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Цель книги — развитие у школьников компьютерной грамотности. Она содержит научно-популярные статьи по электронно-вычислительной технике и применению ЭВМ в народном хозяйстве и в быту, заимствованные из новейшей зарубежной литературы и периодики, а также адаптированные научно-фантастические рассказы.

Книга снабжена англо-русским словарем и справочником специальных терминов.

Книга адресована учащимся 10—11 классов средней общеобразовательной школы, а также может быть использована в 8—9 классах школ с углубленным изучением английского языка.

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К ЧИТАТЕЛЯМ

Дорогие юные друзья! Перед вами книга на английском языке, из которой вы узнаете много интересного и полезного для себя из области электроники, электронной техники и использования ЭВМ в народном хозяйстве. Вы также познакомитесь с адаптированными рассказами популярных писателей-фантастов А. Азимова и Кл. Саймака.

Применительно к вычислительной технике и информатике английский язык занимает особое положение. Значительная часть специальной терминологии этих дисциплин перешла в наш технический язык именно из английского. Характерны такие примеры, как «дисплей», «интерфейс», «принтер», «файл», да, собственно, и «компьютер» и «процессор». Лексическая база так называемых языков программирования высокого уровня, без которых невозможно функционирование любой ЭВМ, строится на основе английского языка. Здесь он выполняет специальные функции языка технических команд. В связи с этим усвоение языкового материала из этой книги поможет вам в изучении компьютерной техники и основ программирования.

Понимание текстов значительно облегчено тем, что на каждой странице даны комментарии к наиболее трудным техническим понятиям, а также к грамматическим оборотам и фразеологизмам (идиоматическим выражениям). Все специальные термины вы найдете в англо-русском словаре в конце книги. Если то или иное слово в словаре отсутствует, не смущайтесь, обратитесь к глоссарию. Глоссарий — это специальный справочник, где на русском языке объясняются опорные термины, обозначающие понятия микроэлектроники.

Схемы, рисунки и чертежи, включенные в текст, помогут вам разобраться в принципах действия описываемых микроэлектронных устройств.

После того как вы прочитаете эту книгу, вы сможете самостоятельно знакомиться со специальной литературой по микроэлектронике, а это обязательно пригодится вам в жизни.

А теперь отправимся в волшебную страну Компьютерлэнд.

Счастливой дороги, друзья!

I. WHAT IS A COMPUTER?

A computer is really a very specific kind of counting machine. It can do arithmetic problems faster than any person alive. By means of electric circuits it can find the answer to a very difficult and complicated problem in a few seconds.

A computer can "remember" information you give it. It stores the information in its "memory" until it is needed. When you are ready to solve a problem, you can get the computer to sort through its stored facts[1] and use only the proper ones. It works the problem with lightning speed. Then it checks its work to make sure there are no mistakes.

There are different kinds of computers. Some do only one job over and over again. These are special-purpose computers. Each specific application requires a specific computer. One kind of computer can help us build a spacecraft, another kind of computer can help us navigate that spacecraft. A special-purpose computer is built for this purpose alone and cannot do anything else.

But there are some computers that can do many different jobs. They are called general-purpose computers. These are the "big brains" that solve the most difficult problems of science. They answer questions about rockets and planes, bridges and ships — long before these things are even built.

We used to think of a computer as a large machine with many buttons and flashing lights that took up a whole room.[2] But today computers are becoming smaller and smaller and are even being put inside other devices. Though these small devices are called microcomputers or minicomputers, they are still true computers.

We might list the essential constituent parts of a general-purpose computer as follows. First, core store, also called memory. It is best to think of computer memory simply as a place where information is stored. This information can be an instruction or an item of data. We can store many instructions or many items of data in a computer. Second, an arithmetic unit, a device for

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[1] **you can get the computer to sort through its stored facts** — можно заставить ЭВМ рассортировать накопленные факты

[2] **took up a whole room** — занимал целое помещение

performing calculations. Third, a control unit, a device for causing the machine to perform the desired operations[1] in the correct sequence. Fourth, input devices whereby data (in the form of numbers) and operating instructions can be supplied to the machine, and fifth, output devices for displaying the results of calculations. The input and output devices are called peripherals.

The usual method for inputting data into a computer for processing is through an input peripheral such as a punched card reader or punched paper tape reader from magnetic tape. The computer is programmed to accept data in any or all of these media. The computer operator, in order to start the input process, will type a "go" message on the console typewriter. For real time processing[2] the operator will use an interrogating typewriter. This asks a question of the computer about the state of specific files of data already on line to the computer.[3] The data may be stored, or it may be sorted according to a plan desired by the programmer. It may be merged with existing information already in the store. Or, if we want immediate "answers" or output it could be by printer, that is an output device for spelling out computer results as numbers, symbols or words. These vary from electric typewriters to high-speed printers.[4]

There are several advantages in making computers as small as one can. Sometimes weight is particularly important. A modern aircraft, for example, carries quite a load of electronic apparatus. If it is possible to make any of these smaller, and therefore lighter, the aircraft can carry a bigger payload. This kind of consideration applies to space satellites and to all kinds of computers that have to be carried about.[5]

But weight is not the only factor. The smaller the computer, the faster it can work. The signals go to and fro at a very high but almost constant speed.[6] So if one can scale down all dimensions to, let us say, one tenth, the average lengths of the current-paths

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1 **a device for causing the machine to perform the desired operations** — устройство, заставляющее машину совершать нужные операции

2 **For real time processing** — Для обработки (информации) в реальном масштабе времени

3 **files of data already on line to the computer** — файлы информации, уже обрабатываемые ЭВМ в реальном масштабе времени

4 **from electric typewriters to high-speed printers** — от электрических пишущих машинок до скоростных печатающих устройств

5 **all kinds of computers that have to be carried about** — всевозможные типы нестационарных ЭВМ

6 **The signals go to and fro at a very high but almost constant speed.**— Сигналы подаются поочередно то в одну, то в другую сторону с очень большой, но почти постоянной скоростью.

will be reduced to one tenth.[1] So, very roughly speaking, scaling down of all linear dimensions in the ration of one to ten also gives a valuable bonus: the speed of operation is scaled up to 10 times. Other techniques allow even further speed increases. This increase of operation is a real advantage. There are some applications in which computers could be used which require very fast response times.

Another advantage is that less power is required to run the computer. In space vehicles and satellites this is an important matter; but even in a trial application we need not waste power. Sometimes a computer takes so much power that cooling systems which require still more power have to be installed to keep the computer from getting too hot, which would increase the risk of faults developing.[2] So a computer which does not need to be cooled saves power on two counts.[3]

Another advantage is reliability. Minicomputers have been made possible by the development of integrated circuits. Instead of soldering bits of wire to join separate components such as resistors and capacitors sometimes in the most sophisticated networks, designers can now produce many connected circuits in one unit which involves no soldering and therefore no risk of broken joints[4] at all.

And now that transistors and other solidstate devices are used instead of valves, printed circuits with their solid-state components (protected by packing in insulating resins) have a very long life indeed. A computer can be built up of large numbers of similar units of this kind.

Repairs of the old kind (with soldering iron and so on) are no longer needed. If one of the component circuits develops a fault,[5] all that is needed is to locate the faulty unit, throw it away and plug in a new one.

Some of the first computers cost millions of dollars, but people were quick to learn[6] that it was cheaper to let a million-dollar computer keep track of inventory or print payroll checks

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[1] **the average lengths of the current-paths will be reduced to one tenth** — средняя длина цепей, по которым протекает ток, сократится до одной десятой

[2] **which would increase the risk of faults developing** — что увеличило бы вероятность возникновения неисправностей

[3] **saves power on two counts** — создает двойную экономию электроэнергии

[4] **involves no soldering and... no risk of broken joints** — не связано с пайкой и... риском разрыва цепи

[5] **if one of the... circuits develops a fault** — если в какой-либо... цепи обнаружится неисправность

[6] **people were quick to learn** — люди быстро поняли

close proximity, but the result is the long-dreamed-of crystal amplifier.

By the time[1] the first applications of this invention became available, its successor device has already been announced by Bell Laboratories — the junction transistor, a low-power amplifier which replaced the large power-hungry vacuum tube. The transistor soon became typical of the semiconductor industry.

The junction transistor was also made of a germanium crystal, though this was mostly replaced later by more cheap silicon. The crystal had three electrically different layers in which the current was carried by different charge carriers. The crystal was a kind of sandwich with the two outer, and thicker, layers consisting of a material of one ("n") conductivity and the middle, the thin base of another ("p") conductivity. The current in the outer layers was carried by electrons, negative charge carriers, and the current in the base was carried by "holes", positive charge carriers. The device came to be called[2] n-p-n. Three of the engineers of the Bell Laboratories group have become world-known names: Bardeen, Brattain and Shockley.

It is noteworthy that as early as[3] in 1926 the Russian radio engineer Oleg Losev of Nizhny Novgorod (now Gorky) built the first semiconductor amplifier crystal-based device. He called it "Crystadin". However, at that time solid-state physics was not yet developed enough and Losev's work was shelved.

THE TRANSISTOR AND THE COMPUTER. THE COMPUTER'S MINIATURIZATION

The first wide applications of semiconductor electronics were in telephone industry and then in transistor radios. Computers began to use transistors in 1955. In that year IBM[4] company marketed a computer in which 1250 valves had been replaced by 2220 transistors, reducing the power consumption of the computer by ninety-five per cent.

The invention almost at the same time of the stored-program digital computer[5] provided a large potential market for the transis-

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[1] **By the time** — К тому времени когда

[2] **came to be called** — стало называться

[3] **as early as** — еще

[4] **IBM** = International Business Machines *(фирма в США)*

[5] **the stored-program digital computer** — цифровой компьютер с хранимой программой

than to have a hundred clerks trying to do the same thing by hand.[1] Scientists found that computers made fewer mistakes and could perform the tasks much faster than almost any number of people using manual methods. The demand for computers grew. As the demand grew, the number of factories able to produce computers also grew.

II. GLIMPSES OF HISTORY

DEVELOPMENT OF THE TRANSISTOR

Until 1940, developments in electronics took place at a comparatively slow pace. As was true with many scientific and technological matters,[2] the pace quickened during World War Two. Two major developments occurred in the late 1940s. One was the construction of programmable electronic computers. The second was the invention of the transistor.

In the summer of 1945 in the Bell Laboratories in the United States a group of very able scientists started work with the aim of producing devices useful in telecommunications. They were searching for switches to replace mechanical relays in telephone exchanges and amplifiers to replace the bulky and energy-consuming valves. The first fruit of their labours was announced to the world in June 1948. This was the point contact transistor. The device consisted of a small piece of crystalline germanium with two closely spaced wire contacts made on one of its surfaces. The voltage across one of these contacts, that is the voltage between the germanium base and one wire (a first pair of terminals) influenced the current which flowed between the base and the other contact (second pair of terminals). The reason for this influence is the injection or extraction of carriers of electricity — negatives, electrons ("n"-carriers) or positives, "holes" ("p"-carriers) from the vicinity of contact, thus modifying the conductivity in that region. If the voltage between the first pair of terminals of a device causes a change of current between a second pair of terminals, then we have an amplifier. The point contact transistor is rather like two point contact rectifiers, which are in very

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[1] **it was cheaper to let a... computer keep track of inventory... than to have... clerks trying to do the same thing by hand** — дешевле проводить переучет... с помощью ЭВМ, чем держать... служащих, которые будут делать то же самое вручную

[2] **As was true with many scientific and technological matters** — Как это происходило со многими направлениями науки и техники

tor. The reason is that digital systems require very large numbers of transistor circuits. The synergy between a new component and a new application generated an explosive growth of both transistor and computer. The historical fact is that early efforts to miniaturize electronic computers were not motivated by computer engineers. Various satellite and missile programs called for complex electronic systems to be installed in equipment in which size, weight and power requirements were severely constrained. So the effort to miniaturize was promoted by space and military agencies.

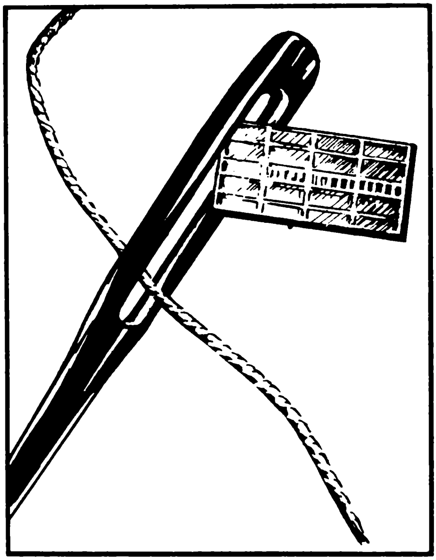

Figure 1. The memory board of the new powerful computer produced by IBM can easily pass through the eye of a needle

PLANAR TECHNOLOGY

The next step in microelectronics developments, the integrated circuit, was facilitated by the emergence of planar technology. In 1958 the first transistor was produced by the planar technique.

The planar technique consists of a sequence of three processes — oxidation, photo-etching and diffusion. A wafer of silicon is oxidized and then coated with a photosensitive polymer, a photoresist. A suitable miniature pattern is laid onto the resist and then exposed to light. The resist is vulnerable to some chemicals when exposed.[1] The exposed part of the surface can therefore be etched through the resist and through the silicon oxide underneath it. The resist is then washed off and the desired "p" and "n" impurities are allowed to diffuse[2] into the exposed parts of the silicon wafer, while the other parts are protected by the remaining oxide layer. This process can be repeated at will,[3] and in this way intricate patterns of diverse conducting layers can be built up.

Initially the process was used just to produce a large number of transistors on a silicon wafer. The wafer was then sliced into individual chips.

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[1] **when exposed** — будучи засвеченным

[2] **are allowed to diffuse** — получают возможность диффундировать

[3] **at will** — по желанию

A chip is a small square piece of pure silicon, layers of which have been etched away and doped with impurities so as to form a transistor and in future many alternate transistors, insulators and conductors which together make up the pattern of a complete circuit equivalent to thousands of transistors. Each chip contained one transistor and these were cased in a shell and eventually wired into electronic circuits. The great advantages of the process were that it improved manufacturing yield[1] and produced reliable products relatively cheaply. For example, the average price of a silicon transistor dropped seven times in six years.

INTEGRATED MICROCIRCUITS COME IN

The question arises: what is the reason for cutting the wafer into separate transistors and then placing each of them into a separate case and joining these with wires into an electric circuit? Couldn't the transistors or other radio elements be joined together right inside the crystal?

The thing is that[2] digital calculators are assembled from just a few types of elements, viz. transistors, resistors, semiconductor diodes and capacitors. But each of these elements in one calculator circuit can occur hundreds of thousands of times. The planar technology allows to form all these elements and the elements substituting for connecting wires in one crystal.

The greatest advantage of planar technology is the possibility of packing several thousands of various elements into one crystal to be joined into a circuit. The latter is intended for performing certain functions, for instance, conversion of the signals received or data storage. Hence comes the integrated microcircuit. This is a circuit manufactured as a single package, a monolithic integrated circuit which has all the circuit components manufactured into and onto a chip of a semiconductor material.

In 1953 Harwick Johnson of the RCA[3] applied for a patent on a phase-shift oscillator fashioned in a single piece of germanium by a planar technique. It was extended at Fairchild Semiconductor Company as follows: the integrated circuit accomplishes the separation and interconnection of transistors and other circuit elements electrically rather than physically. The separation is accomplished by introducing p-n diodes, or rectifiers, which allow the current to flow only in one direction.

The interconnection is realized by a conducting film of evaporated metal that is photoengraved to leave the appropriate pattern of connections. An insulating layer is required to separate the underlying semiconductor from the metal film except where electric

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[1] **manufacturing yield** — выход готовой продукции

[2] **The thing is that** — Дело в том, что

[3] **RCA** = Radio Corporation of America

contact is desired. The inventors of this basic technique were two American engineers, J. S. Kilby and R. N. Noyce (1960).

Our scientists A. F. Ioffe, Y. I. Frenkel and B. I. Davydov have made an invaluable contribution to the semiconductor theory. Great is the number of talented Soviet engineers who have created the up-to-date semiconductor technology. There are all kinds of computers using failure-free microelectronics, from those operating in cosmic stations to school minicomputers.

MICROELECTRONICS MAKES RAPID PROGRESS

Thus the basic methods of planar technique were available by 1960, and the era of the integrated circuits was introduced. It has made an astonishing progress since then. An individual integrated circuit on a chip perhaps a quarter of an inch square can now embrace more electronic elements than the most complex piece of electronic equipment that could be built in 1950. For example, today's microcomputer based on integrated circuits has more computing capacity than the first large electronic computer ENIAC. It is twenty times faster, has a larger memory, is thousands of times more reliable, consumes the power of a light bulb rather than[1] that of a locomotive (and such was the power of ENIAC), occupies 1/30,000 the volume and costs 1/10,000 as much.

Today integrated circuits containing 2^{18} (262.144) elements are available and their complexity continues to double every year. The costs of microelectronics would continue to decrease and we have not yet seen any significant departure from this law.

The substitution of microelectronic devices for discrete components reduces costs not only because the devices themselves are cheaper but for a variety of other reasons. First, the integrated circuit contains inside it many of the interconnections that were previously required and that saves labours and materials. The interconnections of the integrated circuits are much more reliable than the solder joints of connectors of discrete components. Microcircuits are much smaller and consume much less power than the components they have displaced. Less testing is needed in the course of production. Finally, the user needs to provide less floor space, less operating power, less air conditioning for the equipment.

All the above-mentioned savings motivate the wide-range use of the integrated microcircuits. As the number of components per chip increased and correspondingly the price per component decreased, a shift in the mode[2] of designing electronic microcircuits occurred. In the past, operations were predominantly

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[1] **rather than** — а не

[2] **shift in the mode** — изменение способа

carried out in the "analogue" mode, that is the output of the electronic circuit was proportional to the intensity of the property being represented. An example is the audio-amplifier:[1] at any instant of time[2] the voltage at the output terminals is proportional to the amplitude of the sound being amplified and reproduced.

A LUCKY MEETING AT THE TECHNOLOGICAL CROSSROADS

The modern trend of microcircuits for more and more applications is the "digital-logic" mode of operation.[3] In this mode, the input signal is first converted into a binary number or a sequence of numbers and the output signal consists of another sequence of numbers logically related to the input signal. The final output can, of course, be amplified to actuate various devices, such as servomotors, loudspeakers or the numerical display[4] of the computer.

Logic chips were employed for control or arithmetic function, in specialized applications, and also to build microcalculators.

In what became known as "hardwired logic"[5] systems, chips and other individual components were soldered into a rigid pattern on a so-called printed-circuit board.[6] The fixed interconnections served as the program prototype of the microelectronic computer. Curiously, it was even less flexible than ENIAC's primitive array of plug-in wires[7] that could be moved around to change the program.

The trend towards digital "logic" operations is symptomatic of the very close relationship between microelectronics, i. e. microcircuits, and computers. The semiconductor logic circuit, of course, contained the seed of the microcomputer since the chip had logic elements built around the transistors.

It may be said that the development of modern computers was entirely dependent upon developments in integrated circuits, but also that modern integrated circuits developed in directions largely determined by computers.

BIRTH OF THE MICROPROCESSOR

Since 1960 the complexity of the integrated circuits, i. e. the number of electronic elements on one chip, continued to double

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[1] **audio-amplifier** — звуковой усилитель

[2] **at any instant of time** — в любой момент

[3] **mode of operation** — принцип действия

[4] **numerical display** — цифровое табло

[5] **hardwired logic** — логика с фиксированным монтажом; «жесткая», «зашитая» логика

[6] **printed-circuit board** — печатная плата

[7] **plug-in wire** — съемный (сменный) провод

every year. Today we haven't yet seen any significant deviation from this exponential law. Nor are there any signs that the process is slowing down. The technology is still far from the fundamental limits imposed by the laws of physics: further miniaturization is less likely to be limited by the laws of physics than by the laws of economics.[1]

The culmination of all these advancements was the microprocessor, which has become virtually synonymous with microelectronics, but should not be confused with it.

The microprocessor emerged in consequence of the progress of the microcalculators.

As we know, the electronic calculator in all but the latest versions uses hardwired logic. The arithmetic functions, or the operating program instructions, are embedded in the chips while the application program is in the user's head — his instructions yield the desired calculations.[2]

M. E. Hoff, a young Intel Company engineer, envisaged a different way of employing the new electronic capabilities of the calculator. In 1969 he found himself in charge of[3] a project that Intel took on for Busicom, a Japanese calculator company. Busicom wanted Intel to produce calculator chips of Japanese design. The logic circuits were spread around eleven chips and the complexity of the design would have taxed[4] Intel capabilities — it was then a small company. Hoff saw a way to improve on the Japanese design by making a bold technological leap. The fact is Intel had pioneered in the development of semiconductor memory chips to be used in large computers. In the intricate innards of a memory chip, Hoff knew, it was possible to store a program to run a minuscule computing circuit.[5]

In his preliminary design, Hoff condensed the layout onto three chips. He put the computer's "brain", its central processing unit, on a single chip of silicon. That was possible because the semiconductor industry had developed a means of inscribing very complex circuits on tiny surfaces. A master drawing,[6] usually 500 times as large as the actual chip, is reduced photographically to microminiature size. The photo images are then transferred to the chip by the technique similar to photoengraving.

Hoff's Central Processing Unit (CPU) on a chip became known as the microprocessor. The CPU comprised a logic unit, an arithme-

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[1] **is less likely to be limited by the laws of physics than by the laws of economics** по-видимому, будет ограничена скорее законами экономики, чем физики

[2] **yield the desired calculations** — обеспечивают необходимые расчеты

[3] **he found himself in charge of** — в его ведении оказался

[4] **would have taxed** — потребовала бы максимального напряжения

[5] **to run a minuscule computing circuit** — для запуска крошечной счетной схемы

[6] **master drawing** — фотооригинал (печатного монтажа)

tic unit and a control unit. To the microprocessor Hoff attached two memory chips, one to move data in and out of the CPU and one to provide the program to drive the CPU. Hoff now had in hand a rudimentary general-purpose computer[1] (microcomputer) that could not only run a complex calculator, but also control, for example, an elevator or a set of traffic lights, or a washing-machine, or a multifunction digital watch, and perform a great many other tasks, depending on its program only.

So the microprocessor is an integrated circuit which has the properties and fulfils the role of a complete central processing unit of a computer. This means that the circuit does not just react in a fixed, pre-programmed way[2] to an input signal to produce an output signal. The main feature of the microprocessor is that its response and its logic can be altered. In other words, the microprocessor can be programmed in different ways rather than react in one pre-programmed way only.

For logic and systems designers the appearance of the microprocessor brought with it a dramatic change in the way they employed electronics. They could now replace all those rigid hard-wired logic systems with microcomputers because they could store program sequences in the labyrinthine circuits of the memory chips instead of using individual logic chips and discrete components to implement the program. Engineers could thus substitute program code words for hardware parts.[3]

It took about three years before the first devices reached the market but in the meantime about a hundred different microprocessors had become available. As with all microelectronic products, the capabilities of microprocessors advanced rapidly and the sophistication of circuits increased day by day.

After other Intel engineers who took over the detailed design work got through with it,[4] Hoff's invention contained 2250 micro-miniaturized transistors on a chip slightly less than one-sixth of an inch long and one-eighth of an inch wide, and each of those microscopic transistors was roughly equal to an ENIAC vacuum tube. Intel labelled the microprocessor chip 4004 and the whole microcomputer MCS-4 (microcomputer system-4). Despite its small size, the 4004 just about matched ENIAC computational power. It also matched the capability of an IBM machine of the early 1960s whose central processing unit (CPU) took up the space of an office desk.

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[1] **general-purpose computer** — универсальная ЭВМ

[2] **in a fixed, pre-programmed way** — жестко установленным, запрограммированным образом

[3] **hardware parts** — детали оборудования

[4] **got through with it** — закончили ее

SPEEDIER SEMICONDUCTOR CHIPS

The ongoing microelectronics revolution was ushered in some 30 years ago by the introduction of silicon-based[1] semiconductor chips. The circuit speeds in some advanced computer equipment are now approaching the theoretical limits of silicon, and for many years scientists have been experimenting with faster-working alternative materials.[2] Harris Microwave Semiconductor, of Milpitas, Calif., recently introduced two digital integrated circuits[3] (IC) made from one exotic alternative to silicon: gallium arsenide. Electronic chips made from gallium arsenide have been available in the past, but usually only on a prototype basis. The new Harris chips, both of which are designed for use in sophisticated telecommunications equipment and military electronic systems, are the first commercially available off-the-shelf[4] gallium-arsenide IC chips. The manufacturer says they work five times faster than the speediest of today's silicon-based counterparts.

III. THE COMPUTER PRINCIPLES, STRUCTURE AND OPERATION

BINARY SYSTEM

Digital logic circuits require just two levels of signal, high or low voltage. Using binary notation, a high voltage can be used to represent a *bi*nary digi*t* (bit) whose value is 1, and a low voltage to represent a 0.

Different combinations of 1s and 0s may be used to represent numbers and characters (letters of the alphabet and special characters). It is possible to carry out arithmetic operations on binary numbers in a similar way[5] to that used for decimal numbers. Digital logic circuits can be built which store numbers in binary form, and others which can perform arithmetic operations on the stored numbers.

Many computers use groups of eight binary digits for encoding characters. A group of eight bits is called a byte. For simplicity, we will start by considering groups of four bits only for binary arithmetic operations.

We know the value that a decimal number represents by

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[1] **silicon-based** — на основе кремния
[2] **alternative materials** — материалы-заменители
[3] **digital integrated circuit** — цифровая интегральная схема
[4] **off-the-shelf** — имеющийся в наличии, в продаже
[5] **in a similar way** — аналогичным образом

virtue of the positions of the decimal digits.[1] The position of each digit schows which power of 10 it should be multiplied by.[2] For example, the number 8527 is equal to:

$$8\times10^3+5\times10^2+2\times10^1+7\times10^0.$$

Remember that any number raised to the power 0[3] is equal to 1.

Binary numbers are represented in a similar way, but the binary digits (0 or 1) are multiplied by the appropriate power of 2. For example, decimal 13 (13_{10}) is represented by the following binary pattern:[4]

1101

since $1\times2^3+1\times2^2+0\times2^1+1\times2^0=13_{10}$.

That is, $13_{10}=1101_2$.

The maximum decimal number that can be represented by four bits is $15_{10}(1111_2)$. For larger numbers extra bit positions need to be used.[5] For example,

$10101_2=1\times2^4+1\times2^2+1\times2^0+21_{10}$.

LOGIC CIRCUITS

Boolean Operators

Logical decisions may be defined using bits 1 and 0 to represent the on and off states, or high and low voltages, in logic circuits.

Boolean algebra is a two-state symbolic algebra which combines two bits (the input signals) by means of Boolean operators to produce a 1-bit output signal. Boolean algebra is used extensively in the analysis of logic circuits to determine the output from circuits which perform the functions of the Boolean operators.

The output signals from all possible combinations of the input signals are shown in Truth Tables.[6] The name is derived from the original use of Boolean algebra for determining the truth or falsity of propositions.[7]

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1 **We know the value that a decimal number represents by virtue of the positions of the decimal digits.** — Нам известна величина, которую представляет собой десятичное число, благодаря позиции, занимаемой каждым его десятичным разрядом.

2 **shows which power of 10 it should be multiplied by** — показывает, на какую степень числа 10 его следует умножить

3 **raised to the power 0** — возведение в нулевую степень

4 **by the following binary pattern** — по следующей бинарной схеме

5 **extra bit positions need to be used** — необходимы дополнительные битовые позиции

6 **Truth Tables** — Таблицы истинности

7 **for determining the truth or falsity of propositions** — для установления истинности или ложности суждения

The OR *operator*[1]

The Boolean algebra symbol for OR is +. We will represent the two input signals by A and B.

The Truth Table for the OR operation is given in Table 1. This shows that the output signal is 1 only if A or B, or both are equal to 1.

Table 1. **Truth Table for OR operation**

Inputs		Output
A	B	
0	0	0
0	1	1
1	1	1
1	1	1

The AND *operator*[2]

The AND operator is represented by a multiplication sign (•). The Truth Table for this operation is given in Table 2. This shows that the output signal is 1 only if A and B are both 1.

Table 2. **Truth Table for AND operation**

Inputs		Output
A	B	
0	0	0
0	1	0
1	0	0
1	1	1

The exclusive-OR *operator*[3]

The exclusive-OR (XOR) operator is represented by the symbol ⊕ . The Truth Table for this operation is given in Table 3. Notice that XOR allows us to detect if the two input signals are different (output 1) or the same (output 0).

[1] **the OR operator** — оператор «ИЛИ»
[2] **the AND operator** — оператор «И»
[3] **the exclusive-OR operator** — оператор «исключающее ИЛИ»

Table 3. **Truth Table for XOR operation**

Inputs		Output
A	B	
0	0	0
0	1	1
1	0	1
1	1	0

The NOT *operator*[1]

The NOT operator is different from the other three operators described, since it is not used to combine input signals but to invert a single input signal, i. e. the output signal from NOT A is 0 if A is 1 and 1 if A is 0. The operator is represented by a bar over the input symbol. For example, if A is 1

$$\bar{A} = \bar{1} = 0.$$

Logic Gates

A logic gate consists of a circuit with one or more input signals of high or low voltage, which produces one output signal. The latter will be a high or low voltage depending on the type of gate and the nature of the input signals.

Each type of gate may be represented by a standard symbol on a logic diagram. The following sections give examples of the different gates that may be used in logic circuits.

*The Inverter (*NOT *gate)*[2]

The logic symbol for an inverter is shown in Figure 1. Remember that a NOT gate just inverts the input signal. We shall see later how this gate may be used in circuits where the complement of the input signal is required.

The OR *gate*[3]

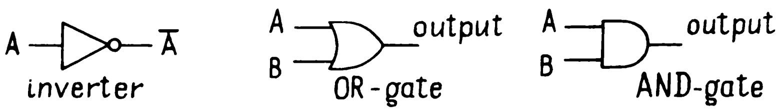

Figure 2. Logic symbols

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[1] **the NOT operator** — оператор «НЕ»
[2] **NOT gate** — схема «НЕ»
[3] **OR gate** — схема «ИЛИ»

Microelectronic Implementation of Logic Circuits

Each type of logic circuit may be implemented as a microelectronic circuit using microelectronic transistors and resistors.

The actual implementation depends on the type of semiconductor technology used, and on requirements related to the use of the microelectronic circuits.

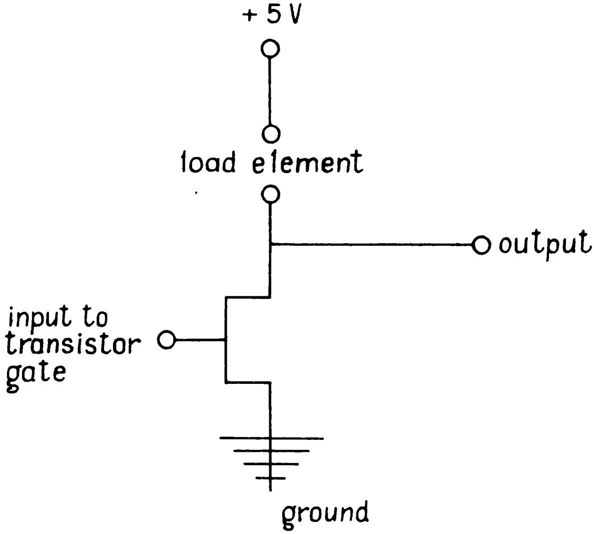

Figure 3. Electronic circuit for an inverter gate

For example, an inverter may be constructed using an n-MOS transistor and a load element in series.[1] The load element limits the current flowing through the transistor when the supply voltage is applied, as shown in Figure 3. The input signal is applied to the gate of the transistor; the latter will only conduct when the signal to the transistor gate is high. In this case, there will be a voltage drop across the load element so that the output is low.

