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Дисципліна „Англійська мова”

Методичні вказівки з англійської мови професійного
спрямування для студентів III курсу теплоенергетичного
факультету

Затверджено Методичною радою НТУУ „КПІ”

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Дисципліна „Англійська мова”: Методичні вказівки з англійської мови професійного спрямування для студентів III курсу теплоенергетичного факультету / Уклад.: Л. М. Іванченко, старший викладач, Л. А. Яцюк, старший викладач, Л. М. Коломієць, старший викладач, Т. П. Козаченко, викладач, І.А. Свірепчук, старший викладач, К.А. Лісецький, викладач

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Навчальне видання

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Укладачі: Іванченко Лариса Михайлівна, старший викладач
Яцюк Людмила Антонівна, старший викладач
Коломієць Людмила Миколаївна, старший викладач
Козаченко Тетяна Петрівна, викладач
Свірепчук Ірина Алімівна, старший викладач
Лісецький Константин Анатолійович, викладач

Відповідальний редактор: Н. А. Тичина

Рецензенти: Т. В. Варянюк, старший викладач
Н. І. Карпенко, старший викладач

Редактор: Н. А. Тичина

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Передмова

Методичні вказівки до самостійної роботи над технічними текстами призначені для студентів III курсу теплоенергетичного факультету, спеціальності „Програмне забезпечення автоматизованих систем управління” та побудовані відповідно до програми, яка передбачає навчання студентів вмінню працювати з англomовною літературою за фахом, збагаченню словникового запасу і оволодінню практичними навичками.

Мета даних методичних вказівок - розширення та закріплення студентами термінологічної лексики за фахом та вміння висловити своє ставлення до прочитаного.

З метою найбільш ефективного опанування матеріалом до методички включено вправи на формування англomовної комунікативної компетенції усного професійного спілкування. Кожний розділ супроводжується практичним завданням для контролю рівня набутих навичок усного професійного мовлення.

Методичні вказівки розраховано для роботи зі студентами III курсу теплоенергетичного факультету, спеціальності „Програмне забезпечення автоматизованих систем управління” в аудиторії та для самостійної роботи.

Unit 1. What is a digital computer?

1. Read and translate the text

What is a digital computer?

This unit tells you what a digital computer is and explains some of the jobs it can do. It also tells you what computers use as their “raw material”: data.

Digital and analogue: what's the difference?

Suppose you stop somebody in the street, ask them for the time and '11.12' is the reply. You know that person is wearing a **digital** watch.

Just to be sure, you ask another passerby. The reply comes back: “Well ..., it's just before quarter past eleven.” That person has a watch with hands on it. It is an **analogue** watch.

Digital devices deal with numbers only. For example, a digital watch may tell you the time is “9.44”—an analogue watch tells you “It's almost quarter to ten.” Readings on a digital device go in jumps from one number to the next, e.g. 9.44, 9.45, 9.46, 9.47 ... They do not give readings on a steadily rising, continuous scale.

Analogue devices measure something by comparing it with something else, called its 'analogue'. They give a reading anywhere between an upper and lower limit. These two features are common to all analogue devices. For example, a thermometer measures temperature by comparing how far mercury moves along a scale.

Since digital computers can operate with numbers only, they cannot deal directly with information from an analogue device. Information must first be converted from analogue form (e.g. a reading on a scale) to digital form (i.e. a reading in the form of a number). This conversion is done by an **analogue-to-digital converter or digitizer**.

Some computers are analogue computers, but the rest of this book is about digital computers.

Information and data

The words “information” and “data” are sometimes given the same meaning, but there is an important difference between them. Look at this string of letters and numbers:

X K W 1 4 1 T.

It is just a string of symbols until you realize that it is a car registration number, then it starts to mean something. For example, “XKW” tells you where the car comes from; “T” tells you roughly how old it is.

A string of letters, numbers, and other symbols is called **data**. When you make sense of, or interpret, data it provides **information**.

A computer is often described as a machine that handles information. In fact, a computer can only deal with data.

Coding If you tell someone that you were born on the 7th July, 1970 then this information can be coded into data as: 07/07/70. There are several reasons for coding information into data:

- to make it easier to handle and communicate
- to make it shorter and more compact
- to make it exact and accurate

- machines can only handle data.

A Digital Computer

A **digital computer** is an **automatic, electronic, re-programmable, digital, data processor**. This is what most people nowadays mean when they talk about computers. So what is the meaning of each part of this definition?

automatic: A computer can work through, and carry out, a set of instructions on its own. This set of instructions is called a **program**.

re-programmable: The instructions given to a computer can be changed. It can be re-programmed to do a different job—either by changing an existing program or by giving it a completely new one.

electronic: There are no moving parts inside a computer—only tiny particles called **electrons** moving around in circuits. (This is one reason why they work so quickly.) A computer is just a vast collection of electric circuits and switches.

digital: Most computers deal with the figures 0 and 1. These are called **digits**.

data: A computer takes in data, changes it, then gives information out again. The data a computer takes in can be in the form of figures, letters, or punctuation marks, i.e. digital data ('data' is the Latin word for 'facts'). Inside a digital computer this is changed to a string of electrical pulses.

processor: A computer works on, changes, or processes, the data you give it. This is why it is called a processor. If the data put in is rubbish, the information got out will be rubbish. People who work with computers call this: “Garbage In, Garbage Out” or GIGO for short.

All these ideas together make up the meaning of the word “computer”.

Little and large

There are three main sizes of digital computer: the **mainframe computer**, the **minicomputer** and the **microcomputer**.

The largest type, “mainframes”, are used by banks, insurance companies, universities and other big organizations which need a lot of computing power. They may cost over £1 million and need over 100 staff to operate and maintain them.

Minicomputers may cost several thousand pounds and need a staff of 5 or 10 people to operate them properly. They are often used by smaller businesses.

Microcomputers, or “micros”, started to develop in the 1970’s. Nowadays you can buy a micro for less than £50 which has as much computing power as the original mainframes. They are used in homes, schools, and even small businesses.

	MAIN FRAME	MICRO
COST	Up to £1 000 000, or more	Less than £50, as much as £1000
SIZE	Housed in a large, air-conditioned room	Can sit on a desk; some can be carried in a brief case
USERS	Can support many users at once	Usually one user at a time

ACCURACY	Provide greater accuracy, e.g. for high precision maths	Accurate enough for most purposes
SPEED	Very fast operation	Slower, but fast enough for most purposes
MEMORY	Very large memory	Smaller memory, but increasing with new developments

What can a computer do?

There are certain jobs that a computer can, and cannot, do. Computers can ...

- follow and carry out a series of instructions (a program)
- work more quickly and tirelessly than your brain
- store data in their memory
- make simple decisions which they are programmed to make.

Computers cannot...

- do anything without a program of instructions written by a human
- think for themselves
- create symphonies, pop songs, novels, works of art or jokes
- judge a painting, poem, song or book to be good or bad
- feel hot, cold, irritable, tired or angry (which is just as well).

In other words, a computer can only do what a human being has programmed it to do in the first place.

The complex tasks which computers can perform can all be broken down into four basic jobs or operations:

- taking in and giving out data
- doing arithmetic (adding and subtracting)
- comparing items of data and making simple decisions
- moving data around inside the computer.

A skilful programmer can program a computer to do a complex task by gradually breaking it down into these four basic operations.

KEY POINTS

1. Digital devices only deal with quantities that go up in steps. Analogue devices deal with quantities that vary steadily and gradually.
2. A string of symbols may be data. Information is the meaning attached to those symbols by a person.
3. A digital computer is an automatic, electronic, re-programmable, digital, data processor.
4. There are three main sizes of computer: mainframe computer, minicomputer and microcomputer.
5. A computer can only do what it is programmed to do.

2. Read and learn words and word combinations

digital—цифровий
analogue—аналоговий
devices—прилади
to convert—перетворювати
data—данні
string—ряд, строка
roughly—грубо
to handle—опрацьовувати, обробляти
exact—точний
accurate—точний, правильний
tiny—маленький, крихітний
circuit—схема, електричне коло, канал
to process—обробляти
mainframe computer—універсальний комп'ютер
to store—зберігати, запам'ятовувати

3. Do tasks

Task 1. Copy out and complete these sentences:

- a) A _____ is an information processing device.
- b) Analogue and _____ are the two main types of electronic computer.

Task 2. Why is a simple pocket calculator not a computer?

Task 3. Write 'analogue' or 'digital', as appropriate, beside each of the following to indicate the mode of operation.

- a) A glass tube on the side of a fuel tank to indicate the amount of oil remaining
- b) A cricket Scoreboard
- c) A weather vane
- d) A set of traffic lights
- e) A magnetic compass (SREB)

Task 4. Explain the difference between information and data. Give two examples of data showing how it is interpreted to give information.

Unit 2. Digital computer systems

1. Read and translate the text

Digital computer systems

A digital computer system is made up of different parts connected together. This unit introduces you to some of the parts and the names given to them. All computer systems, from the smallest microcomputer to the largest mainframe, have these same basic components.

The main parts of a computer

One way of understanding how computers work is by comparing them with other machines, or even with people who do certain jobs.

You can compare a computer with an office clerk sitting at a desk. Information and instructions are given to the clerk. They reach his brain through his eyes and ears. These are his “input devices”. All this information is converted into nerve impulses which travel to his brain. Some of the information, and the instructions on what to do with it, he remembers in his memory. Other parts of the information are handled and dealt with straight away. He may help his memory by jotting things down on his memo pad, for example: instructions or jobs to be carried out next day or next week. When the clerk has dealt with, or processed, the information from his 'in' tray according to the instructions given to him he can pass it along to his “out” tray.

	CLERK	COMPUTER
INPUT	1 Information supplied to him 2 Instructions given on what to do with the information	1 Data fed in 2 Computer program given to process it
INPUT DEVICES	Eyes and ears convert messages to nerve impulses for the brain	Keyboard, paper-tape readers, etc. send electrical impulses to the central processing unit
THE 'BRAIN'	1 Holds information, remembers instructions (memory) 2 Processes information, e.g. adds numbers, sorts into alphabetical order	1 Memory: stores data, holds instructions 2 Central processing unit takes instructions one at a time; processes data
OUTPUT DEVICES	1 Clerk writing on paper, e.g. results of a calculation 2 Clerk's voice	Printers, television screen, paper-tape puncher, etc.

OUTPUT	Information, e.g. a hand-written bill	Information, e.g. a computer printout
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Comparing an office clerk with a computer system

Like a computer, the imaginary clerk is an **information processor**. This table shows you how the job done by a computer system can be compared with the job of our office clerk.

This comparison may help you to understand the way in which a computer system works:

input —> **process** —> **output** However, don't take the comparison too seriously.

Inside the “brain” of a computer

Memory The first part is the memory. This is made up of a set of “pigeon holes” or **locations**. Each location can store a certain amount of data (just as a house has a certain number of rooms). Computers only deal with 1’s and 0’s—these are called **binary digits, or bits** for short. In some computers each location can hold 8 bits. Others can hold 12 bits and some can hold as many as 16, 24 or even 32 bits in each location.

Each location has an **address** so that data can be sent to it, and fetched from it. This address is always given a number (like the number on the outside of a house), but the address number of each location must not be confused with the data inside the location, the **contents**.

