienced VR, and you might have been pretty impressed. Particularly if you're a gamer, there are some great experiences to be had out there (or rather, in there) today.

But over the next few years, in VR, as in all fields of technology, we're going to see things that make what is cutting-edge today look like Space Invaders. And although the games will be amazing, the effects of this transformation will be far broader, touching on our work, education, and social lives.

Today's most popular VR applications involve taking total control of a user's senses (sight and hearing, particularly) to create a totally immersive experience that places the user in a fully virtual environment that feels pretty realistic.

Climb up something high and look down, and you're likely to get a sense of vertigo. If you see an object moving quickly towards your head, you'll feel an urge to duck out of the way.

Very soon, VR creators will extend this sensory hijacking to our other faculties – for example, touch and smell – to deepen that sense of immersion. At the same time, the devices we use to visit these virtual worlds will become cheaper and lighter, removing the friction that can currently be a barrier.

I believe extended reality (XR) – a term that covers virtual reality (VR), augmented reality (AR), and mixed reality (MR) – will be one of the most transformative tech trends of the next five years. It will be enabled and augmented by other tech trends, including super-fast networking, that will let us experience VR as a cloud service just like we currently consume music and movies. And artificial intelligence (AI) will provide us with more personalized virtual worlds to explore, even giving us realistic virtual characters to share our experiences with.

VR in education and training

VR is already making great inroads into education, with a large number of startups and established companies offering packaged experiences and services aimed at schools. Engage's platform is used by the likes of Facebook, HTC, and the European Commission to enable remote learning. And one study published in 2019 found that medical students trained using VR were able to carry out certain procedures quicker and more accurately than peers trained using traditional methods.

These new methods of teaching and learning will become increasingly effective as new technologies emerge. One that is likely to make waves is the Teslasuit, which uses a full-body suit to offer haptic feedback, enhancing the immersion through the sense of touch. It also offers an array of biometric sensors enabling the user's heartbeat, perspiration, and other stress indicators to be measured. The suit is already used in NASA astronaut training, but its potential uses are unlimited.

For training, it could be used to safely simulate any number of hazardous or stressful conditions and monitor the way we respond to them. For example, Walmart has used it to train retail staff to work in Black Friday situations, instructing them on how to best to operate in busy shop environments with long queues of customers.

As well as training us for dangerous situations, it will also drastically reduce the financial risks involved with letting students and inexperienced recruits loose with expensive tools and machinery in any industry.

VR in industry and work

The pandemic has changed many things about the way we work, including the wholesale shift to home working for large numbers of employees. This brings challenges, including the need to retain an environment that fosters cooperative activity and the building of company culture. Solutions involving VR are quickly emerging to help tackle these.

Spatial, which creates a tool best described as a VR version of Zoom, reported a 1,000% increase in the use of its platform since March 2020. In total, the value of the market for VR business equipment is forecast to grow from $829 million in 2018 to $4.26 billion by 2023, according to research by ARtillery Intelligence.

Communication giant Ericsson (which has provided Oculus VR headsets to employees working from home during the pandemic for VR meetings) has talked about

creating the "Internet of Senses." This involves developing projects involving simulating touch, taste and smell, and sensations such as hot or cold. It predicts that by 2030, we will be able to enter digital environments that appear completely real to all of our five senses simultaneously.

This will lead to the advent of what it calls the “dematerialized office” – where the office effectively vanishes from our lives as we’re able to create entirely interactive and collaborative working environments wherever we are in the world, simply by slipping on a headset and whatever other devices are needed for the task at hand.

VR in socializing

There are already a number of VR-based social platforms that allow friends or strangers to meet up and chat or play in virtual environments, such as VR Chat, Altspace VR, and Rec Room. As with VR in other fields, the growing level of immersion that is possible thanks to new technological developments will make them more useful and more attractive to mainstream audiences throughout the coming decade.

This year Facebook, which has long had a stake in VR due to its acquisition of headset manufacturer Oculus, unveiled its Horizon platform. Currently, in beta, it allows people to build and share collaborative online worlds where they can hang out, play games, or work together on collaborative projects.

While we will always make time for meeting up with friends and loved ones in the real world, as our working and school lives become increasingly remote, it’s likely that more of our social interaction will move into the online realm, too. Just as we are no longer barred from careers or educational opportunities due to an increasingly virtualized world, we will have more meaningful ways to connect with other humans as technology improves in this area.

And of course – VR in games and entertainment

The “killer app” for VR is gaming, and the reason the technology is developing at the pace it is, is due to the large market of people willing to spend money on the most impressive and immersive entertainment experiences.

Sandbox VR operates real-world VR centers where equipment that it simply wouldn’t be practical or affordable to use in our homes offer some of the most immersive experiences yet created.

Using full-body haptic feedback suits, they offer five games – one licensed from Star Trek – that let groups cooperate or battle it out in deep space, aboard ghostly pirate ships, or through a zombie infestation.

CEO Steve Zhao describes the experience his company has created as a "minimal viable Matrix or holodeck." In a recent conversation that you can see here, he told me, "the outcome is that you believe in the world – it's very real, and in order to progress, you and your friends have to communicate and work together. One of the best ways to describe it is that you are the stars inside your own movie – that's basically what we created."

It makes sense in many ways that there could be two markets for consuming VR entertainment – at least in its early days. While the most immersive and impressive tech is big, expensive, and requires technical skill to operate, it's more viable to offer it at dedicated venues rather than as an in-home experience. As with movies, the stay-at-home offerings will provide something perhaps a little less spectacular but more convenient – at least until we get to the point where we can have full-size Star Trek holodecks in our own homes!

(by **Bernard Marr**)