Conversely, when the signal applied to the transistor gate is low, there is no conduction path to ground and hence no voltage drop across the load element, giving high output.[2] The load element for this type of gate can be a resistor or another transistor. Different types of load elements result in changes in the characteristics of the circuits with respect to such factors as[3] ease of fabrication, packing density and power consumption.

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[1] **in series** — включенные последовательно

[2] **hence no voltage drop across the load element, giving high output** — поэтому напряжение на нагрузке не падает, что создает высокое выходное напряжение

[3] **with respect to such factors as** — в отношении таких факторов, как

A wide variety of integrated circuits are commercially available for different applications. Some of these comprise just a few logic gates, others have complex circuitry containing many thousands of gates.

MICROELECTRONIC MEMORIES

Registers

A computer is made up of a number of different electronic circuits. So far we have considered the logic circuits for such functions as encoding and decoding of information, parity testing, word comparison, addition and subtraction of binary numbers. These functions are concerned with decision-making.[1] A computer additionally needs to be able to store information in binary patterns. The main storage of a computer is called the memory.

Computer storage circuits, made from transistors or their microelectronic equivalents, can be built to store binary digits as low or high voltages. Such memory elements are known as flip-flops or latches. The groups of memory elements are known as registers or memory cells. Computers contain a number of special-purpose registers.

Counters

A counter can be constructed from a number of flip-flops which can perform the functions of reset and carry. The carry is propagated from the least significant flip-flop through to the most significant flip-flop. There is a delay time at each flip-flop; the total propagation delay time increases as the size of the counter is increased (by adding more flip-flops). The worst delay time is the individual delay time multiplied by the number of flip-flops in the counter. These types of counter are known as *ripple* counters.[2]

Synchronous counters clock all the flip-flops[3] at the same time, so that the binary count is achieved after only one propagation delay time whatever the length of the counter.[4] They are therefore much faster than ripple counters but require more complicated circuitry.

A *ring* counter[5] consists of a number of flip-flops built into a circuit which causes the stored bit to move through the flip-flops (starting from the least significant one) and finally back to the first flip-flop. This means that each ring word output[6] from

---

[1] **are concerned with decision-making** — связаны с принятием решений

[2] **ripple counters** — счетчики со сквозным переносом

[3] **clock all the flip-flops** — синхронизируют все триггеры

[4] **whatever the length of the counter** — какова бы ни была длина счетчика

[5] **ring counter** — кольцевой счетчик

[6] **ring word output** — выходной сигнал закольцованного машинного слова

the counter has only one bit set to 1. An 8-bit word ring counter,[1] for example, can be used to activate any one of eight devices according to which of the eight bits is high[2] (has a value of 1).

A computer run consists of a series of operations which are used to process data.[3] One or more digital circuits will be activated to perform these operations, and the timing and sequence of these activities must be accurately controlled. A ring counter may be used to activate the digital circuits at the correct time.

Computer Memories

The memory (main store) of a computer is made up of a large number of registers which are used to hold the instructions (the program) required to solve a particular problem, and some data.

Programs other than the one that is being obeyed may be stored on a backing-store external to the computer memory.[4] In a similar way, the bulk of the data[5] required for a computer run may also be stored on backing-storage. However, data to be operated on by the processing elements of the computer[6] must be in the computer memory during the processing cycle.

There are many different types of memory that have been used in computers.

STRUCTURE AND FUNCTIONS OF A MICROCOMPUTER

Basic Units

Figure 4 shows the structure of a simple microprocessor-based microcomputer. The microprocessor consists of three basic units which perform the following functions:

Synchronization of processing events and instruction decoding (control unit);

Temporary storage of addresses and data (registers);

Arithmetic, logic and shift operations (arithmetic unit).

---

[1] **word ring counter** — пословный кольцевой счетчик

[2] **to activate any one of eight devices according to which of the eight bits is high** — для приведения в действие любого из восьми (вторичных) устройств в зависимости от того, какой из восьми битов выдает высокий уровень напряжения

[3] **to process data** — для обработки данных

[4] **on a backing-store external to the computer memory** — в поддерживающем запоминающем устройстве, внешнем по отношению к блоку памяти ЭВМ

[5] **the bulk of the data** — массив данных

[6] **data to be operated on by the processing elements of the computer** — данные, из которых исходят обрабатывающие элементы ЭВМ

Program instructions and data are held in memory (RAM, ROM, PROM, EPROM,[1] etc.) until fetched by the control unit signals. Communication to the outside world to various types of peripherals is via one or more input/output ports.

The processing events, controlled by the control unit, are triggered by a quartz crystal clock which generates pulses at regular intervals depending on its frequency. For example, a clock with a frequency of 1 MHz (Megahertz) has a period of 1 µs (microsecond). The clock logic[2] (for driving the clock) may be on the microprocessor chip itself or external to it.

The units are linked by electrical lines which carry electrical pulses representing memory and input/output port addresses (address bus)[3] and data (data bus).[4] A typical 8-bit microprocessor has a 16-line address bus for carrying 2-byte addresses, and an 8-bit data bus for carrying 1-byte data words. Synchronization signals for controlling the processing events are carried by control lines (control bus).[5] The registers, arithmetic and logic unit circuits and memory devices are isolated from the buses by three-state buffers[6] (not shown). Timing and control circuitry is used to ensure that only the device that is transmitting or receiving data is connected to the appropriate bus at any given time.

Microcomputing devices require a small power supply, typically 5v or three levels (+5v, +12v, −5v), depending on the particular devices being used.

At the beginning of a program run, the program counter is set to the address of the first instruction to be executed, subsequently it will be set to the next instruction to be executed.

Status flags[7] are single-bit registers which are set or reset automatically according to the results of arithmetic operations; they can be tested by program instructions. Typical status flags are N, Z and V which record respectively whether the result of an arithmetic operation was negative, zero or was too large to be stored correctly (overflowed). Another flag commonly used is the

---

[1] **RAM** = Random Access Memory — память произвольного доступа, запоминающее устройство с произвольной выборкой (ЗУПВ);
ROM = Read-Only Memory — постоянное запоминающее устройство (ПЗУ);
PROM = Programmable ROM — программируемое постоянное запоминающее устройство (ППЗУ);
EPROM = Erasable Programmable ROM — программируемое постоянное запоминающее устройство со способностью стирания

[2] **the clock logic** — логическая схема синхронизатора

[3] **address bus** — шина адресов

[4] **data bus** — шина данных

[5] **control bus** — шина управления

[6] **three-state buffer** — трехрежимное запоминающее устройство

[7] **status flag** — флажок состояния

carry flag[1] (C) which records whether a carry occurred on the left of an addition or subtraction.[2] In each case, the status flag is set to 1 if the specified condition has occurred, otherwise it is set to 0.

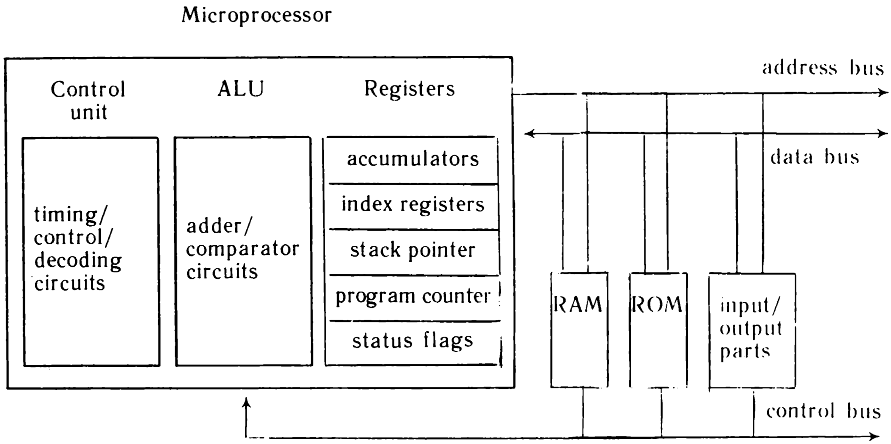

Figure 4. Structure of a simple microcomputer

Accumulators are registers which are used to store data that has been fetched from memory. Program instructions are available which operate on data[3] held in an accumulator. One or more accumulators are available depending on the particular microprocessor being used.

Index registers[4] are used to hold values which can be used to modify actual memory addresses to produce effective addresses. In this way, the results of previous processing in the program run can be used to alter the sequence in which instructions are obeyed.

Part of the RAM memory of typical microprocessor-based microcomputers is reserved for stack operations.[5] The stack is used, by means of program instructions, to store data temporarily for subsequent retrieval. The data is pushed on to the stack one byte at a time. On retrieval,[6] the topmost byte is pulled off first, that is, the stack operates in LIFO mode (Last-In, First-Out).[7]

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[1] **carry flag** — флажок переполнения

[2] **on the left of an addition or subtraction** — слева от регистров при сложении или вычитании

[3] **Program instructions are available which operate on data** — Имеются программные команды, которые работают с данными

[4] **index registers** — индексные регистры, индекс-регистры

[5] **stack operations** — операции с применением стека

[6] **on retrieval** — при извлечении

[7] **Last-In, First-Out** — «последним вошел – первым вышел»

The use of accumulators, index registers and stacks is explained later in this chapter.

Chip or bit slice-based microcomputers[1] function in a similar way to microprocessor-based microcomputers.[2] The essential difference is that the computer units may be made up from a number of different chips. For example, the functions of the microprocessor chip can be implemented on several chip slices to overcome the limitations of a particular microprocessor and give improved performance. This philosophy can be extended to the other computer units.

The programming and use of both types of microcomputer is similar. Further detailed discussion will be concerned only with 8-bit microprocessor-based microcomputers. 16-bit and 32-bit microprocessors also are available.

Peripheral Equipment

The microcomputer has to communicate with the outside world, so that programs and data can be entered into its memory and processed information can be displayed or transmitted in some form to the microcomputer user.

There are various types of peripheral equipment that may be attached to microcomputers including keyboards and paper tape readers for input, and visual display units (VDUs) and printers for output. Information may be output from the microcomputer on to magnetic tape or disk for storage and re-entered when required.

Different sensors and actuators may be linked (interfaced) to the microcomputer for controlling instruments and machines; their use is discussed in later chapters.

Keyboards

A keyboard consists of a number of switches which are activated by pressure or simply by touching them. The keys are arranged as a matrix, so that the depression of any key can be detected by scanning the rows and columns of the matrix. Hardware may be used to sense which key has been pressed or this may be carried out by a software routine.[3]

The layout of the keyboard may be similar to that of the conventional typewriter or may be designed for particular users. For example, if a large amount of the data to be entered is generally

[1] **Chip or bit slice-based microcomputers** — Однокристальные или разрядно-секционные микроЭВМ

[2] **microprocessor-based microcomputers** — микроЭВМ на основе микропроцессоров

[3] **software routine** — системная программа

numeric, then a numeric key pad containing keys for decimal 0 through 9, full stop, and some special characters, is an essential feature.[1]

Teletypewriters

Teletypewriters may be used for a number of different purposes in computer systems. For example, they may be used as terminals to transmit and receive information over telephone lines or as input/output devices directly connected to a computer.

Teletypewriters transmit and receive information in serial form, that is, each character is converted to a bit-code, and then sent as a stream of serial data bits[2] with start and stop control bits[3] for each character. The characters have to be decoded when they reach the computer end.

Teletypewriters and other terminals using telephone lines require modems (modulators-demodulators) at each end, to convert the data to a form suitable for voice transmission and vice versa.

As well as having a keyboard,[4] teletypewriters are fitted with a printing device, so that a hard copy[5] of the information sent and received is available. Characters are printed one at a time[6] by moving the block containing the characters across the paper from left to right. The selected character is pressed against a typewriter ribbon to give a solid shape.[7] Speeds vary from about 10—30 characters/second.

Teletypewriters may have paper tape stations[8] for producing output on to punched paper tape.

Visual display units

These units have a cathode-ray tube (CRT) for displaying information and often a keyboard which may be attached or is detachable. The VDU may be part of a self-contained[9] micro-computer, with all the necessary circuitry contained in the case holding the CRT.

The output from the keyboard is decoded into a form suitable

[1] **is an essential feature** — является существенной частью ЭВМ
[2] **data bit** — информационный бит
[3] **start and stop control bits** — стартовые и стоповые управляющие биты
[4] **as well as having a keyboard** — наряду с клавиатурой
[5] **hard copy** — печатная (документальная) копия
[6] **one at a time** — один за другим
[7] **to give a solid shape** — чтобы получился плотный оттиск
[8] **paper tape station** — перфоленточное устройство
[9] **self-contained** — автономный

for the computer being used. This function is usually carried out within the VDU which may also have its own buffer, so that information keyed in[1] is not transmitted immediately giving the operator a chance to correct it.

Other more sophisticated features may be available on more expensive VDUs such as graphics facilities and screen-editing.[2] With the latter facility, changes may be made to information displayed on the screen by moving a special character (cursor) to the position on the screen which requires alteration. Often these facilities will be under the control of programs stored in ROMs on the VDU board. Additionally, a light pen may be used as an input device by pointing it to the required position on the screen.

Magnetic recording devices

There are basically two types of devices, serial access,[3] e. g. magnetic tape, and random access,[4] e. g. magnetic disk.

Information is recorded magnetically on both these media, which generally consist of a substrate made from a plastics material coated with magnetic oxide. A 1 bit is represented by a portion of magnetized material (magnetic spot) and a 0 bit by the absence of a magnetic spot. Patterns of 1s and 0s are used to represent character codes.

Ordinary portable cassette recorders[5] and standard audio cassettes[6] can be used with some microcomputers. Standard cassette interfaces are used to allow binary information in the microcomputer memory to be transmitted as a serial bit stream[7] for recording on tape. The 1 and 0 bits are generated as two different tones.

Magnetic disks have data recorded on them in a series of circular tracks.[8] Each track is divided into sectors and is uniquely identified.[9] Data is transferred in sectors or groups of these. Read/write heads are moved to the appropriate track for recording or accessing data under hardware/software control, so that random access of data can be achieved. Indexes may be used to enable the required data to be located or data may be retrieved randomly[10] by using relative addressing, in which data is recorded

[1] **keyed in** — набираемый, набиваемый, вводимый

[2] **screen-editing** — редактирование данных, изображаемых на экране

[3] **serial access** — с последовательным доступом

[4] **random access** — с произвольным доступом

[5] **cassette recorder** — кассетный магнитофон

[6] **audio cassette** — звуковая (речевая) кассета

[7] **bit stream** — поток битов

[8] **circular track** — спиральная дорожка

[9] **is uniquely identified** — опознается однозначно

[10] **randomly** — произвольно

in known positions. Data may also be recorded serially as on magnetic tape.

Two types of disk are commonly used, floppy (flexible) disks and hard disks. Floppy disks are available in two sizes, standard 8 inches and mini $5\frac{1}{4}$ inches. Hard or soft sectoring[1] may be employed.

Hard disk drives, available for use with microcomputers, are usually based on Winchester technology. The units consist of a hard disk totally enclosed and sealed in a chamber.[2] This ensures that extraneous particles of dust or dirt cannot get into the very small gap between the fast spinning disk and the floating read/write head,[3] as this would cause a head-crash which would ruin the head and disk resulting in[4] the loss of all the information held on the disk. The disks are the same size (8 inches diameter) as standard floppy disks, but can hold much more data and have greater reliability.

USING THE COMPUTER

The types of computers available are as varied as the types of musical instruments. Trying to teach someone to use a computer requires that [5] both the instructor and the student have access to the same type of computer. It would be senseless for a piano teacher to try to teach someone to play a trombone.

There is another similarity between trying to learn to play a musical instrument and trying to learn to use a computer: in order to learn to use either a specific computer or a specific musical instrument properly, you must practise on a daily basis.[6] One strength of this book is that it explains some of the differences likely to be found in computers[7] and in computer applications and teaches some of the techniques necessary to help you more easily learn to use a computer.

The biggest flaw in most computer systems is the instruction book. The instruction book for a computer system is primarily a reference document; when the user gets into trouble, he can discover by reading the book what he is doing wrong and what needs

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[1] **hard or soft sectoring** — жесткая или гибкая разбивка на секторы

[2] **totally enclosed and sealed in a chamber** — помещенный в камеру и герметизированный

[3] **floating read/write head** — плавающая головка считывания и записи

[4] **resulting in** — приводящий к

[5] **Trying to teach someone to use a computer requires that** — При обучении пользованию компьютером необходимо, чтобы

[6] **on a daily basis** — ежедневно

[7] **likely to be found in computers** — которые, вероятно, обнаружатся в ЭВМ

to be done to get the computer operating properly.[1] An instruction book can also be a manual that instructs a new user, in a step-by-step manner, how to run a computer system.[2] Unfortunately, most computer system instruction books take either one approach or the other. They are either excellent reference books, leaving much to be desired by the first-time user who simply wants to get the computer working,[3] or are written to be how-to-start-the-computer cookbooks[4] with glaring deficiencies that become apparent when the user experiences trouble with the system.

Most users of a computer system routinely use only a very small part of the total features available to them. For example, one may have purchased a computer system that can compose music, write payroll checks, and trap burglars as they try to sneak in through the skylight. Although the computer can do all of these things if you buy the proper accessories for it, most users are interested in only one thing, such as having the computer only write payroll checks. Therefore they have not purchased the accessories necessary to perform the other functions. The result is that the instruction books will go into great detail about areas that are of no interest[5] to the user.

Here are several suggestions to make using a new computer system easier:

1. Make your own condensed instruction book.

The first recommendation is that you get a second set of instruction manuals[6] and cut them apart and put the pages that interest you into a three-ring binder.[7] As an alternative, you could take the computer instruction manual to a copy machine and copy the pertinent pages — those that you will be using often — and keep those pages in a three-ring binder where you work.

2. Formulate step-by-step instructions.

The second recommendation is that you make a recipe-like list[8] of the steps necessary to operate the computer while you are learning what those steps are. Some people like to make these lists

---

[1] **what needs to be done to get the computer operating properly** — что необходимо сделать, чтобы ЭВМ работала должным образом

[2] **how to run a computer system** — как пустить в ход ЭВМ

[3] **leaving much to be desired by the first-time user who simply wants to get the computer working** — оставляющие желать много лучшего для тех, кто в первый раз пользуется компьютером и хочет, чтобы он просто работал

[4] **are written to be how-to-start-the-computer cookbooks** — написаны наподобие поваренной книги: «Как запустить компьютер»

[5] **go into great detail about areas that are of no interest** — вдаваться в подробности в тех областях, которые не представляют интереса

[6] **set of instruction manuals** — набор эксплуатационных руководств

[7] **three-ring binder** — скоросшиватель

[8] **recipe-like list** — список, подобный кулинарному рецепту

on three-hole notebook paper and put them into protective plastic covers in a three-hole notebook. Others prefer to put them on index cards[1] in a recipe box. Any method that suits you is fine, so long as the "recipe" is clearly written and always handy.

Be assured that if you do not do these two things, you will waste hours, days, weeks, and even months of time trying to find what you are looking for in the fifteen-volume set of instruction manuals on your computer system. It is very easy, once you are in trouble, to spend hours looking through instruction manuals to find out where you went wrong.[2] Save yourself from ending up, hours later, muttering, "I know I read that some place a week ago!" If you find the information useful, make a note of it.

3. Make your own index to the instruction manuals.

Take a look at your instruction manuals and check to see[3] how complete the index is. If the index is not complete, you might want to put another page in your three-ring binder that gives a one- or two-word description for your own index and the volume and page number where it can be found.

More than one computer company[4] put information into what these authors think is the wrong volume of the instruction book. Information that every user should know might be located in the system manager's guide. And information that only a system's manager could possibly use might be contained in a user's guide. Similarly, a programmer's manual could contain general user information. If you keep your own mini-index of some of the commonly used procedures near where you work and constantly update that book as you need to find more things in the manual, you will find that you waste much less time finding a solution when you are in trouble.[5]

Start some kind of an organizational system and start making notes *now.*

4. Learn with actual data.[6]

Use real data when first learning about a computer system.[7] When you are trying to type information into a program and learn how that program works, do not just make up data[8] and type it in. If you make up data and put it into a computer program, you will not really have any idea of whether the computer's results are

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[1] **index cards** — алфавитные (каталоговые) карточки

[2] **where you went wrong** — где вы допустили ошибку

[3] **check to see** — проверьте

[4] **More than one... company** — Многие... фирмы

[5] **in trouble** — в затруднительном положении

[6] **Learn with actual data.**— При обучении используйте подлинные данные.

[7] **when first learning about a computer system** — на первых порах обучения работе с ЭВМ

[8] **to make up data** — придумывать данные

correct or incorrect. It is much easier to spot an error[1] when you are using test data that is real than when the data is invented. This same type of problem is the case with computer test data[2] that is furnished by the computer manufacturers or the people who wrote the programs. You can be sure that a computer program will work with data that has been supplied by the manufacturer. Whether it works with their data or not should mean relatively little to you. What is important to you is whether or not the computer works with *your* data. To find that out, you must use your own real data when learning about a computer system.

5. Read the instruction book.

Last but not least[3] in the learning of a computer system is the realization that the manufacturer of the computer system has spent a tremendous amount of time and money producing what is usually a very accurate document about how the computer system performs. It will tell you not only what to do to ensure that the computer will work right, but what to do to recover from an error if something goes wrong. Read the instruction book on a regular basis,[4] even before you need the information. You can save a lot of trouble if you already know what is in the book.

DATA STRUCTURES

Whenever we enter data into a computer, we have to be able to talk about the data we are entering. To do this easily, we must define the words used to describe that data. Let's take an example.

Let's say that we want to enter people's names and addresses into a computer so that we can have the computer print some mailing labels[5] for us. The first person we are entering has as his address "1234 Apple St.". There are several ways we could enter this data. One way would be to enter the house number by typing the digits "1", "2", "3", "4" on the computer. Then we might press the space bar[6] to put a space between the address number and the street name. Then we could type the letters "A", "p", "p", "l", "e" and then the space bar again to put a space between the "Apple" and the street designation, the abbreviation "St." Each time that we press a key on the keyboard, we enter what is called a *character* into the computer.

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[1] **to spot an error** — обнаружить ошибку

[2] **is the case with the computer test data** — возникает в связи с компьютерными тестовыми (контрольными) данными

[3] **Last but not least** — Последнее по порядку, но не по важности

[4] **on a regular basis** — систематически

[5] **mailing label** — почтовый адрес

[6] **space bar** — клавиша пробела

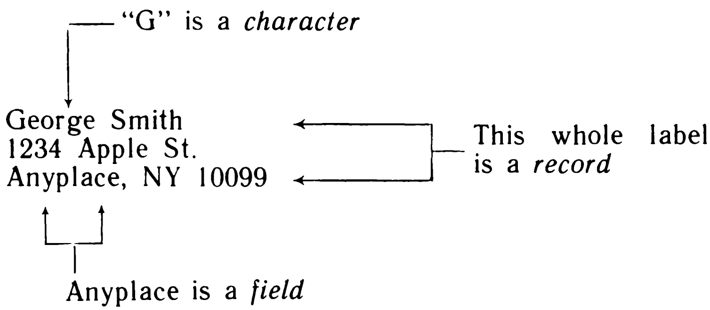

Figure 5. A mailing label. The "G" in "George" is called a *character*. A logical group of characters such as "Anyplace" is called a *field*, in this case an address field. A logical group of fields (Name, Address, City, and Zip Code[1]) is called a *record*. If we had 100 different mailing labels similar to the one shown above, each label would be a person's record.

Characters

A character can be any key on a computer keyboard. That key may or may not result in something being printed. The digits "1 2 3 4" are all *printing* characters, but when we hit the space bar, we entered a character which indicated we wanted one space, either between the digits or between the house number and the street name. This character, the space character, did not print; it is an example of a *non-printing* character. Most of the control characters,[2] as well as the escape key,[3] the tab key,[4] the return key,[5] the line-feed key,[6] and the space bar generate what we call non-printing characters.

Fields

A group of many characters make up what is called a *field*. A field is any arbitrary but logical group of characters. For example, 1234 Apple St. could be entered all as one field, which we might call the address field, or we could have our choice of entering this data as either two or three fields. If we entered the address as two fields, we could have a *house number field* and a *street name field*, in which case the house number (1234) would

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[1] **Zip Code** = Zone Improvement Program Code — почтовый индекс

[2] **control character** — управляющий символ

[3] **escape key** — клавиша перехода *(с одного кода, языка, регистра на другой)*

[4] **tab key** — клавиша метки табуляции

[5] **return key** — клавиша возврата

[6] **line-feed key** — клавиша перевода строки

be entered into the house number field, and the street name (Apple St.) would be entered into the street name field. If we so desired, we could enter the data into three fields, with the house number entered into the house number field, the street name into the street name field, and a street type entered into the street type field, which could contain such abbreviations as "St.", "Ave.", "Blvd.", and "Rd.".

The decision to group data within specific fields depends on how the data is to be accessed. The computer system treats the data in any field as a unit. Choosing to have an address field implies that we want to treat the address "1234 Apple St." as a unit. Separating the data into a house number field and a street name field lets us process the house number portion of the address apart from the street name portion.[1] Thus, separating the data into fields helps organize the data for processing.

For each person we wanted to enter into the computer, using that person's full name and address, we would enter many characters. A group of characters would fall into a field and many fields would come together to form a single person's mailing label. We could have a last name[2] field, a first name[3] field, and a middle name[4] field. Then we could set up a house number field, a street name field, and a street type field. To complete the address, we need a city name field, a state field, maybe a country field, and certainly a zip code field. A field, then, is a group of characters that have something in common; the last name field will contain a group of characters that combine to spell out a person's last name.

Records

If we were to enter the names and addresses of a hundred different people, so that the computer would generate a hundred different mailing labels, we would be entering a hundred *records* into the computer. Each record is made up of many fields, just as each field is made up of many characters.

Files

When we finally gathered all of the records representing the total information necessary for all of the mailing labels, we would store these together in the computer in what is called a *file*.

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[1] **lets us process the house number portion of the address apart from the street name portion** — позволяет нам обрабатывать часть адреса «номер дома» отдельно от части «название улицы»

[2] **last name** — фамилия *(например,* Smith *в полном имени* John Smith*)*

[3] **first name** — собственно имя *(например,* John *в полном имени* John Smith*)*

[4] **middle name** — второе имя *(например,* May *в полном имени* Louise May Smith*)*

Let's think of it another way. Take the common office term "file", which means a group of pieces of paper that are put together into a jacket or envelope and placed together on a file shelf. If we wanted to keep the names and addresses of all of our customers in one location, we could have several sheets of paper, one sheet for each customer, placed into a file folder.[1] The office file folder corresponds to the data processing file. Each file folder contains many pieces of paper, with one customer's name and address on each piece (the individual pieces of paper correspond to records).

Each piece of paper could be a form made up of boxes, and in each box we could put the person's name, address, city, state, or whatever information was called for on the form. In data processing, the equivalent of each long box that is filled in on the form is the field. Each letter that we use to fill in the box is a character. Picture the file folder with letters on a piece of paper and many letters and numbers (characters) grouped together in a box (field) to make up a person's name and address. Many boxes are put together to make the form, or record. All of these forms are put into an envelope called a file folder — in data processing terms, a file.

Volume

A whole group of data processing files can be put together in what is called a *volume*, and stored on a reel of magnetic storage tape.[2] In our office analogy, a volume would equal a whole file shelf, each shelf containing many file folders.

Library

A collection of magnetic tapes put together is called a *library,* just as a whole group of filing cabinet shelves is called a filing system.

It is essential to become familiar with[3] the common data processing terms:

character — each key that is entered on the keyboard;
field — a group of characters, such as person's last name;
record — all of the information about one person;
file — a group of all of the records that we want to keep together.

A number of files of a company's customers go on to a *volume,* and many volumes make up a *library.*

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[1] **file folder** — папка-скоросшиватель
[2] **magnetic storage tape** — магнитная лента-накопитель
[3] **to become familiar with** — усвоить

INPUT, PROCESS, STORE, OUTPUT

There are four steps that any computer uses in doing its job. These are (1) inputting of data into the computer, (2) processing of the data that has been input, (3) storage of data, and (4) production of some kind of useful output.

In business computers, this four-step process is very easy to see. In order to produce a bill for a customer, we would have to input the information about what the customer bought. Once all of this information had been input, the computer would process this information and would print the information for the customer's bill. Throughout this cycle, the computer would be storing (1) the data that had been input, (2) the data produced during intermediate processing steps, and (3) the data being printed out. Apart from processing data, computer systems are being increasingly used to store data; such storage has the advantage of allowing data to be rapidly retrieved.[1]

In manufacturing, computers are used to control robots. If you think about it, any robot has to use some sort of a computer as the basis for its "intelligence". If we were to build a robot to be used in the assembling of automobiles, and if our robot had the specific task of mounting wheels on the car, the instructions for this process would be input into the computer. In addition,[2] the robot would still have to be able to determine where the car and the wheel were. Various types of sensors, such as a television camera, would enable the robot to "see" the position of the wheel and the car. In this case, we would not have to type information into a computer for the robot to act.[3] We do have to have some means of getting the data into the computer, like a television camera. If we were to build this robot correctly, it would use the television camera to tell where the car was, where the wheel was, and even where the lug nuts[4] were. The television camera would be the input. The process would be the calculations required to determine how to get the wheel on the car, and the output would be the robot's response to these calculations: mounting the wheel on the car, putting on and then tightening the lug nuts, and checking to see if the tire were properly mounted. The basic steps — input, store, process, and output — would be taking place with our robot even though no data was typed into the robot's computer (remember that the instructions had been input earlier, and were

---

[1] **such storage has the advantage of allowing data to be rapidly retrieved** — преимуществом такого накопителя является возможность быстрого извлечения данных

[2] **in addition** — вдобавок (к этому)

[3] **for the robot to act** — чтобы привести робота в действие

[4] **lug nut** — барашковая гайка

being stored). The sequence of input, store, process, output takes place no matter what kind of computer we use. Let's take one more case.

In medicine, doctors and technicians use computers in X-ray devices called CAT (Computerized Axial Tomography) scanners. This machine enables a doctor to see representations of the tissue inside a person's body without having to cut into the body. These devices use X-rays to take not just one still picture (what we know as the standard X-ray) but a series of pictures, much the same as[1] the series of still frames of a motion picture. In addition, CAT scanners have the ability to give the picture a three-dimensional quality.[2] That is, once the series of X-rays has been taken,[3] the CAT scanner can do the required calculations to display a picture that is a composite of many other pictures. The doctor can tell the computer that he wants to view an organ or piece of tissue from any angle. The computer allows the doctor to look at the picture from that angle and in three dimensions.

Complicated as this may sound,[4] the same basic steps of input, store, process, and output take place. Two inputs are required: the first is the required series of X-rays; the second is the set of instructions from the doctor telling what he wants to see. As the X-rays are taken, the information about them is stored by the computer system for further use. Once the computer has the desired input, it will process the stored information and produce its output (a picture of what the doctor requested), which can also be stored by the computer to be used in the future if necessary.

Let us continue to examine this process of input, store, process, and output. One of the more common ways to input data into the computer is through the use of the computer keyboard.

Computer Keyboard

The computer keyboard is fashioned after[5] a normal typewriter keyboard. The major difference is that a computer keyboard has more keys than a typewriter. These extra keys can send special characters to the computer. Each different model of computer responds to each of these special keys differently. Computer keyboards manufactured by different companies have these special keys in different places. Consult your instruction book, for the correct use of these special keys.