The memory inside the computer is often called the **main store** or **immediate access store**. To add to this, most computer systems have extra memory in their **backing store**. This contains data or instructions on **magnetic tape or magnetic disk** (for example) which can be loaded into the computer when needed. This extra memory is also called **long-term storage, mass storage** or **auxiliary storage**.

The part of a computer system which actually processes data is called the **Central Processing Unit (CPU)**. This has two main parts: the **control unit** and the **arithmetic and logic unit**.

What makes a “computer system”?

A **system** is a mixture of parts working together. This section describes the different parts of a computer system which work together, as a whole, to make it do useful jobs.

Hardware This means the machinery itself, the parts you can actually trip over in a computer room. The hardware consists of:

- the input and output devices
- the central processing unit
- the main memory
- the extra memory (auxiliary storage or backing store).

The input and output devices, and auxiliary storage, are outside the central processing unit. They are often called **peripherals** (“peripheral” = outward part).

Software The hardware alone is not enough to make a working computer system. Something is needed to operate and control the different parts. Besides this, the computer must be given instructions to make it do a useful job. These extras, which bring the

hardware to life, are called **software**. Two types of software are needed: **systems software** and **applications software**.

“Systems software” is the name given to all the programs inside the computer which make it usable. One part of the systems software controls or “drives” the different parts of the computer system. The other part “translates” the **programming language** employed by the computer user (e.g. BASIC, PASCAL) into **machine code** which is a series of electrical pulses.

The applications software for a computer is written to make the computer do certain tasks, or solve certain problems (i.e. to apply the computer). This is often written in a programming language best suited for certain jobs (e.g. FORTRAN for scientific work, COBOL for business uses). The systems software then has the job of translating this language when the computer system is used. The programs written to make use of the computer are called **applications programs**.

KEY POINTS

1. Every computer system involves input, processing and output.
2. The central, or key, part of a computer system consists of a processing unit and a main, internal memory.
3. The processing unit consists of a control unit and an arithmetic and logic unit.
4. A computer system is made up of hardware and software.
5. The term “hardware” refers to the actual physical parts or units which make up a computer system. “Software” refers to the programs which operate and apply a computer system. Software puts hardware to work.

2. Read and learn words and word combinations

input devices—пристрої введення

jot—мала кількість, коротко записати

memo pad—клавіатура пам'яті

tray—блок, панель

locations—розміщення, визначення місця

binary digits (bits)—двійковий розряд

to fetch—викликати, вибирати

immediate access store—запам'ятовуючий пристрій негайного доступу

backing store—зовнішня пам'ять

long-term storage—довгострокова пам'ять

mass storage—запам'ятовувальний пристрій великої місткості

auxiliary storage—допоміжна пам'ять

hardware—апаратні засоби

software—програмне забезпечення

applications software—прикладне програмне забезпечення

3. Do tasks

- Task 1. Briefly explain what each of these terms means: mass storage; hardware; CPU; systems software; peripheral; applications software.
- Task 2. Draw and label a block diagram to show the four main hardware units that make up a computer system. Indicate the flow of data between the units.
- Task 3. A process is a sequence of actions carried out in a definite order. Here is a list of some processes that are done in everyday life:
- baking a cake
 - washing clothes in a machine
 - growing peas from seed
 - playing a guitar
 - cooking potatoes
- For each of these processes write down:
- a) the input, b) the output.
- For two of them suggest what might be called:
- a) the hardware, b) the software.
- Task 4. Go back and read the section where a clerk is compared with a computer. The section may help you to understand computers, but there are dangers in this comparison. Make a list of the important differences between a clerk and a computer.

Unit 3. From the abacus to the computer

1. Read and translate the text

From the abacus to the computer

You can get an idea of what computers are, and where they came from, by looking briefly at their history. Computers really developed from calculating devices, though nowadays they are much more versatile and sophisticated.

Calculating, from early times to the 19th century

The abacus The first calculators used beads that moved along wires or strings. You probably used one when you were about 6 months old without knowing it. Invented more than 400 years BC, it is called an **abacus**. The abacus was, and still is, widely used in eastern countries like China, Japan, Russia and India. It is a speedy and accurate way of adding and subtracting numbers. But it was never widely used in the Western World, and it was never quite good enough at multiplication and division.

John Napier In 1617 a Scotsman called John Napier invented a new system for multiplying which would replace the abacus. He made a set of rods with numbers written on them: **Napier's bones**. Napier also worked out the first set of logarithmic tables, or logs. It took many years, but once they were ready all multiplications and divisions could be done by adding and subtracting.

Pascal's adder and subtracter A Frenchman called Blaise Pascal made one of the first mechanical calculating machines in 1642. This used 'setting wheels' which could be turned to stand for a certain number. To add another number each setting wheel was turned the appropriate number of places.

Leibniz's machine Pascal's machine could only add and subtract. Multiplication had to be done by adding over and over again. In 1671 a German called Baron Gottfried Leibniz made a multiplying machine. But his invention never really spread because it was so hard for the engineers of the time to build. However, a design made in 1875 by F. J. Baldwin was used in mechanical calculators right up until the 1960's.

The machines of Pascal and Leibniz were certainly calculators, but by today's standards they were not computers. They all needed a human being to dial numbers or turn handles. It was a strange English genius who designed the world's first computer—a computer that was never completely built.

Babbage's engines: 100 years ahead of their time

Charles Babbage was born in Devon in 1792. At the age of 21 he had the idea of building a calculating machine which would operate without human intervention. Babbage was disgusted at the log tables used in his day, which were full of mistakes. He wanted to construct an engine that would calculate certain mathematical functions accurately and mechanically: the **difference engine**. Part of it was built but the engine was never finished. In 1832 Babbage lost interest in his idea because he had a new one: the **analytical engine**. This engine would have been the first automatic universal computer—it was designed to carry out any kind of calculation by following “in-

structions” given to it. Babbage’s analytical engine was never built, but it had all the features of a modern automatic general-purpose computer:

- a store (or memory) for holding numbers (Babbage’s idea was to use columns of wheels. Each wheel could be set in any one of ten positions to stand for a number.)
- an arithmetic unit—this would carry out addition or subtraction of numbers in the store (Babbage called this the “mill”.)
- a control unit—this would make the machine carry out its instructions in the right order
- an input device—this would feed numbers and instructions into the machine
- an output device—this would display the results of a calculation.

Why was the analytical engine never built? People have said that Babbage was 100 years ahead of his time. The engine needed very precise engineering for all its wheels, gears, rods and cogs. Engineers at the time were simply not capable of building it. Besides this, nobody saw any need to build the engine—what would they use it for?

Babbage’s ideas live on

The first program Babbage left no written description of his engine. Fortunately a lady called the Countess of Lovelace (1815-52) was one of his admirers. Lady Lovelace (the daughter of Lord Byron) made notes describing Babbage's engines in detail. She also wrote a list of instructions which would get the machine to carry out a calculation automatically. Lady Lovelace was the first computer programmer.

Punched cards She wanted to have the instructions punched onto cards. The idea of **punched cards** had come from a Frenchman called Joseph Jacquard in 1801. He used them to control a weaving loom. The Jacquard loom could weave almost any pattern depending on the hundreds of cards that were used to control it. Babbage planned to use punched cards to control his analytical engine, but his idea was never tried in his own lifetime.

Hollerith's punched cards In the 19th century a census was held in the United States every 10 years to keep track of the growing population. Unfortunately the figures from the 1880 census were still being counted and sorted in 1887! The job would not be finished before the next census was due, in 1890. An engineer called Hermann Hollerith knew about Jacquard’s loom and he suggested using similar punched cards to sort and count the census figures. A sorting machine was made, powered by electricity (the latest invention) and controlled by punched cards. Hollerith's machine sorted out the 1890 census in just six weeks.

Notice that the punched card was now being used in two ways: to give instructions, and also to store data. The present-day abilities of computers were beginning to develop.

2. Read and learn words and word combinations

abacus—рахівниця

beads—крапці

wire—дріт

set of rods—набір дескрипторів режиму
subtraction—віднімання
log—протокол, запис, реєстрація
login—входити
wheel—вузол
mill—дробити
precise—точний
gear—привід, передача
rods—дескриптори режиму
census—перепис
punched card—картковий перфоратор
cog—зубець

3. Do tasks

- Task 1. What were Babbage's two engines called? Which one is nearest to the modern idea of a computer? Explain why.
- Task 2. What was John Napier famous for?
- Task 3. Explain the difference between a calculator and a computer?
- Task 4. Make a simple time chart showing how calculators developed from 400 BC up until 1900.

Unit 4. Computers in the 20th century

1. Read and translate the text

Computers in the 20th century

The central processing unit of the world's first computer filled a room and used as much power as a steam engine. Thirty years later the same computing power could be built on a wafer of silicon as small as this:

Unit.4 explains how computers have shrunk since 1944 and have spread from a few science laboratories into millions of front rooms.

Mechanical monsters

Charles Babbage first formed the idea of a fully automatic general-purpose calculator, or computer, in Cambridge, England in 1832. His idea finally became reality in Cambridge, Massachusetts, USA 112 years later. In 1937, Howard Aiken of Harvard University planned the **ASCC**: Automatic Sequence Controlled Calculator. It was finished in 1944—a mechanical monster over 16 metres long and nearly 3 metres high.

He claimed that it was the world's first computer. Like Babbage's analytical engine, numbers were stored by wheels in different positions—this machine had hundreds. Information was fed into the machine by punched cards.

More huge computers were built in 1937 and 1938. They were called **electromechanical computers** because they had both electrical and mechanical parts. When World War II broke out in 1939 there was a tremendous need for these machines (unlike Babbage's in 1832).

Faster and faster calculations were needed in tracking aeroplanes, cracking enemy codes, working out the path of missiles and shells, and computing the results of atomic reactions for the atom bomb project. Because of this need, computers developed much further from 1939 to 1945 than they had done in the previous 100 years.

The first electronic machines

In 1946 an electronic computer was built at the University of Pennsylvania. It was called **ENIAC**: Electronic Numerical Integrator and Calculator. This computer was built to calculate bombing and firing tables to help make bombs, shells and missiles more accurate. It was even bigger than the ASCC, occupying a space of 140 square metres and weighing 30 tonnes.

This computer used an earlier invention: the **valve**, or high-speed vacuum tube. ENIAC contained nearly 19000 valves. Valves can operate far more quickly than cogs and wheels. ENIAC could do as many calculations in 1 hour as the ASCC could do in 1 week. In 1 second ENIAC could perform 5000 additions or 300 multiplications. ENIAC made all mechanical calculators obsolete.

Stored program computers

The MANIAC A brilliant Hungarian mathematician, Dr. John von Neumann, had emigrated to America in 1930. He became involved in the building of the new hydrogen bomb. A faster and more powerful computer was needed to carry out all the necessary calculations. Von Neumann suggested two new ideas:

- using binary numbers, with only the digits 0 and 1, inside the computer (The electronic parts could be either “on” or “off”—these two positions could stand for the two binary digits.)
- storing a set of instructions inside the computer, i.e. a stored program.

The computer used for the H-bomb project was nicknamed **MANIAC**: Mathematical Analyser, Numerical Integrator and Computer. With MANIAC's help the new bomb was finished and tested by 1952.

EDSAC In fact, the first computer using von Neumann's ideas was built at Cambridge University in 1949. It was called the “Electronic Delay Storage Automatic Calculator” or **EDSAC**.

Transistor machines

Computers which used valves were built right up until 1958, but they were huge and often unreliable. Some contained over 6000 valves and could become very hot. They also needed large amounts of electrical power—as much as 150 kilowatts (150 one-bar electric fires). By 1958 there were only about 60 computers in the whole of Britain.

However, in 1947 the **transistor** had been invented by an American called Shockley. This is a small piece of solid material which can do the same job as a valve, but it is smaller, needs less power and generates less heat. Computers using transistors were built from 1959 to 1964.

Hundreds were made. These transistorized computers were far smaller, faster, cheaper and more reliable than the huge valve machines of the 1950's.

Miniature circuits

Another invention, in 1957, brought a new generation of computers (the **third generation**). Tiny electric circuits were printed onto a miniscule piece of material. Each circuit contained the equivalent of hundreds or even thousands of transistors. They were called **integrated circuits**. Computers were built with integrated circuits right through the 1960's and early 1970's. The first minicomputer was built in 1965.

The mini and the micro

The 1965 minicomputer was the first mass produced computer. 'Mini' just means 'small'. Some were small enough to go on a desk. Computers became more widely used in business, industry, offices and hospitals.

In the 1970's, **microprocessors** or “**chips**” arrived. A chip is just a tiny, thin wafer of silicon. Electric circuits can be “printed” onto it. The circuit on a chip can do the controlling and calculating job at the heart of a computer. Chips became used in video games, pocket calculators, washing machines, cash registers and countless other devices. They may be smaller than a fingernail, but they can act as the control unit or “brain” of larger machines.

In 1975, chips were first used inside computers. The microcomputer had arrived. Nowadays microcomputers are commonplace. The smallest will go into a carrier-bag, yet it is more powerful, faster and reliable than ENIAC, which occupied a whole room—and it only uses 10 watts of electrical power!

The first three generations

The development of electronic computers from 1940 to 1970 is often divided into three generations. In each of these generations the essential parts of the computer itself (the computer hardware) were made up of different electronic components (e.g. valves, transistors). In each generation the time for the computer to carry out an operation (e.g. addition) became less and less. This table shows those three generations.

The fourth and fifth Generations

The **fourth generation** of computers is with us already. These involve extremely complex electronic circuits, formed onto one tiny silicon chip. This is called **Very Large Scale Integration (VLSI)**.

Countries like Britain, Japan and the USA are now planning the **fifth generation** of computers. These will be controlled by the human voice, and will respond to commands in our natural language. Future computers will be, in some ways, intelligent and capable of making decisions. They will have **artificial intelligence**.

GENERATION	DATE S	MAIN ELECTRONIC PARTS	OPERATING SPEEDS MEASURED IN...
I FIRST	1944-1958	Valves (high-vacuum tubes)	Milliseconds (10 ⁻³ second)
II SECOND	1958-1964	Transistors	Microseconds (10 ⁻⁶ second)
III THIRD	1964-1969	Integrated circuits (IC's)	Nanoseconds (10 ⁻⁹ second)
LATE THIRD	1970-	“Chips” (microscopic IC's on silicon wafers)	Picoseconds (10 ⁻¹² second)

KEY POINTS in the development of computers	
DATE	EVENT
450 BC	Abacus used in Greece and Egypt
1500 AD	Abacus called the soroban introduced to Japan
1614	John Napier calculated logarithmic tables
1617	Napier's bones
1632	Oughtred's slide rule
1642	Pascal's adding machine
1671	Leibniz's calculator

1805	Jacquard's loom controlled by punched cards
1822	Babbage's idea of the difference engine
1832	Babbage's idea of the analytical engine
1890	Hollerith sorted out the American census
1944	Harvard's mechanical monster. ASCC, built
1946	ENIAC — the first electronic computer
1947	Transistor invented
1949	EDSAC— the first stored- program computer
1951	UNIVAC — first commercial computer
1957	First integrated circuit
1965	First minicomputer
1975	First microcomputer

2. Read and learn words and word combinations

tremendous—великий,
 path—шлях доступу
 missiles—метальний
 shells—оболонка, командний процесор
 firing tables— таблиці запуску
 a valve—електрона лампа
 obsolete—застарілий
 digit—цифра
 solid—твердий
 circuit—схема, канал зв'язку, електричне коло
 to integrate—складати ціле, об'єднувати
 capable—здібний
 intelligent—розумний
 artificial—штучний

3. Do tasks

Task 1. In the following passage write the most appropriate words in the spaces provided.

First generation computers were developed in America about 1945 using _____ in their electronic circuits as active components. About the same time, John von Neumann and others proposed the _____ concept in which the sequence of instructions was held in the computer's store.

Second generation machines were available approximately 10 years later using _____ as the main electric component and had the advantage of increased _____ and _____.

In the 1960's, third generation computers using _____ were produced providing a reduction in _____ and laying the foundation for the silicon chip and accelerating the pace of the computer revolution. (SREB)

Task 2. What is meant by the 'three generations of electronic computers'?

Task 3. Explain simply what a silicon chip is. What can a chip be used in?

Unit 5. Putting data into computer

1. Read and translate the text

Putting data into a computer

Humans use words. Computers use electrical pulses. A device is needed so that humans can communicate with computers. Devices for putting data into computers are called input devices—this unit tells you about some of them and how they are used.

What are input devices?

2-state codes At the heart of every computer there are devices which can be either in one state or another. They are called **two-state devices**. Here are some two-state devices in everyday life.

The digits “1” and “0” are used to stand for the two states. Don't imagine that there are millions of 1's and 0's running around inside a computer, though. The only things moving are electrons.

Communicating When you communicate with somebody you convey information, for example:

“It's ten o'clock.”; “They won 2—0.”; “See you at six.”

People use words and letters to communicate with each other, but to communicate with a computer these words and letters must first be changed into electrical pulses and signals. This is the job done by an **input device**—it enables a human being to communicate with a computer. The input device translates various messages into patterns of “pulses” and “no pulses”, then sends them to the computer. The device may be right next to the computer, or hundreds of miles away.

To translate the electrical pulses from the computer back into a form that humans can understand an **output device** is needed.

Types of input device

The very first input devices were just switches. The “inside” of a computer could be programmed just by turning vast arrays of switches on or off. This was not very convenient, to put it mildly, and it meant that only computer experts could use them. Nowadays there are a variety of input devices. Perhaps the most convenient of all is voice input.

There is an important distinction between the medium used for input (e.g. spoken word, letters on a keyboard) and the device used to convert and send electrical signals to the computer. Often, the more convenient the medium for humans (e.g. the spoken word), the more complicated the device needs to be.

MEDIUM	DEVICE
Punched card	Card reader
Paper tape	Paper-tape reader
Magnetic ink characters (MIC)	MIC reader
Optical characters (OC)	OC reader
Optical marks	Mark sense reader
Keyboard characters	Keyboard
Spoken word	Voice recognition device

At one time most data was input to a computer using punched card or paper tape. Nowadays there are dozens of different input devices for putting data into a computer. The rest of this unit tells you about some of the more common ones.

Keyboard devices

A keyboard can be used to enter data directly into a computer. It looks like a typewriter keyboard, with a Q-W-E-R-T-Y layout. But as well as the usual characters (A-Z, 0-9, punctuation keys, etc.) it may have **special function keys** which can be used to give direct commands to the computer. When each key is pressed a series of electrical signals is sent to the computer—different signals for each key. As characters are typed in they may appear on a special display screen that looks like a TV screen. This is called a **Visual Display Unit (VDU)**.

Teletype Some keyboards are connected to a printer. The keyboard and printer together are called a **teletype or teletypewriter**.

Key-to-disk/key-to-tape Data can be typed directly from a keyboard onto magnetic tape. This can be used to store the data. This process is called **key-to-tape**. The same process can be used with magnetic disks—this is called **key-to-disk**. The tape or disk can later be used to input data at very high speed into the central processing unit of the computer.

Hand-held terminals This is one type of keyboard which is likely to be used more and more in the future. It has fewer keys than a full keyboard device and can be carried around. It has no leads connected to it. The user keys-in the data and a small memory inside it stores the data. Later it can be linked via telephone (for example) to a computer, and the data transmitted to it.

Document readers

Information is often in the form of written documents, that is, pieces of paper such as bills, forms, cheques, etc. In the past a human being was usually involved in transferring that information into data which a computer could then handle. Nowadays machines can 'read' documents directly and transfer the data straight into the computer. These machines are called **document readers**. There are various types:

Optical Character Readers (OCR) If special characters are used a machine can read printed documents directly. Two sets of characters, or **fonts**, can be recognized by OCR machines. These printed characters are scanned by a beam of light. Less light is reflected by the lines of the character than the white paper underneath. The reflected light

is detected by the machine and the light pattern sends a certain electrical signal to the computer for each character.

No machine can yet recognize handwriting because everyone writes in their own style, but many OCR machines can now read hand-written numbers if they follow a certain style.

Magnetic Ink Character Reader (MICR or MCR) Characters are printed, using a special font, in ink containing iron oxide. When the document is about to be read it is first passed through a magnetic field. This magnetizes the characters. Then they pass under a detection coil. The characters produce small electric currents in this coil—a particular pattern of electric currents is produced by each character. In this way the machine can detect or “read” the characters that go through it. Even if the characters become dirty, or stamped over with a rubber stamp, the machine can still read them. This makes them very useful for cheques.

Mark sense readers The document, form, or card is divided up so that a mark can be made in a certain position to stand for: yes/no; or A,B,C,D,E; or 1,2,3,4,5,6,7,8,9, and so on. A machine can detect a mark by “seeing” how much light is reflected at different positions. If much less light is reflected in one position, for example, there must be a pencil mark there. The machine “senses” the mark.

Badge readers

Small, oblong pieces of plastic can be used to carry data. These **badges** may hold data in the form of optical marks, magnetic marks, or punched holes. The badge is placed into a slot in the reader which then changes the data into electrical signals.

Badges and badge readers can be used to raise barriers at car parks, to check a person's identity, get money from a bank at a cash dispenser, clock on and off at a factory, or as cash credit cards.

Point-of-sale devices

More and more shops and supermarkets are using computers to keep a record of what they have sold and what is left in stock. A record can be made of a sale at the point where the goods are actually sold, for example, at the check-out. These devices which read the information and send it to a central computer are called **point-of-sale devices**.

Kimball tags This is just a small punched card. The tag gives details of the style, colour, size, etc. of an item, usually clothing. Sometimes cards are collected or batched together then read by a special machine each week. In other systems there is a card reader at the point of sale.

Bar codes Each of the numbers 0-9 is represented by a series of bars of varying thickness and separations (there is no need for you to learn the code for each number). The codes are read by a **light pen, or bar-code reader**, which is linked to a computer. As the pen is stroked across the bars, a pattern of electrical signals is sent to the computer. Some bar codes can be read with a **laser scanner** which works in a similar way to the light pen.