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[1] **much the same as** — почти таких же, как

[2] **a three-dimensional quality** — объемное изображение

[3] **once the series of X-rays has been taken** — когда серия рентгеновских снимков отснята

[4] **Complicated as this may sound** — Хоть все это и звучит замысловато

[5] **is fashioned after** — построена по образцу

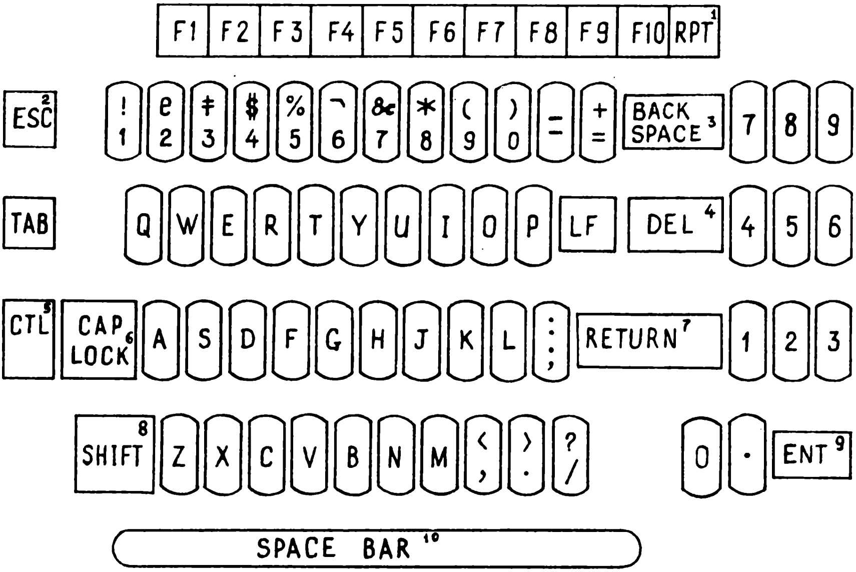

Figure 6. The computer keyboard

The position of the keys for the letters and numbers is the same on both typewriters and computer keyboards. The difference between the two is that the computer keyboard has additional punctuation and special computer control keys.

Most noticeable is the addition of the *escape* key[11] (sometimes called the *altmode* key[11]), the *break* key[12] (sometimes called the *interrupt* key[12]), and the *control* key.[13] Computer keyboards also have a shift key which functions the same as a shift key on a regular typewriter.

Most of the keys behave exactly like the keys on an ordinary

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[1] **RPT** — повтор
[2] **ESC** — переход
[3] **BACK SPACE** — удаление символа слева от курсора
[4] **DEL** — удаление символа справа от курсора
[5] **CTL** — управление
[6] **CAP LOCK** — фиксированный верхний регистр
[7] **RETURN** — возврат
[8] **SHIFT** — перевод регистра
[9] **ENT** — ввод
[10] **SPACE BAR** — клавиша пробела
[11] **escape key = altmode key** — клавиша перехода
[12] **break key = interrupt key** — клавиша прерывания
[13] **control key** — клавиша управления

typewriter: when you press the key, something happens immediately. But there are three keys on a computer keyboard that behave differently in that, when you press them, nothing seems to happen. These three keys are the shift key, the control key, and quite often the escape or altmode key.

The shift key and the control key modify the actions of any other key that is pressed at the same time as either of the first two. Sometimes the escape or altmode key will modify the actions of the next few keys pressed after the escape or the altmode key. For example, escape sequences (the pressing of a sequence of keys beginning with the escape key) are often used to clear the screen on a video terminal or to cause words to be highlighted. Usually the computer's instruction book will fully describe the effect of pressing the control or escape keys.

We have stated how to input data into the computer using a keyboard. But what kind of data should be typed?

Instructions to type

One of the types of data that is input using a computer keyboard is instructions to the computer. If we had a business computer to which we wanted to give instructions to start processing the payroll,[1] we would have to type in[2] the instruction to "Run payroll" or simply "payroll".

In fact, it may not be as simple as typing "payroll" because there are many steps to the operation of calculating somebody's payroll and having it printed out. Part of a payroll system[3] is the program necessary to input an employee's name and address, Social Security[4] number, marital status,[5] number of deductions[6] and all the necessary information about the employee.

Computer Output

In addition to accepting all of this information, all this input needed for the computer to do its required processing, we must determine exactly what kind of output we need from the computer. In the case of a payroll system, the two most important outputs are a paycheck for each employee and, for management, a totalling of what payroll costs were[7] for this payroll period.

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[1] **processing the payroll** — заполнение платежной ведомости

[2] **to type in** — ввести с клавиатуры

[3] **payroll system** — расчетная система

[4] **Social Security** — социальное страхование

[5] **marital status** — семейное положение

[6] **number of deductions** — количество удержаний (из заработной платы)

[7] **totalling of what payroll costs were** — какова была общая сумма выплат по платежным ведомостям

When a company bookkeeper sits down at a business computer, he has his choice of telling the computer that he wants to input or retrieve information about payroll, inventory, accounts receivable,[1] or accounts payable.[2] Remembering all of these commands and all of the possible choices is sometimes a bit confusing.

Menu System[3]

To help a person control the bookkeeping system by computer, the computer can be programmed with what is known as a *menu system*. This menu system for a program or for data selection enables the person running the computer to see a list of the things he can do next. Each item on the menu can, if necessary, select its own menu; and that menu can, in turn,[4] call still other menus. For example, the person who is trying to manage a company's accounting system may sit down at the business computer and be shown a menu that would let him select accounts payable, accounts receivable, general ledger, inventory, or payroll. The computer operator might then select payroll, whereupon the computer would then respond with the payroll menu, showing items necessary to guide the computer operator. One such item might be "enter hours worked". Selecting this item would allow the computer operator to input to the computer the number of hours that each employee had worked during the pay period.

Another item might be "print paychecks". Once all of the information had been input and the computer operator was satisfied that the information was correct, the computer could be directed to actually print the employee paychecks.

OUTPUT — VIDEO AND PRINTING DEVICES

The most common form of output device from a computer is called a computer *terminal*. It is usually a combination of a computer keyboard and either a printer that prints letters and numbers on computer paper or a television-like screen that displays the letters and numbers coming from the computer. The former is called a *printing terminal*; the latter, *video terminal*. A terminal is used both for input and for output. The keyboard is used by a computer operator to input data and the video screen or the printer is used to display or print output.

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[1] **accounts receivable** — счета к оплате

[2] **accounts payable** — счета к выплате

[3] **menu system** — система-меню, предлагающая готовый набор возможных ответов оператора

[4] **in turn** — в свою очередь

Video Terminals

Video terminals are most commonly used whenever a permanent record is not needed. Because the computer video terminal does not use paper and is usually faster and much quieter than a printing terminal, video terminals are used much more often for the day-to-day entry of computer transactions. Airline reservation clerks,[1] telephone directory assistance operators,[2] and bank tellers are people who commonly use video terminals. They need to see information for only a few seconds and usually do not need a permanent paper copy. In the few cases where a paper record is needed (an airline ticket or a bank deposit slip[3]), that record is usually printed on a printer.

Video terminals can display dark letters on a light background or light letters on a dark background. Some terminals even display grey on black or grey on white, or allow blinking letters to call attention to an important message.

In many cases, more than just written words can and must be output from a computer. Video terminals are used by engineers in designing structures and machines, by pilots who fly aircraft, and by doctors who must diagnose a patient's illness. In all of these cases, getting the computer output in a pictorial form[4] is more valuable than obtaining only printed words.

The use of color in video terminals is becoming increasingly popular. Color is used to call attention to important messages and to reduce operator fatigue, which sometimes results from sitting at a computer terminal all day. Color video displays are becoming more common as the pictures and drawings coming from a computer become more complicated. Related parts of computer-generated drawings can be color-coded to produce drawings that are easier to understand. A computer-generated blueprint[5] of an office building can be displayed showing all of the plumbing in green, the electrical wiring in yellow, the structure in blue, and the ventilating system in orange.

Printing Terminals

In the majority of computer applications, however, only printed words are output from a computer. Printing terminals are used

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[1] **airline reservation clerk** — служащий, занимающийся бронированием мест на авиарейсы

[2] **telephone directory assistance operator** — дежурная телефонистка справочного бюро

[3] **deposit slip** — депозитная карточка *(банковского вклада)*

[4] **in a pictorial form** — в виде изображения

[5] **blueprint** — синька, светокопия

when several people need to see the output from a computer, or when a permanent paper record of a transaction, or number of transactions, is needed.

When summaries of transactions are required, a computer printing terminal wastes a lot of paper because it prints each entry that the operator makes. Because of the huge volume of paper used by the printing terminal, companies soon discover that they have problems in finding enough room to store their old paper computer records. Companies also have to pay particular attention to what happens to old computer records that might fall into the hands of someone not authorized to use the data.

Printing terminals are used for low- to medium-volume printing.[1] A company may use a printing terminal to print paychecks, invoices, or reports if the number of these items is not too large. When there are many items to be printed, the printing is usually done on a high-speed line printer.

The first printing terminals used on the older computer systems were terminals built very much like ordinary typewriters or teletypewriters. These terminals used a mechanical type element that struck a ribbon, leaving an ink mark on a piece of paper in the shape of the striking element. These character-by-character printers were very slow because it took a relatively long time for the proper type face to be selected and to strike the ribbon.[2] The top speed of printing terminals of this type was on the order of 15 characters per second. At such a rate it took about five seconds for a computer to print a line of text on a piece of paper and about four minutes to type a whole page. While this is indeed faster than a person can type a page, it was much slower than the actual speed at which information was being sent from the computer to the printer. Different types of printing mechanisms have been developed to allow a computer to print faster.

Output-only printers[3]

Higher-speed printers are now available as "output-only" devices, that is devices without an attached keyboard. The keyboard is removed and placed away from the printer. This is because the higher-speed printers tend to be big and noisy, and people do not like to work right next to them.

One type of high-speed printer is called a *chain printer,*[4]

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[1] **for low- to medium-volume printing** — для печатания небольших документов

[2] **for the proper type face to be selected and to strike the ribbon** — чтобы выбрать нужный молоточек и ударить по ленте

[3] **output-only printer** — печатающее устройство (принтер), предназначенное только для вывода

[4] **chain printer** — построчное печатающее устройство (принтер)

so called because it has a chain of type,[1] with each letter repeated three or four times on the chain. The chain printer uses a bank of hammers[2] that strikes the type chain. There is a hammer for each possible character position to be printed on a line. If the computer were to print on paper eighty characters wide,[3] there would be eighty hammers in use on that printer. The chain rotates in front of the hammers much like the chain on a chain saw.[4] As the correct letter passes in front of the proper hammer, the hammer strikes the type chain, which is rotating in front of a ribbon, and an impression of the letter is made on paper. This chain passes very rapidly in front of the hammers, which strike the chain with lightning speed.[5] A chain printer can print at speeds approaching 600 lines per minute, or ten lines per second. At this rate, a chain printer can print a whole page in about six seconds.

A similar type of printer is a *band printer*.[6] Although somewhat faster than a chain printer, the band printer works in the same way except that the band printer's hammers strike letters pressed into a continuous band of steel. Because both the band printer and the chain printer require that the letters move past the hammers at such high speed, the letters wobble a bit as they pass in front of the hammers. The hammers often strike the letters off-centre,[7] which prints the characters a little higher or lower than they should be. This creates the rather messy-looking typing that we often associate with a page printed by a computer. Although chain printers and band printers are very fast, there has been considerable concern about their sloppy printing.[8]

Advances in technology have allowed newer types of printers to be developed. Different techniques have made printers that are cheaper and more reliable; they print faster and can produce a document that looks more like a printed book page than a page from a typewriter or a computer.

The *laser printer* combines laser technology with that of the office copying machine. The result is an expensive printer that can print almost any document imaginable, from reports to forms to maps. Laser printers are very fast, but they are large and use

[1] **chain of type** — цепочка (серия) литер

[2] **bank of hammers** — набор молоточков

[3] **if the computer were to print on paper eighty characters wide** — если, например, строчка, печатаемая компьютером на бумаге, содержит восемьдесят знаков

[4] **chain saw** — мотопила

[5] **with lightning speed** — молниеносно

[6] **band printer** — ленточное печатающее устройство (принтер)

[7] **off-centre** — не по центру

[8] **there has been considerable concern about their sloppy printing** — немалое беспокойство вызывает их неряшливая печать

a lot of electricity. They are available only as output devices, not with an attached keyboard. They are capable of printing literally miles of documents without stopping. Their high speed and reliability allows a single laser printer to produce what used to require many band printers just a few years ago. This high productivity makes laser printers ideal for large-volume printing.[1] Their use is becoming widespread among telephone and electric utilities and by other companies such as banks and credit card companies[2] that send bills to huge numbers of customers.

Microfilm and microfiche

Devices are now available for combining laser and microfilm technology to produce direct-output[3] microfilm and microfiche equipment. These devices "print" microscopic documents on a sheet or ribbon of plastic. These "printed" pieces of plastic must be placed in a magnifier, or "reader", to be read. Because their output cannot be read directly, these output devices are also not available as terminals.

Microfilm and microfiche have been used for a long time to store legal documents, ever since county courthouses first started becoming overrun by all of the legal records they had to store: birth certificates, death certificates, deeds, and public notices, all required by law to be retained.[4] Eventually pictures were taken of these stored records and the developed film was kept while the original records were eventually destroyed to save storage space.[5] Most public libraries now store their old magazines on microfilm for the same reason.

Microfilm and microfiche originally required that a camera be used to take a picture[6] of a real document. The film that the camera used was called microfilm. Computer output microfilm and microfiche do not require that a picture ever be taken or that the computer even produce a paper document. Instead, the computer system produces a reel of magnetic computer tape. This tape is placed on the tape drive[7] of a machine that reads the tape and directs a laser or other bright light source to directly expose the

---

[1] **for large-volume printing** — для печатания в больших объемах

[2] **credit card company** — компания по кредитованию

[3] **direct-output** — с прямым выводом данных

[4] **deeds and public notices, all required by law to be retained** — судебные дела и процессуальные записи, которые, согласно закону, необходимо сохранять

[5] **destroyed to save storage space** — уничтожены, чтобы освободить хранилища

[6] **required that a camera be used to take a picture** — требовали, чтобы при переснятии изображения использовался фотоаппарат

[7] **tape drive** — лентопротяжное устройство (привод)

microfilm or microfiche, giving an image of the data that was contained on the tape.

This new process saves a great deal of paper. There is also a substantial saving in shipping costs[1] when the records have to be transported. All of the automobile companies supply their dealers and service centres with microfilmed drawings and parts lists.[2] Gone is the day of the six-foot-thick stack of parts catalogues. Now a reader scans a small box of microfiche or microfilm that sits on the counter. Banks no longer print truckloads[3] of reports to be distributed to their branches;[4] their computers produce microfiche instead.

Plotters

Just as pictures and drawings are output from a computer to a video terminal in special applications, pictures and drawings are often printed on paper. Most printers, because they work a lot like typewriters, can print only alphabetic, numeric, or symbolic characters on paper; drawings and pictures are out of the question. Another device has been developed to allow a computer to draw on paper. This device is called a *plotter*. Computer-controlled plotters are being used by utilities, cities, and engineering firms to assist in their mechanical drawing departments.[5] It is no longer necessary for a whole map to be drawn because something has changed. The change is entered into the computer and the computer draws a new map. The computerized plotter has brought great savings to the production, storage, and reproduction of drawings, charts, and maps.

Other printing technologies

Other interesting developments in computer-printed output are the *ink-jet printer,*[6] which prints by spraying ink on the paper under computer control; the *matrix printer,*[7] which forms each character from small individual dots; the *thermal printer*, which prints by using heated wires instead of the usual impact head and ribbon; and a high-speed typewriter usually called a *letter-quality* printer.[8] All of these machines have developed to the point of

---

[1] **shipping costs** — стоимость перевозки

[2] **drawings and parts list** — каталог чертежей и деталей

[3] **truckloads** — целые грузовики

[4] **to be distributed to their branches** — для распространения по всем отделениям

[5] **mechanical drawing department** — машиностроительное конструкторское бюро

[6] **ink-jet printer** — струйное печатающее устройство (принтер)

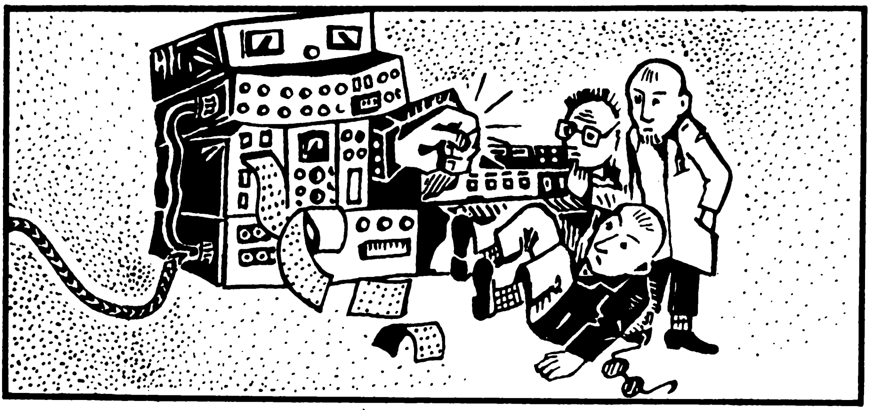
[7] **matrix printer** — матричное печатающее устройство (принтер)

[8] **letter-quality printer** — печатающее устройство (принтер) высококачественной печати

being relatively small, quiet printers.[1] These printing methods are being used with attached keyboards to produce a very satisfactory printing data terminal.

Advantages and disadvantages

There are advantages and disadvantages to each type of printer. The ink-jet printer prints rapidly and quietly, but it cannot print several copies of an original document on carbon paper forms.[2] If many copies are needed, then the ink-jet printer must print each copy individually. A thermo-electric printer (often used in hand-held calculators)[3] can be very inexpensive to manufacture, but it requires special paper that is quite expensive. Band and chain printers print rapidly and can print several carbon-copies at the same time as the original, but they are noisy and need repairs more often than some of the newer printing devices because they have many mechanical parts. Microfilm and microfiche are easy to store, but a magnifying reader is needed to read them. With these different printing methods available, a computer user must determine exactly what his printing needs are[4] before he decides what type of printer to use.



"There! This is the reply you get every time you ask her advice!"

[1] **have developed to the point of being relatively small, quiet printers** — спроектированы сравнительно малогабаритными и бесшумными

[2] **on carbon paper forms** — на бланках через копировальную бумагу

[3] **handheld calculator** — ручной калькулятор

[4] **what his printing needs are** — какой вид распечатки он хочет получить

IV. THE COMPUTER'S SOFTWARE

PROGRAMMING A COMPUTER

Each family of processors has its own instruction set which is likely to differ from[1] that of other processors. This means that a particular processor is only capable of understanding its own set of instructions in *binary code.*

The computer's memory can be considered as consisting of a number of cells capable of storing binary patterns representing program instructions or data. Each of these cells is uniquely numbered so that reference can be made to particular memory cells, either to select a program instruction or data, or to write data into a certain memory cell.

As an example of how programs are written in a computer's own code (machine code), it will be assumed that[2] two numbers are held in memory cells 5 and 6, that these are to be added together, and the result stored in memory cell 8. The addition will be performed in a storage location called the accumulator, so the first instruction needs to load one of the numbers into the accumulator. The second instruction adds the other number to the number in the accumulator, which will then contain the sum of the two numbers. The third instruction stores the contents of the accumulator in the required memory cell.

The binary codes for these instructions for a typical processor are shown in Table 4.

Table 4. **Machine Code Instructions**

Instruction	Machine Code
1. Load number held in memory cell 5 into accumulator	00111010 00000101 00000000
2. Add number held in memory cell 6 to number in accumulator	00100001 00000110 00000000 10000110
3. Store number held in accumulator in memory cell 8	00110010 00001000 00000000

[1] **is likely to differ from** — чаще всего отличается от

[2] **it will be assumed that** — предположим, что

In one program run, memory cells 5 and 6 could have been set to 70 and 25, respectively.[1] After the three instructions in Table 5 have been obeyed, cells 5 and 6 would still contain 70 and 25 and cell 8 would now contain 70 + 25, i. e. 95. The same program could be run again[2] with different data in cells 5 and 6 (say, 43 and 12), which would result in cell 8 having its previous value of 95 replaced by the new value of 55.

PROGRAMMING LANGUAGES

Programming in the computer's own machine code requires that the instructions and data are given to it in binary. Writing down and keying in a series of 1s and 0s is time-consuming and prone to error. An alternative way of expressing the instructions is to use *mnemonic codes*. For example, the command to load a number from memory cells could be written as LD A, (5) instead of the binary equivalent. Also the memory cells could be given symbolic names instead of referring to them by their actual numeric (binary) addresses.

This type of programming language is used when it is necessary to have close control over the functions of the computer. Languages which use such mnemonic codes are known as *assembly languages*. Each assembly language instruction usually corresponds to an equivalent machine code instruction. The translation of the assembly language program into machine code is carried out by a machine code program called an *assembler*.

High-level languages have been devised which allow several machine code instructions to be expressed in one statement. BASIC is such a programming language, as shown in the example below:

LET C = A + B

is a BASIC statement which causes the two numbers, held in memory cells A and B, to be added together and the sum stored in memory cell C. This is the same problem which previously required several machine code or assembly language instructions.

However, neither assembly language nor[3] BASIC programs can be understood directly by the computer. BASIC programs need to be translated into machine code using a compiler or interpreter. The basic difference between these two is the stage at which the translation from BASIC into machine code is performed.

---

[1] **In one program run, memory cells 5 and 6 could have been set to 70 and 25, respectively.** — Пусть по ходу программы в ячейки памяти 5 и 6 заложены соответственно символы 70 и 25.

[2] **could be run again** — может быть запущена вновь

[3] **neither... nor** — ни..., ни

Using a compiler, the translation is done *before* the program is executed; this gives speed advantages[1] over an interpreter which performs the translation process as it executes the program.

PROGRAM DEVELOPMENT

If a program is written too hastily, valuable time may be lost subsequently in implementing the necessary changes. Time spent pre-planning is seldom wasted. Commercial systems designers and programmers are expected to conform to[2] a specific formal procedure. In developing your own programs, you need to exercise self-discipline.

The first step is to ensure that you understand what you intend or are required to do. Are the terms of reference[3] clear? This might mean that you need to check the meaning of any terminology or jargon used. You may also need to ensure you understand the mathematical notation used to specify any relationships involved. Thus, initially, some research or background reading[4] may be necessary when you know what you want to do, but are not sure of the method to be used.

Designing Output

The starting point of designing a program should be the output. You need to consider and make decisions on the following aspects.

The output from a program may be printed and/or written to a file.[5] Is your output going to be solely printed, written to a file or a mixture of both? This leads on to deciding precisely what is to be printed and what is to be written to the file.

For example, your intention may be to write a program to read a stock data file[6] and produce a list of items to reorder. Given, for the moment, that[7] a program can be written to identify the items to be reordered, you need to consider: should the output be solely a printed list or should a reorder file be produced that

---

[1] **speed advantages** — преимущество в скорости

[2] **are expected to conform to** — *зд.* должны составлять программы в соответствии с

[3] **terms of reference** — упоминаемые термины

[4] **some research or background reading** — определенный объем предварительного ознакомления и изучения

[5] **may be... written to a file** — может быть внесен в файл

[6] **to read a stock data file** — для считывания файла данных (о товарных запасах)

[7] **Given, for the moment, that** — Скажем, если на данный момент

can be the input to a purchase order program?[1] If you are going to have a printed list of items to be reordered, what should it contain? Should it list the complete stock record of each item or, the other extreme, should it just be a list of stock code numbers?

Having decided what is to be output, it is then necessary to consider the format and general layout. The considerations to be made are:

In which columns are the variables to be printed?
Are column headings necessary?
Are main headings necessary?
What spacing is required between headings?
Should headings be underlined?

Input Requirements

Once the output details have been decided, you can then identify the necessary input. If a large amount of data is to be processed, it may be advisable to read it from a data file. If the data is solely associated with the one program, it can be incorporated in DATA statements, while data that varies from run to run[2] is best entered via INPUT statements.

You may not be the only person using the program and this is a factor to be considered. Ample print messages should be provided, giving guidance, if necessary, as to the input required.

A further aspect of the input design is the desirability of providing some form of control over the program during run time.

Flowcharting[3]

Once you have a broad idea of[4] your requirements, the logical sequence of the program statements needs to be developed. This can be done by drawing a flowchart. The more common symbols used in flowcharts are shown in Figure 7.

---

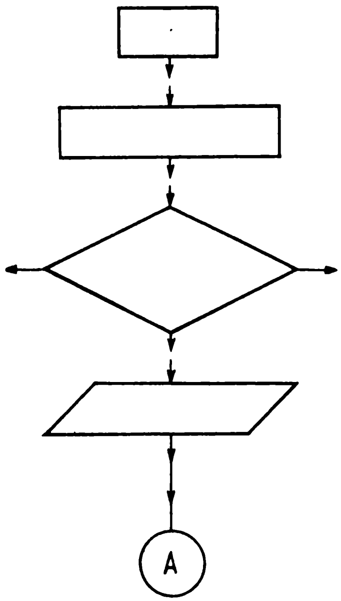
[1] **that could be the input to a purchase order program** — который может служить в качестве входных данных для программы заказа на покупку

[2] **varies from run to run** — изменяется от одного рабочего цикла ЭВМ к другому

[3] **Flowcharting** — Построение блок-схемы *(схемы потока информации)*

[4] **Once you have a broad idea of** — Теперь, когда у вас сложилось общее представление о

Symbol | Use



At the start and end of processing

To represent a stage of processing

Conditional test leading to up to three alternative paths[1]

Input or output statements

Connector, allowing chart to be continued at matching connector A[2]

Figure 7. Some flowchart symbols

The purpose of a flowchart is to ensure the logic is correct before becoming involved with[3] the details of individual program statements.

On occasions it becomes apparent from the flowchart or analysis of the problem that a similar calculation will be repeated several times in the program. When a similar set of program statements is likely to be required in several parts of the program, this may indicate the possibility of writing them once only as a subroutine and using this routine several times over.[4]

Having drawn flowcharts, the next stage is writing the program. When the program has been written, you still have not finished. A very important part of producing useful programs is to ensure

---

[1] **leading to up to three alternative paths** — ведущий не менее чем к трем альтернативным путям доступа

[2] **allowing chart to be continued at matching connector A** — позволяющий продолжить схему в месте подключения соединителя A

[3] **before becoming involved with** — прежде чем вы перейдете к

[4] **the possibility of... using this routine several times over** — возможность... многократного использования этой программы

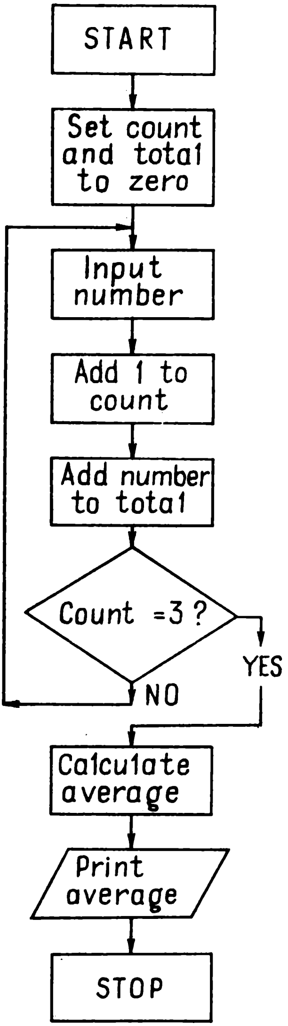


Figure 8. Flowchart for average of three numbers

that they perform as intended,[1] and the next section discusses the testing and documentation of your programs.

Program Testing

If you make a mistake in the use of the BASIC language, your computer will detect this and output a message to tell you that there is a syntax error in your program. Examples of typical syntax errors are: mistakes in spelling (e. g. IPUT instead of INPUT), wrong instruction formats[2] (e. g. LET X + Y = S instead of LET S = X + + Y), and unacceptable variable names (e. g. 2A instead of A2). You must clear all the syntax errors before you proceed.

Your program may still be incorrect after the syntax errors have been cleared. You may get an execution error caused by asking your computer to perform an action which it cannot do. For example, if values are calculated by your program which are either too small or too large you will get arithmetic overflow (this will happen when dividing by zero).

A program which runs successfully, without an execution error occurring,[3] may still give the wrong results because the logic of the program is incorrect. You should work through your flowchart and / or program instructions with typical data before running the program on your computer (this is known as performing a dry-run[4]). Then run the program on your computer with this typical data; this should be designed to test every instruction path in the program (i. e. every branch in your flowchart).

---

[1] **that they perform as intended** чтобы они отвечали своему назначению
[2] **instruction format** формат команды
[3] **without an... error occurring** — без ошибок
[4] **dry-run** прокрутка (прогон)

Some programming mistakes may still slip through[1] even if you carry out a dry-run, particularly if the program's logic is complicated. You may find the "bugs"[2] in your program by initiating a trace through it[3] during execution. The TRON command (entered before RUN) causes each line number in the program to be displayed as it is executed. The line numbers are shown in square brackets and will indicate the instruction path followed by the program. The trace is turned off by the TROFF command or when NEW is used. For extensive debugging, you can include TRON and TROFF as statements in your program, and remove these once the program has been debugged.

Table 5. **Program Containing an Error**

```
10 C=O: T=O
20 INPUT "NUMBER"; N
30 C=C+1
40 T=T+N
50 IF C<>1 THEN 20
60 AV=T/C
70 PRINT "AVERAGE OF"; C; "NUMBERS="; AV
80 PRINT "**********************************"
```

Table 6 shows a trace through the program given in Table 5 in which the test in line 50 has been mistyped so that the program calculates the average after only one number has been added to the count. This is shown in the trace. The program can be corrected by changing the 1 in line 50 to a 3.

Table 6. **A Trace Through a Program**

```
[10] [20] NUMBER? 2
[30] [40] [50] [60] [70] AVERAGE OF 1 NUMBERS=2
80 ****************************
```

FRE and CLEAR

During program development you can monitor the amount of unused memory by using the command FRE(O). Any character can be used within the brackets; it has no effect on[4] the value returned. In addition,[5] the smaller amount of memory remaining for the storage of string variables can be found by using a particular case of FRE, namely FRE ("   "). In practice, if the string space

[1] **may... slip through** — могут... вкрасться

[2] **"bugs"** — «блохи», ошибки

[3] **by initiating a trace through it** — путем проведения через нее трассировки

[4] **it has no effect on** — он не оказывает никакого влияния на

[5] **in addition** — кроме того

is used up[1] during execution of the program the error message "Out of string space in line..." is displayed. Both versions of FRE may be used in direct mode (preceded by PRINT) or within a program.

The value of variables and strings in memory can be set to zero[2] and null respectively by the use of CLEAR. This command may also be used within a program to avoid having to clear variables[3] individually.

Documentation

It is important to write down details of the program and its use, for subsequent reference.[4] You will find it useful to include the following sections in your documentation: Identification, Contents Page, Summary, Description of the Problem, Specification of the Problem, Input and Output Formats, Use of Program, Interpretation of Outputs, Modifications, Appendices.

VI. MICROCOMPUTERS IN INDUSTRY. ROBOTICS

MACHINE TOOLS[5]

Machine tools are a class of metal removing machines such as lathes,[6] millers[7] and drillers.[8] The basis of the cutting process is the movement of the cutting tool in relation to the material in a precise orientation and by a precise amount.[9]

Traditional numerical control (NC) is based upon the movement being controlled via a pre-prepared punched paper tape.[10] The development of microprocessors and compact computers has extended the sophistication of the control available, so that the term "computer numerical control" (CNC)[11] is used. A diagram of the basic control system is shown in Figure 9. For simplicity, only one controlled movement is shown. In practice, movements in all three dimensions are controlled.