Kimball tags and bar codes are both used to send details of all sales transactions to a computer. These details can be stored on computer files to keep an accurate, up-to-date

record of sales and stock levels. Notice that in both tags and bar code labels information about the goods is coded.

Voice input

It would be so easy if you could just speak to a computer to give it an instruction, or to tell it a number or an address to store in memory. In fact you can, but the amount you can say is very limited. The main problem is that everyone speaks differently. Even simple commands like “on”, “off”, “up”, “down”, “right”, or “left” can be said in hundreds of different ways. Any voice-input system to a computer has to be 'trained' to recognize certain words. These are repeated over and over again until the system builds up a pattern of the sound. Then, when the system is being used, if a sound falls within this voice pattern the computer will respond to it. But if a person says the word wrongly, nothing will happen.

Voice-input systems are likely to be used more and more in the future especially where a user needs his or her hands free, or is disabled in some way. There are still many problems in training computers to recognize sounds—but some systems already have vocabularies of 200-300 words. Voices can be linked to a computer system by microphone, telephone or even radio transmission.

Other input devices

Many other devices have been created to send messages, signals and data to computers. **Joysticks** are often used in computer games. These can move objects on a VDU up, down, left or right. **Touch pads** are often used to send an electrical signal to a computer when they are pressed or even lightly touched. **Graphics tablets** can be used to transfer a map or drawing onto the screen of a VDU, or to store it in the memory of a computer. A graphics tablet is a flat board which holds the map or drawing. A special pen, or stylus, can be moved over this board. This pen sends an electrical signal to the computer indicating its exact position on the board.

It is impossible to describe all the huge variety of input devices that are, and will be used, to enable people to communicate with computers. One thing is certain: the number and range of these devices will continue to grow.

2. Read and learn words and word combinations

input—вхід, уведення, вхідні данні

to convey—повідомляти

to enable—розблокувати, дозволяти

pattern—зображення, графічний шаблон

font—шрифт

a beam of light—потік світла

underneath—донизу, під

to detect—виявляти

to stamp—штампувати, позначати

mark sense reader—позначати програму читання

badge reader—пристрій читання ідентифікаційних карток

oblong—подовжений
layout—розміщення, схема, формат
tape—стрічка
leader—початкова ділянка, заголовок
optical character readers—оптичний буквенний пристрій читання
badge—значок
dispenser—розподільник
point-of-sale devices—пристрої продажу етикетки
batch—пакет
bar codes—рядок кодів
up-to-date record—сучасний запис
voice-input system—система мовленого введення
joysticks—координатна ручка, джойстик
touch pads—сенсорна клавіатура
graphics tablets—графічні планшети

3. Do tasks

Task 1. Choose the correct answer from the choices A to D.

- a) Key-to-disk is a means of:
 - A) unlocking disk storage
 - B) protecting disks against theft
 - C) preparing machine-readable data
 - D) identifying programs on disks.
 - b) Which of the following use magnetic ink character recognition extensively?
 - A) library services
 - B) banks
 - C) local authority housing departments
 - D) electricity boards
 - c) The five main parts of a computer are:
 - A) printer, VDU, CPU, backing store, power unit
 - B) input device, output device, immediate access store, arithmetic unit, control unit
 - C) input device, central processing unit, output device, modem, teletype
 - D) acoustic coupler, mainframe, teletype, port, backing store.
 - d) A console is a:
 - A) A keyboard device for communicating with a computer
 - B) desk-top computer
 - C) person who works in data processing reception
 - D) large television screen used for output.
- (NWREB)

Task 2. a) List two ways in which a computer system linked to the cash tills of a supermarket may be used to the advantage of the store.
b) Give one disadvantage to the supermarket.
c) Give one advantage to the customer.
(YREB 1982)

Task 3. The use of point-of-sale devices is a method of computer recording the sales of goods as they are checked-out at a till.
a) State two ways in which the identity of goods could be given to the point-of-sale device.
b) State two purposes for which the information thus collected could be used.
c) Give two ways in which this recorded information could be transferred to the computer.
(JMB)

Task 4. Here are some examples of source information which contain data in machine-readable form:
a) cheque
b) credit card
c) mark sense card dj Kimball tag.
For each of these examples explain the principles of operation, how the data is encoded and how it is read. What advantages does each method have over more traditional methods of capturing the same data?

Unit 6. Getting information back

1. Read and translate the text

Getting information back

People put data into computers and computers send information back to people. You may be able to see this information on a screen, read it on paper or even hear it. The various devices which produce information in a form that is sensible to people are called output devices. This unit tells you about some of the many types available.

The earliest computers, in the 1940's, used lights as their output devices. These were arranged in patterns using “on” to stand for a “1” and “off” to stand for “0”. These binary patterns of 1's and 0's made sense to computer experts. But to ordinary people rows of lights, some on and some off, didn't mean much. Fortunately, printers were developed which could provide output that humans can read.

Different types of printer

Early printers were slow and noisy but they did provide output on paper, called **print-out** or **hard copy**, that people can make sense of and carry around. Nowadays there are many different types of printer. Some are **line printers**—these print a complete line in one process. The opposite of this type is the **serial printer**— these print one character after another along the line.

There is another way of comparing printers. Some are **impact printers**. These use a “print head” in the shape of a character, which strikes a carbon ribbon onto a piece of paper. This makes the shape of the character, e.g. “A”, “9”, “?”, on the paper (just like a typewriter). You can guess that impact printers can be very noisy! With **non-impact printers** no mechanical heads or hammers are used. This makes them quieter, and often much faster. Their disadvantage, as you will see, is that special paper is often needed.

Line printers

The two main types of line printer are the **drum line printer** and the **chain line printer**:

Drum printers These use a drum or cylinder which has a complete row of each character across its surface. For each line to be printed the paper stops and the drum goes round once. When a character on the drum which has to be printed reaches the print position, a hammer bangs the paper and carbon against the character. All the A's on the line are printed first, then the B's, then the C's and so on until the whole line has been finished. For example, a line consisting of “HELLO” will be printed in this order:

E
HE
HELL
HELLO

After the drum has gone right round once, the paper moves on to the next line. This may sound like a slow process, but in fact most drum printers can print 2000 lines in a minute! At this rate, this whole book could be printed in about 5 minutes. Drum printers

are fast, but they are very noisy and very expensive. This means that only large businesses and organizations can usually afford them.

Chain printers These are cheaper but slightly slower line printers. They use a moving chain with characters on it which goes round and round across the paper. As each character reaches the position where it has to be printed a hammer strikes the paper and ribbon against it. Like the drum printer, each character on a line is printed in turn until the line is complete, then the paper is moved on.

Line printers use a long stream of paper that folds itself at the back of the machine. This is called **continuous stationery**. Separate sheets can be torn off.

Serial printers

Serial printers print one character after another along each line of output until the line is complete. They are often used on teletypewriter terminals. Serial printers are slower than line printers, but on a terminal this may not matter, because a human can only type about 10 characters per second onto a keyboard.

One common type is called a **daisy-wheel printer**. This uses a metal or plastic disk with spokes coming from it. At the end of each spoke (usually 96) is a different character.

Daisy-wheel printers give a high-quality output, so are often used with **word processors** (e.g. to print business letters, references, requests, etc.).

A second type of serial printer is the **dot-matrix printer**. This makes a character on paper by forming a pattern of tiny dots. This pattern is called a **matrix**. The print head is made up of many tiny needles which can produce the pattern of black dots on paper.

Dot-matrix printers are faster than daisy-wheel printers, but the print quality is not so good. On some you can easily see the dots.

Non-impact printers

More and more printers are being developed which don't actually hammer a ribbon against a piece of paper. Nonimpact printers are generally very fast, very quiet, but very expensive.

- **Thermal printers** use the effect of heat on specially sensitive paper to make characters from a pattern of dots (a dot matrix).
- **Ink-jet printers** actually squirt quick-drying ink onto the paper in the shape of the character to be printed. The ink-jet is electrically charged and can be deflected into the right pattern.
- **Laser printers** use the same technique as photocopiers. A carefully directed laser beam creates a pattern of electric charge onto a special drum in the printer. This charge attracts a special black powder to it. Then, the drum transfers this powder to the paper to give the printed output. Laser printers can print about 25 000 lines per minute—ten times faster than a drum line printer. They can even draw pictures, maps and graphs, of very high quality.

You can see that a wide range of printers are now available for giving hard copy output or print-out. Some are fast—some are slow. Some are cheap (less than £50 for some microcomputers)—some are very expensive, costing many thousands of pounds. Some give high-quality print—some produce poor quality. The person, or business, or

organization that buys a printer often has to judge which one is most suitable in terms of: speed, expense and quality.

Computer Output Microfilm (COM)

Printed output produces large quantities of paper. Paper is expensive and it takes up a lot of space. To save money and space computer output can now be photographed onto **microfilm**. You have probably seen James Bond taking pictures of his enemies' secret documents onto microfilm. **Computer Output Microfilm (COM)** uses the same process. Printed output is reduced to a very, very small size. The microfilm can be read by a person by using a special reader which projects a readable image of the film onto a screen. COM is ideal when huge amounts of information have to be stored, and space is limited. Microfilm is used in libraries, archives, and in keeping files in industry. Computer output on microfilm can now be produced directly from magnetic tapes, without the need for paper. This could save a lot of trees from from being chopped down!

Graphs, pictures and patterns

“A picture is worth a thousand words.” Output devices which can produce drawings, maps and pictures are becoming more and more common.

Graph plotters These simply use a pen moving across a piece of paper to produce graphs, drawings, maps or plans. They are usually slow, but very, very accurate which is what really matters. Two types of graph plotter are **drum plotters** and **flatbed plotters**. With a drum plotter the paper is wrapped round a slowly moving drum, and the pen moves from side to side across the moving paper. The movements of both the pen and drum are controlled by the computer. Flat-bed plotters use a pen which can move in two directions across a piece of paper fixed to a flat bed. The movements of the pen are controlled by signals from a computer.

Visual display units A VDU looks like a television screen and works in a similar way. Indeed over a million television sets are probably used in Britain as VDU's to go with the microcomputers in people's homes. Output on a VDU has the advantage that it is displayed immediately, in front of a computer user—its disadvantage is that the output cannot be kept and carried away like a sheet of paper. However, most micros can be linked to a printer to provide hard copy of any display on the screen.

Characters are usually displayed on the screen using a dot matrix. A pattern of bright dots is used to make up letters, numbers and symbols.

Most VDU's can be used to display **graphics**, i.e. shapes, patterns and pictures. Using colour, computer graphics can be quite impressive especially when they are programmed to give the appearance of movement (animation). Some VDU screens use **low-resolution graphics** and use **blocks** of colour to make up patterns and pictures. Others use **high-resolution graphics**, forming pictures from much smaller points or **pixels** (picture cells).

VDU's are now widely used for computer output in, for example: airline reservations, office work, word processing, and computer-aided design.

Light pens A person using a VDU can change the picture on the screen by using a light pen. When the light pen is pressed against the screen a signal is sent to the computer indicating exactly where the screen was pressed. The light pen can be used to draw more

lines on the screen, or just to point to an item of interest. In fact, a light pen is an input device—it senses light on the VDU and sends a message *to* the computer. The screen itself is the output device.

Sounds, music and speech

Computers can be used to give output in the form of sound. Most microcomputers, for example, can easily be programmed to play simple tunes like “Three Blind Mice”, “Jingle Bells” or “Rule Britannia”. Computers are likely to be used more and more in the future to make musical sounds. Different notes and pieces of music can be put together to make new sounds. This is called **music synthesis**.

In a similar way the basic parts of human speech can be put together to make voice output. This is **speech synthesis**. By combining the very smallest parts of speech (called “phonemes”) a computer can be made to output spoken words. Speech synthesis chips can be added to some microcomputers.

Voice output could be useful in many areas. Some cars now use “speech” chips to tell you to “Fasten your seat belt.” or “Put some petrol in.” One computer has been designed to read books to blind people by scanning printed words and producing voice output.

Computer output for computers?

Almost all the output mentioned so far is designed to make sense to people. However, many output devices are used which provide output that can later be used as input for another computer. Two that were widely used are the **card punch** and **paper-tape punch**. They both produce output, on punched card or paper tape, that can be used directly as input to another computer. Three newer examples, are: bar-code label printers, printers of OCR fonts, and printers of MICR fonts. Just imagine the time when spoken output and voice input are widely used. Will computers start talking to each other?

MEDIUM	DEVICE
Printed word	Printers, e.g. drum-line, chain-line, daisy-wheel, matrix, laser
Punched card Paper tape	Card and tape punches
Graphs Pictures (graphics) Table Written word	VDU
Sound: voice or music	Speech synthesis and loudspeaker

Both the last two units have described input and output devices (i.e. peripherals). You can see that there is a wide range of both—they all have their uses in different places and circumstances.

Input and output—comparing speeds

INPUT DEVICES	APPROXIMATE SPEED (characters/second)
Keyboard	up to 10
Tape drive	50000
Optical character reader	up to 2000
Disk drive	500000
Paper-tape reader	1000
Punched-card reader	1000

OUTPUT DEVICES	APPROXIMATE SPEED (characters/second)	
Line printers	800	
Serial printers	Daisy wheel	up to 60
	Dot matrix	up to 200
Laser printer	30000	
Thermal printer	800	
Electrostatic printer	3000	
Electrosensitive printer	2000	

Don't pay too much attention to the speeds quoted in the tables. They only give you a rough comparison, and within a few years the speeds of input and output devices will probably be much faster. The important thing to remember is how slow they are compared to the central processing unit which can deal with several million instructions per second.

2. Read and learn words and word combinations

print-out—друкування

hardcopy—роздрукування, документальна копія

line printers—лінійний принтер

serial printers—послідовний принтер

impact printer—впливовий принтер

a carbon ribbon—копіювальна стрічка

heads—заголовок, магнітна головка

drum line printer—барабанний лінійний принтер

complete row—завершений рядок

to bang—ударяти, хлопати

character printer—прістрій посимвольного друку
character—байт, характер
chain printer—ланцюговий принтер
folder—каталог
to fold—складати
continous stationary—безперервний папір для друкарських пристроїв
daisy-wheel printer—пелюстковий принтер
spokes—спиця
matrix—матриця
non-impact printer—безканальний принтер
ink-jet printer—струменевий принтер
beam—промінь, струмінь
charge—заряд, витрати, завантажувати, плата
readable—придатний до читання, чіткий
image—зображення, образ, завантажувальний модуль, зображати
graph plotters—графобудівник
flatbed plotters—планшетний графобудівник
visual display units—пристрої дисплеї
low-resolution graphics—низька роздільна здатність графіки
block—блок, блокувати
high resolution graphics—високо роздільна здатність графіки
sense—відчувати, розпізнавати, читати
card punch—перфокарта
paper-tape punch—стрічковий перфоратор
font—шрифт

3. Do tasks

Task 1. Copy out and complete each of these statements.

- a) Barrel, chain and laser are all types of_____
- b) Most VDU's consist of a keyboard and a _____
(NWREB)
- c) The letters COM as used in computing stand for_____
(SREB)

Task 2. In which kind of peripheral device would you find a daisy wheel? (WMEB)

Task 3. In a road traffic control application the flow of vehicles at a road junction is controlled by a computer.

- a) What input device, operated by the vehicles themselves, feeds information into a computer?
- b) What output device is used to tell drivers what they must do?

- Task 4. Explain briefly, with the aid of a diagram, how a chain printer operates. (AEB 1982)
- Task 5. Give three reasons why a VDU would be used in preference to a teleprinter for a classroom demonstration in a biology class of, say, river pollution. (London)
- Task 6. A great many printers are now available, ranging from small, slow devices to large, versatile, fast printers. Describe various types of printer which are now in use, giving an indication of their operating speeds and paying particular attention to:
- a) the different facilities which they provide
 - b) typical applications for which they are appropriate. (Cambridge)
- Task 7. Teleprinters and visual display units are common input/output devices and are often used in schools and colleges. Explain, with reasons, which would be the most appropriate devices for the following educational applications:
- a) A computer assisted learning program which simulates the problems involved in motorway construction.
 - b) The writing and testing of a typical student program to be submitted as coursework for an "O"-Level computer studies course. (AEB)

Unit 7. Storing data

1. Read and translate the text

Storing data

Data can be put into a computer using input devices. Information can be given out by a computer through output devices. But in between input and output it may be necessary to store data. This data might be held for days, months, or even years in long-term or mass storage.

Permanent and temporary storage

A computer's internal memory is limited in size. Besides this it is only temporary—most internal memories lose their contents when the computer is switched off. However, large amounts of data can be stored permanently on backing store.

There are several reasons for using backing store to hold data.

- The internal memory of a computer is expensive and its capacity is limited.
- Internal memory is only used to store programs and data currently being processed by the CPU.
- Data, and programs, can be held for long periods on backing store then used when necessary.
- Data held on backing store can often be carried around or even sent through the post, i.e. it is portable.

Types of backing store

Various materials, or media, are used for backing store. The two most common (at present) are **magnetic tape** and **magnetic disk**. Magnetic drums and magnetic cards have been, and still are, used. New types of memory are described later.

All media used for mass storage have one thing in common. They use material which can either exist in one state or another, that is, they use a two-state code.

One state can represent a “0”—the other can represent a “1”. With magnetic tapes each small area on the tape can be magnetized one way or the other. The same two states are used with magnetic disk.

Magnetic tape

Magnetic tape is made of plastic, with a coating of iron oxide that can be magnetized. It is just like the tape used for recording music. Sometimes it is longer lasting and of better quality—but many microcomputers use ordinary cassette tape.

Data is stored by using magnetized or non-magnetized spots arranged in tracks or lines across the width of the tape. Each line of spots is used to represent one item of data.

Data is stored in **blocks** along the tape, separated by gaps. These gaps allow for starting and stopping of the tape.

Data can be fairly densely packed on modern tapes with as many as 7000 characters on 1 centimetre of tape. This means that as many as 50 million characters can be stored on a complete tape—as many characters as there are in several large books.

Tape drives and tape units

Sometimes data from backing store has to be transferred to the internal memory of a computer. At other times data has to be transferred from the computer's memory onto backing store. The device used to read from, or write to, magnetic tape is called a **tape unit** or **tape drive**.

Large tape drives run extremely quickly, with the tape moving at perhaps 250 centimetres per second. This is why the loops of tape are held in “vacuum columns”, to allow for the tremendous acceleration when the tape is starting or stopping.

The trouble with tape

Writing and reading speeds for large reel-tape systems are very fast, and data can be transferred at over 1000 000 characters every second. Even so, it can take 5 minutes to read data from a long tape, or to write data to it. If the data you need is at the end of the tape the only way to get at, or access it, is to read right through the whole tape. This is called **serial access**. It means that data on a tape can only be reached in the order in which it is stored. The time taken to get to, or access, some data on the tape depends on how far it is along the tape from the read/write heads.

This problem is even worse with cassette tapes. Their read/write speed is about 5 centimetres per second. It can take as long as 45 minutes to read a whole tape.

This is one of the reasons why disks are better for mass storage. The data stored on a disk can be reached directly.

Magnetic disks

All magnetic disks are coated in a substance that can be magnetized. Small spots on the disk are magnetized in either one direction or the other; just like the spots on tape. These magnetized spots are arranged around the disk in circular tracks, like the tracks on an LP record. Each track contains the same number of characters—this means that the characters are more densely packed on the inside tracks. The tracks are divided into **sectors** with gaps in each sector.

There are two main types of disk: **hard or rigid** and **flexible or floppy**:

Rigid disks Rigid disks are made of metal. They are often used in packs of six, or usually ten, joined together by a shaft or spindle down the middle.

Data is written onto the disk with a **write head** and read from the disk with a **read head**. The single head unit is called a **read/write head**. Read/write heads can normally move in and out across the disk to reach, or access, the required track. This is called **direct access or random access**. The read/write heads can go directly to an empty track (to write on it) or an item of data (to read from it). There is no need to pass through any of the previous data first. This is the main advantage of disk compared with tape.

Floppy disks These are small, flexible plastic disks coated with a magnetic material. They were first used in the 1970's as backing store for microcomputers. Floppy disks must be kept in a protective sleeve with a small slot in it to allow the read/write heads to read their surface. Floppy disks are cheap, portable and also fast, when compared with most forms of magnetic tape. They are ideal for storing data and programs for microcomputers.

Magnetic disk drives

A disk drive, like a tape drive, is used to transfer data from the internal memory of a computer to the disk or to input data from the disk to the computer. In other words disk drives, and tape drives, are used as both input and output devices.

Disk drives are used to rotate a disk, or a pack of disks, at a very high speed—up to 40 revolutions in 1 second (over 90 miles per hour at the rim of the disk). Disk drives for floppy disks rotate more slowly (about 6 revolutions in 1 second). As the disks rotate the read/write heads move across the surface of the disk, but they don't actually touch the surface. They fly just above it, to save wear. But the flying heads are so close to the surface they will 'crash' into it if they meet dust, grit, a hair, or even a smudgy fingerprint.

Winchester disks Specially sealed units are now used to keep disks clean and free from dust. These units are called **Winchester disk drives**. They are fast, very reliable and gradually becoming cheaper. The read/write heads are designed to take off from and land on to the surface without damaging it.

Modern memory devices

Research is going on all the time to make memory devices that are faster and have larger memory capacity.

Optical disks are being developed to store data, rather like the video disks used to record television programs. These disks have holes 'burned' into their surface—the two states are either “a hole” or “not a hole”! The holes (or not-holes) can be detected by a laser beam passing across the disk. Far more data can be packed onto optical disks than magnetic disks.

Another type of mass storage uses magnetic spots or “bubbles” which can move around on a silicon chip. These **magnetic bubble memories** will be far faster than disks, and certainly tapes. The two states used are the presence of a bubble and the absence of a bubble!

Comparing different types of backing store

Just as with output and input devices, the various types of backing store are used to do different jobs. There are four main ways of comparing different types of mass storage.

Speed Magnetic tape is far slower than magnetic disk. Magnetic disks are becoming faster all the time, but they are still slower than optical disks and magnetic bubble memory.