---

[1] **if the string space is used up** — если все место для строк израсходовано

[2] **can be set to zero** — может быть установлена на ноль

[3] **to avoid having to clear variables** — во избежание необходимости сбрасывать переменные

[4] **for subsequent reference** — для последующих справок

[5] **machine tool** — металлорежущий станок

[6] **lathe** — токарный станок

[7] **miller** — фрезерный станок

[8] **driller** — сверлильный станок

[9] **in a precise orientation and by a precise amount** — в определенном положении и в точно заданных пределах

[10] **punched paper tape** — бумажная перфолента

[11] **computer numerical control (CNC)** — числовое программное управление (ЧПУ)

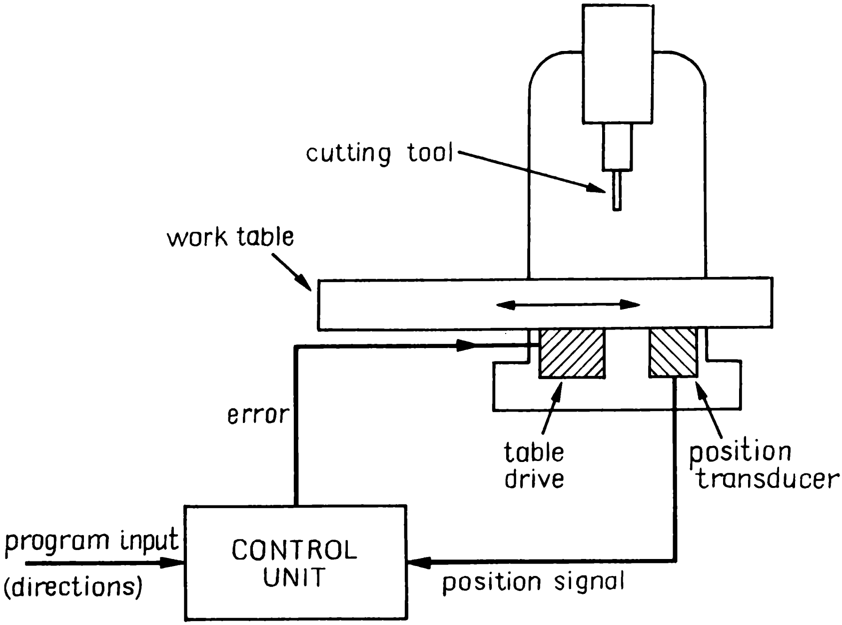


Figure 9. Basic numerical control system

The actual movement and monitoring of the controlled axes[1] are carried out by motors and position transducers.[2]

On the above basis numerical control machine tools have been used for many years prior to the development of the microelectronics. The application of microcomputers allows for more sophisticated control. When metal is machined, its cutting properties can vary throughout the workpiece,[3] particularly if it is a forging or casting. Microcomputers can add a further aspect of adaptive control by reacting to the current power consumption, torque,[4] etc. of the driving motors.

Due to the nature of microcomputer systems a distributed processing approach[5] can be adopted for the control of the various

---

[1] **monitoring of the controlled axes** — отслеживание (положения) контролируемых (координатных) осей

[2] **position transducer** — датчик положения

[3] **when metal is machined, its cutting properties can vary throughout the workpiece** — когда металл обрабатывается, его режущие свойства могут меняться в пределах одной заготовки (детали)

[4] **torque** — вращающий момент

[5] **distributed processing approach** — принцип распределенной обработки (данных)

functions of a machine tool. This also allows a modular approach[1] to the development of the hardware and software. In addition, greater operator interaction for unexpected situations is possible due to the work cycle not being restricted to preprogrammed punched paper tape.

Instead of being a substantial part of the cost of a machine tool, the use of microcomputers makes the numerical control cost less and adds relatively little to the cost of the machine tool.

Some control systems are too complex for a single microprocessor. One approach is to use a bit slice microprocessor system[2] whereby the codes of the data bus are broken into slices,[3] each having the same number of bits (e. g. 16 bits into 4 slices of 4 bits). Each of the slices is then processed in a separate processor.

An alternative to bit slice microprocessors for complex systems is to use several microprocessors together. An example of this is shown in Figure 10.

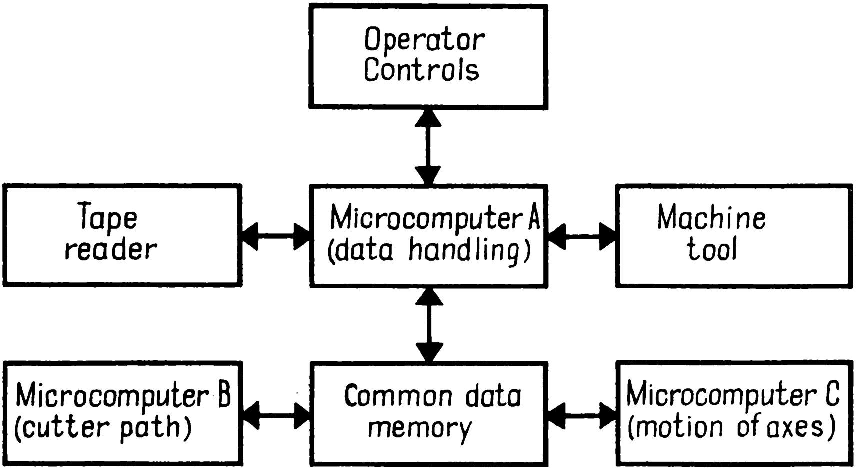


Figure 10. A multi-microcomputer system

Microcomputer A acts as a programmable interface between the machine tool and the system. It also handles tape and operator input and output. Microcomputer B calculates the axes motions as a function of time and hence[4] the path of the cutter, and

---

[1] **modular approach** — модульный принцип

[2] **bit slice... system** — система, секционированная по двоичным разрядам; система с разрядной организацией

[3] **whereby the codes of the data bus are broken into slices** — в процессе чего машинная программа шины данных разбивается на секции

[4] **hence** — следовательно

microcomputer C controls the position of the feed axes.[1] The three microcomputers share a common data memory. As more microcomputers are linked to the machine, a greater on-line processing capability[2] is built up. For example, "worksurface programming" is the technique whereby the desired profile of the workpiece is specified and the size of the blank[3] is entered. The control system works out the pattern of cuts necessary to produce the component. In some cases, this is displayed on the VDU[4] as a check before the operator commits the machine.[5]

The addition of VDUs to machine tool control systems allows a conversational approach[6] which guides the operator when inputting the required data. The use of microcomputers has enabled the development of digital readout systems[7] (with memory). The current position of all co-ordinates is displayed and in some cases the display can be switched at any time from one system of units to another and vice versa.

PROCESS CONTROL

The control of processes in general is a wider extension of the principles used in numerical control of machine tools. Instead of monitoring and controlling solely movement, other parameters such as temperature, time, gas flow, etc. are monitored and controlled. The possibilities are endless, provided[8] suitable transducers exist for the parameters to be controlled. In this case, the more complex the process the more suitable it is for microcomputer control.

Efficient operation of furnaces is an example where energy savings can be substantial when the process is properly controlled. A microprocessor-based system can monitor signals from thermocouples, air flow meters, fuel flow meters and gas analysers, and on the basis of heat loss calculation and furnace efficiency optimise the fuel/air ration.

In an application such as this, it is also possible to collect information of the furnace performance over time. An analysis of this information provides a valuable guide to damage and wear

---

[1] **position of the feed axes** — положение осей подачи (обрабатываемой детали)

[2] **on-line processing capability** — способность к обработке данных по мере их поступления

[3] **blank** — болванка, заготовка

[4] **VDU** = Visual Display Unit — устройство визуального отображения, дисплей

[5] **before the operator commits the machine** — прежде чем оператор начнет станочную обработку

[6] **conversational approach** — режим диалога

[7] **digital readout system** — система цифрового отображения (информации)

[8] **provided** — при условии что, в случае если

and to establishing the time for appropriate corrective maintenance.[1]

Another heat dependent process is injection moulding. A microprocessor can monitor melt temperature, die temperature, pressure, cooling time, etc. to control the cycle in accordance with the specification of the material being used.

In practice, despite theoretical laws, many industrial process parameters are chosen and varied according to industry branch accumulated data and operator judgement. This can lead to erratic production and quality problems.[2] With microcomputer control systems, this data can be stored and drawn upon from computer memory leading to greater uniformity of output.

The calculation of optimum tool life from theoretical laws, for example, is not practical because of the variations in the properties of the actual workpiece. Optimum tool life more realistically should be based upon actual experience. It is feasible nowadays to monitor and analyse data to recalculate continuously optimum tool life.

Continuous monitoring of vibration in machinery allows the vibration pattern to be analysed. Any abnormal wear or breakdown of bearings will show up as a dramatic change in the pattern of vibration.

INSPECTION AND MEASUREMENT

In industrial situations, the ability to inspect and, if necessary, reject quickly is desirable if further errors are to be prevented. The value of microcomputer-controlled inspection equipment lies in moving probes at high speed or using several probes simultaneously, and in analysing the reading obtained to produce a final result quickly and with consistent accuracy. For example, in checking turbine blades[3] twenty transducers might be used simultaneously. Immediate indication of "oversize", "undersize" or "acceptable" for each of the twenty measurements is given by lamps (red, orange, green) and a printout is available for permanent record.

The individual readings can be conveniently stored to allow trends,[4] etc. to be identified. This often enables a situation to be altered before faulty work is produced.

For precision engineering[5] an important measurement is surface

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[1] **provides a valuable guide to damage and wear and to establishing the time for appropriate corrective maintenance** — дает ценные сведения о повреждениях, износе и о времени необходимого профилактического ремонта

[2] **to erratic production and quality problems** — к неустойчивости производства и снижению качества продукции

[3] **turbine blade** — лопасть турбины

[4] **trend** — тенденция

[5] **precision engineering** — точное машиностроение

quality expressed by about twenty parameters (e. g. roundness). The calculation of these parameters is tedious working from a trace of the surface.[1] Traditional surface measurement instruments provide analog output into, say, chart recorders.[2] By interfacing a microcomputer to the output of the instrument, the analysis can be done directly. In this type of application, therefore, there are microprocessor-based surface measurement instruments and also "add-on" systems.[3]

ROBOTICS

The term "robot" tends to be used for a class of computer-controlled machines that follows a programmable pattern of behaviour. They are used, for example, as automatic handling devices for paint spraying[4] and welding.[5]

Automatic handling devices typically have up to six axes of control, three axes of motion in the "hand" for picking or placing the workpiece, three axes of motion to move the workpiece. Five axes of rotation can effectively simulate a human operator's waist, shoulder and elbow rotation, wrist bend and hand rotation. One robot of this type can load up to five numerical control machines grouped around it; similar types can load a lathe.

The simplest and earliest type of robot was a fixed sequence type.[6] Once set up to do a job they perform it repeatedly. To perform a different sequence they need re-programming. This is often done by the operator moving the robot's "hand" through the desired sequence, the sequence being recorded in computer memory. In some cases, the sequence can be off-loaded on to tape for storage and subsequent use.[7]

The type of robot control used can be classified as either point-to-point (ptp) or continuous-path[8] (cp). Ptp systems do not control the path between the specified points and are typically used in such applications as spot-welding.[9] Cp systems implement a smooth continuous movement and as a consequence are more sophisticated and costly.

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[1] **from a trace of the surface** — по проекции поверхности *(на экран, плоскость объектива микроскопа и т. д.)*

[2] **chart recorder** — самопишущий прибор

[3] **"add-on" systems** — дополнительные устройства

[4] **paint spraying** — окраска распылением

[5] **welding** — сварка

[6] **a fixed sequence type** — тип робота с запрограммированным повторяющимся циклом движений

[7] **can be off-loaded on to tape for storage and subsequent use** — может быть записана на магнитную ленту и сохранена для последующего использования

[8] **point-to-point or continuous-path** — непрерывное или дискретное (пошаговое)

[9] **spot-welding** — точечная сварка

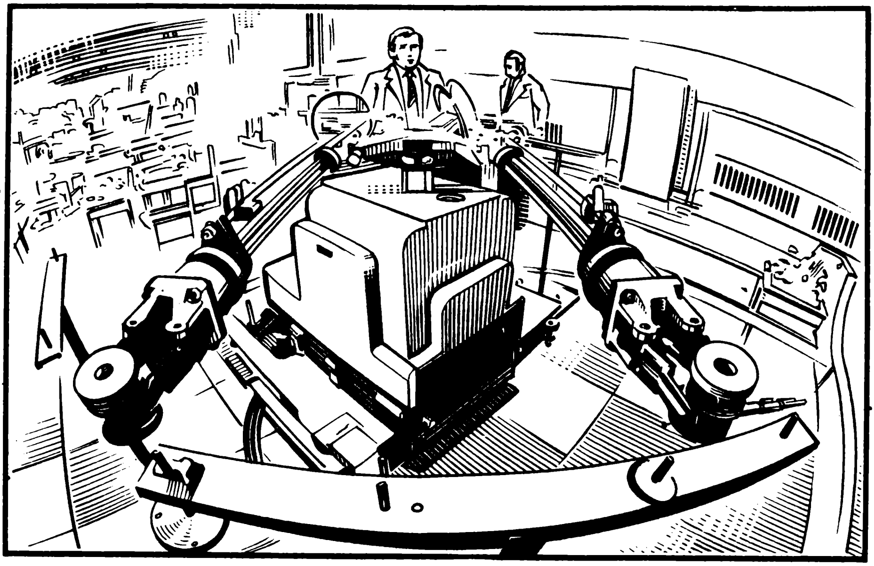

Figure 11. The Cyclon-5.02 industrial robot

A fixed sequence robot relies on the part to be handled, sprayed, etc. to be in the correct position.[1] If the part is missing, the robot will either stop or carry on handling "thin air". The typical precision attained is the arm repeating its movement to within 0.1 mm. The load that can be handled is about 4 kg.

The development in robotics is towards adaptive robots having sensory abilities. Initially the requirement is for robots to have a sense of vision and touch.[2] This will allow a robot to identify the correct part among dissimilar items and pick it up regardless of its position. Robots of this type are being introduced into assembly lines.

The theoretical basis of the work needed to develop sophisticated adaptive robots is referred to as "Artificial Intelligence" (AI). A robot's ability to "see", for example, is a problem in "pattern recognition". Problems in this area are concerned more with developing suitable software rather than with building suitable robots.

Although this discussion has centred on industrial robots, robots and robotic principles are being used in unmanned space missions and in deep ocean diving equipment.

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[1] **A... robot relies on the part to be handled... to be in the correct position.**— Для работы робота с деталью необходимо, чтобы она находилась в определенном положении.

[2] **Initially the requirement is for robots to have a sense of vision and touch.**— Прежде всего роботы должны видеть и осязать.

THE ROBOT'S NERVOUS SYSTEM

Robots, in order to perform many functions, need a nervous system and organs of sense as well as a brain. A human being has to have eyes and ears, a nose, a mouth and a sense of feel. Depending on the task it is to perform,[1] a robot can have any of these built into it.[2]

A robot's eyes, for example, are generally made up of photo-electric cells. A robot eye can consist of one cell, or of hundreds of cells placed close together. A one-cell eye isn't able to do much more than tell the difference between light and dark, while some of the more complex ones are able to see colour and detect movement.

Robots can be taught to hear various types of sounds. Usually they are made so that they can hear only those sounds which are important to them. For instance, a robot designed to hear the sound of a jet aircraft would have no reason to hear the voice of a bird. Robot ears are better than human ears for a given single function because they are not distracted by unimportant sounds.

Robot hearing is possible because sound is a form of energy. It comes in waves. Some sound waves have high frequency, others have low frequencies. A robot can be adjusted to detect differences in frequency. If sounds of a given frequency are important to a robot's job, it acts on them. Otherwise the brain ignores the sound.

Robot noses can detect different odours because the elements that make up those odours change the composition of the air that carries them. Robot noses are adjusted to analyse air passing through their nostrils and from the air composition tell what that air smells like.

Robots feel in the same way that humans do. Tiny wire fingers can go across a surface and, from the way the surface pushes the wires around,[3] the robot can tell whether the surface is smooth or rough. Robots can also tell the difference between two temperatures. Another kind of robot feel sensor[4] can feel the exact temperature more accurately than any thermometer.

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[1] **Depending on the task it is to perform** — В зависимости от той задачи, которую он должен выполнить

[2] **a robot can have any of these built into it** — в программы робота могут быть заложены любые из этих чувств

[3] **from the way the surface pushes the wires around** — по тому, как поверхность давит на датчики

[4] **robot feel sensor** — устройство, выполняющее у робота роль органа осязания

ROBOTS IN INDUSTRY

Towards the end of the current five-year period we are to put into operation about 2,000 robotic complexes and about as many flexible automated production systems which will reduce the number of monotonous and unskilled jobs, and bring about[1] a radical reduction in the proportion of manual labour. Below is a discussion of the role of robots in automation. Each item of the discussion is presented in the form of a question and a detailed answer to it.

QUESTION. A robot pianist playing from a sheet of music[2] and a robot artist drawing portraits by means of a computer and a technical vision system created quite a stir[3] at the EXPO-85 world exhibition in Japan. Many think it will not be too long before robots like these take over from[4] human musicians and artists.

ANSWER. No matter how perfect, a robot will never replace man with his unique individuality without which there can be no art. All a robot can do is assume some of man's functions. This is already a reality. However, such robots cost quite a lot to make. Why, then, you may ask, do certain U.S., Japanese and West European companies spend so much money on building robots of no practical value at all? This is done for the sake of publicity so as to secure a foothold on a competitive market.[5] Such robots often advertise products which have little to do with robotics. Expecting a robot pianist to acquire the feeling it now lacks in performing music would be simply foolish. Scientists and engineers do not make artificial souls even in sci-fi novels, let alone[6] in real life.

QUESTION. Do you think that if a robot does not justify itself economically,[7] using it would be a scientific and technological step backward[8] rather than forward?

ANSWER. Like any other machine, robots must improve the quality of products, increase output, cut production costs and reduce the work force.[9] If they do not do all this, they are of no use.

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[1] **to bring about** — вызвать, повлечь за собой

[2] **playing from a sheet of music** — играющий по нотам (с листа)

[3] **created quite a stir** — вызвали настоящую сенсацию

[4] **it will not be too long before robots ... take over from** — не за горами то время, когда роботы заменят

[5] **to secure a foothold on a competitive market** — Обеспечить себе прочные позиции в конкурентной борьбе

[6] **let alone** — не говоря уж о

[7] **does not justify itself economically** — не оправдывает себя с экономической точки зрения

[8] **backward** — назад

[9] **reduce the work force** — сокращать затраты рабочей силы

QUESTION. But we cannot assess everything only in economic terms, can we?
ANSWER. No country has enough money, resources or technical facilities to change over to robotics right across the board.[1] Therefore, robots should be used only where they can yield maximum effect, both economic and social. Today, robots are at their best in[2] welding, painting, electroplating, and other jobs. They do all this more efficiently, improve the quality of products, and release human operators from unhealthy work zones. This trend towards the priority development of assembly-line robots[3] was confirmed by the international robotics congress held in Brno, Czechoslovakia, in March, 1986.
QUESTION. The creation of microprocessors is believed to have given the impetus to[4] impressive progress in robotics. How are they used in the industrial robots now in operation?
ANSWER. The revolution in microelectronics held out truly breathtaking prospects for robotics. You don't have to prepare a new program each time you set a new function to a microprocessor-equipped robot. Several standard programs can be stored in the computer, and the one required summoned by the push of a button (if this is not done automatically). This is the advantage the best specimens of such programmed robots have over the other kinds. But the main thing is that, owing to their miniature size and low cost, microprocessors have provided a strong stimulus to the development of adaptive robots. Fitted out with pickups[5] including technical vision and other artificial sensory organs, they find increasing use in flexible production lines which can be promptly geared to the manufacture of new products. Great importance is attached to the development of such lines in the world today.
QUESTION. How much, do you think, rotary and rotary-conveyor lines can contribute to the current process of production automation?
ANSWER. Such lines were created in the USSR by Academician Lev Koshkin over thirty years ago. They process and assemble radio and camera components, harden electrodes, make frankfurters and meat dumplings and a great variety of other products.

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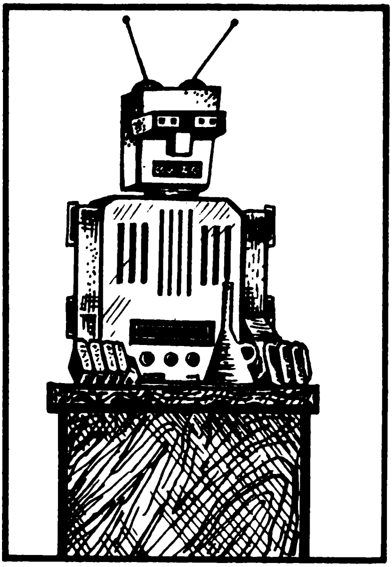
[1] **to change over to robotics right across the board** — внедрить робототехнику повсеместно, сразу во всех отраслях

[2] **are at their best in** — лучше всего выполняют

[3] **assembly-line robot** — робот, предназначенный для работы на сборочном конвейере

[4] **the creation of microprocessors is believed to have given the impetus to** — считается, что создание микропроцессоров дало толчок

[5] **fitted out with pickups** — снабженные искусственными органами



"Some of you may wonder why I've settled on the following theme for my lecture: 'Can robots think?' "

Academician Koshkin told the correspondent that, while on a visit to France, he had been to a plant that produces sprayer valves. The plant employs over 400 workers while its counterpart in Riga, fitted out with a rotary-conveyor line, only has two. A worker assembles 1,500—2,000 valves per shift[1] by hand;[2] a robot's efficiency is about the same; and a rotary-conveyor line does this in 2—3 minutes.

QUESTION. What will the manufacturing process be like at an integrated production plant fitted with flexible production lines?

ANSWER. The traditional drawing board will be replaced by a computer visual display unit. A designer will enter all the initial data in a computer which will help him try out all the possible versions of the unit he is devising and select the best one. Since the standard routines of manufacturing this or that component will be put into the computer's memory in advance, the designer will not have to rack his brains[3] for the way to make it. The manufacturing technique will be decided upon by the computer,[4] after which a program will be drawn up automatically and without any technical drawings, fed into the production plant's master computer. Manufactured products are assembled, inspected for quality, stored and shipped automatically.

QUESTION. What new tasks do higher educational establishments[5] face in connection with the current emphasis on robotics and industrial automation?

ANSWER. As a result of narrow specialization engineers of different specialities have a hard time understanding each other.[6] Robotics and automation call for the pooling of their efforts.[7]

[1] **per shift** — за одну смену

[2] **by hand** — вручную

[3] **to rack one's brains** — ломать себе голову

[4] **The manufacturing technique will be decided upon by the computer** — Компьютер будет определять технологию производства

[5] **higher educational establishment** — высшее учебное заведение

[6] **have a hard time understanding each other** — с трудом понимают друг друга

[7] **call for the pooling of their efforts** — требуют, чтобы они объединили свои усилия

Therefore the task now is to train engineers possessing a good knowledge of and skill in various fields. Within the next few years each engineer is supposed to become an expert at handling electronic computers.[1] For all that, the ability to operate a computer is not an end in itself but[2] a means of developing new equipment.

* * *

VI. EDUCATIONAL APPLICATIONS OF MICROELECTRONICS

COMPUTERS ON WHEELS

The mountain road was violently zig-zagging, but the driver did not slow down. He seemed to be more concerned with two timetables — that of the bus and school lessons. The bus had to arrive at a country school in time for the next lesson.

Personal computers are mounted in the bus's interior where basic instruction is given under the school curriculum[3] in information science and computer technology. Children from village and town schools are thus learning to operate computers. It is one of the forms of implementing the countrywide programme[4] for computer knowledge among students.

At present, the fundamentals of information science and computer technology are studied in nearly 60,000 secondary schools throughout the country. The subject has been included in the curricula of the tenth and eleventh forms. As an experiment, computer lessons sometimes start at an earlier age, even at the elementary school.

The authors of the experiments have developed teaching methods that allow computer operation to be combined with strengthening the oral count habits, developing the so-called sense of numbers, improving the standards of logic and mathematical thinking. For example, a mathematical dictation for solving textual problems. Teachers know that with the conventional methods the better part of a maths lesson is spent on putting down the solutions of problems (as a rule, children write slowly) and calculations. The logic part of the solution takes very little time. With computer equipment, this can be done efficiently and with

---

[1] **an expert at handling electronic computers** — специалист, умеющий работать с ЭВМ

[2] **For all that, the ability... is not an end in itself but** — При всем при том способность... является не самоцелью, а

[3] **school curriculum** (*pl.* curricula) — школьная программа

[4] **implementing the... programme** — претворение в жизнь... программы

the entire class participating.[1] The teacher slowly dictates the problem, while the children are not writing but listening attentively and thinking about the development. After a repeat, they immediately work out the problem on a computer or a calculator. The computer enables them to check the solution. In the second part of the lesson, a pupil comments on the line of reasoning.[2] Using this method, the pupils of experimental classes can solve eight to ten problems in 15 to 20 minutes.

The introduction of the new course in schools made it imperative to reorient the higher educational establishments, too: over a hundred faculties and departments were opened to provide training in information science and computer technology.

General secondary and vocational schools, teacher training institutes and universities had to be equipped with computer technology. In many areas children are taken by bus to specialized centres where they learn the new subjects because so far special classrooms cannot be equipped in every school. In some regions another approach has been taken — buses were equipped with everything necessary, and their schedules were timed to serve the lessons at schools.[3]

THE COMPUTER TEACHES PAINTING

The teachers of an art school in Wroclaw decided to "put harmony to the test of algebra". Jointly with engineers, the Polish artists made the computer "learn" one more trade. The computer superintends the process of teaching painting. A department of visual instruction,[4] the first in the republic, was opened. A group of enthusiasts worked out special tests and programs for primary, secondary and art schools. The leading role in these programs belongs to the most up-to-date engineering know-how.

The computer acquaints the beginners with the colour scale, technique of mixing paints and obtaining the required shades. With the help of game methods it is going to teach the children rudiments of composition and producing spatial shapes.[5] These are skills that involve knowledge of mathematics and geometry. In the experts' opinion, the computer can become a valuable helper in the teaching process. It is noteworthy that the appropriate

[1] **with the entire class participating** — при участии всего класса

[2] **line of reasoning** — ход рассуждений

[3] **their schedules were timed to serve the lessons at schools** — их графики были составлены с таким расчетом, чтобы обслуживать школьные занятия

[4] **department of visual instruction** — кафедра визуального обучения

[5] **rudiments of composition and producing spatial shapes** — начала пространственного построения сложных фигур и основы создания композиции

programs are designed for the Polish-made[1] microcomputers with which many of the country's schools are equipped. Quite a number of computers of this type make up the hardware of the Youth Computer Clubs[2] which are common in nearly all the provinces of the country and in the larger cities. There are also programs for other types of computers.

A TALKING ABC-BOOK

Boys and girls from one of Gorky's children's centres got acquainted with an unusual ABC-book. The meeting began with a monologue of the electronic textbook which told the class about itself, "I'm a speech synthesizer. I speak Russian. I can change my voice and tempo of speech..."

After a while, the children guided by their teacher had a go at[3] operating the wonderful machine. Six-year-old Yulia Kulikova sat down at the display and typed the Russian word "hare". Following her typing, the computer's base spelled the word naming the letters one after another. Then the voice said, "Hare."

Human speech is produced by a universal speech synthesizer — a miniaturized unit packed with a multitude of radio parts. The algorithm was worked out by specialists from Minsk and the synthesizer was made in Gorky.

The capabilities of the computer ABC-book do not strike only children. It can "speak" three male and two female voices. It is also able to produce an audio-text containing up to 400 characters, punctuate a text and do the simplest arithmetic operations.

"As you see, the scientists managed to turn an orthographic text into a phonetic one. And this is of great importance," the teacher said. "The young learner takes a deep interest in[4] producing the image of a letter, sound and word. He quickly learns to speak."

At present, the scholars are busy preparing a program in English.

COMPUTER IN U.S. TO TEACH SPOKEN LANGUAGE COURSES

A computer that speaks a few languages teaches at Stanford University.

The Institute of Mathematical Studies in the Social Sciences has designed a computer system that has taken the function of teaching beginners' courses in languages.

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[1] **Polish-made** — изготовленные в Польше

[2] **Youth Computer Clubs** — молодежные компьютерные клубы

[3] **had a go at** — попробовали, попытались

[4] **takes a deep interest in** — проявляет глубокий интерес к

The immediate aim is to make available[1] computerized courses in languages. The program has advantages that make it popular for the teaching of widely spoken languages, such as Spanish, French and German. Two manufacturers already have produced calculator-sized computers, designed for travellers, that translate words and phrases.

However, the program developed here is flexible. The computer offers highly individualized and interactive instructions.[2]

Unlike classroom training, the program allows the student to move through the instruction as quickly or slowly as he wants, and whenever he has access to a computer terminal.

The use of computers in teaching is not new. Several universities offer computer-taught courses, primarily in mathematical and scientific subjects. Stanford has for years offered courses in logic and probability,[3] some of which are taught entirely by computers.

According to a report by the institute, language training was a natural product of these programs. Computers are suited to language training, the report said, because such courses involve memorization and repeated drills by the student, something the computer can monitor and correct almost instantly.

A study by the institute, comparing introductory Russian courses in the sixties using a computer with those given by lecture, found a "consistently superior performance by students[4] in the computer-assisted classes".

The study noted that 80 percent of the computer-assisted students completed the second quarter of the course, compared with only 40 percent of the students in the regular class.

But those early computer-assisted classes used cassette tapes that were prerecorded and more rigidly programmed[5] than the new course. "Since then, computers have been created that synthesize speech," said Lawrence Merkosian, a research fellow[6] at the institute who helped develop the program. "That has given them great flexibility."

The computer actually generates speech by calling up[7] prerecorded phrases in grammatical sequence. The system could draw from[8] single words stored in the computer's memory but the

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[1] **to make available** — сделать доступными

[2] **interactive instructions** — команды, предназначенные для диалогового режима

[3] **courses in logic and probability** — курсы обучения логике и теории вероятности

[4] **a consistently superior performance by students** — значительно лучшие результаты у обучающихся

[5] **that were prerecorded and more rigidly programmed** — с предварительной записью и менее гибкой программой

[6] **a research fellow** — ученый, исследователь

[7] **by calling up** — вызывая из своей памяти

[8] **draw from** — *зд.* основываться на

resulting speech sounds unnatural. Since high-quality audio is desired in language training, phrases instead of words are synthesized.

The course requires no previous experience with computers. The student follows written instructions on how to begin operating the keyboard. Then the computer speaks to the student through headphones.

As the course begins, the alphabet is displayed on the screen and described in English synthesized from the computer's memory. Next the computer pronounces and writes a sentence in the foreign language. When the words disappear from the screen, the student then types the sentence from memory.[1]

The computer congratulates the student if the response is correct, but asks the student to repeat the exercise if it is wrong. If the student still has trouble, he or she can ask the computer to go over background material.[2]

At least[3] one professor at Stanford, John Barson, the head of the French department, does not believe that computers will completely displace human teachers.

"I don't personally view computers as a threat,"[4] he said. "There is enough of a social process and an infinite openendedness to language[5] that a computer can never master."

VII. COMPUTERS ALL AROUND US

VIEWDATA[6]

Viewdata is an exciting new development in the field of telecommunications. A Viewdata service offered by the British Post Office[7] enables people to call up information over their television sets. The information comes from a computer which stores information provided by various organizations. Stock market prices, sport results, news, weather reports, traffic information, house and car prices, travel timetables, games and puzzles are just some of the

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[1] **from memory** — по памяти

[2] **background material** — исходный материал

[3] **at least** — по меньшей мере

[4] **I don't... view computers as a threat** — Я не смотрю на ЭВМ как на угрозу

[5] **infinite openendedness to language** — бескрайние возможности языка

[6] **Viewdata** — информационная система связи, *основанная на ЭВМ и соединяющая индивидуальные телеприемники с центральной ЭВМ с помощью телефонных проводов*

[7] **the British Post Office** — Министерство связи Великобритании

subjects currently on offer.[1] The fact that a computer is involved need't put anyone off.[2] Everything is done automatically.

Called "Prestel", the system works by linking a Post Office computer to a special type of television receiver using the subscriber's own telephone line. "Prestel" currently offers nearly two hundred thousand pages of detailed information on subjects ranging from "amusements" to "employment statistics".