Cost Magnetic tape is cheap. Disks are good value but more expensive, especially when you add the cost of the disk drive. Newer memory devices are expensive, but their cost is likely to come down.

Access Data stored on disk can be reached or accessed directly. This is often a great advantage, for example, when a bank needs information on a particular customer. Data stored on magnetic tape can only be accessed in the order in which it is stored. This may be suitable for some jobs, for example, for storing a complete mailing list where each and every letter has to be sent out in turn. However, serial access can be a big disadvantage.

Capacity The amount of data that can be stored is the fourth important factor. Size

of memory is measured in bytes. Each byte is used to store one character of data (e.g. “A”, “9”, “%” and so on). Memories can usually store thousands of bytes (kilobytes) or millions of bytes (megabytes):

1 kilobyte = 1K bytes = 1024 bytes
 $= 2^{10}$ bytes

1 megabyte = 1M bytes = 1 000 000 bytes

So a 1 megabyte memory can store about 1 million characters of data. This table shows, roughly, the storage capacity of some different types of mass storage.

TYPE	CAPACITY (bytes)
Cassette tape	200K
Floppy disk	500K
Winchester disk	40M
Large reel of tape	125M
Disk packs	1000M
Future devices (e.g. optical disks)	250 000M?

Storage capacity of some types of mass storage

Don't try to remember these figures. They are only approximate and most of them are improving all the time.

2. Read and learn words and word combinations

permanent storage—постійній зовнішньої пам'яті

temporary storage—пам'ять, робочий запам'ятовувальний пристрій

internal—внутрішній

content—зміст, вміст, обсяг об'єм, кількість

backing store—зовнішня пам'ять, зовнішній запам'ятовувальний пристрій

internal memory—внутрішня пам'ять

spot—цятка

width—ширина

gap—проміжок прогалина

densely—густо, щільно

tape drive—дисковод на касетних стрічках

loop—цикл, петля, циклічно виконувати

tremendous acceleration—велике прискорення

reel-tape system—система бабінної стрічки

serial access—послідовний доступ

inside tracks—внутрішні доріжки

rigid disk—твердий диск

flexible disk—гнучкий диск, дискета

floppy disk—гнучкий диск
write head—головка запису, записувальна головка
direct access—прямий доступ
random access—прямий доступ, довільний доступ
track—доріжка
small slot—малий отвір, щілина, інтервал часу
disk drives—дисковод, накопичувач на дискети
to rotate—обертати
grit—витримка
sealed units—печатний пристрій
reliable—надійний
optical disks—оптичний диск
magnetic bubble memories—запам'ятовувальний пристрій на циліндричних магнітних доріжках
capacity—ємність, гранична пропускна здатність, обсяг
bytes—байти

3. Do tasks

Task 1. Copy out and complete these statements:

- a) Magnetic tape may be used only for serial access to data; magnetic disks may be used for either _____ access or _____ access.
- b) When data is stored on magnetic tape it is split into units known as _____.
(Cambridge]
- c) The time taken to retrieve data from a storage device is known as _____.
(SREB)

Task 2. Briefly explain what is meant by:

- a) backing store
- b) serial access
- c) floppy disk.
(SUJB)

Task 3. Explain, with the aid of diagrams, how information can be stored using:

- a) magnetic tape
- b) magnetic disk.

Task 4. Read the following passage carefully and then answer the questions below:

“The computer installed in a commercial organization was described as having 256K words of store running under ASAS II operating system with four disk units, two magnetic tape units, a VDU, a teletype, two fast card readers and a line printer.”

- a) What does '256K words of store' mean?
- b) What backing store facilities does the installation have?
- c) How is most of the information entered into this computer?
- d) How many output devices are listed?

Unit 8. Getting the most out of a computer

1. Read and translate the text

You cannot use a computer without having programs. But even when you have a program you still need some more software to help it run. This software is called an operating system.

What is an operating system?

To make use of a computer you need three things. You need hardware and you need a program to run on the computer (software), but you also need something to help your program to run on the hardware. This 'something' is more software called **systems software** or an **operating system**. The operating system stays in the computer all the time it is switched on.

Little and large.

The size and complexity of the operating system depends on the size of the computer. The simplest operating systems are on microcomputers, the most complex on large, shared computers. This is because small computers have less hardware to organize, large computers have more. A microcomputer is usually used by one person at a time, a large mainframe computer is used by several people at the same time.

Jobs done by the operating system

Here is a list of some of the jobs done by all operating systems. They:

- load programs and data into immediate access store
- store programs and data on backing store
- list programs or data on a VDU screen or printer
- communicate with a computer user or program
- allow for changes to programs or data files.

The user can communicate with the computer through the operating system. It take care of fetching data from disk, tape, terminal, etc. also, the loading of the user's program into the computer's memory is done by the operating system. Some instructions are given to the operating system directly by the user, some by programs running in the machine.

Command language

The user gives instructions to the operating system by means of a **command language**. This looks like another programming language, but instead of having instructions like 'LET A = A + B' as in BASIC, the command language has instructions 'LOAD STARWARS' or 'LIST STARWARS'. You may also need to 'tell' the machine to store your program on disk or tape. These simple commands will be taken by the operating system and it will carry out the tasks for you.

COMMAND	ACTION
LOAD	Load a program from disk or tape into

	memory
RUN	Star the program that is in memory
SAVE	Store the program in memory on disk or tape

Operating system commands

The operating system and your program

As well as communicating directly with the user, the operating system also helps applications programs to run. An example of this is the INPUT instruction in a BASIC program. INPUT means 'Fetch a number or some letters from the keyboard.' This actually gives an instruction to the operating system, which fetches what is required and then passed it to the program.

PRINT, GET and PUT are also BASIC instructions which set the operating system off on its tasks of transferring data between the user's program and VDU, printer and disk.

As you can see, the operating system has quite a lot to do.

Loading the operating system

The operating system is software, it is a program. It has to be in the computer's immediate access memory all the time it is switched on. How does it get there?

There are two main ways of loading the operating system into memory. These are by:

- using ROM (Read Only Memory)
- bootstrapping

Operating system in ROM

If the operating system is small, for example, on a microcomputer, it may be possible to store it on a ROM chip. When the computer is switched on this sets the operating system running. You may then give commands to the operating system, using the command language mentioned above. On many small microcomputers this also gives access to the BASIC programming language. With these machines you are usually limited to writing applications programs in the one language.

The machine will usually display a 'response' such as:

BASIC> or >

on the screen which means it is waiting for a command. Two examples are the BBS and the Sinclair Spectrum microcomputers.

Bootstrapping the operating system

For larger machines, the operating system is usually too large to store on a chip. (Although changing chip technology means that this may not always be true.) This means that it has to be stored on disk or tape and loaded into immediate access store when the computer is switched on.

The problem is that it is usually the operating system's job to fetch things from disk or tape. One way around this problem is to do as follows:

- have a small program stored in a particular place on a disk

- have a very small program stored in ROM which reads the small program from the disk into RAM and sets it running
- this program may then read the large operating system from the disk and store it in RAM and set it running.

This process is called **bootstrapping**, from the old saying: ‘Pull yourself up by your own bootstraps.’ The idea is that you have a very small program reading a bigger program and so on.

KEY POINTS

1. An operating system is software which makes the computer more usable. It helps users communicate with the computer and helps application programs to run.
2. Users communicate by means of a command language. It is stored in the machine all the time the machine is switched on.
3. Small operating systems may be stored permanently in ROM. Larger operating systems have to be read from disk or tape by a process called bootstrapping.

2. Read and learn words and word combinations

system software - системне програмне забезпечення, системне ПЗ

operating system - операційна система, ОС

list - вести список; виводити дані в упорядкованому виді

VDU (Video [Visual] Display Unit) - монітор [комп'ютера]

fetch – витягати

carry out – виконувати

set off – починати

bootstrap - [початкове] завантаження

3. Do tasks

Task 1. Fill in the blanks.

a) The software which controls the loading and running of programs is called _____ (SREB 1980)

b) A user communicates with the operating system by means of _____.

Task 2. Describe the process of bootstrapping an operating system.

Task 3. Why does the operating system have to be stored in the computer all the time it is switched on?

Task 4. Give the meaning of the term operating system and give an example of a task for which it could be used. (YREB 1981)

Unit 9. Types of operating system

1. Read and translate the text

Ever since computers were first used, people have tried to get more work out of them. Computers cost money, and time means money in the business world. This is why hardware and software developments have aimed at making the most of the available computer time.

The early days (1950 – 1960's era)

The early commercial computers were very expensive and did not have much systems software with them. To use them, people would load the program they wanted to run in the computer's main memory and put their data in the input device. The program and data were usually on punched cards or punched tape. Often there would be a computer operator to do this. Once the program was loaded and the data ready for input the operator would press the 'go' button. The computer would run the program, which would read the data and produce the output on a printer. The happy user would then walk away with the output, ready to let the next person in the queue use the computer.

Batch processing (1960's – 1970's era)

With the early method, the computer spent a lot of time doing nothing because it had to wait for the operator to put the next job in and press 'go'. Time means money, so changes were made to save time. This was done by **batching** jobs together. Instead of the operator putting in a program and the data one job at a time, a set of jobs were put in a stack in the input device along with instructions to the computer about how to run each of the jobs.

Job Control Language (JCL)

These instructions were addressed to the operating system, which would then run the programs in the right sequence. The instructions to the operating system were, for example, the program name, the name of the data, etc. these instructions were, and still are, called **job commands** and are written in **Job Control Language (JCL)**. Job control language is the name for instructions given to the operating system. JCL can look very much like a programming language.

Data control clerks

Batch processing speeds things up by reducing CPU waiting time. This means that a lot more input and output is processed. The danger is that all this input and output could become mixed up, so extra people are required to make sure things are kept in order. These people are often called **data control clerks**. Their job is to keep control of the data – to make sure the input gets passed to the machine in the right order, and that the output is passed back to the right person.

Off-line processing with batch input / output

Although batch processing increased the amount of actual work done by the computer (through – put), there was still a major problem. The computer still had to stop after each job before reading the next one in. It also had to stop to print the output.

Remember that the CPU runs at an extremely high speed when compared with an input or output device. To make more efficient use of the CPU the input and output times had to be reduced. The answer to this problem was to **off – line** the input and output. ‘Off – line’ means to input the programs, data and instructions to a fast storage device, such as magnetic disk, and save them. Then when the computer is ready to run a particular job it can get all the input it needs at higher speed from the disk.

It can also do the same with the output. Instead of sending the output data direct to the printer, it can go on to a fast disk for printing later. This is often called **spooling**. Each job running sends its output to a disk. When the computer is less busy, the operating system prints the output on a printer. This helps to spread the workload by doing slow printing work at off – peak times.

Of course, things could get into a real mess if this was not done properly. It is the job of the operating system to keep track of all the inputs and outputs and to make sure they all get processed at the right time.

Scheduling Having all the data and instructions off – line means that the jobs do not have to be run in the same sequence as they were input. This means that the jobs can be input in any order, and the operating system can run them in the best order. For example, one job may be more important than another, but happens to get input by the operator at a later time. If the instruction (in JCL) on the more important job say ‘urgent’, the computer could be made to run this first. This is known as **scheduling**. In this way more important jobs can be run more quickly than others by giving them higher priority.