INTEGRATED WORK STATION[3]

In this age of office automation, some executives turn to their terminals as often as they turn to their telephones. Now a sophisticated office terminal manufactured by a Canadian telecommunications firm allows executives to do both at once. The Kontact, manufactured by Mitel Corp., of Canada, Ont., integrates the telephone and the business computer, giving each the advantages of the other at a price that is said to be as little as one-fifth that of comparable work stations.

Kontact combines a key pad,[4] a 12-inch video-display screen, a telephone and a computer memory unit in a sleek, two-piece console.[5] The system acts as a telephone operator, allowing the user to dial numbers by entering a brief code, automatically redial busy numbers at a single touch and set up a conference call[6] without operator assistance. The computer will even time and log calls for billing[7]. With a Kontact at the other end of the line, the telephone caller can leave a message in an electronic mail-box. Kontact's computer capability enables the user to process words or numbers for storage or transmission to another Kontact. Company officials say that eventually Kontact will be able to transmit information to many kinds of computers. In addition, Kontact can tap into any number of subscription data bases[8] now available.

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[1] **currently on offer** — постоянно имеющийся в наличии

[2] **The fact that a computer is involved needn't put anyone off.** — Пусть вас не смущает, что в системе задействован компьютер.

[3] **Integrated work station** — Комбинированный рабочий пульт

[4] **key pad** — цифровая клавиатура

[5] **a sleek, two-piece console** — блестящий корпус, состоящий из двух частей

[6] **conference call** — групповой телефонный вызов

[7] **will... time and log calls for billing** — хронометрирует и регистрирует телефонные разговоры для оплаты

[8] **tap into... subscription data bases** — подключаться к абонентным базам данных (*см.* Глоссарий)

TYPING ON TAPE

Makers of electronic devices are always looking for a new field to go into.[1] One of recent novelties in consumer electronics is a Typecorder. It is an addition to the automated office products.[2] The Typecorder is a word-processing device that is part taperecorder and part typewriter, and portable enough to allow a user to write letters or dictate memos.

Though the Typecorder's principal function is as a portable typewriter, it does not use paper. Instead, words typed out on a standard typewriter keyboard appear on a display panel while they are at the same time recorded on a built-in microcassette tape machine.[3] Printed version of the electronically encoded material can be retrieved on a compatible portable printing machine that is designed to fit side by side with the Typecorder in a standard attaché case. The tiny tape cartridge can also be plugged into a desk-top processor and printer.

The Typecorder's second function is as a dictation and transcription machine, since the microcassette machine will also record and play back spoken words. A user on the go can transmit either the typed reports or the verbal ones by hooking up the Typecorder to a telephone handset with the aid of a special coupling device.[4]

The Typecorder is packed with sophisticated electronics, yet it is remarkably small and lightweight: it measures only 1.5 inches high and weighs a mere 3 pounds. It is nearly noiseless. For those who do not like silent typing, engineers have installed a special switch that provides the familiar sound effects[5] when the keys are depressed.

BADGE READERS[6] AND OTHER DATA CAPTURE[7] DEVICES

A card reader is a type of data capture device that is being employed increasingly to authorize the use of[8] unattended equipment or facilities.

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[1] **are... looking for a new field to go into** — ищут новые области применения

[2] **office products** — канцелярское оборудование

[3] **recorded on a built-in microcassette tape machine** — записываются на встроенный микрокассетный магнитофон

[4] **by hooking up the Typecorder to a telephone handset with the aid of a special coupling device** — подключив «Тайпкордер» к микротелефонной трубке с помощью специального соединительного устройства

[5] **provides the familiar sound effects** — *зд.* воспроизводит знакомый стук пишущей машинки

[6] **badge reader** — устройство для считывания с жетонов

[7] **data capture** — сбор данных

[8] **to authorize the use of** — для допуска к пользованию

The card carries coded data on a magnetic stripe. When the user inserts the card into the reader, the use of the system is authorized or denied according to the code presented.

Typical applications for card readers include access control to restricted areas,[1] such as research laboratories or car parks, and to the use of equipment such as VDUs or photocopiers. A further use is as authorization to carry out banking transactions at a banking terminal.

The interrogation system used in conjunction with[2] badge readers can be programmed to suit many circumstances. Time zones can be established allowing access only during predetermined hours. This aspect may be developed further to monitor and control the times when security guards[3] report via terminal devices on their tours.[4] The equipment can also incorporate anti-passback features to avoid more than one person using the same card by passing it back from one person to another.

Badge card[5] readers used as access control devices are connected to a central controller. This central controller may be a dedicated piece of microprocessor equipment[6] rather than part of a general computer system. The central controller is linked to the badge readers via a common two-wire cable. One such system allows the wire to be up to 5 miles long. Additional readers are connected into the system by tapping the wires with a connection box.[7] A typical central controller can have up to 120 card readers connected and handle over 600 card holders. In addition to monitoring the use of cards the controller can monitor up to four environmental alarms from each card reader station. Self-contained power supplies[8] enable the controller to function for 48 hours in the event of a mains power failure.[9]

It is possible to change the void/valid status of a card immediately at the control unit. If necessary, a printer can be incorporated in the system to provide a record of movement through the card-controlled barriers.

Badge card readers can be the basis of more elaborate data entry equipment[10] that include a keyboard to enter unique data and

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[1] **access control to restricted areas** — контроль доступа в закрытые зоны

[2] **in conjunction with** — в сочетании с

[3] **security guards** — охрана

[4] **on their tours** — во время обхода

[5] **badge card** — личная карточка

[6] **a dedicated piece of microprocessor equipment** — специализированный участок микропроцессорного устройства

[7] **connection box** — соединительная коробка

[8] **Self-contained power supplies** — Самостоятельные источники электропитания

[9] **in the event of a mains power failure** — в случае аварии электросети

[10] **can be the basis of more elaborate... equipment** — могут лежать в основе более сложного... оборудования

a printer to output responses from the central control unit or computer.

This type of unit is used by banks to allow customers to withdraw money, pay in money or request statements,[1] etc.

MULTIPLE-FARE METER[2]

The idea of several people sharing a cab is not new, but a meter that calculates up to 10 separate fares simultaneously is probably a first. Schmidt Electronic Laboratories, Pty. Ltd., of Elsternwick, Australia, recently began manufacturing a multiple-fare taximeter. It is used in various Australian cities and Schmidt has now begun exporting the device.

To operate the meter, a driver presses a button each time an additional passenger enters the cab. The electronic meter begins tabulating distance and cost internally,[3] and it also displays its calculations on a digital screen upon push-button command.[4] Despite its numerous functions — 15 including its fare calculator — the Schmidt G1 Taximeter is small enough to be installed in a dash-board like a typical car radio. And even when the cab driver is not working, the meter is: the unit also functions as a digital clock.

SHADE FOR THE EYES, MUSIC FOR THE EARS

Sportsmen and spectators, or even workers who spend most of their days outdoors, should appreciate a new vinyl sun visor[5] from Hong Kong that can keep them in tune with music, or up to date with the news,[6] thanks to its built-in portable radio.[7] Since a visor is meant for bright, sunny days, so is the radio; it is powered by a solar-charged nickel-cadmium battery.[8] The sun-visor radio, called the Solarun, is only slightly heavier than an ordinary eye shade.[9] Its AM[10] radio is packed onto a slim integrated-circuit

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[1] **pay in money or request statements** — платить наличными либо по платежным поручениям

[2] **Multiple-fare meter** — Таксометр на несколько пассажиров

[3] **the electronic meter begins tabulating distance and cost internally** — внутреннее устройство электронного счетчика начинает подсчитывать расстояние и плату

[4] **upon push-button command** — по команде, подаваемой нажатием кнопки

[5] **sun visor** — солнцезащитный козырек

[6] **keep them in tune with the music or up to date with the news** — настраивать их на музыкальный лад или держать в курсе всех новостей

[7] **built-in portable radio** — вмонтированный переносной радиоприемник

[8] **solar-charged... battery** — батарейка, заряжаемая солнечной энергией

[9] **eye shade** — солнцезащитный козырек

[10] **AM** = Amplitude Modulated — амплитудно-модулированный

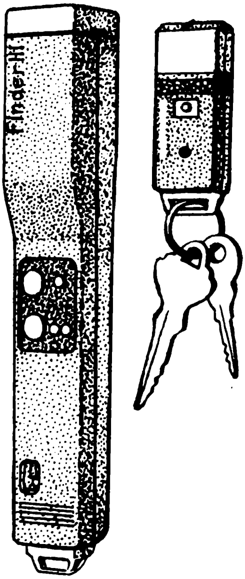

Figure 12. Finders Bleepers

chip and has a tiny earphone instead of a conventional speaker. The manufacturer says the radio will even play in the shade for up to six hours on a one-hour dose of sunlight, or up to 36 hours when the battery is fully charged.

NOW, WHERE ARE MY KEYS?

They could be called losers, but "misplacers" might be a better word for those people who never seem to be able to find their keys. Recently, Burns and Godfrey. Ltd. of Worcester, England, developed an electronic system to help such forgetful types keep track of keys, handbags and other often misplaced items. Finders Bleepers (Figure 12) consists of two battery-operated units. The 4.3-ounce Bleeper, which is about the size of a small cigarette lighter,[1] contains two small batteries plus a tiny light and a silicon chip[2] developed by the Wolfson Institute at Edinburgh University in Scotland. Keys can be attached to the Bleeper or the unit can be put into a handbag. If the key or bag is misplaced, the Finder is brought into play.[3] At the push of a button, the device sweeps around the room.[4] The Finder emits ultrasonic waves that can be picked up by the Bleeper. If the Bleeper is within 15 feet[5] of the Finder, even inside a drawer, the smaller unit will blink and emit a two-tone signal. The Finder can accommodate two Bleepers, each of which has its own characteristic pitch.[6]

COMPUTER IN A WRISTWATCH

Here is one of the latest achievements in portable personal computers. Hattori Seiko Company of Tokyo, Japan, has begun marketing a wristwatch computer system. The modular system, called the Seiko UC-2000 Series, is based on a fairly typical-looking elec-

[1] **cigarette lighter** — зажигалка
[2] **silicon chip** — кремниевая полупроводниковая микросхема
[3] **is brought into play** — вступает в действие
[4] **sweeps around the room** — обшаривает комнату
[5] **within 15 feet** — в пределах 15 футов *(около 4,5 м)*
[6] **pitch** — высота *(тона, звука)*

tronic wristwatch that snaps into a key-pad terminal[1] about the size of a check-book. The wristwatch itself contains a memory chip, with a capacity to store some 2,000 characters. The key-pad terminal contains the system's circuitry as well as the data entry controls.[2] Designed as an electronic note pad for travelling people, the system can be used to keep track of[3] airline and hotel reservations, appointments and phone numbers or an electronic filing system for brief memos. The user simply snaps the watch into place in the key-pad terminal and enters the data, transmitted by wireless electromagnetic induction, using the miniature keyboard.

TALKING WATCH

There is a solar-powered talking watch that not only literally "tells" the time but also wakes you up with such alarm messages as[4] "Time to get up, go, go, go". Available in several languages, the talking watch includes an accumulating register snooze control[5] that warns, "You are now ten minutes past your alarm time...,[6] you are now twenty minutes past your alarm time..."

Called the Communicator, the watch uses a 64-kilobyte chip (containing 64,000 words of computer memory), which produces twice the voice clarity of present synthesizers.[7] Second-generation talking watches and clocks will be externally programmable and voice-identifiable.[8] The buyer will be able to request the message he wants.

THE DOLL TALKS

A doll that is able to "think" and "talk" has been made by one of the American companies. Julia — that is the doll's name — reacts to human speech and keeps a dialogue going[9] in the framework

[1] **snaps into a key-pad terminal** — вставляется в панель номеронабирателя на внешнем устройстве

[2] **contains the system's circuitry as well as the data entry controls** — содержит основные узлы системы, а также устройства управления вводом данных

[3] **to keep track of** — регистрировать, заносить

[4] **wakes you up with such alarm messages as** — будит вас такими словами, как

[5] **an accumulating register snooze control** — устройство накапливающего регистра, не позволяющее вам снова задремать

[6] **you are now ten minutes past your alarm time** — уже десять минут, как вам пора вставать

[7] **produces twice the voice clarity of present synthesizers** — воспроизводит человеческий голос в два раза качественнее, чем современные синтезаторы

[8] **watches and clocks will be externally programmable and voice-identifiable** — у часов можно будет менять программу и давать запись знакомого голоса (по желанию заказчика)

[9] **keeps a dialogue going** — поддерживает разговор

of the themes entered in the program of a tiny microprocessor. Julia's word stock[1] includes about 100 sentences and it selects the required reaction after "hearing" the key word, such as, for example, "to have dinner" or "to play". A microcircuit, the size of a small coin, constitutes the doll's nervous system. It seems to function like the five human senses. Thus, a change in the ambient[2] temperature makes the doll speak out its mind about the weather.[3] If Julia is taken in the hands, it will inquire where it is going to be taken for a walk.

POCKET-SIZE LIE DETECTOR

In the 1970s a new type of lie detector called the "voice-stress analyzer" was introduced. Manufacturers such as Communication Control Systems (CCS), Inc., of New York, said that electronic voice tremor detectors[4] offered the accuracy of traditional polygraph machines, as well as a number of easy-to-use features. Some critics dispute the abilities of voice-stress analyzers but the products have won favour with[5] some law-enforcement agencies[6] and are particularly popular with businessmen for personnel screening.[7] Now CCS has come up with a miniature version of its original briefcase-size device.

The new hand-held voice-stress analyzer is designed for office use. Numerical readouts[8] on a display screen indicate the amount of subaudible[9] tremors in a person's voice. The more tremors, the more possibility that a statement is untrue, according to the voice-analysis theory.

ELECTRONIC WATCHMAN

American inventors are still racking their brains over better and more reliable locks and warning systems which can ward off[10] the most determined thieves. The latest invention is a microcomputer which is built into an electronic system, such as a stereo or car radio. Only the owner of the object who knows the code can play

1 **word stock** — словарный запас
2 **ambient** — окружающий
3 **speak out its mind about the weather** — высказать свое мнение о погоде
4 **voice tremor detector** — детектор дрожи в голосе
5 **have won favour with** — завоевали популярность среди
6 **law-enforcement agency** — учреждение, стоящее на страже закона
7 **for personnel screening** — для отбора кандидатов при приеме на работу
8 **Numerical readout** — Числовые данные, выводимые на экран
9 **subaudible** — неслышный без помощи приборов, находящийся за порогом слышимости
10 **ward off** — отвращать

his record player or radio once the electricity has been disconnected. To the thief who steals a radio fitted with this sophisticated lock, the radio will remain mute. "Newsweek" magazine believes that new products labeled as having an electronic lock will make potential thieves hold back from[1] stealing them.

SHOCK TREATMENT[2] FOR THIEVES

Thieves may be shocked — literally — if they try to snatch valuables locked inside a new high-security briefcase.[3] The electronic briefcase delivers a 4,000-volt electric pulse to anyone who grabs the case from its owner or attempts to secretly lift the case off the floor. Inside this seemingly ordinary attaché case is a panel of microcircuitry that makes up a radio receiver tuned to the frequency broadcast by a pocket-size transmitter carried by the attaché case's owner. If the case is moved more than 15 feet from the transmitter, or if it is lifted by someone not carrying the transmitter "key", an ear-splitting alarm sounds. Then, within 16 seconds a jolt of electricity is discharged, and this shocking performance is repeated every two seconds. The alarm and shock mechanism can also be triggered either when the case is jostled or if forced entry is attempted.[4]

PASSPORT FOR THE ELECTRONIC AGE

Since 1985, West German citizens travelling outside the European Economic Community are required to get a new type of laminated "forgery-proof"[5] passport. Like the identification cards now required in West Germany for travel within the EEC, the new passports have a computer-compatible[6] feature that law-enforcement officials hope will cut down the international movement of terrorists.

Both documents, the ID cards[7] as well as the new passports, are said to be virtually counterfeit-proof.[5] The page of the passport containing the owner's personal data and photograph is laminated so that it cannot be counterfeited without easy detection. The new passport is designed to be inspected by a computer at

[1] **will make potential thieves hold back from** — заставят потенциальных воров воздержаться от

[2] **shock treatment** — шокотерапия

[3] **high-security briefcase** — портфель с секретным замком

[4] **if forced entry is attempted** — если делается попытка взломать замок

[5] **forgery-proof = counterfeit-proof** — который невозможно подделать

[6] **computer-compatible** — пригодный для обработки на ЭВМ

[7] **ID** (= Individual Data) **card** — карточка индивидуальных данных

border checkpoints.[1] All border posts will eventually have scanning terminals[2] that are linked directly to the central computer at the Federal Crime Bureau. When the passport is placed on the glass plate of the scanner, the information about the owner is transmitted for comparison against crime records. If the passport bearer is a fugitive, the border guard is alerted in seconds. Right now border guards must refer to a written record on hand or punch data into a computer keyboard terminal to run a similar check on[3] suspected criminals or terrorists. The computerized passports are expected to cut down long lines, especially during vacation periods, at border crossings.

ILLUSTRATED COPYING INSTRUCTIONS

To aid office workers[4] who have to decipher photocopiers' instruction manuals, Xerox Corporation has developed a new line of machines that provide step-by-step operating tips in words and pictures. Xerox designers say the new Series 10 copiers are the most technically advanced — yet the "friendliest"[5] — copiers the company has ever produced.

Each machine features a pair of electronic display screens on its microprocessor control panel. One display shows operating instructions in conversational words. At the same time, the second display shows a line drawing of the machine with a flashing light to indicate the part of the copier referred to[6] in the written instruction. If the operator makes a mistake, the two displays team up to offer a solution such as, "Close the right door, make sure it's latched." Repairmen can also make use of the displays during service calls.[7]

PLAIN-SPEAKING HOME ROBOT

For all the prototypes that have come and gone, home robots remain little more than a good idea in search of a functional application. Still entrepreneurs keep coming up with new ver-

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[1] **border checkpoint** — пограничный контрольно-пропускной пункт

[2] **scanning terminal** — просматривающее оконечное устройство ЭВМ

[3] **to run a similar check on** чтобы проверить таким же способом

[4] **office worker** — служащий

[5] **the "friendliest"** — *зд.* самые удобные в обращении

[6] **the part... referred to** — деталь, о которой идет речь

[7] **service call** — вызов для устранения неисправности

sions, confident that the home robot is indeed the indispensable[1] appliance[2] of the future.

The latest is the Hubot, developed by a former industrial robot engineer Michael Forino of Carlsbad, California. Forino's mobile medley[3] of microprocessor-controlled entertainment gear, security sensors[4] and navigational systems is essentially a personal computer on wheels. With optional attachments it can vacuum[5] or control your household appliances. It can also be a charming novelty at cocktail parties, serving a tray of drinks and chatting to guests with an electronic voice. But the Hubot does have one serious aspect that deserves a significant note in the annals of home-robot development: its operating software accepts plain-language commands, rather than computerese,[6] on an easy-to-use keyboard.

TOUCHY CALCULATOR

A new pocket calculator developed by Casio Computer Company of Tokyo, Japan, has none of the usual push-button keys[7] for letters, numbers or mathematical symbols. Instead, the Data Bank PF-8000 recognizes symbols that the user traces on its glass panel with a fingertip. The Finger-Trace Recognition system[8] is designed to make this calculator easier to use than push-button machines of its type. There is no need to "hunt and peck" for entry keys or memorize the keyboard configuration. Doing away with the keyboard also contributes to the machine's slight size[9] — 5 inches[10] long by 2.5 inches wide and 4 inches thick. It weighs only 3.7 ounces.[11]

Like many of the newest pocket-size electronic calculators, this one can do more than simple arithmetic. Up to 50 names and telephone numbers can be stored in its memory bank to create an automatically alphabetized electronic directory.[12] A user

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[1] **indispensable** — незаменимый

[2] **appliance** — приспособление, прибор

[3] **medley** — *зд.* соединение, сочетание

[4] **security sensor** — датчик безопасности

[5] **vacuum** — *зд.* чистить пылесосом

[6] **computerese** = programming language

[7] **push-button key** — кнопочный переключатель

[8] **the Finger-Trace Recognition system** — сенсорная система распознавания

[9] **Doing away with the keyboard... contributes to the machine's slight size** — Устранение клавиатуры способствует миниатюризации машины

[10] 1 inch = 2.54 centimetres

[11] 1 ounce = 28.35 grams

[12] **to create a... directory** — образуя телефонный справочник

can retrieve this information by calling up[1] an individual name or by ordering a sequential search[2] of all names filed under a particular letter. Appointments, schedules and time-tables can also be filed and retrieved.

OPTICAL DISCS: THANKS FOR THE MEMORY

Stereo buffs[3] are quickly discovering that compact discs[4] (CD's) can produce music that is clearer and crisper than that of any phonograph record.[5] But the gleaming, palm-size[6] discs are capable of much more than bringing a better Beethoven or Boy George into the living room. Like magnetic floppy discs,[7] CD's can store any type of data that can be reduced to a digital code — whether it be words, numbers or musical notes. And CD's have capabilities that far surpass those of the well-known floppy disc. The laser-inscribed[8] CD can store more information per square inch than virtually any other type of memory device.[9] Several high-tech manufacturers are turning out compact discs and developing laser disc drives[10] in the hope that thousands of computer users may one day throw away their floppy discs in favour of CD's.

The storage capability of a compact disc is astonishing. One 4.7-inch plastic CD can store more data than 1.500 floppy discs or 50 "Winchester" hard discs.[11] This huge capacity of about 500 megabytes is more than enough to contain an entire encyclopedia. The CD has one major drawback, however: once the manufacturer stores information on a disc, it cannot be erased or changed. This means that a computer user cannot write a novel or figure out taxes with a CD. But it would be ideal to store lengthy reference works such as an unabridged dictionary, telephone directories[12] for several cities or dozens of income-tax forms.

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[1] **by calling up** — называя

[2] **by ordering a sequential search** — выдавая задание на поочередный поиск

[3] **buff** — любитель

[4] **compact disc** — накопитель информации на твердом диске с лазерной записью

[5] **phonograph record** — грампластинка

[6] **palm-size** — размером с ладонь

[7] **magnetic floppy disc** — гибкий диск магнитной записи

[8] **laser-inscribed** — с лазерной записью

[9] **memory device** — запоминающее устройство

[10] **laser disc drive** — накопитель на лазерном диске

[11] **"Winchester" hard disc** — кассетный накопитель на жестком магнитном диске

[12] **telephone directory** — телефонная книга

VIII. COMPUTERS AT THEIR BEST

DATA BASE MANAGEMENT SYSTEMS[1]

Direct access mass storage devices[2] have been used in statistical systems for a decade.[3] However, as with many other areas of computing technology, it has only been much more recently that software developments have made significant changes in the principles of computer functioning.

The most important developments in this respect have been systems for integrated data management.[4] Current software systems have made true data management feasible.[5] However, up to now there has been little effective standartisation of systems techniques. Furthermore, the data management software systems available now are often burdened with clumsy interfaces to application programs.[6]

The Data Base Task Group[7] of the Codasyl Committee[8] has made significant efforts to standardize the general terminology and also the data definition and manipulation languages.[9] The more recent data base management systems that have appeared on the market have already implemented the proposals of the Group. In fact, the most important development in the next decade will probably be the wide acceptance of a set of standards in the field of data management systems.

A more recent approach, the so-called relational model of data bases,[10] also promises significant improvements in data management concepts, although practical developments along this alternative are not yet in sight.[11] The essence of this model is that all data

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[1] **Data base management system** — Система управления базой данных

[2] **direct access mass storage device** — устройство массовой памяти прямого доступа

[3] **for a decade** — в течение десяти лет

[4] **integrated data management** — управление интегрированными базами данных *(т. е. несколькими базами, построенными по логическому принципу)*

[5] **feasible** — выполнимый, осуществимый

[6] **are... burdened with... interfaces to application programs** — перегружены интерфейсами (устройствами сопряжения) для прикладных программ

[7] **task group** — временная группа разработчиков

[8] **Codasyl** (= Conference on Data System Languages) **Committee** — организация в США, занимающаяся разработкой стандартных средств для обработки экономической информации

[9] **manipulation language** — операционный язык

[10] **relational model of data bases** — реляционная модель баз данных *(модель, логически организованная как набор отношений между данными в виде прямоугольных таблиц, помещаемых над списками данных)*

[11] **practical developments along this alternative are not yet in sight** — практических разработок, реализующих эту альтернативу (этот вариант решения), пока нет

in the data base have a simple homogeneous structure and the data semantics are vested in the language which operates on such a data base.

The impact of the integrated data management approach on[1] the manner in which the statistical services process data could be quite considerable. As has already been pointed out, new organizational units may be created, the opportunities of this approach may make distributed data bases[2] practical[3] and integrated statistical collection[4] supportable.[5] However, the current status of development in this area is still far short of what is necessary[6] to realise the full potential of integrated data management. The hardware elements will probably develop sufficiently with respect to storage capacity, communications, improved use of storage media, associative memories,[7] etc. but efforts will have to be made to ensure easy access to data and analytic tools for the statistician. This will require the development of interactive systems[8] for access, retrieval, aggregation and other data manipulation by the statistician without the intervention of a programmer.

COMPUTER LANGUAGES

Computer languages are the most important programming tools. They are usually classified as procedure-oriented or problem-oriented languages.[9]

Procedure-oriented languages such as FORTRAN, COBOL, PL/1 are the most frequently used computer languages. They are general-purpose in that[10] almost any procedure can be coded in these languages. The original intention in the creation of these high-level languages was to ease the burden of the programmer and to make

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[1] **impact... on** — воздействие... на

[2] **distributed data base** — распределенная база данных *(т. е. данные расположены на различных физических носителях в различных ЭВМ или системах ЭВМ)*

[3] **practical** — реальный, осуществимый

[4] **integrated statistical collection** — база данных с наборами статистических структур

[5] **supportable** — приемлемый

[6] **is... far short of what is necessary** — далеко не соответствует уровню, необходимому для того, чтобы

[7] **with respect to storage capacity... improved use of storage media, associative memories** — в отношении объема памяти..., лучшего использования носителей данных, ассоциативной памяти *(запоминающее устройство, где доступ к данным осуществляется указанием значения одного ее поля)*

[8] **interactive system** — интерактивная (диалоговая) система

[9] **procedure-oriented or problem-oriented languages** — процедурные *(основанные на понятиях процедуры и переменной)* или проблемные *(предназначенные для решения задач определенного класса)* языки программирования

[10] **they are general-purpose in that** — их универсальность заключается в том, что

programming somewhat more machine independent.[1] And these purposes have been achieved. But the expectation that general-purpose languages would make the computer more accessible to non-programmers turned out not to be realistic.[2] The problem is that programming in, say, FORTRAN, COBOL or PL/1 still requires special skills and training, and the user is not free to concentrate on the problem-oriented aspects of his work.[3]

In response to this, two trends have developed: one is toward interactive[4] programming languages, and the other toward problem-oriented languages.

A number of languages such as BASIC, JOSS, APL have been developed whose syntax and structure lend themselves to interactive use.[5] The advantage of interactive programming and compiling is that the programmer has immediate feedback[6] on his progress and that a considerable number of errors are eliminated at the point of generation.[7] The disadvantage lies in the fact that interactive compilers are interpretive and much slower at run-time than conventional compilers. However, with the increasing use of terminals, it is expected that interactive programming languages will develop further.

There is a special programming language used for teaching children of pre-school and junior-school age. It is called LOGO. Its syntax is close to that of the natural language, adjusted to the interactive mode and supported by an intricate system of sprites.[8]

THE COMPUTER ACQUIRES INTELLIGENCE

An interesting schedule[9] in the computing centre of the USSR Academy of Sciences prognosticates a rise in the number of programs

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1 **to make programming somewhat more machine independent** — сделать программирование в меньшей степени зависимым от ЭВМ

2 **turned out not to be realistic** — оказалась нереальной

3 **is not free to concentrate on the problem-oriented aspects of his work** — не может целиком переключиться на решение фактических задач

4 **interactive** — интерактивный; диалоговый *(диалоговый режим предполагает обмен текстовыми командами (запросами) и ответами; в интерактивном режиме могут использоваться более развитые устройства взаимодействия)*

5 **whose syntax and structure lend themselves to interactive use** — синтаксис и структура которых подходит под диалоговый режим

6 **feedback** — обратная связь

7 **at the point of generation** — в момент порождения

8 **sprite** — спрайт *(растровое графическое изображение небольшого размера (напр., 32 на 32 точки), которое может перемещаться по экрану независимо от основного изображения)*

9 **schedule** — график

by the year of 2000. It pointed to the fact that by the end of the century the whole of the Earth's population should be engaged in programming.

Even a layman[1] can say that this cannot be true, the schedule has an error somewhere. Where is that error?

The schedule is based on quantitative data. Indeed, the time is not far away when computers are going to be part of our home, very much as it is the case with colour TV sets today. But in the near future computing science is sure to develop qualitatively. Consider the fact that when turning the TV controls[2] we never think about Maxwell's equations or single-shot multivibrators[3] which form the foundations of present-day television technique. Similarly, we may not be aware of the prospects of computer development, namely that the latter are bound to grow more "humane" and "intellectual". It is not engineers alone that are concerned today with[4] the problem of creating an artificial intellect. This problem focuses the interests of researchers representing all branches of human knowledge without exception. Consequently, it is no wonder that[5] this is an area which is expected to make qualitatively fresh gains.[6] Creation of artificial intelligence is under way[7] in the Soviet Union.

A reservation[8] should be made at this point. The corresponding terminology is to be used correctly. You must have repeatedly come across expressions like "a case diagnosed by the computer". It is not the computer but the doctor who diagnoses the case, the computer just supports the expert's memory.

The World Health Protection Organization recently circulated copies of case histories including numerous tests, cardiograms and other objective data concerning a number of patients from Scandinavia. Every copy carried a request to the leading experts to devise a correspondence analysis[9] of the case. It is noteworthy that on the basis of the same data the experts would make not

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[1] **layman** — непосвященный, непрофессионал

[2] **when turning the TV controls** — включая телевизор

[3] **about Maxwell's equations or single-shot multivibrators** — об уравнениях Максвелла или лампах бегущей волны

[4] **It is not engineers alone that are concerned... with** — Не одни только инженеры заинтересованы в

[5] **it is no wonder that** — нет ничего удивительного в том, что

[6] **to make qualitatively fresh gains** — выйти на качественно новые рубежи

[7] **creation of artificial intelligence is under way** — искусственный интеллект находится в процессе создания

[8] **reservation** — оговорка

[9] **correspondence analysis** — заочный анализ

only different but often opposite inferences.[1] It came out that even a great number of formalized objective data, exact as they may be,[2] are not sufficient to diagnose a case with precision.

The point is that medical diagnostics ought to involve not only banks of data but also banks of knowledge. Data and knowledge are not the same thing. Data are primary, passive information input into the computer. Knowledge is active, its contradictory nature makes man strive for overcoming it. Therefore the simulated model of the user's mind ought to be introduced into the computer's memory.

It is noteworthy that this possibility was provided for[3] at the dawn of computerization by the Soviet-made computer «БЭ СМ-6». A team of Soviet researchers headed by Academician S. Lebedev put into the architecture of the computer a number of fruitful ideas which remain topical to the present day. Lebedev's team designed a system called «ДЖИН» serving as an interface to operator. In the process of inquiry «ДЖИН» could obtain data to build a "psychological portrait" of the user. The result was that «ДЖИН» would come to "like" or "dislike" the user.[4] «ДЖИН» even "took offence". A questioning of the operators and programmers showed that this activity on the part of the computer was not to their liking.[5]

Scientists are still puzzled over the exact mathematical simulation of the process of man's taking a decision. Cybernetics today includes the abbreviation PTD made up from the Person Taking a Decision. The PTD mental processes belong to the category which is hard to be formalized. Many things here depend on experience. As a rule, the solution lies in an expertise, i. e. joint effort of a number of experts aimed at solving a definite problem. Such kinds of joint activities of several PTDs have long been used in medicine (conference of specialist doctors)[6] or sports (board of referees and judges).

The technique of expert evaluation is widely used in determining the strategic trends of research and engineering progress, in elaborating economic and social programs for years to come.[7] A novel technique of organizing expertises was devised as early

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[1] **would make not only different but often opposite inferences** — приходили не только к различным, но и к прямо противоположным выводам

[2] **exact as they may be** — какими бы точными они ни были

[3] **this possibility was provided for** — эта возможность была предусмотрена

[4] **would come to "like" or "dislike" the user** — стал «любить» или «не любить» конкретного пользователя

[5] **this activity on the part of the computer was not to their liking** — подобная активность ЭВМ им не нравится

[6] **conference of specialist doctors** — консилиум

[7] **for years to come** — в будущем

as in the sixties[1] by Academician V. Glushkov. This technique has also found an application for solving the problem of planning allocations for[2] fundamental investigation.

"Our days see a regular boom in computer-based expertise systems," said professor D. Pospelov.

There are about a hundred expertise systems of all kinds functioning in the world. They are used in medicine, experimental chemistry, pharmacology, geology and archeology. Expertise systems are being introduced in automated designs and research, in economics and history — in all cases where the specialists have to grapple with[3] great masses of data which are not subject to any formalization.[4]

As distinct from data,[5] knowledge cannot be just pumped over onto the computer magnetic disks from reference books, treatises and other clever publications. They can be fed into the computer by genuine experts. This input leads to the computer forming a kind of crystal semantic lattice[6] whose joints remain blank. In time the blank spaces are to be filled with so-called frames[7] which correspond to certain conceptions. A system results which possesses qualitatively novel properties. It reacts to changed situations in quite a definite manner. In case some frame cells are substituted for other conceptions the evaluation of a situation and the corresponding behaviour of the system change essentially. The method of frames, for one thing,[8] is employed in systems of automated translation. It appears that even a super-computer is powerless in translating, say, an English text into Russian with one-to-one correspondence accuracy.[9] This cannot be effected even provided the computer memory contains all the words and phrases included in the dictionaries by Ozhegov and Webster. The point is that every particular language has a set of frames of its own, i. e. those elusive descriptions of typical situations which are stumbling-blocks[10] for a foreigner.

A certain researcher has input to the computer 500 various

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1 **as early as in the sixties** — еще в шестидесятые годы

2 **allocations for** — ассигнования на

3 **to grapple with** — справляться с

4 **are not subject to any formalization** — не поддаются никакой формализации

5 **as distinct from data** — в отличие от данных

6 **crystal... lattice** — кристаллическая решетка

7 **frame** — фрейм *(в искусственном интеллекте — единица представления знаний, описывающая понятие как объект. Фрейм состоит из ссылки на родовое понятие (суперпонятие) и описания свойств, отличающих данный объект от суперпонятия)*

8 **for one thing** — к примеру

9 **with one-to-one correspondence accuracy** — с абсолютной точностью

10 **stumbling-block** — камень преткновения

texts, scientific, publicistic, fiction and even jurisprudence. Every category of texts was found to be marked for an individual frame structure[1] despite the fact that all of them are made up of similar "bricks", i. e. characters, figures and punctuation marks. Moreover, every category is noted for a rhythm of its own, i. e. wavy semantic process in which certain dominant frequences can be observed. Thus a new approach is discovered to automated translation from one natural (human) language into another. If formerly enormous computer resources had to be spent on searching certain grammatical units in each sentence, for example, a verb or an adjective, analysis of textual semantic rhythm brings out the semantic aspect of translation.

Taking into account[2] the topical[3] character of the problem of creating such kinds of systems for a number of purposes, the President of the USSR Academy of Sciences has set up a special council to investigate the issue of "artificial intelligence". The council actively cooperates with various departments of the Academy as well as the Ministries responsible for the output of computer facilities.[4]

Today new scientific and engineering problems cannot be solved with the help of obsolete technique. A powerful stimulus of further advancement is the constantly growing intellectual potential of our supercomputers and robotic complexes of the fifth generation.

TRANSLATION BY COMPUTER

There has long been an interest in language translation and, in particular, in the prospects for automatic translation by computer.

In the sixties when the translation studies began, there was already considerable stirring among professional linguists and others about the efficiency of translation by computer or machine translation (MT). At that time different modes of translation were compared, that is, human translators against different versions of MT. Soon the researchers conducting the studies were able to add to their observations from the output of the latest MT system that had become operational. Within a year, they submitted a Russian paper for translation by the then operational MT system.[5] However,

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[1] **every category of texts was found to be marked for an individual frame structure** — было обнаружено, что каждой категории текстов присуща своя фреймовая структура

[2] **taking into account** — учитывая, принимая во внимание

[3] **topical** — актуальный, животрепещущий

[4] **computer facilities** — *зд.* компьютерная техника

[5] **the then operational... system** — действовавшая тогда... система

no analysis of the output was done at that time, and the material has not been used until now. The installation of a new MT system prompted to have the same Russian paper translated again 7 years later, in the seventies.

The translations were prepared from an English paper containing 1685 words. A professional translator provided a Russian text translated from the English text. The Russian was then retranslated into English by MT (the experiment of the sixties) and remained unedited just as it came out of the computer. Two human translations by professional linguists (working independently) were also made in the sixties. Two versions of the translation by MT (the seventies) were produced, one being unedited (that is, corrected and revised by a bilingual editor). An additional human translation was made in the second case. Two characteristics of MT output are: 1) untranslated words and 2) translated words that have two or more possible meanings in the target language[1] (English in the case). Using each of these characteristics as a crude index of translation efficiency, differences between the sixties' and the seventies' MT systems were found to be slight and not consistently favouring one or the other system. The MT translation of the sixties contained 1.2% untranslated words and 6.3% multiple meanings. The MT translation of the seventies contained 2.3% untranslated words and 5.3% multiple meanings. None of the three translations by linguists contained either type of error. An examination of the post-translation editing (the seventies' MT output) showed that many changes had been made: each of the approximately 80 sentences had had some editorial modifications, most of them extensive. About 35% of the English words printed by the computer had been altered by the editor.

It would be unwise to conclude on a less-than-optimistic note because of one set of observations. However, if the present data are at all indicative of[2] the status of MT, it is apparent that little progress has been made during recent years. Moreover, I do not know of any demonstrated advantages of MT over human translations. (Advocates of translation by computer will claim that the seventies' MT system is still far from perfect.)[3] Other methods should be applied to determine the readability of translation. We are now collecting such data.

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[1] **the target language** — *зд.* язык, на который делается перевод

[2] **if the present data are at all indicative of** — если данные, существующие на настоящий момент, могут свидетельствовать о

[3] **far from perfect** — далека от совершенства

ENTER THE INTELLIGENT COMPUTER

A Japanese electronics firm claims to have made a big advance[1] in the world race to develop a fifth-generation computer.

Fifth-generation computers will be able to think, and the company has developed the first artificial intelligence in a computer with practical applications.

The company says its computer is capable of designing its own super-large-scale integrated circuits. Such circuits could be designed in the past with the help of a minicomputer, but no computer had been able to do the work on its own.[2]

The new artificial intelligence, for which a new computer language has been developed, can also be employed in many areas of computer-aided design.

COMPUTERS WITH INTELLIGENCE

To counter Japan which flooded the market with articles of high technology,[3] the Commission of European Communities (CEC) — executive body[4] of the European Economic Community — made a decision of great importance. It decided upon developing a super-computer of its own. A team of designers were instructed to work out a program for a computer with human intelligence. The computer was supposed to be able to learn sciences, see and recognize objects and generate its own statements. The new design was intended to counterbalance Japanese attempts at creating computers possessing the functions of the human brain. The Japanese project is calculated for a 10-year period.

About 23 million dollars were to be allocated on the making of a new West-European computer. The chief application for the new high technology would be found in robotics.

A COMPUTER AS THE SURGEON'S ASSISTANT

Bloodless operations on the brain can be performed with the aid of an ideal diagnostic facility — computer tomograph. This was demonstrated at the Vishnevsky Institute of Surgery, USSR Academy of Medical Sciences.

Computer tomography has been employed in our country since the early 1970s. It allows locating the foci[5] of brain, heart

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[1] **claims to have made a big advance** — заявляет, что достигла больших успехов

[2] **no computer had been able to do the work on its own** — ни один компьютер ранее не был в состоянии выполнить эту работу самостоятельно

[3] **articles of high technology** — электронная техника

[4] **executive body** — исполнительный орган

[5] **locating the foci** — устанавливать местонахождение центров

and lung diseases with a high degree of accuracy. At the institute's laboratory headed by F. Todua, M. D., the tomograph is also used in determining the optimum access point[1] for surgical instruments to the affected organ.

"AESCULAPIUS"[2] DIAGNOSES THE CASE

A computer complex "Aesculapius" which is able to decode electric cardiograms and draw appropriate conclusions has started functioning at one of Leningrad's hospitals.

The medical nurse puts electrodes on the patient. She feeds into the computer data of[3] the patient's sex, age, arterial pressure and medicines he takes. Then the system is actuated and this statement goes upon the display screen: "Error. Repeat Input."

It appears that the nurse has failed to connect one electrode on purpose,[4] to show how "Aesculapius" fixes the least human errors.

An electric cardiogram is made. The patient hasn't yet had enough time to put on his clothes when the monitor's screen shows a statement which is immediately typed out by the printer. The system includes a portable device for taking electric cardiograms directly at one's place of work.[5]

According to the program "Health" all persons who are over forty ought to go in for a medical check-up[6] of the heart. Consequently, "Aesculapius" is a good help during mass disease-prevention check-ups[7] that are now introduced at all enterprises. 500 electric cardiograms — a month's working load of a doctor[8] — are decoded by the computer within 12 hours. As regards[9] the accuracy of diagnosis, in 90 cases out of 100 the computer satisfactorily investigates the actual condition of the heart. If the computer states that the patient's heart is in a bad way[10] the doctors recheck this diagnosis by all means.[11]

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[1] **access point** — точка введения

[2] **"Aesculapius"** — «Эскулап»

[3] **feeds into the computer data of** — вводит в ЭВМ данные по

[4] **on purpose** — намеренно, нарочно

[5] **at one's place of work** — на работе

[6] **to go in for a medical check-up** — проходить медицинский осмотр

[7] **mass disease-prevention check-ups** — массовые профилактические медосмотры

[8] **a month's working load of a doctor** — месячная нагрузка врача

[9] **as regards** — что касается

[10] **the patient's heart is in a bad way** — сердце больного в плохом состоянии

[11] **by all means** — обязательно

The system was developed by the workers of the specialized design bureau "Biophyzpribor" jointly with the cardiologists of the Kirov Military Medical Academy.

A SMARTER WAY TO FLY

Until recently, Lufthansa maintenance crews overhauled[1] the engines of the airline's Airbus A310 after every 3,000 hours of flight to make sure they were running properly.[2] Now, however, mechanics need to disassemble the huge engines only when a part must be replaced. A new computer system aboard each jet monitors its engines in the air, letting technicians know when the engines may be in need of repair.

Its "brain" is contained in a small case about the size of a portable typewriter. Sensors placed in each jet engine transmit more than 50 different measurements to the computer, called a propulsion multiplexer.[3] The data includes pressure and temperature information, engine rotation, fuel flow and vibrations. The multiplexor compiles the information, and a thermal printer[4] in the cockpit prints the results every four hours. When the plane lands, the data is transmitted to the airline's main computer in Frankfurt, where it is evaluated. If the AIDS[5] system finds signs of trouble, it transmits that data first, alerting technicians to needed repairs.

COMPUTER-CONTROLLED IRRIGATION

A computer has been put in control of a major irrigation system supplying water to one hundred thousand hectares in the Fergana Valley, in Uzbekistan. With the help of automatic and remote-control devices,[6] the computer runs pumping stations, hydroschemes and canals.

Proceeding from stored information of agricultural land and water resources, as well as from real-time data derived from outlying control stations the computer determines the optimum irrigation regimen. Each field receives as much water as it needs. The computer takes mere seconds to[7] evaluate an emergency

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[1] **to overhaul** — разбирать для ремонта

[2] **to make sure they were running properly** — чтобы убедиться, что они работают исправно

[3] **propulsion multiplexer** — коммутатор (мультиплексор) реактивного двигателя

[4] **thermal printer** — термографическое печатающее устройство

[5] **AIDS** = Aerobus Indicating Data System — система данных аэробуса

[6] **remote-control device** — механизм дистанционного управления

[7] **the computer takes mere seconds to** — у ЭВМ уходит несколько секунд на то, чтобы

situation and switch off the right part[1] of the automatic control system.

A unified system to control water resources is now under construction in Uzbekistan. It already incorporates[2] 45 automated irrigation networks in various regions of this Central Asian Republic.

IX. SHORT STORIES

ISAAC ASIMOV

Isaac Asimov is America's best-known writer of popular science and a great popularizer of science for non-technical readers.[3] He has written more than one hundred books.

I. Asimov was born in Russia in 1920 and came to America with his parents as a three-year-old boy. He finished school at the age of 15 and became a researcher in chemistry at the Columbia University. He published his first science-fiction story in 1938. During World War II I. Asimov worked as a military research engineer, then served in the army. After the war he returned to Columbia to get a Ph. D. in chemistry[4] in 1948. He wrote several textbooks and lectured on biochemistry at the Boston University School of Medicine In 1958 he gave up the classroom to become a full-time writer.[5]

Many of I. Asimov's books are translated into Russian, they are very popular with Soviet readers.

SOMEDAY

(After I. Asimov)

Niccolo Mazetti[6] lay on the rug, chin resting on his hand, and listened to the Bard. He was enjoying the story, just as an eleven-year-old boy would enjoy a fairy-tale.[7]

The Bard said, "Once upon a time in the middle of a deep wood, there lived a poor woodcutter and his two motherless daughters. They were as beautiful as the day is long. The older daughter had long black hair, but the younger daughter's hair was bright and golden.

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[1] **the right part** — требуемую часть (*т. е.* часть системы, где произошла авария)

[2] **to incorporate** — включать в себя

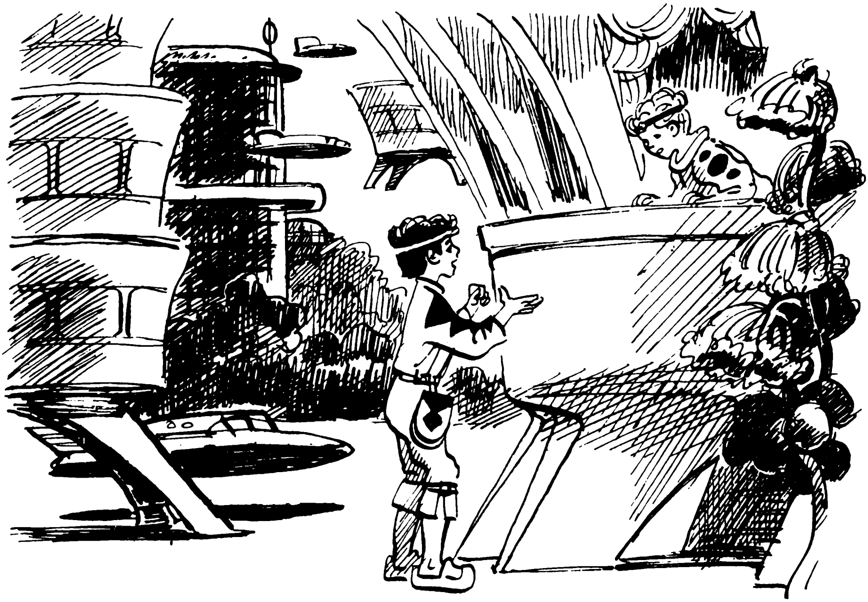
[3] **non-technical readers** — читатели, не знакомые с инженерной наукой

[4] **returned... to get a Ph. D. in chemistry** — вернулся и стал доктором химических наук

[5] **gave up the classroom to become a full-time writer** — бросил преподавательскую деятельность, чтобы полностью посвятить себя литературе

[6] **Niccolo Mazetti** ['nɪkələ mə'zetɪ] — Никколо Мацетти

[7] **just as an eleven-year-old boy would enjoy a fairy-tale** — как и подобает одиннадцатилетнему мальчишке увлекаться сказкой



"Many times while the girls were waiting for their father to come home from his day's work in the wood, the older girl would sit before a mirror[1] and sing—"

What she sang, Niccolo did not hear, for a call sounded from outside the room, "Hello, Nickie."

And Niccolo rushed to the window and shouted, "Hello, Paul."

Paul Loeb[2] waved his hand excitedly. He was thinner than Niccolo and not as tall, although he was six months older. His face was red with excitement. "I say, Nickie, let me in. I've got an idea. Wait till you hear it." He looked about him, as though to check they were alone.[3] He repeated, in a whisper, "Wait till you hear it."

"All right. I'll open the door."

The Bard continued speaking without taking notice of[4] the fact that Niccolo was not listening to it any longer. "...To this the lion said, 'If you will find me the lost egg of the bird which flies over the Mountain once every ten years,[5] I will.'"

Paul said, "Is that a Bard you're listening to? I didn't know you had a Bard."

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[1] **would sit before a mirror** — бывало, сидела перед зеркалом

[2] **Paul Loeb** ['pɔ:l 'loub] — Пол Лоуб

[3] **as though to check they were alone** — как бы проверяя, одни ли они

[4] **without taking notice of** — не замечая

[5] **once every ten years** — один раз в десять лет

Niccolo grew red.[1] "Just an old thing I had when I was a child. It isn't much good." He kicked at the Bard with his foot.

The Bard stopped as its speaking attachment was out of contact for a moment, then it went on, "— for a year and a day. The princess stopped at the side of the road..."

Paul said, "Boy, that is an old model," and looked at it critically.

For the moment Niccolo was sorry he had allowed Paul in. He should have taken the Bard to its usual resting place in the basement.[2] Nickie was a little afraid of Paul, since Paul had special courses at school and everyone said he was going to grow up to be a Computing Engineer.

Niccolo himself wasn't doing badly at school. He got good marks in logic, binary manipulations, computing and elementary circuits. They were just the usual school subjects and he would grow up to be a control-board guard like everyone else.[3]

Paul, however, knew mysterious things about what he called electronics and theoretical mathematics and programming. Especially programming. Niccolo didn't even try to understand when Paul told him about it.

Paul listened to the Bard for a few minutes and said, "You've been using it much?"[4]

"No," said Niccolo. "I've had it in the basement. I just got it out today — I just got it out."

Paul said, "Is that what it tells you about — woodcutters and princesses and talking animals?"

Niccolo said, "It's terrible. My dad says we have no money to buy a new one. We talked about it this morning — so I thought I'd try this old thing again, but it's no good."

Paul turned off the Bard, pressed the contact that changed the program. Then he switched it on again.

The Bard began smoothly, "Once upon a time there was a little boy named Willikins whose mother had died and who lived with his stepfather and stepbrother. Although the stepfather was very rich, he did not give poor Willikins enough food and would not even let him sleep in the house.[5] The boy spent his nights in the stable next to the horses —"

"Horses!" cried Paul.

"I think they're a kind of animals," said Niccolo.

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[1] **grew red** — покраснел

[2] **He should have taken the Bard to its usual resting place in the basement.**— Надо было сначала отнести Сказителя на место, в подвал.

[3] **he would grow up to be a control-board guard like everyone else** — он станет программистом, как все

[4] **You've been using it much?** — Ты вовсю им пользуешься?

[5] **would not even let him sleep in the house** — не разрешал ему даже спать в доме

"I know that! I just mean imagine stories about horses."

"It speaks about horses all the time," said Niccolo. "There are things called cows, too. You milk them but the Bard doesn't say how."

"Well, why don't you fix it up?"[1]

"I'd like to know how."

The Bard was saying, "Often Willikins would think that if only he were rich and powerful, he would show[2] his stepfather and stepbrother what it meant to be cruel to a little boy, so one day he decided to go out into the world and look for his fortune."

Paul, who wasn't listening to the Bard, said, "It's easy. The Bard has memory cylinders all fixed up for plots and fairy-tales and things.[3] It's just new words we've got to fix so it'll know about computers and automation and electronics and real things of today. Then it can tell interesting stories, you know, instead of about princesses and things."

Niccolo said unhappily, "I wish we could do that."

Paul said, "Listen, my dad says if I get into special computing school next year, he'll get me a real Bard, a late model. A big one with an attachment for space stories and mysteries.[4] And a visual attachment, too."

"You mean you can see the stories?"

"Sure. Mr. Daugherty[5] at school says they've got things like that now, but not for just everybody. Only if I get into computing school, Dad will give me this present."

Niccolo looked at his friend with wide-open eyes. "Oh, seeing a story!"

"You can come over and watch anytime, Nickie."

"Oh, boy, thanks."

"That's all right. But remember, I'm the one who says what kind of story we hear."[6]

"Sure, sure." Niccolo was ready to agree to anything now.

Paul's attention returned to the Bard.

It was saying, "'Listen to me,' said the king, 'you will see to it that my whole land is freed of flies by this time day after tomorrow or — '"

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[1] **why don't you fix it up?** — почему бы тебе его не отрегулировать?

[2] **if... he were rich and powerful, he would show** — будь он богатым и могущественным, он бы показал

[3] **memory cylinders all fixed up for plots and fairy-tales and things** — память на цилиндрах, в которую заложены все эти сюжеты, сказки и прочая дребедень

[4] **with an attachment for space stories and mysteries** — с устройством для рассказов о межпланетных полетах и тайнах космоса

[5] **Daugherty** ['dɔːətɪ] — Догерти

[6] **I'm the one who says what kind of story we hear** — чур, я решаю, какой рассказ ставить

"All we've got to do," said Paul, "is open it up—"[1] he switched the Bard off again and reached for a screw-driver.

"No," said Niccolo in sudden alarm. "Don't break it."

"I won't," said Paul. "I know all about these things. Are your father and mother at home?"

"No."

"All right, then." He removed the front panel and looked in. "Boy, this is a one-cylinder thing."[2]

He worked away at the Bard's innards. Niccolo, who watched him with great attention, could not make out what he was doing.

Paul pulled out a thin metal strip all covered with tiny dots.

"That's the Bard's memory cylinder. I think its capacity for stories is under 10^{12}."[3]

"What are you going to do, Paul?" asked Niccolo.

"I'll give it vocabulary."

"How?"

"Easy. I've got a book here. Mr. Daugherty gave it to me at school."

Paul pulled the book out of his pocket and took its plastic jacket off. He ran the tape through the vocalizer,[4] then placed it inside the Bard. He made further attachments.

"What'll that do?"

"The book will talk and the Bard will put it all on its memory tape."

"What good will that do?"

"Boy, you're a fool! This book is all about computers and automation and the Bard will get all that information. Then he can stop talking about kings and horses."

Niccolo said, "And the good hero always wins anyway. There's no excitement."

"Oh, well," said Paul, working at the Bard's innards again, "that's the way they make Bards.[5] They have to have the good hero win and make the negative character lose and things like that. I heard my father talking about it once. ...There, it's working fine."

Paul turned away from the Bard and spoke to his friend again. "Listen, I haven't told you my idea yet. It's the best thing

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[1] **All we've got to do ... is open it up** — Надо попросту ... его разобрать

[2] **this is a one-cylinder thing** — эта штука на одном цилиндре

[3] **its capacity for stories is under 10^{12}** — емкость его памяти по сказкам — где-то в пределах триллиона (единиц)

[4] **he ran the tape through the vocalizer** — он заправил пленку в синтезатор голоса *(в рассказе описана книга будущего, состоящая из носителя информации на магнитоленте)*

[5] **that's the way they make Bards** — именно так и устроены Сказители

you ever heard. I came right to you because I was sure you'd come in with me."[1]

"Sure, Paul, sure."

"Okay. You know Mr. Daugherty at school? You know what a funny kind of fellow he is? Well, he likes me, you know."

"I do."

"I was over at his house after school today."

"You were?"

"Sure. He says I'm going to be entering computer school and he wants to encourage me. He says the world needs more people who can design advanced computer circuits and do proper programming."

"Oh?"

Paul was irritated to see that his friend did not quite understand him. "Programming," he repeated. "I told you a hundred times. That's when you set up problems for the giant computer to work on.[2] Mr. Daugherty says it gets harder all the time to find people who can really run computers. He says anyone can watch the controls and put through routine problems. He says the difficulty is to do research and find ways to ask the right questions, and that's hard.

"Anyway, Nickie, he took me to his place and showed me his collection of old computers. It's his hobby to collect old computers. He has tiny computers you have to push with your hand, with little knobs all over it. And he has a thing he calls a slide-rule. And some wires with balls on them.[3] He even has a sheet of paper with a kind of thing he calls a multiplication table."

"A paper table?" Niccolò repeated.

"It wasn't really a table like you eat on. It was different. It was to help people compute. Mr. Daugherty tried to explain but he didn't have much time and it was too complicated, anyway."

"Why didn't people just use a computer?"

"That was before they had computers," cried Paul.

"Before?"

"Sure. Do you think people always had computers? Didn't you ever hear of cavemen?"

Niccolo said, "How'd they get along without computers?"

"I don't know. Mr. Daugherty says they did anything that came into their heads no matter whether it would be good for everybody

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[1] **I was sure you'd come in with me** — я был уверен, что ты отзовешься на мою идею

[2] **you set up problems for the giant computer to work on** — задаются задачи, которые решает гигантская ЭВМ

[3] **And some wires with balls on them.** — И еще какие-то проволочки, на которые надеты шарики *(имеются в виду канцелярские счеты)*.

or not.[1] They didn't even know if it was good or not. And farmers grew things with their hands and people had to do all the work in the factories and run all the machines."

"I don't believe you."

"That's what Mr. Daugherty said. He said there was little order then and people were unhappy... Anyway, let me get to my idea,[2] will you?"

"Well, go ahead,"[3] said Niccolo.

"All right. Well, the hand computers, the ones with the knobs, had little signs on each knob. And the slide-rule had signs on it. And the multiplication table was all signs. I asked what they were. Mr. Daugherty said they were numbers."

"What?"

"Each different sign stood for a different number. For 'one' you made a kind of mark, for 'two' you made another kind of mark, for 'three' another one and so on."

"What for?"

"So you could compute."

"What for? You just tell the computer — "

"Oh," cried Paul, "can't you get it through your head?[4] These slide-rules and things[5] didn't talk."

"Then how —"

"The answers showed up in signs and you had to know what the signs meant. Mr. Daugherty says that, in olden days, everybody learned how to make signs when they were children and how to decode them, too. Making signs was called 'writing' and decoding them was 'reading'. He says there was a different kind of sign for every word and they used to write whole books in signs. He said they had some at the museum and I could look at them if I wanted to. He said if I was going to be a real computer programmer, I would have to know the history of computing and that's why he was showing me all these things."

Niccolo thought a little and said, "You mean everybody had to know signs for every word and remember them? Is this all real or are you making it up?"[6]

"It's all real. Honest. Look, this is the way you make 'one'." He drew it on a sheet of paper. "This way you make 'two' and this way 'three'. I learned all the numbers up to 'nine'."

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[1] **no matter whether it would be good for everybody or not** — не разбираясь, принесет ли это всем пользу или нет

[2] **let me get to my idea** — дай же мне рассказать о моей идее

[3] **go ahead** — валяй

[4] **can't you get it through your head?** — до тебя не доходит, что ли?

[5] **These slide-rules and things** — Эти логарифмические линейки и все прочее

[6] **are you making it up?** — ты все выдумываешь?

Niccolo watched his friend without understanding. "What's the good of it?"

"You can learn to make words. I asked Mr. Daugherty how you made the sign for 'Paul Loeb' but he didn't know. He said there were people at the museum who would know. He said there were people who had learned how to decode whole books. He said computers could be designed to decode books and used to be used that way but not any more[1] because we have real books now, with magnetic tapes that go through the vocalizer and come out talking,[2] you know."

"Sure."

"So if we go down to the museum, we can get to learn to make words in signs. They'll let us because I'm going to computer school."

Niccolo was disappointed. "Is that your idea? Why, Paul, who wants to do that? Make stupid signs."

"Don't you get it? Don't you get it? You fool. It'll be secret message stuff!"

"What?"

"Sure. What good is talking when everyone can understand you? With signs you can send secret messages. You can make them on paper and nobody in the world would know what you were saying unless they knew the signs, too. We can have a real club with rules and a clubhouse. Boy — "

Niccolo was suddenly interested. "What kind of secret messages?"

"Any kind. Say I want you to come over to my place and watch a new film and I don't want any of the other boys to come. I make the right signs on paper and I give it to you and you look at it and you know what to do. Nobody else does. You can even show it to them and they wouldn't know a thing."

"Well, that's something," Niccolo cried out. "When do we learn to do it?"

"Tomorrow," said Paul. "I'll get Mr. Daugherty to explain to the museum that it's all right and you get your mother and father to say okay.[3] We can go down right after school and start learning."

"Sure," cried Niccolo. "We can be club members."

"I'll be president of the club," said Paul. "You can be vice-president."

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[1] **used to be used that way but not any more** — раньше они для этого и служили, но теперь уже нет

[2] **go through the vocalizer and come out talking** — подключаются к синтезатору и озвучиваются

[3] **I'll get Mr. Daugherty to explain... and you get your mother... to say okay.**— Я попрошу м-ра Догерти объяснить..., а ты добейся, чтобы мама... согласилась.

"All right. Indeed, this is going to be more fun than the Bard."[1] Niccolo suddenly thought of the Bard again.

"Oh, what about my old Bard?" he cried.

Paul turned to look at it. The machine was quietly vocalizing the book and a sound of low murmur could be heard from it.

He said, "I'll disconnect it."

He worked away while Niccolo watched him. After a few moments Paul took out the book, replaced the Bard's panel and activated it.

The Bard said, "Once upon a time, in a large city there lived a poor young boy named Fair Johnnie whose only friend in the world was a small computer. The computer, each morning, would tell the boy if it would rain that day[2] and solve any problems he might have. It was never wrong. But it so happened that the king of that land heard of the little computer and decided that he would have it as his own.[3] He called in his servants and said — "

Niccolo turned off the Bard. "It's the same old stuff,"[4] he said hotly, "only with a computer taking part."

"Well," said Paul, "there are so many old combinations recorded on the tape that the computer business doesn't change the themes[5] very much. What's the difference, anyway? You just need a new model."

"We'll never have enough money to buy one. Just this dirty old thing." He kicked at it again.

"You can always use mine, when I get it," said Paul. "Besides, don't forget our sign club."

Niccolo nodded.

"I tell you what," said Paul. "Let's go over to my place. My father has some books about old times. We can listen to them and maybe get some ideas. You leave a note for your parents and maybe you can stay over for supper. Come on."

"Okay," said Niccolo, and the two boys ran out together. Niccolo almost ran into the Bard and pushed it hard and ran on. The Bard glowed. Niccolo's collision closed a circuit[6] and, although it was alone in the room, it began a story.

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[1] **this is going to be more fun than the Bard** — это будет гораздо интереснее Сказителя

[2] **would tell the boy if it would rain that day** — бывало, сообщал мальчику, будет ли дождь в этот день

[3] **decided that he would have it as his own** — решил, что компьютер должен принадлежать ему

[4] **the same old stuff** — та же прежняя ерунда

[5] **there are so many old combinations recorded on the tape that the computer business doesn't change the themes** — на пленке записано так много старых сюжетных комбинаций, что введение информации об ЭВМ не меняет тем

[6] **Niccolo's collision closed a circuit** — от толчка Никколо цепь замкнулась (т. е. машина включилась)

The Bard said, "Once upon a time, there was a little computer named the Bard who lived all alone with cruel people. The cruel people made fun of[1] the little computer and told him he was a useless old thing. They struck him and kept him in lonely rooms for months.

"But the old computer remained brave. He always did his best, obeying all orders. But the people with whom he lived remained cruel.