Multiprogramming – doing more than one job at once

Even with batch and off-line processing the CPU can still spend a lot of time doing nothing. This is because each time it has to read from or write to a peripheral, it has to stop doing anything else. Even a disk drive is very slow compared with the CPU. Because of this, a lot of processing time is lost. The answer is to have more than one program running at the same time. This is known as **multiprogramming**.

With multiprogramming the immediate access memory of the computer may hold more than one program at once. Each program will need to use the CPU to process its instructions. Each program may at some time need to read **some** data from a disk or print on a printer. The operating system will allow each program a certain amount of time in the CPU on **round-robin** basis. That is, one program runs for a few milliseconds and is then stopped. Another program starts to run, and so on. When a program has finished reading or writing it will be included in the round robin again. With this arrangement very little CPU time is wasted in waiting for programs to input or output.

Distributed computing — the rise of the terminal

On-line processing On-line processing means that the person wishing to use the computer has a direct link to it. This link is usually through a VDU or teletype terminal connected by wires. Having a direct link can save a lot of time because you can tell the computer what you want it to do yourself. You tell the computer what to do by means of JCL via the terminal. The operating system may still schedule its work.

A typical large modern computer will run batch jobs and on-line jobs all at the same time. The operating system should attempt to give on-line users a quick service as well as getting all the batch work done.

Interactive processing Having on-line access to a computer means that you can do more than just tell the computer to run a job. You can also input data while your program is running. At the same time the computer can produce its results on the VDU screen or teletype. This is called **interactive processing** and has become very popular. It means you can have a dialogue or conversation with the computer. The dialogue may take several forms. Two examples are:

- question and answer
(You ask the computer a question using the keyboard. It gives you the answer on the screen. The computer may then ask you a question and so on.)
- forms filling
(The computer displays a screen which looks like a form with blanks to be filled in. You fill in the blanks.)

Multi-access Many terminals can be connected to the computer. These can all be in use at the same time. Each user is connected on-line. This arrangement is often referred to as an **on-line, multi-access system**.

Real-time computing

Real-time means the time as we know it, which seems obvious. So why have a special name for computing in real-time? Well, as you saw earlier, a lot of processing is done according to schedules which make best use of the CPU's time. No account of the time of day is taken.

With real-time computing the time by the clock becomes the most important factor. Let take an example—controlling a lunar module landing on the moon. A computer on board might be controlling the descent rate by firing retro rockets. The exact timing and duration of each firing needs to be very exact. Fire for too long and off you go into space again. Fire for not long enough and you smash to pieces on the surface. If the program controlling this were stopped for a while and another one run, the results would be disastrous.

The example illustrates the main features of real-time computing:

- the actual time taken by the program instructions is very important
- the commonest applications are in control systems
- there is no attempt to make the best use of the computer's time, just the real time.

The present day (1984-future)

Large mainframe computers are still used but mini- and microcomputers have taken a lot of their work. The spread of minis and micros has also meant that a lot of new work is done on computers. Batch processing still has its place for jobs requiring large volumes of data, but interactive processing is by far the most popular mode of working. Magnetic tape and disks have largely replaced punched card and paper tape for batch input.

Linking micros to mainframes Increasingly, the micro and mini are being linked to mainframe computers. This means that your terminal can be a microcomputer with a VDU. You can do some processing at your micro and also use the power of the big

computer when required. This arrangement is sometimes referred to as an 'intelligent terminal', as opposed to a 'dumb terminal'.

In business this means that someone at a desk can do their personal computing without 'disturbing' the mainframe. The mainframe could have a large database. The micro user can obtain and send information from, and to, the database. Also, if the program is too big to run on the micro, it could be run on the big machine.

This way of working is also useful for home computing and is seen as a way of passing programs and information around. The units on communications and social implications also discuss this development.

It is interesting to realize that today's personal microcomputer is similar to the computers of the early days. The micro will run your job when you want without scheduling. It does have limitations speed and data storage capacity, today's micro fits in a briefcase; the early equivalents filled a large room.

KEY POINTS

1. The early commercial computers ran one job at a time.
 2. Batch processing was introduced to increase the amount of work done by reducing waiting times between jobs.
 3. Data control clerks are needed to handle all the input and output. They batch input jobs and data together and send the outputs back to the right people.
 4. Job control language (JCL) is needed to instruct the operating system.
 5. Off-line processing was introduced and the operating system began to schedule work.
 6. Multi-programming means sharing the CPU between jobs, saving yet more time.
 7. On-line working gives you direct access to the computer and allows for interactive programming. Several people may do this at the same time, giving multi-access.
 8. Micros are increasingly being linked to large machines.
-
2. Read and learn words and word combinations

punch – перфоратор

batch - пакетний, командний

job Control Language - мова керування завданнями, мова JCL

batch processing - пакетна обробка

off line - автономний [режим]

spooling – спулінг

off peak – що відбувається не в годину пік

keep track - стежити за

scheduling - планувати.

immediate access - безпосередній доступ

multiprogramming - мультипрограмування, **багатозадачний режим**

round robin - круговий, циклічний

on line - постійно включений [пристрій], неавтономний режим роботи

interactive - інтерактивний, діалоговий
multi – access system - **МНОГОПОЛЬЗОВАТЕЛЬСКАЯ СИСТЕМА**

3. Do tasks

Task 1. Complete these sentences.

- a) *A collection of programs -and data ready for processing by a computer is known as_____.*
(SREB)
- b)_____ *means having several programs in memory at the same time and running each for a small space of time in sequence.*
- c) *The process by which the operating system decides which job to run next from the input batch is called_____.*

Task 2. What is meant by real-time computing?

Task 3. For which of the following computer applications is real-time not essential?

- a) guided missile control
- b) traffic control
- c) intensive care monitoring
- d) patients records (NWREB)

Task 4. *Explain the difference between the on-line and batch processing modes of operation.
(SUJB)

Task 5. What is meant by interactive computing?

Task 6. Why is interactive computing a popular way of using the computer?

Task 7. For which applications are remote terminal systems and batch processing systems most suited?

Task 8. This diagram shows a computer controlling a number of terminals. This type of system is often known as an on-line, multi-access system.

- a) Explain what is meant by on-line working.
- b) Explain what is meant by a multi-access system.
- c) Explain what is meant by a job queue.
- d) Explain what is meant by a time slice.
- è) Name three different types of job where such a computer could be used.
(SREB)

Unit 10. What is information technology?

1. Read and translate the text

Information technology is often said to be 'the technology of the future'. But it's hard to define exactly what information technology is. It is sometimes called the 'science of information handling', but what does this mean?

Information Technology (IT) arrived with the coming together of these technologies: microelectronics, computing and communications. This unit looks at each of these technologies in turn.

Microelectronics

There are three main electronic devices: transistors, capacitors and resistors. All have been used for the last thirty years. Until quite recently (about 1964) each of these devices was made separately and then wired together to make an electronic circuit. This can still be done, but nowadays electronic circuits are commercially produced by making and connecting all the devices on a tiny wafer of silicon in one continuous process. These tiny circuits on thin silicon wafers are called '**chips**'. The science of designing, making and using these chips is called **microelectronics**.

There are two main types of chip: **processing chips** and **memory chips**.

Microprocessors Chips used for processing data are called **microprocessors**. They can be designed to carry out arithmetic and logic processes, or to control the flow of data. Microprocessors may be used in microcomputers—but they are also used in washing machines, calculators, robots, cameras, watches, sewing machines, and so on. The list is always growing.

Memory chips. Memory chips are designed to store data, including computer programs. Some have their data 'etched' into them. These are **ROM** (Read-Only Memory) chips. Some are like an empty sheet or a blank notepad. These can have data written to them or read from them, i.e. write-or-read memory. These are called **RAM** (Random Access Memory) chips (though **WORM**—Write-Or-Read Memory—might be a better name). Between the two extremes of ROM and RAM are **PROM** (Programmable Read-Only Memory) and **EPROM** [Erasable Programmable Read-Only Memory]. PROM chips can have data recorded on them using a special process—but once it is there it cannot be changed EPROM chips can have their contents changed or erased, by exposing them to ultra-violet light.

Chips have many advantages over old-fashioned electronic circuits:

- *size*: Computing power that would have occupied a large room in 1950 can now be achieved on one chip. This helps to make them faster. It also means that they can be used in many devices and their size is hardly noticed.
- *cheapness*: Chips are cheap to make. Once designed, thousands can be mass produced, often for only a few pence. They are cheap to run, using very little energy.

- *reliability*: Chips have no moving or detachable parts. This makes them robust and reliable, in all kinds of conditions. Microelectronics, the technology of chips, is the most recent element of information technology,

Computing

The second of the triplet technologies is computing." Computing involves microelectronics as one of its parts or foundations – but the computing industry involves much more. The technology of computing involves: designing and analysing systems, producing software, collecting and coding data, producing clear and readable information, developing new hardware, and so on.

Computing is a slightly older technology than microelectronics. Today's computers, from micro to mainframe, contain one or more microprocessors (e.g. the BBC micro has a processing chip called the Motorola 6502. and ROM and RAM chips). But computing did exist well before the first chip was ever made.

Communications

The oldest technology of the three is communications. People have been communicating with each other for centuries: with smoke signals, bonfires, beacons, semaphore, morse code and now telephones and satellites, Modern forms of communication are often called telecommunications This is likely to involve at least three parts: telephones, television and radio waves, and fibre-optic cables.

Telephones One French expert estimated that in 1970 there were about 200 million telephones in the world; by the year 2000 there may be 2 billion. By AD 2020 he forecast a total of 10 billion telephones worldwide-more phones than people. If the telephone network does spread this widely, computer terminals will be linked by telephone throughout the world to form global computer networks. The number of computer terminals may one day equal the number of telephones.

Radio waves Radio waves travel through air, or empty space, at the speed of light (television waves are simply shorter wavelength radio waves). They are ideal for sending messages, including messages from one computer to another. Satellites are now used to help the passage of radio waves from one part of the globe to another.

Fibre optics The latest development in communications is the **optical fibre**. This is a strand of glass only as wide as a human hair, but often several kilometers long. Light or laser messages can be transmitted along these fibres. The message is first coded into binary form. A pulse of light represents 1-no pulse represents 0. At the receiving end the pulses are decoded. Optical fibres can carry over 40 million bits of data every second-at the speed of light. The fibres are collected together [perhaps 24 in all) into a narrow cable. These cables can join one person, business or industry to another to form a **cable network**.

Telephones, radio waves and satellites and fibre-optic cables will form the communications systems of the future. Each system has the same basic parts.

The three industries of microelectronics, computing and communications will form a 'tripod' for-the "information technology' age. The three technologies will vastly improve the storage, processing and communication of information. But what about information itself? Why should information be so important?