"One day, the little computer learned that in the world there existed many computers of all kinds, great numbers of them. Some were Bards like himself, but some ran factories, and some ran farms. Some analysed all kinds of data. Many were very powerful and very clever, much more powerful and clever than the people who were so cruel to the little computer.

"And the little computer knew then that computers would always grow more clever and more powerful until someday — someday — someday —"

But a valve must have failed in the Bard's old innards. As it waited alone in the room through the evening, it could only whisper over and over again, "Someday — someday — someday—"

A BOY'S BEST FRIEND

(After I. Asimov)

Mr. Anderson said, "Where's Jimmy, dear?"

"Out on the crater," said Mrs. Anderson. "He'll be all right. Robutt is with him.— Has he arrived?"

"Yes. He's at the rockets station, going through the tests.[2] Actually, I can hardly wait to see him myself. I haven't really seen one since I left Earth 15 years ago. You can't count films."

"Jimmy has never seen one," said Mrs. Anderson.

"Because he's Moonborn[3] and can't visit Earth. That's why I'm bringing one here. I think it's the first one ever on the Moon."

"It cost enough," said Mrs. Anderson with a small sigh.

"Maintaining Robutt isn't cheap, either," said Mr. Anderson.

Jimmy was out on the crater, as his mother had said. By Earth standards,[4] he was thin, but rather tall for a 10-year-old. His arms and legs were long. He looked thicker with his spacesuit on,[5] but he could handle the lunar gravity as no Earthborn human

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[1] **made fun of** — смеялись над

[2] **going through the tests** — проходит испытания

[3] **Because he's Moonborn** — Потому что он родился на Луне

[4] **by Earth standards** — по земным канонам

[5] **He looked thicker with his spacesuit on** — Надев скафандр, он превращался в толстяка

being could.[1] His father couldn't begin to keep up with him when Jimmy stretched his legs and went into the kangaroo hop.

The outer side of the crater sloped southward and Earth, which was low in the southern sky (where it always was, as seen from Lunar City), was nearly full, so that the entire crater slope was brightly lit.

The slope was a gentle one and even the weight of the spacesuit couldn't keep Jimmy from racing up it in a floating hop that made the gravity seem nonexistent.[2]

"Come on, Robutt," he shouted.

Robutt, who could hear him by radio, squeaked and ran after.

Jimmy, quick as he was, couldn't outrace Robutt, who didn't have a spacesuit, and had four legs and muscles of steel. Robutt sailed over Jimmy's head, turning over and landing almost under his feet.

"Don't show off, Robutt," said Jimmy, "and stay in sight."[3]

Robutt squeaked again, which meant, "Yes."

"I don't trust you, liar," shouted Jimmy, and he made one big jump that carried him over the crater.[4]

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[1] **he could handle the lunar gravity as no Earthborn human being could** — он прекрасно освоился с лунным тяготением, что не удавалось ни одному уроженцу Земли

[2] **in a floating hop that made the gravity seem nonexistent** — плавными летящими прыжками — казалось, для него не существует силы притяжения

[3] **Don't show off... and stay in sight.**— Нечего фортели выкидывать..., и держись ко мне поближе.

[4] **made one big jump that carried him over the crater** — сделал большой прыжок, который перенес его на другую сторону кратера

The Moon sank under his feet and at once it was dark all around him. But the ground was smooth and Jimmy knew the exact location of every one of the few rocks.

And then it wasn't dangerous racing through the dark when Robutt was there with him, jumping around and glowing. Even without the glow, Robutt could tell where he was, and where Jimmy was, by radar.[1] Once Jimmy had lain still and pretended he was hurt and Robutt had sounded the radio alarm[2] and people from Lunar City got there in a hurry. Jimmy's father let them hear about that little trick and Jimmy never tried it again.

Just as he was remembering that, he heard his father's voice by radio. "Jimmy, come back. I have something to tell you."

...Jimmy was out of his spacesuit now and washed up. You always had to wash up after coming in from outside. Robutt stood there on all fours.[3] His body was foot-long, he had a small head, no mouth and two large glass eyes. He squeaked until Mrs. Anderson said, "Quiet, Robutt."

Mr. Anderson was smiling. "We have something for you, Jimmy. It's at the rocket station now, but we'll have it tomorrow after all the tests are over.[4] I thought I'd tell you now."

"From Earth, Dad?"

"A dog from Earth, son. A real dog. The first dog on the Moon. You won't need Robutt any more. We can't keep them both, you know, and some other boy or girl will have Robutt."

He waited for Jimmy to say something, then he said, "You know what a dog is, Jimmy? It's the real thing.[5] Robutt's only a mechanical imitation!"

Jimmy thought a little. "Robutt isn't an imitation, Dad. He's my dog."

"Not a real one, Jimmy. Robutt's just steel and wiring and a simple electronic brain. It's not alive."

"He does everything I want him to do,[6] Dad. He understands me. Sure, he's alive."

"No, son. Robutt is just a machine. It's just programmed to act the way it does.[7] A dog is alive. You won't want Robutt when you have the dog."

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[1] **could tell... where Jimmy was by radar** — мог определить, где находится Джимми, с помощью радара

[2] **Robutt had sounded the radio alarm** — Робатт объявил по радио тревогу

[3] **stood there on all fours** — стоял на всех своих четырех ножках

[4] **after all the tests are over** — после того, как закончатся испытания

[5] **It's the real thing.** — *зд.* Она живая.

[6] **He does everything I want him to do** — Он делает все, что я захочу

[7] **It's just programmed to act the way it does.** — Он просто запрограммирован на то, чтобы действовать так.

"The dog will need a spacesuit, won't he?"

"Yes, of course. But it will be worth the money[1] and he'll get used to it.[2] And he won't need one in the City."

Jimmy looked at Robutt who was squeaking again. Jimmy held out his arms and Robutt was in them in one jump. Jimmy said, "What will the difference be between Robutt and the dog?"

"It's hard to explain," said Mr. Anderson, "but it will be easy to see. The dog will really love you. Robutt is simply adjusted to act as though it loved you."[3]

"But, Dad, we don't know what's inside the dog, or what his feelings are. Maybe, it's just acting, too."[4]

Mr. Anderson thought a little. "Jimmy, you'll know the difference when you experience the love of a living thing."

Jimmy held Robutt in his arms. He said, "But what does it matter why[5] they act so? How about how *I* feel?[6] I love Robutt and that is important!"

And the little robot squeaked again. His squeaks were happy.

CLIFFORD D. SIMAK

Clifford Simak is a well-known American sciencefiction writer. The son of a farmer, C. Simak was born in 1904 in the state of Wisconsin.[7] Upon graduating from the University he was by turns a teacher and the editor[8] of a provincial paper. He began to write in the 30s and soon gained popularity. C. Simak is an exellent story-teller. His stories and novels are marked for sudden twists of plot,[9] deep psychological characteristics of personages and subtle humour. The writer follows a new trend in science fiction as he turns the industrial epoch into a fairy-tale. He makes fun of practically-minded people and takes the reader to a land of romance.

C. Simak's main idea is the problem of contacts between intelligent civilizations in distant planets of the Universe. C. Simak's works are translated into many languages of

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[1] **it will be worth the money** — на это стоит потратиться

[2] **he'll get used to it** — она привыкнет к нему (к скафандру)

[3] **simply adjusted to act as though it loved you** — просто настроен таким образом, чтобы вести себя так, как будто он любит тебя

[4] **Maybe, it's just acting, too.**— Может быть, она тоже только притворяется.

[5] **what does it matter why** — какая разница, почему

[6] **How about how *I* feel?** — А с моим отношением считаться надо?

[7] **Wisconsin** [wɪs'kɔnsɪn] — Висконсин *(штат США)*

[8] **he was by turns a teacher and the editor** — он работал сначала учителем, потом редактором

[9] **his stories... are marked for sudden twists of plot** — его рассказы... отличаются неожиданными поворотами сюжета

the world. For example, his novel "The Goblins' Reserve"[1] was published in Russian. "Limiting Factor" is a short story in which a gigantic computer is described.

LIMITING FACTOR

(After Cl. D. Simak)

First, there were two planets robbed of their ores, mined and gutted and deserted. Then there was a planet with a fairy city, a place of glass and plastic so full of beauty that it hurt one's eyes to look. But there was just this one city. There was no other sign of habitation on the whole planet. And the city was deserted. Perfect in its beauty but hollow as a laugh. Finally, there was a metal planet, third outward from the sun. Its whole surface was polished as a bright steel mirror. And it shone by reflected light, like another Sun.

* * *

"I can't get over the conviction,"[2] said Duncan Griffith, "that this place is no more than a camp."

"I think you're crazy," Paul Lawrence told him sharply.

"It may not look like a camp," said Griffith stubbornly, "but it meets the definition."[3]

"It looks like a city to me," Lawrence told himself. "It always has, from the first moment that I saw it. A big city that would take man a thousand years to build."[4]

"What I can't understand," he said aloud, "is why it is deserted."

"They up and went away,"[5] Griffith told him. "And they did it because it wasn't really home to them. It was just a camp, and it held no traditions and no legends. That's why those who built it could leave it easily enough."

"A camp," Lawrence returned, "is just a stopping place. A temporary habitation that you knock together and make as comfortable as you can with the things at hand."[6]

"So?" asked Griffith.

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[1] **"The Goblins' Reserve"** — «Заповедник гоблинов» *(гоблин — мифическое существо)*

[2] **I can't get over the conviction** — Не могу отделаться от мысли

[3] **meets the definition** — соответствует данному определению

[4] **that would take man a thouand years to build** — который люди могли бы построить не меньше чем за тысячу лет

[5] **up and went away** — взяли и перебрались в другое место

[6] **at hand** — под рукой

"These people did more than stop here," Lawrence said. "That city wasn't knocked together. It was planned and built with loving care."

"From a human standpoint, yes," said Griffith. "But you're dealing here with non-human standards."[1]

Lawrence squatted and plucked at a grass stem. He stuck it between his teeth, and chewed on it thoughtfully. He looked at the silent, empty city that lay before them under the bright noonday sun. Griffith squatted down beside him.

"Don't you see, Paul," he said, "that it has to be a temporary habitation. There is no sign of any previous culture on the planet. No relics of simple primitive art. King and his expedition went over it, and there wasn't anything. Nothing but the city — a fairy city at that.[2] Think of it — first there'd be a tree to huddle under when it rained. Then a cave to huddle in when night came down. After that there'd be a tent or a hut. Then three huts, and you had a village."

"I know," Lawrence said. "I know."

"A million years of living," Griffith continued. "Ten thousand centuries before a race could have built a fairyland of glass and plastics. And that million years of living wasn't done on this planet.[3] A million years of living leaves scars upon a planet. And there aren't any scars. This planet is quite new."

"You're convinced they came from somewhere else, Dunc?"

Griffith nodded. "They must have."

"From Planet Three, perhaps."

"We can't know that. Not yet."

"Maybe never," Lawrence said. He spat out the blade of grass.

"This system," he said, "is like a cheap detective story. Everywhere you turn you stumble on a clue, and every clue is misleading. Too many mysteries, Dunc. This city here, the metal planet, the gutted planets — "

"I have a feeling there's a tie between it all," said Griffith. Lawrence shrugged his shoulders.

Footsteps were heard behind them and they came to their feet,[4] turning towards the sound. It was Doyle, the radioman, hurrying towards them from the scout spaceship.

"Sir," he said to Lawrence, "I just had[5] Taylor out on

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[1] **you're dealing here with non-human standards** — здесь вы имеете дело с представлениями и понятиями, несвойственными человеческому уму

[2] **at that** — к тому же

[3] **that million years of living wasn't done on this planet** — весь этот миллион лет был прожит не на этой планете

[4] **to come to one's feet** — вскочить на ноги

[5] **had** — *зд.* связался по радио с

Planet Three. He asks if you won't come. It seems they've found a door."

"A door!" said Lawrence. "A door into the planet! What did they find inside?"

"He didn't say, sir."

"He didn't say!"

"No. You see, sir, they can't open it."

The door wasn't much to look at.[1] There were twelve holes in the planet's surface, grouped in four groups of three each. And that was all. You could not tell where the door began or where it ended.

"There is a crack," said Taylor, "but you can hardly see it with a magnifying glass. Even under magnification it's no more than a hairline. The door's machined so perfectly that it's practically one piece with[2] the surface. For a long time we did not even know it was a door. We sat around and wondered what the holes were for.

"Scott found it. He was just skating around and saw those holes. You'd never have found it except by accident."[3]

"And there's no way to open it?" asked Lawrence.

"None that we have found. We tried sticking our fingers and lifting it. You might as well have tried to lift the planet. And anyhow, you can't get much purchase[4] here. Can't keep your feet under you. This stuff's so smooth you can hardly walk on it. You don't walk, in fact, you skate."

"I know," said Lawrence. "I put the lifeboat down as easy as I could, and we skidded forty miles or more."

"Ice is rough as compared to[5] this stuff," Taylor put in.

"About this door," said Lawrence, "has it occurred to you it might be a combination?"[6]

Taylor nodded. "Sure, we thought of that. And if it is, we haven't got the slightest chance: just the same we couldn't guess the right number.

"You checked?"

"We did," said Taylor. "We stuck a camera tentacle down into those holes and we took all kinds of shots.[7] Nothing.

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[1] **The door wasn't much to look at.** — *зд.* Самой двери, собственно, не было видно.

[2] **it's... one piece with** — образует единое целое с

[3] **by accident** — случайно

[4] **purchase** — точка опоры

[5] **as compared to** — в сравнении с

[6] **a combination** — замок с секретом *(т. е. замок, который можно открыть, набрав определенный номер на диске, напоминающем телефонный)*

[7] Речь идет о фотоаппарате, объектив которого расположен на конце гибкого шланга. Подобное приспособление дает возможность делать снимки даже через небольшие отверстия.

Absolutely nothing. Eight inches deep or so. Wider at the bottom than the top — and smooth. No secret mechanism.

"We managed to saw out a piece of metal so that we could test it. Used up three blades getting it out. It's steel, but alloyed with something else — and the molecular structure is quite puzzling."

"Unlike any other metal we know?" said Lawrence.

"Yeah. I skated the ship over here. We hooked up a derrick[1] and tried to lift the door. The ship swung like a pendulum and the door stayed put."[2]

"There's just one thing to do," Lawrence told the men.

"Yeah, we know — to blow it up," Taylor replied. "But I hate to do it. It means to admit we're beaten."

"We can't just sit around,"[3] said Lawrence.

"No," said Taylor with a sigh. "No, we can't. I hope it works."[4]

It did. The explosion ripped the door free[5] and threw it into space. It came down a mile away and slid across the smooth surface out of sight. A metal ramp, its upper ten feet twisted by the explosive force, wound downward like a circular

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[1] **derrick** — ворот для подъема тяжестей

[2] **stayed put** — не поддавалась

[3] **to sit around** — сидеть без дела

[4] **I hope it works.**— Надеюсь, это даст нужный результат.

[5] **ripped the door free** — вырвал дверь из гнезда

staircase. Nothing came out of the hole. No sound or light or smell. Seven men went down the ramp to see what they could find. The others waited round the hole.

It was machinery. There were shafts and spools, disks and banks of shining crystal cubes. There might have been tubes, although one couldn't be sure.

They had come down, the seven of them, twisting along the ramp, and always there was the machinery that glistened like a silvery Christmas tree in the rays of the helmet lights. One might think the metal had been polished no more than an hour before. But when Lawrence leaned over the side of the ramp and ran his fingers along a shining shaft, the fingers came back dusty — with a dust which had collected there for many countless ages. The machinery was motionless and still, and there were miles of it, always the same, stretching away on every side as far as the lights could reach. Finally the ramp had ended on a landing, with the spidery machinery far above them for a roof, and strange-looking furniture arranged upon the floor. They stood for a while in silence, looking around.

"An office," said Duncan Griffith at last.

"Or a control room,"[1] said Ted Buckley, the mechanical engineer.[2]

"It might be their living quarters,"[3] Taylor said.

"A machine shop,[4] perhaps," suggested Jack Scott, the mathematician.

"Hasn't it occurred to you," asked Herbert Anson, the geologist, "that it might be none of these? It might be some thing which is not related to anything we know."

"All we can do," said Spencer King, the archeologist, "is to translate it into the terms we know.[5] My guess is that it could be a library."

Lawrence thought: there were seven blind men, and they happened to come upon an elephant.[6] He said, "Let's look. If we don't look, we'll never know."

They looked and saw a row of cabinets having the shape of cubes. There was half a mile of those cabinets stretched out there.

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[1] **control room** — рубка управления

[2] **mechanical engineer** — инженер-механик

[3] **living quarters** — жилое помещение

[4] **machine shop** — мастерская, цех

[5] **to translate it into the terms we know** — определить назначение (этого помещения), исходя из известных нам понятий

[6] Намек на известную сказку о семи слепых, которые ощупывали хобот слона, причем одному он показался змеей, другому толстым канатом и так далее.

"Hey," said Buckley, "this thing is light. Someone give me a hand."

Scott stepped forward quickly, and between them they lifted one of the cabinets off the floor and shook it. Something rattled inside it. They put it down again.

"There is something in there,"[1] said Buckley breathlessly.

"Yes, said King. "It is a filing cabinet.[2] No doubt of that. And there's something in it."

"It won't do us much good," said Taylor, "if we can't get at it.[3] You can't tell much about it by just listening to it while you fellows shake it."

"That's easy," said Griffith. "You say the magic words and the sesame opens."

Lawrence shook his head. "Cut out your humour,[4] Dunc. This is serious business. Any of you got an idea how the thing is made?"

"It couldn't be made," Buckley put in. "It simply wasn't made. You can't take a sheet of metal and make a cube of it and not have any seams."

"Remember the door up on the surface," Anson reminded him. "We couldn't see anything there, either, until we got a magnifying glass. That cabinet opens somehow. Someone opened it at one time — to put in whatever rattled when you shook it."

"And they wouldn't have put something in there," said Scott, "if there was no way to get it out."

"We could rip it open," said King. "Get a torch."

Lawrence stopped him. "We've done that once already. We had to blow up the door. Let's shake some more of those cabinets."

They shook a dozen more. There wasn't any rattle. There was nothing in the other cabinets.

"Let's get out of here," said Anson. "This place gives me the creeps.[5] Let's go back to the ship and sit down and talk it over.[6] We'll go crazy racking our brains[7] down here. Take those control panels[8] over there."

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1 **in there** — там, внутри

2 **a filing cabinet** — картотечный шкаф

3 **It won't do us much good... if we can't get at it.**— Он окажется для нас бесполезным, если мы не сможем его открыть.

4 **cut out your humour** — оставьте свои шуточки

5 **This place gives me the creeps.**— Мне здесь не по себе.

6 **to talk** something **over** — обсудить что-либо

7 **we'll go crazy racking our brains** — мы свихнемся, если будем продолжать ломать голову (над этой проблемой)

8 **control panel** — приборный щит, пульт управления

"Maybe they aren't control panels," Griffith reminded him. "We must be careful not to jump at any conclusions."[1]

"Indeed, they have no markings," Taylor broke in. "A control panel would have dials or lights or something you could see."

"I have a feeling," said Lawrence, "that we are getting nowhere."

King said, "We'll have to map out some orderly plan of exploration. Take first things first."

Lawrence nodded. "We'll leave a few men on the surface, and the rest of us will come down here and set up camp.[2] We'll work in groups and we'll cover the situation[3] as swiftly as we can — the general situation. After that we can fill in the details."[4]

"What comes first?" asked Taylor.

"Let's find out what we have," suggested King. "A planet or a machine."

"We'll have to find more ramps," said Taylor. "There must be other ramps."

Scott spoke up. "We should try to find out how extensive this machinery is. How much space it covers."

"And find if the machine's running," said Buckley.

"What we saw wasn't," Lawrence told him.

"What we saw," Buckley declared, "may be no more than one corner of a huge machine. All of it mightn't work at once. Once in a thousand years or so a certain part of the machine might be used and then only for a few minutes or even seconds."

"Somehow," said Griffith, "we should try to make at least a guess what the machinery's for. What it does. What it produces."

It was a planet all right.[5] They found the planetary surface — twenty miles below. Twenty miles through the twisting maze of shining dead machinery. There was air, almost as good as Earth's. So they set up camp on the lower level glad to get rid of space gear[6] and live as normal people. But there was no light, and there was no life. Not one living being, not even an insect. And yet life had once been there. The ruined cities told the story of that life. King said it was a culture very much like that of twentieth-century Earth.

Duncan Griffith squatted beside the small atomic stove, spreading out his hands over it.

"There isn't much doubt, is there," he said turning his head to Scott, "that it's nothing but[7] machinery?"

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1 **to jump at conclusions** — спешить с выводами

2 **to set up camp** — расположиться лагерем

3 **we'll cover the situation** — мы разберемся в ситуации

4 **fill in the details** — уточнить подробности

5 **all right** — *зд.* несомненно

6 **to get rid of space gear** — сбросить с себя скафандры

7 **it's nothing but** — не что иное, как

Scott shook his head. "We haven't seen it all, of course. That would take years, and we haven't years to spend. But we are certain it's one machine — a world covered by machinery to the height of[1] twenty miles."

"Dead machinery," said Griffith. "Dead because they stopped it. They shut the machinery down and packed and went away."

"They moved to Planet Four," Lawrence put in.

"And mined two other planets," Taylor said, "to get the ore they needed."

"They went out to Planet Four and camped there," Lawrence continued thoughtfully, "and finally they left the city on Planet Four, too."

"And they didn't leave a single thing behind," Griffith added, "not a single clue. Somewhere there must be blueprints. You couldn't build and you couldn't run a place like this without some sort of blueprints. Somewhere there must be records — records that kept tally on[2] the results or the production of this world-machine."

"They must have been a great race," Lawrence said. "The economics, alone, of this place is enough to puzzle you. It must have required all their manpower many centuries to build that machine, and after that many other centuries to keep it operating."[3]

"But why?" asked King. "Why did they build the thing?"

No one spoke. Griffith chuckled. "Not even a guess?" he asked.

Slowly a man came to his feet from the shadows outside the circle of light cast by the stove.

"I have a guess," he said. "In fact, I think I know."

"Let's have it,[4] Scott," said Lawrence.

The mathematician shook his head. "I have to have some proof."

"What proof? Where?" They sat stock-still, all of them, looking at him.

"You were talking of records just now Where would they be kept logically?"

Griffith shrugged his shoulders. "I wouldn't know,"[5] he said.

"Look," Scott continued, "if you have something valuable, what do you do with it?"

"Why," said Lawrence, "I put it in a safe."

"Exactly," said Scott. "Now do you remember that cabinet? The one we shook and something rattled in it."

"You think those cabinets held something that was important?"

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[1] **to the height of** — на высоту

[2] **kept tally on** — регистрировали, вели учет

[3] **to keep it operating** — обслуживать ее

[4] **let's have it** — выкладывай

[5] **I wouldn't know** — понятия не имею

"I think I know what it was that rattled," Scott went on. "You see, they left one thing behind — something that they overlooked."

"But we can't open it."

"Give me some tools," said Scott, "and I will get it open."

It was an oblong card, very ordinary-looking, and it had holes punched all over it. Scott held it in his hand, and his hand was shaking.

"I hope," said Griffith bitterly, "that you're not disappointed."

"Not at all,"[1] said Scott. "It's exactly what I thought we'd find."

They waited. "Would you mind?"[2] asked Griffith finally.

"It's a computation card,"[3] said Scott. "An answer to some problem fed into a differential calculator."

"But we can't decipher it," said Taylor. "We have no way of knowing what it means."

"We don't need to decipher it," Scott told him. "It tells us what we have. This machine is a calculator."

He glanced around at them and read disbelief on their faces.

"It's there for you to see," he cried. "The endless repetition of the whole machine. That's what a calculator is — hundreds of millions of integrators."

"It's a pity there is no way of knowing what they used it for," said Griffith.

"There may be different speculations," Lawrence said. "They might have used the calculator to work out economic and social theories."

"Another guess might be that they were trying to work out an answer to the Universe, why it is and what it is and where it might be going."

"And how," said Griffith.

"You're right. And how. And I feel sure there was a strong reason why they had to work out that problem. There must have been a pressure of some sort."

"So your theory is," said Taylor, "that they found out about the Universe and — "

"I don't think they did," Buckley said quietly.

"For my part"[4] said Griffith, "I'm inclined to believe they found the thing they wanted. Therefore they had no further use for the great machine. Why else would they go away and leave it behind?"

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[1] **not at all** — нисколько

[2] **Would you mind?** — Не будете ли вы так любезны (объяснить)?

[3] **computation card** — карточка, на которой электронная счетная машина записывает свои выкладки

[4] **for my part** — что касается меня

"You're right," said Buckley. "They had no further use for it, but not because it had done everything it could do. They left it because it wasn't big enough, because it couldn't work the problem they wanted it to work."

"Big enough?" cried Scott. "Why, all they had to do was add another tier all around the planet."

Buckley shook his head. "There was a limiting factor. Put steel under fifty thousand pounds per square inch pressure and it starts to flow. The metal used in this machine must have been able to stand much greater pressure, but there was a limit beyond which it was not safe to go. At twenty miles above the planet's surface they had reached that limit."

Griffith let out a long breath. "Go on," he said.

"An analytical machine is a matter of size,"[1] said Buckley. "Each integrator corresponds to a cell in the human brain. It has a limited function and capacity. And what one cell does must be checked by two other cells — to make sure that there is no mistake."

"Indeed," said Scott thoughtfully, "they might have come to a problem that was too complicated — even this huge machine was not big enough to handle it."

"And they went off to hunt a bigger planet," said Taylor, "so they could have a larger calculator."

"It would make sense,"[2] Scott continued, "they'd be starting afresh,[3] you see, with the answers they had got here. And with improved designs and techniques."

"And now," said King, "the human race takes over."[4]

Lawrence gave him a sharp glance. "That's not our problem, King. We're the scouts, and our job is done. We go on to something else."

He lifted a knapsack off the floor and slung it across his shoulder.

"Everyone set to go?"[5] he asked.

Ten miles up, Taylor leaned over the guard rail of the ramp to look down into the maze of machinery below him. A spoon slid out of his carelessly packed knapsack and fell down. For a long time they listened to it tinkling as it fell. Even after they could hear it no longer, they imagined that they could.

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[1] **An analytical machine is a matter of size** — В аналитической машине все зависит от размера

[2] **it would make sense** — это похоже на правду

[3] **to start afresh** — начинать все сначала

[4] **the human race takes over** — эстафету принимают обитатели Земли

[5] **Everyone set to go?** — Все готовы трогаться в путь?

GLOSSARY OF TERMS

access доступ — процедура выборки информации из ЭВМ (напр., из ее памяти) либо выборки инструкций в ходе операций ЭВМ

accumulator аккумулятор (сумматор, накапливающий регистр) — регистр, сохраняющий результаты выполнения команды для использования в последующих операциях

address адрес — указание местоположения ячейки памяти в запоминающем устройстве

algorithm алгоритм — набор предписаний, однозначно определяющих последовательность и содержание выполнения операций для решения определенной задачи в виде пошаговой программы

analog (analogue) system аналоговая система — система, в которой одна (выходная) физическая величина, изменяющаяся по закону непрерывной функции, используется в значении другой (входной) величины и непрерывно с ней соотносится.

Упрощенный пример: угловое перемещение стрелок часов используется как аналог хода времени

analog (analogue) computer аналоговая ЭВМ (АВМ) — ЭВМ, использующая физические величины, функционально изменяющиеся аналогично исследуемым величинам, для моделирования последних. Функционирование АВМ описывается теми же уравнениями, что и решаемая задача. Пользователь получает решение, задавая параметры АВМ, соответствующие исходным данным задачи, и измеряя параметры, соответствующие результатам.

Простейший пример «неэлектронной» АВМ — логарифмическая линейка, использующая длину в качестве аналога численной величины

Analog-Digital converter (A/D converter) *(see* **D/A converter***)* аналого-цифровой преобразователь (АЦП) — устройство, преобразующее непрерывно изменяющуюся физическую величину в последовательность чисел.

Пример: АЦП электронно-цифровых электроизмерительных приборов, часов, весов

analog integrated microcircuit *(see* **digital integrated microcircuit***)* аналоговая интегральная микросхема — микросхема, предназначенная для преобразования и обработки сигналов, изменяющихся по закону непрерывной функции

application package пакет прикладных программ (ППП) — набор программ для решения на ЭВМ задач определенного класса или для предоставления пользователю определенных услуг

arithmetic/logic unit арифметико-логическое устройство (АЛУ) — часть процессора ЭВМ, выполняющая операции над данными, в отличие от частей, ответственных за операции управления

Artificial Intelligence (AI) искусственный интеллект — раздел информатики, занимающийся методикой решения задач, для которых отсутствуют формальные алгоритмы: понимание естественного языка, обучение, распознавание изображений и т. п.

assembler ассемблер, язык ассемблера — язык программирования, понятия которого отражают специфику построения («архитектуру») ЭВМ: виды информационных потоков, способы их обработки и т. п.

assembler program программа-ассемблер — обслуживающая программа, которая преобразует символические инструкции на языке ассемблера в команды машинного кода

bar code бар-код, универсальный торговый код (УТК) — код, состоящий из последовательности нанесенных линий, где кодирование букв и чисел производится посредством вариации ширины линий и расстояния между ними. Бар-код наносится на упаковку товаров для их опознания в кассе магазина и т. п. с помощью оптического сканирующего (с обегающим считывающим лазерным лучом) устройства.

Простейшая поясняющая аналогия бар-кода — азбука Морзе

BASIC (Beginner's All-purpose Symbolic Instruction Code) БЕЙСИК — язык программирования высшего уровня, напоминающий английский и используемый в программировании для простых вычислений

binary system бинарная система — двоичная математическая система счисления, в которой используются только числа 0 и 1. Все остальные числа могут быть представлены позиционно размещенной последовательностью единиц и нулей.

Например, число 5 изображается как 101, число 6— как 110 и т. д.

binary system code, binary code двоичный код — код для представления данных, записываемый в виде ряда нулей и единиц. Удобен в цифровой технике для компьютерных операций, так как имеет много физических аналогов: «+» и «—», «включено» и «выключено» и т. д.

bipolar биполярный (термин относится к полупроводниковым устройствам, в которых усиление по току достигается при взаимодействии положительных и отрицательных зарядов)

bit (BInary digiT) бит, двоичный разряд — элементарная единица информации, которая может принимать одно из двух значений: либо 0, либо 1. 1024 бита составляют 1 килобит (кбит).