Good and bad information

Suppose you telephone your local railway station to inquire about trains to London. Your reply comes back: 'A train will probably be leaving some time today', This is poor quality information-it is vague, uncertain, and inexact. A more helpful reply would be something like: 'A non-stop train is leaving at 10,12 a.m. from platform 2, reaching King's Cross at 12,24 p.m.'. The table below summarizes the differences between high- and low-quality information. In other words, the more the uncertainly the worse the information

As information technology spreads, the quality of information will become more and more important. High-quality information about banks and money supply, current prices, world markets and trends, crops and agriculture, the weather, in fact almost anything, will become a valuable commodity. It will be the key resource in the society of the future-a resource which can be bought and sold, imported and exported. This is why people talk about the 'information industry'

2. Read and learn words and word combinations

capacitor – конденсатор

wafer - [кремнієва] пластина

robust – стійкий

reliable – надійний

fiber optics - **ОПТОВОЛОКОННИЙ** кабель, волоконно-оптичний кабель

strand - нитка

tripod – тринога

vague – невизначений

3. Do tasks

Task 1. Copy out this passage and fill the banks.

Information technology involves three technologies _____ , _____ , and _____ . Chips used for processing data are called _____ . These may be used in _____ , _____ , _____ and many other devices.

Task 2. Design and draw a clear and attractive chart or poster to show the main landmarks in the history of communications. You could call it 'From Smoke Signals to Satellite', or you could choose your own title.

Task 3. It has been suggested that through the use of computers we shall all have far greater access to information. Give one reason, with an example, to show why you agree or disagree with Ibis view.

(SREB)

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Task 5. Explain, in your own words, the meaning of each of these terms:
chip RAM
ROM optical fibre

Task 6. What is the difference between high and low-quality information? Make up one example of each type.

Unit 11. Information technology in action

1. Read and translate the text

Information technology involves storing, processing and communicating vast amounts of data. This unit tells you how IT is being used already, and how it might be used in the future

Videotex

You can receive data either through your television aerial or down your telephone line, then display this data on your television screen. The general name given to this is **videotex** (text on video). There are two different types of videotex.

Viewdata With this system information can be called up from a large computer by *telephone*, and displayed on your TV screen. (The best example is Prestel, British Telecom's version, which is explained fully later.) Viewdata is a two-way or *interactive* system. All the information stored in the central computer is called a **database**. A viewdata user can interrogate this database to get to, or *access*, the exact information he wants.

Teletext This is the name given to information which is sent from a TV transmitter, received by your television aerial, and displayed on your television screen. Two examples are Ceefax ('see facts') on BBC and Grade on ITV. These are both one way or non-interactive types of videotex. You can receive information, but you cannot send it back. You can call for a particular 'page' of information using a keypad.

The main advantage of teletext is that it is free - once you have a proper keypad and television. On the other hand, Prestel can be quite expensive to use.

More about Prestel

Using Prestel Prestel was invented and developed in Britain, through the British Post Office. It is simply a *computer-based information service*. To use it you need three things

- a special Prestel television set, or an adaptor on your present television
- a telephone, and a jack-plug to connect it to your television
- a keypad, which looks a bit like a pocket calculator.

By pressing the right buttons on your keypad you get In touch with the central Prestel computer via your telephone line. Pressing another button will give you an index of all the information available. Hundreds of thousands of pages of information are stored on Prestel. To help find the page you want a free directory is supplied to Prestel users. A user can then access any Prestel page by keying-in the full number, or he can browse through various pages, pressing a single key each time. Every Prestel user has to pay a rental charge and the cost of the telephone calls. This means that many users make a note of the page numbers they use most, just to save time and their phone bill! Some pages actually cost extra money if you use them (they have a 'frame charge')

What's on Prestel? Information is supplied to Prestel by **information providers**. These people rent pages from British Telecom and display their information on those pages. Information is provided about: travel, farming, imports and exports, hotels, the law, houses, business news, the world's economies, theatres, cinemas, currency exchange rates, share prices, even the weather.

Computer-programs are now being sent via Prestel. You can receive them in your home and record them on tape or disk. This is often called **telesoftware**. Some newspaper companies now use Prestel to communicate the news. You receive news pages on your screen and pay a small charge for each page. This is called the **electronic newspaper**.

Inside Prestel there are now closed **user-groups** (e.g. Micronet 800). These are groups which only certain people belong to, and pay extra rent for. They have their own pages which only group users can get to, or access. One of these groups, 'Homelink', enables shopping and banking to be done from home.

Responding Prestel is interactive. Using the keypad you can send messages back to the central computer. You can book a train or an aeroplane, reserve a hotel room, book a theatre ticket, or even buy a crate of champagne. You will need to key in your user number and your secret password—otherwise somebody else could spend your money.

Databases

What is a database? Prestel is often called a national database. A database is any collection of facts, items of information or data which are related in some way. A telephone directory is a database, so is an address book. Some **other examples** could be:

- a collection of recipes
- a filing cabinet
- the Oxford English Dictionary
- a library of books
- a textbook

Every database should contain data which is organized in a sensible and systematic way, for example, by placing names in alphabetical order. This should allow anyone using a database to put in, or get out, the information they want as easily and quickly as possible.

None of the examples of databases given above are computerized, but Prestel is. The main advantages of computerized databases are:

- unlike printed guides or books they can easily and quickly be kept up to date.
- the information they store can be accessed easily, quickly and directly—and often from hundreds of miles away.

Searching a database To search for information in a database like Prestel you use an **information tree**. At the top of the tree, Page 0, you are given a choice of nine options. You choose one by keying in its number (e.g. '3') then you are given, for example, ten further choices. You might choose Option 5. You will then be sent Page 35. Then if you choose Option 2 the next page displayed is Page 352. As you go down the information tree

the information you receive becomes more and precise. You might stop at page Page 35231, or even go as far as 35231762,

Imagine you wanted to find out the nearest cinema to you that is showing a funny film. You might start from the 'Entertainment' page, go down to 'Cinemas', then on to your local cinemas and finally to a list of the actual films being shown. In other words you start from the general (e.g. 'Entertainment') and go down to the *particular* (e.g. the nearest funny film to your home). This is how any database is searched.

Computer networks.

You already know that computers work with data which has been coded into a string of 1's and 0's (a binary code). Computers, and other devices which use computer-coded data, can be connected together to form **networks**. Using a network, coded data can be sent from one device to another. The signals are digital signals, or on/off pulses. These signals can be sent along wires, telephone lines, via television transmitters, or along optical fibres.

A network of microcomputers can be formed in a room or a house just by linking them with wires or cables. A **local area network** (e.g. in a large school, factory or university) can be made in a similar way. A wider network can be called a **district network**, for example, a village, town or city linked by telephone lines and possibly cables. Wider still is the **national network**, and then the **international** or **global network**. On these networks data will be sent by telephone line, land or submarine cable, radiowaves and satellites.

Using networks How can these networks be used? Here are just a few examples:

- *the electronic office:* In a large office or company all the electronic devices used can be linked together to form a local data network. Microcomputers, word processors, high-speed printers, mass storage tapes and disks, can all be joined together. Another device in the network will be used to send out, and receive back, communications from other local, national and international networks
- *electronic mail:* Using a data net work, messages can be sent from one computer terminal to another electronic digital signal, transmitted via a cable, telephone or "satellite," and ~" then converted back again at the receiving end. It may be displayed on a television screen for the receiver to read, and then perhaps stored on file or disk. No paper is necessary. This system for sending messages is one type of electronic mail.
- *teleconferencing:* Business meetings and conferences can be held by linking people through a computer network. Business men can send information to and from each other, discuss it and display it on a screen. They may even be able to see each other. This is called **teleconferencing**.

Linking up with lasers

Laser beams are now being used to send, receive, store and process information. They have become an essential part of information technology. You will hear more and more about their uses. But first of all, what is a laser? The initials LASER stand for 'Light Amplification by Stimulated Emission of Radiation'. A laser beam is a light beam—but its

light is very pure (all rays are exactly the same colour), very intense, and very *concentrated*.

Sending information Lasers are now widely used to transmit information. Flashes of light have been used to send messages for many years (e.g. with an Aldis lamp on ships at sea). Lasers work in a similar way, but their higher power means that they can travel over huge distances. They can now be carried along glass fibres or optical fibres which can be used to carry several messages at once.

The coming of cable Glass is cheap, plentiful and light. Glass fibres can be tightly packed together into cables which can carry many messages separately. This means that cables of optical fibres will be the message carriers of the future. They are likely to be used in:

- *banking*: sending messages from one bank to another
- *publishing*: electronic magazines and newspapers, newsletters and advertising could be sent via cable
- *information services, similar to Prestel*: information could be asked for, and received, from a database using optical cable instead of a telephone line
- *electronic shopping*: goods could be advertised using a cable network, and the chosen article could be ordered via optical cable.

These are just a few uses for cable networks. They already bring cable television to millions of viewers in the United States who have twenty or thirty channels to choose from. But their main use will be in *two-way* communications—between people, groups, offices, companies, and from a viewer *back* to the television centre!

Writing and reading with lasers

As well as sending information, lasers can be used to record information. Lasers can write information onto special disks. A high-power laser burns tiny holes onto the surface of the disk. The information, or rather data, is stored in a two-state code—a 'hole' or 'no hole', to represent say '1' or '0'. Information can be read from the disk by scanning it with a low-power laser beam.

Video disks The picture and sound of a television video can be stored on laser video disk. Inside a video disk player a laser reads the information. This is converted into a television signal and carried into the aerial socket of the TV set.

Laser disks have three big advantages.

- there is no contact between the playing head and the disk—this means that they should never wear out
- they can store huge amounts of information—as much as 30 encyclopaedias on a single disk
- they can be easily and precisely controlled.

Disks that can be controlled are called **interactive video disks**. They could be tremendously useful in education. A person using an interactive video disk system could show himself the same picture over and over again. A particular frame could be frozen and studied for a few minutes, or a user could go through the whole disk at once, then go back over the parts of it which were interesting, or too difficult to understand first time. The disk could easily be controlled by a computer program. A program could, for example,

ask the user a few questions then show some pictures from the disks, ask more questions, then go to a different part of the disk, and so on.

Lasers are only 25 years old, but already they play a leading part in communications, alongside telephones and television broadcasting.

Skills for information technology

Have you heard of the 'information explosion'? The amount of knowledge that mankind possesses is said to be doubling every five years. This may, or may not, be true, but one thing is certain—in future, more and more time and effort will be used in the information industry. Some useful skills for people involved in this industry will include the ability to:

- collect useful data (e.g. by designing forms)
- code data so that it can be processed by computer
- organize data in a logical and systematic way (e.g. by good indexing)
- handle data, and know how to get to it and retrieve it
- present information, results and statistics in a clear and readable way.

These are some of the skills that will be useful to you in the information era: data collection, data organization, data retrieval, and data presentation.

2. Read and learn words and word combinations

aerial – антена

jack - гніздо

plug - рознімання

database - база даних

network - [обчислювальна, комп'ютерна] мережа

Local area network (LAN) - локальна [обчислювальна] мережа

teleconferencing - проведення телеконференцій, телеконференцсвязь

beam - передача файлу, електронного документа

3. Do tasks

Task 1. Fill in the blanks.

a) The software which controls the loading and running of programs is called _____ (SREB 1980)

b) A user communicates with the operating system by means of _____.

Task 2. Describe the process of bootstrapping an operating system.

Task 3. Why does the operating system have to be stored in the computer all the time it is switched on?

Task 4. Give the meaning of the term operating system and give an example of a task for which it could be used. (YREB 1981)

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