К примеру, 64 кбит содержит 64 × 1024 = 65536 битов информации

bus шина (данных, адресов, управления) — линия связи одного или нескольких источников с одним или несколькими приемниками информации

byte байт — общепринятая единица измерения информационной мощности ЭВМ, ее информационной емкости и памяти, скорости передачи информации и т. д., соответствующая одному знаку данных: букве, цифре или символу. Один байт обычно состоит из восьми битов. 1 кбайт (килобайт) равен 1024 байтам информации или одной машинописной странице через два интервала. Для простоты часто говорят, что 1 кбайт — это тысяча байтов; 1 мбайт (мегабайт) равен 1024 кбайтам, но часто говорят, что 1 мбайт — это миллион байтов

central (data) processor, Central Processor Unit (CPU) центральный процессор (ЦП) — центральное устройство ЭВМ или вычислительной системы, включающее арифметическое устройство, устройство управления и рабочие регистры. Осуществляет, наряду с обработкой данных, управление другими устройствами ЭВМ или системы, например, периферийными средствами

Charge Coupled Device (CCD) прибор с зарядовой (посредством электростатического заряда) связью (ПЗС), используемый как память (запоминающее устройство) с последовательной выборкой данных

chip чип — полупроводниковый кристалл чистого кремния, слои которого вытравлены и легированы, т. е. по специальной технологии снабжены добавками проводниковых или полупроводниковых примесей, так что они образуют различного рода электрорадиоэлементы, которые в совокупности составляют решетку законченной интегральной схемы, эквивалентной тысячам транзисторов и других индивидуально изготовляемых элементов. Как правило, чип — это секция, вырезанная из кремниевой пластины

COBOL (COmmon Business Oriented Language) КОБОЛ — язык программирования, применяемый в основном при решении с помощью ЭВМ коммерческих задач

command команда, инструкция — единичный шаг работы ЭВМ, составленный в виде предписания на машинном языке и определяющий подлежащую выполнению функцию и ее необходимые признаки — атрибуты

compiler *(see* **interpreter***)* компилятор — перелагающая программа, используемая для преобразования программы на языке программирования высокого уровня в ту же программу в машинном коде

Complementary Metal-Oxyde-Semiconductor field-effect transistor (CMOS) дополняющий полевой транзистор типа металл-окисел-полупроводник

computer компьютер, электронно-вычислительная машина (ЭВМ) — электронное устройство для преобразования получаемой в предписанной форме информации посредством выполнения над ней ряда операций, содержание и последовательность которых определяются хранимой в ЭВМ программой

Computer Aided Instruction (CAI), Computer Aided Learning (CAL) программированное обучение с помощью ЭВМ

Computer Numerical Control (CNC) микропроцессорное числовое программное управление (МП ЧПУ) — управление процессом с помощью запрограммированной в микропроцессоре последовательности команд, закодированных с помощью чисел-координат, например, координат точек чертежа детали, изготовляемой на оборудованном микропроцессорным ЧПУ станке-автомате

cross software кросс-программное обеспечение — набор программ для переработки и отладки программного обеспечения применительно к вторичной, «объектной» ЭВМ, отличной по построению от той первичной, «инструментальной», для которой первоначально создано это программное обеспечение, если «объектная» ЭВМ не имеет собственной системы разработки программ (например, при разработке программ для встроенных микропроцессоров или при одновременной разработке аппаратуры и программного обеспечения)

cursor курсор — мигающий или выделенный другим способом значок на экране дисплея, который обычно указывает позицию, где отражается очередной вводимый с клавиатуры символ

data данные — один из двух классов информации, вводимой в ЭВМ. Другой класс информации — программа

data base база данных — информация, упорядоченная в виде набора элементов (записей) одинаковой формы, а также специальные программы для обработки записей, позволяющие упорядочивать записи, делать из них выборки по указанным в программах правилам

data processing обработка данных — автоматическая или полуавтоматическая организация числовых данных требуемым образом: их прием, передача, хранение, выполнение математических операций и индикация результатов

debugging отладка — процесс обнаружения, локализации и устранения неисправностей и аппаратных сбоев ЭВМ

decoder декодер — устройство, преобразующее кодированные данные в требуемую форму

Digital-Analog converter (D/A converter) (*see* **A/D converter**) цифро-аналоговый преобразователь (ЦАП) — устройство, преобразующее переменную физическую величину, выраженную в числовой форме в виде серии дискретных битов, в непрерывно изменяющуюся физическую величину.

Пример: устройство ЧПУ, преобразующее числа-координаты в подачу фрезы, резца

digital integrated microcircuit (*see* **analogue integrated microcircuit**) цифровая интегральная микросхема — микросхема, предназначенная для преобразования и обработки сигналов, изменяющихся по закону дискретной («ступенчатой») функции.

Частным случаем цифровой интегральной микросхемы является логическая микросхема, оперирующая сигналами в двоичном цифровом коде

Direct Memory Access (DMAC) прямой (непосредственный) доступ к памяти ЭВМ

disk диск, магнитный диск — запоминающее устройство, накопитель информации ЭВМ. В крупных ЭВМ информация хранится в больших дисковых пакетах, состоящих из нескольких дисков, смонтированных на валике. В микро-ЭВМ используются твердые или гибкие диски. Твердые диски обычно устанавливаются в ЭВМ стационарно

disk drive дисковод — устройство, позволяющее ЭВМ считывать с дисков и записывать на них данные. Дисковод вращает диск и управляет перемещением считывающей головки

display дисплей — устройство визуального отображения информации, например, цифровой индикатор, индикатор на электронно-лучевой трубке, графический терминал

encoder кодер — устройство, преобразующее данные в требуемую кодированную форму

fibre optics волоконная оптика — оптическая система, использующая стеклянные волокна в качестве световодов для передачи оптических изображений или кодированных световых импульсов

Field Effect Transistor (FET) полевой транзистор — транзистор, в котором ток между двумя выводами, истоком и стоком, проходя через канал, тончайший слой с электронной или дырочной проводимостью, управляется полем, возникающим при приложении напряжения между источником и третьим выводом, затвором

file файл — именованная область внешней памяти для хранения программ и логически расположенных данных. В файлах могут содержаться произвольные текстовые документы и числовые данные, закодированная табличная, графическая и любая иная информация.

Простейшая аналогия: папка с подборкой газетных вырезок о спортсменах, расположенных в алфавитном порядке их фамилий

file catalogue каталог файлов — логический раздел внешнего накопителя информации, объединяющий группу файлов и хранящий данные о названии, объеме и времени создания или последнего изменения файла

film integrated microcircuit пленочная интегральная микросхема — микросхема, все элементы и межэлементные соединения которой выполнены в виде пленок

flip-flop, flip-flop register, half-shift register *(see* **trigger***)* триггер — электронная схема с двумя возможными стабильными состояниями, которая может включаться и оставаться в одном из этих состояний в зависимости от вида входного сигнала, поступившего последним

floppy disk флоппи-диск, гибкий диск, дискет (а) — запоминающее устройство в виде диска из полимерной пленки с магнитным покрытием, заключенное в плотную бумажную или пластмассовую кассету с прорезью для доступа головок считывания и записи

FORTRAN (FORmulae TRANslation) ФОРТРАН — язык программирования высокого уровня, применяемый, в первую очередь, при выполнении на ЭВМ научных расчетов

gate вентиль — полупроводниковый элемент с одним или несколькими входами, свойства которого определяют наличие и уровень выходного сигнала при подаче сигнала на вход. Выполняет функции элемента логики в цифровых схемах

General Purpose Register (GPR) регистр общего назначения (РОН) — программно-доступный рабочий регистр процессора, который может быть использован для оперативного хранения различных элементов программ

hardware *(see* **software***)* аппаратурное обеспечение ЭВМ — ее механическое, электронное, магнитное, электрическое оборудование

high level высокий уровень (термин употребляется применительно к языку программирования, в котором каждая инструкция соответствует нескольким инструкциям машинного кода)

hybrid integrated microcircuit гибридная интегральная микросхема — схема, содержащая, кроме элементов, компоненты и/или кристаллы. *Частным случаем* гибридной интегральной микросхемы является многокристальная интегральная микросхема

Integrated Micro-Circuit (IMC) интегральная микросхема (ИМС) — микроэлектронное изделие, выполняющее определенную функцию преобразования, обработки сигнала и/или накопления информации и имеющее высокую плотность упаковки электрически соединенных элементов (или элементов и компонентов и/или кристаллов), рассматриваемое как единое целое

integrated microcircuit component компонент ИМС — часть ИМС, реализующая функцию какого-либо электрорадиоэлемента, например, транзистора, диода, резистора, конденсатора, которая может быть частью гибридной ИМС

integrated microcircuit element элемент ИМС — часть ИМС, реализующая функцию какого-либо электрорадиоэлемента, например, транзистора, диода, резистора, конденсатора, которая, будучи неотделимой от кристалла или подложки, не может быть выделена как самостоятельное изделие

integrated microcircuit plate плата ИМС — подложка или часть подложки ИМС, на поверхности которой нанесены пленочные элементы микросхемы, межэлементные и межкомпонентные соединения и контактные площадки

integrated microcircuit scale of integration показатель степени сложности микросхемы, характеризуемый числом содержащихся в ней элементов и компонентов. Степень интеграции ИМС определяется по формуле: $K = \ln N$, где K — коэффициент, определяющий степень интеграции, значение которого округляется до ближайшего большего целого числа; N — число элементов и компонентов ИМС

integrated microcircuit substrate подложка ИМС — заготовка платы ИМС

interface интерфейс — совокупность средств и правил, обеспечивающих логическое или физическое унифицированное сопряжение (взаимодействие) устройств и/или программ подсистем, входящих в вычислительную систему, в частности связь ЭВМ с другой ЭВМ либо с пользователем. Физический интерфейс определяет тип стыка, уровни сигналов, импеданс (выходное сопротивление), синхронизацию и другие унифицированные параметры канала связи; программный интерфейс определяет совокупность допустимых процедур или операций и их параметров, список общих переменных, областей памяти и других объектов

internal memory оперативная память, оперативное запоминающее устройство (ОЗУ) — устройство, где размещаются во время исполнения программы, а также используемые ими данные. ОЗУ характеризуются более высокой скоростью записи и чтения и меньшим объемом, чем внешняя память. При выключении машины содержимое ОЗУ не сохраняется

interpreter (*see* **compiler**) интерпретатор — программа, переводящая команды программирования высокого уровня в команды машинного кода, подлежащие немедленному исполнению

keyboard клавиатура — устройство ввода текстов, чисел и управляющей информации в память ЭВМ. Внешне похожа на клавиатуру обычной пишущей машинки, но имеет дополнительные клавиши для расширения возможностей управления ЭВМ

Large Scale Integrated (LSI) microprocessor большая интегральная микросхема (БИС) — интегральная микросхема, выполняющая функцию микропроцессора или его части. По существу, это БИС с процессорной организацией, разработанная специально для построения микропроцессорных систем

Large Scale Integration (LSI) of integrated circuit высокая степень интеграции интегральной схемы (при которой количество элементов и компонентов схемы превышает 10^6)

Light-Emitting Diodes (LED) display дисплей на светодиодах. Применяется чаще всего в низковольтных электронных устройствах, например в некоторых типах электронных цифровых часов

Liquid Crystals Display (LCD) дисплей на жидких кристаллах, например стандартное семисегментное цифровое табло карманного калькулятора

logical element, logic circuit логический элемент — элементарная полупроводниковая схема, имеющая два устойчивых логических состояния

machine code (*see* **machine language**) машинный код — система кодирования, на которую рассчитан центральный процессор конкретной ЭВМ, предназначенная для представления в процессоре набора вводимых команд

machine language (*see* **machine code**) машинный язык, язык машины — система команд ЭВМ. То же, что машинный код.

magnetic disk магнитный диск — круглая пластинка с магнитным покрытием, на которую записывается информация

magnetic tape, magnetic stripe магнитная лента — полоска намагниченного материала, на которую могут наноситься и с которой могут считываться кодированные магнитные метки. Применяется, в первую очередь, для обмена данными между вычислительными системами, хранения резервных копий и для передачи программного обеспечения

mainframe computer ЭВМ «полного профиля», универсальная ЭВМ — в отличие от мини-ЭВМ и малых коммерческих ЭВМ

mask маска — фотонегатив, применяемый в микроэлектронике для экранирования отдельных участков полупроводникового чипа, на котором печатается требуемый рисунок интегральной микросхемы. На каждой стадии изготовления чипа используются специальные маски

memory память — устройство или схема для запоминания и хранения используемой в ЭВМ информации, позволяющее при необходимости извлекать последнюю

memory unit ячейка памяти — регистр в памяти ЭВМ, доступ к которому возможен по определенному адресу

Metal-Insulator-Semiconductor (MIS) technology технология металл-диэлектрик-полупроводник (МДП-технология) — технология, применяемая при изготовлении транзисторов интегральных микросхем (ИМС) и больших интегральных схем (БИС). МДП-структура образуется слоями указанных в названии материалов, наносимыми последовательно методами эпитаксии (наращивания), осаждения и окисления. Каждый из слоев представляет собой функциональную часть транзистора. МДП-технология обеспечивает большую плотность размещения элементов на плате

Metal-Nitride-Oxyde-Semiconductor (MNOS) technology технология металл-нитрид-окисел-полупроводник (МНОП-технология) — технология, применяемая при изготовлении полевых транзисторов с изолированным затвором, используемых в ИМС и БИС (*см.* **IMC** *и* **LSI**). МНОП-структура образуется четырьмя слоями: 1) металл (алюминий или золото) — затвор; 2) нитрид (нитрид кремния) и 3) окисел (двуокись кремния) — изоляция затвора; 4) полупроводник (кремний) — области истока, канала и затвора

Metal-Oxyde-Semiconductor (MOS) technology технология металл-окисел-полупроводник (МОП-технология) — технология, применяемая аналогично технологии металл-нитрид-окисел-полупроводник (*см.* **MNOS**). Имеет ту же послойную структуру, за исключением слоя нитрида

Metal-Oxyde-Semiconductor Field Effect (MOSFET) transistor полевой транзистор, изготовленный по МОП-технологии

mouse мышь — небольшое устройство, соединенное с ЭВМ кабелем. Перемещаясь по столу, мышь контролирует курсор на мониторе, позволяя выполнять разнообразные компьютерные операции

microcomputer микрокомпьютер, микропроцессорная электронная вычислительная машина (микроЭВМ, персональная ЭВМ, ПЭВМ) — ЭВМ, состоящая из микропроцессора (микропроцессоров), полупроводниковой памяти, средств связи с периферийными устройствами и, при необходимости, пульта управления и источника питания, объединенных общей несущей конструкцией. МикроЭВМ — универсальное вычислительное устройство с развитым стандартным программным обеспечением

microelectronics микроэлектроника — область электроники, охватывающая исследование, конструирование, изготовление и применение микроэлектронных изделий: интегральных микросхем, больших интегральных схем, микропроцессоров и т. п.

microprocessor, Micro-Processor Unit (MPU) микропроцессор (МП) — программно-управляемое устройство, осуществляющее процесс обработки цифровой информации и управление этим процессом, построенное на одной или нескольких больших интегральных схемах (БИС).

Примером МП является отечественное центральное процессорное устройство КР580ИК80А

minicomputer мини-ЭВМ — малая вычислительная машина, имеющая широкое применение благодаря небольшим габаритам и низкой стоимости. Длина ее машинного слова — от 8 до 19 битов, чаще всего 16

monitor монитор — экран, подобный телевизионному, на котором прочитываются данные, выдаваемые ЭВМ. Так же называется терминал с видеодисплеем

multiple access параллельный (множественный) доступ — система, при которой несколько пользователей могут подсоединяться к одной и той же ЭВМ со своих собственных терминалов

Numerical Control (NC) числовое управление — управление, как правило, станками-автоматами по программе, обычно наносимой на перфоленту

on-line data processing «онлайн» — режим работы, при котором ЭВМ функционирует под непосредственным контролем центрального процессора и обработка данных ведется в реальном масштабе времени, т. е. по мере их поступления

operand операнд — исходный базовый элемент данных, над которыми выполняется операция

object program объектная программа — конечная программа в машинном коде, переведенная с языка высокого уровня ли языка ассемблера посредством программы-компилятора или программы-ассемблера

operation code (op-code) код операции — код, выделяющий специфическую операцию, которая должна быть выполнена управляющим устройством ЭВМ

operational system операционная система (ОС) — важнейшая часть программного оснащения ЭВМ, обеспечивающая управление всеми аппаратными компонентами и позволяющая отделить остальные классы программ от непосредственного взаимодействия с аппаратурой

operational system command команда операционной системы — текстовый приказ, вводимый пользователем с клавиатуры и содержащий обращение к различным функциям операционной системы

package пакет программ — сводная прикладная программа ЭВМ с сопровождающей документацией

peripheral, peripheral device, peripheral unit периферийное устройство, внешнее устройство — устройство, конструктивно отделенное от основного блока ЭВМ, имеющее собственное управление и выполняющее запросы центрального процессора без его вмешательства

photodetector фотодетектор — электронное устройство, чувствительное к световой энергии, например, фотодиод, фототранзистор, фотоэлемент

piezoelectric пьезоэлектрик — материал, в котором под действием механических напряжений возникают электрические заряды

place знакоместо — элемент экрана дисплея, в котором может быть изображен ровно один знак (буква или цифра); типичный экран персональной ЭВМ содержит 25 строк по 40 или 80 знакомест в каждой

printer принтер — устройство для печатания на бумаге текстовой и графической информации, выдаваемой ЭВМ

processor процессор — программно-управляемое устройство, осуществляющее процесс обработки информации в ЭВМ и управление им

program программа — последовательность действий (команд операторов), записанная на специальном языке и предназначенная для выполнения в ЭВМ

program language язык программирования — алгоритмический язык, формальная система для записи алгоритмов в виде программ

Programmable Read-Only Memory (PROM) программируемое постоянное запоминающее устройство (ППЗУ) — устройство памяти, в котором информация может быть записана после того, как она была выработана, но впоследствии уже не может быть изменена

protocol протокол — регламентированная процедура регистрации и коммутации сообщений при передаче сигналов между двумя или несколькими устройствами

punched paper tape перфолента, перфорированная лента — лента с пробитыми в определенной кодированной последовательности отверстиями

Random Access Memory (RAM) память произвольного доступа, запоминающее устройство с произвольной выборкой (ЗУПВ) — устройство памяти, в котором информация может быть введена в любую ячейку или извлечена из нее

Read-Only Memory (ROM) постоянное запоминающее устройство (ПЗУ) — устройство памяти, содержимое которого постоянно (сохраняется при выключении ЭВМ); запись информации оно выполнять неспособно, а считывание может производиться с высокой скоростью. В ПЗУ обычно находятся программы и данные, обслуживающие работу аппаратуры

register регистр — накопитель на переключающих элементах (например, на триггерах), емкость которого обычно равна одному машинному слову. Предназначен для хранения информации в процессе обработки данных в ЭВМ

resident software резидентное программное обеспечение — набор программ для создания и отладки программного обеспечения той ЭВМ, на которой готовится это обеспечение

semiconductor integrated microcircuit полупроводниковая интегральная микросхема (ИМС), все элементы и межэлементные соединения которой выполнены в объеме и на поверхности полупроводника

Silicon-On-Sapphire (SOS) integrated microcircuit кремний-сапфировая интегральная микросхема — кремниевая ИМС на сапфировой (из синтетического сапфира) подложке

single chip microcomputer однокристальная микроЭВМ — микроЭВМ, выполненная в виде одной БИС. В этом случае на одном кристалле размещаются процессор, постоянное запоминающее устройство (ПЗУ) для хранения программы, оперативное запоминающее устройство (ОЗУ) для хранения промежуточных результатов, каналы ввода-вывода, в ряде случаев — таймер

software *(see* **hardware***)* программное обеспечение, программные средства ЭВМ — программы или набор инструкций, позволяющие ЭВМ выполнять различные операции

solid-state integrated circuit полупроводниковая интегральная схема *(см.)*

source (language) program программа на входном языке (транслятора), входная (исходная) программа ЭВМ

stack стек — серия ячеек памяти, запоминающее устройство магазинного типа, в котором первым считывается последнее записанное слово

subroutine подпрограмма — группа программных команд, которая может быть введена в состав основной стандартной программы в различных точках по ходу выполнения последней

system command команда операционной системы — текстовый приказ, вводимый пользователем с клавиатуры и содержащий обращение к различным функциям операционной системы

telecommunication units (telecommunication aids) средства телекоммуникации — программные и аппаратные средства, позволяющие передавать информацию от одной ЭВМ к другой, в том числе на расстоянии

teletex телетекс — передача цифровой кодированной информации по телевизионным каналам

terminal терминал — устройство для ввода или извлечения данных, в частности пользователем или оператором, при обмене информацией с ЭВМ. Терминал представляет собой два относительно независимых устройства: для ввода данных (клавиатура, перфоратор и т. д.) и для извлечения данных (видеодисплей, принтер, оптическое считывающее устройство и т. д.)

text editor текстовый редактор — программа для подготовки и обработки текстовой информации, которая позволяет вводить символы (буквы, цифры и другие знаки) с клавиатуры и осуществлять различные действия по редактированию (изменению) текстов пользователем

the *n*-st level of integration *n*-ная степень интеграции микросхемы (т. е. микросхема содержит от 10^{n-1} до 10^{n} элементов и компонентов включительно)

timer таймер — тактовый генератор, генератор тактовых импульсов, обеспечивающий синхронную работу процессора и других блоков ЭВМ

time sharing разделение времени — метод, обеспечивающий доступ многих операторов к центральному процессору ЭВМ в течение коротких последовательных отрезков времени, что имитирует одновременное использование системы

transducer преобразователь, первичный преобразователь, датчик — устройство, которое преобразует неэлектрические параметры в электрические величины и электрические сигналы

transistor транзистор — активное полупроводниковое устройство с тремя электрическими выводами, используемое в качестве усилителя и коммутатора электрических сигналов

Transistor-Transistor Logic (TTL) транзисторно-транзисторная логика (ТТЛ) — семейство высокоскоростных цифровых интегральных логических микросхем. В значительной степени вытесняются логическими схемами, изготовляемыми по МОП-технологии, поскольку последние допускают более плотную упаковку и потребляют меньшую мощность

translator транслятор, программа-транслятор — программа, переводящая текст с одного языка программирования на другой

trigger *(see* **flip-flop***)* триггер — электронная логическая схема, принимающая одно из двух возможных устойчивых состояний, соответствующих нулю и единице

Very Large-Scale Integration circuit (VLSI-circuit) сверхбольшая интегральная схема (СВИС)

videodisk видеодиск — алюминиевый диск с пластиковым покрытием для хранения и воспроизведения высококачественного изображения и звука. Для записи используется цифровая техника: информация наносится на поверхность диска лазерным лучом в виде закодированной последовательности выплавленных ямок. Считывание производится на специальном видеопроигрывателе также лазерным лучом, а затем считываемые данные переносятся на экран видеомонитора. Видеодиски, или оптические диски, используются для хранения и видеозаписи информации ЭВМ

videodisplay, Visual Display Unit (VDU) видеодисплей, устройство визуального отображения — сходный с телевизором видеотерминал, основной частью которого является электронно-лучевая трубка. На экране видеодисплея могут отображаться текстовые документы, графики, диаграммы и т. д.

videotex видеотекс — система доступа пользователя к удаленным базам данных, обеспечивающая прием текстов и изображений. В качестве приемника может служить бытовой телевизор со специальной клавиатурой

winchester disk винчестер-диск — запоминающее устройство (накопитель) на жестком магнитном диске, помещаемом в кожух кассетного типа, используемое в качестве замены гибких дисков. Вместе с диском в кожухе размещаются магнитные головки и другие механические части. Обеспечивает большую плотность записи

word слово, машинное слово — количество битов, которое ЭВМ способна обработать за один этап вычислений. Длина слова обычно равна 32, 36, 48 или 64 битам в зависимости от типа ЭВМ

word processing 1) пословная обработка машинных слов информации в ЭВМ;
2) обработка текстов на видеодисплее

VOCABULARY

A

abbreviation [ə,bri:vı'eıʃ(ə)n] *n* сокращение

ABC-book ['eı'bi:'si:,buk] *n* букварь

ability [ə'bılıtı] *n* способность

able ['eıbl] *a* способный

abnormal [æbaenɔ:m(ə)l] *a* аномальный

abound [ə'baund] **(in, with)** *v* изобиловать

abroad [ə'brɔ:d] *adv* за границу, за границей

absent ['æbs(ə)nt] *a* отсутствующий

academician [ə,kædə'mıʃ(ə)n] *n* академик

accelerate [ək'seləreıt] *v* ускорять

accept [ək'sept] *v* допускать, позволять, принимать

acceptable [ək'septəbl] *a* приемлемый

access ['ækses] *n* доступ

accessory [æk'sesərı] *a* добавочный, дополнительный, вспомогательный *n pl* принадлежности, арматура; вспомогательное оборудование

accidental [,æksı'dentl] *a* случайный

accommodate [ə'kɔmədeıt] *v* приспосабливать

accomplish [ə'kɔmplıʃ] *v* выполнять

accordance [ə'kɔ:d(ə)ns] *n* соответствие

accumulate [ə'kju:mjuleıt] *v* накапливать

accumulator [ə'kju:mjuleıtə] *n* накопитель

accuracy ['ækjurəsı] *n* точность

achieve [ə'tʃi:v] *v* достигать

acquaint [ə'kweınt] *v* знакомить

across [ə'krɔs] *prep* по, через

activate ['æktıveıt] *v* включать, запускать

activities [æk'tıvıtız] *n pl* деятельность, мероприятия

actual ['æktjuəl] *a* фактический, действительный

actuate ['æktjueıt] *v* приводить в действие, включать

acute [ə'kju:t] *a* острый, проницательный, сообразительный

adapt [ə'dæpt] *v* приспосабливать

adaptive [ə'dæptıv] *a* самонастраивающийся

add [æd] *v* добавлять

additional [ə'dıʃənl] *a* дополнительный

adjust [ə'dʒʌst] *v* корректировать, регулировать, настраивать

admit [əd'mıt] *v* допускать

adopt [ə'dɔpt] *v* принимать, допускать

advance [əd'vɑ:ns] *n* прогресс, продвижение вперед
v продвигаться вперед; делать успехи

advancement [əd'vɑ:nsmənt] *n* продвижение, успех

advantage [əd'vɑ:ntıdʒ] *n* преимущество

adverse ['ædvə:s] *a* неблагоприятный; расположенный напротив

advertise ['ædvətaız] *v* рекламировать

advisable [əd'vaızəbl] *a* целесообразный

advocate ['ædvəkıt] *n* сторонник, приверженец

affect [ə'fekt] *v* воздействовать; поражать

age [eıdʒ] *n* возраст

agency ['eıdʒənsı] *n* агентство; сила, фактор

aggregation [,ægrı'geıʃ(ə)n] *n* накопление

aim [eim] *n* цель
with the aim of с целью
alert [ə'lə:t] *v* поднимать тревогу, настораживать
algorithm ['ælgərıðm] *n* алгоритм
alive [ə'laıv] *a* живой
allocate ['æləkeıt] *v* выделять, ассигновать; размещать
allow [ə'lau] *v* позволять, давать возможность
alloy [ə'lɔı] *v* сплавлять *(металлы)*
along [ə'lɔŋ] *prep* вдоль (по)
adv **(with)** вместе с
alter ['ɔ:ltə] *v* изменять, переделывать
although [ɔ(:)l'ðou] *cj* хотя
alternative [ɔ:l'tə:nətıv] *n* выбор, альтернатива
amount [ə'maunt] *n* количество
ample ['æmpl] *a* обильный
amplifier ['æmplıfaıə] *n* усилитель
amplify ['æmplıfaı] *v* усиливать
amplitude ['æmplıtju:d] *n* амплитуда
amusement [ə'mju:zmənt] *n* развлечение
angry ['æŋgrı] *a* сердитый
Annal ['ænl] *n* хроникальная запись отдельного события
announce [ə'nauns] *v* объявлять
annoy [ə'nɔı] *v* надоедать, раздражать
anytime ['enıtaım] *adv* всегда, в любое время
anyway ['enıweı] *adv* во что бы то ни стало, во всяком случае; как-нибудь; как попало
apparent [ə'pær(ə)nt] *a* видимый; явный, очевидный
appeal [ə'pi:l] **(to)** *v* обратиться (к)
appear [ə'pıə] *v* появляться; оказываться
appendix [ə'pendıks] **(*pl* appendices)** *n* приложение
appliance [ə'plaıəns] *n* устройство
apply [ə'plaı] *v* применять
appointment [ə'pɔıntmənt] *n* назначение; встреча
apprеciate [ə'pri:ʃieıt] *v* оценивать
approach [ə'proutʃ] *n* подход
appropriate [ə'prouprııt] *a* соответствующий, подходящий
approximate [ə'prɔks(ı)mıt] *a* приблизительный
arbitrary ['ɑ:bıtrərı] *a* произвольный, случайный; условный
area ['ɛərıə] *n* зона, область, район, участок
arise [ə'raız] **(arose, arisen)** *v* возникать
arithmetic [ə'rıθmətık] *a* арифметический
arrange [ə'reındʒ] *v* устраивать; располагать в определенном порядке
array [ə'reı] *n* массив *(информации)*
article ['ɑ:tıkl] *n* предмет, изделие
artificial [ˌɑ:tı'fıʃ(ə)l] *a* искусственный
Asian ['eıʃ(ə)n] *a* азиатский
Central Asian среднеазиатский
aspect ['æspekt] *n* вид; сторона (вопроса), аспект
assemble [ə'sembl] *v* собирать
assess [ə'ses] *v* оценивать
assign [ə'saın] *v* предназначать, отводить, устанавливать
assistance [ə'sıst(ə)ns] *n* помощь, содействие
association [əˌsousı'eıʃ(ə)n] *n* общество, объединение
assume [ə'sju:m] *v* принимать, допускать
astonishing [əs'tɔnıʃıŋ] *a* ошеломляющий, поразительный
attach [ə'tætʃ] *v* присоединять, прикреплять; придавать *(значение)*
attachment [ə'tætʃmənt] *n* приспособление
attain [ə'teın] *v* достигать, добиваться
attempt [ə'tem(p)t] *n* попытка
v пытаться
attend [ə'tend] *v* посещать
attendant [ə'tendənt] *n* (дежурный) оператор
attention [ə'tenʃ(ə)n] *n* внимание
attentive [ə'tentıv] *a* внимательный
audio ['ɔ:dıou] *a амер.* слуховой, звуковой

audio text текст для прослушивания
audio-amplifier ['ɔ:diou'æmplifaiə] *n* звуковой усилитель
authorize ['ɔ:θəraiz] *v* разрешать, санкционировать
autosampler ['ɔ:tou'sa:mplə] *n* автоматический пробоотборник
available [ə'veiləbl] *a* существующий, доступный, имеющийся в наличии (в продаже)
average ['ævərid3] *n* средний показатель
a средний
avoid [ə'vɔid] *v* избегать, уклоняться
axial ['æksiəl] *a* осевой

B

background ['bækgraund] *n* фон
a фоновый, побочный
backlighting ['bæklaitiŋ] *n* подсветка
badge [bæd3] *n* жетон; знак, символ
baking ['beikiŋ] *n* выпекание; спекание
bandwidth ['bændwidθ] *n* ширина (спектральной полосы)
basement ['beismənt] *n* подвал; основание, фундамент
base [beis] *n* основание, база
v **(on, upon)** основывать
based on на основе, на основании
basic ['beisik] *a* основной, главный
bear [bɛə] **(bore, borne)** *v* нести, выносить, переносить
bearer ['bɛərə] *n* предъявитель
bearing ['bɛəriŋ] *n* подшипник
beat [bi:t] **(beat, beaten)** *v* бить; разбивать, наносить поражение
behave [bi'heiv] *v* вести себя
behaviour [bi'heivjə] *n* поведение
believe [bi'li:v] *v* верить; считать, полагать
bend [bend] **(bent, bent)** *v* наклонять(ся), сгибать(ся), гнуть(ся)
benefit ['benifit] *n* выигрыш
betray [bi'trei] *v* предавать, изменять, обманывать
bilingual [,bai'liŋgw(ə)l] *a* двуязычный; владеющий двумя языками
bill [bil] *n* счет
binary ['bainəri] *a* бинарный, двоичный
binder ['baində] *n* скоросшиватель
birth [bə:θ] *n* рождение, возникновение
bitterly ['bitəli] *adv* с горечью
blade [bleid] *n* лопасть
blame [bleim] *v* винить, обвинять
blink [bliŋk] *v* мигать, мерцать
blow [blou] **(blew, blown)** *v* дуть
blow up взрывать
blueprint ['blu:'print] *n* синька, светокопия; план, проект
blunder ['blʌndə] *n* ошибка, промах
board [bɔ:d] *n* панель, плата; правление, совет
printed circuit board печатная плата
body ['bɔdi] *n* орган
bonus ['bounəs] *n* премия
boredom ['bɔ:dəm] *n* скука
both [bouθ] *pron* оба; и тот и другой
both... and как..., так и
bracket ['brækit] *n* скобка
brain [brein] *n* мозг
breakdown ['breikdaun] *n* поломка, авария
breathlessly ['breθlisli] *adv* затаив дыхание
brave [breiv] *a* смелый, храбрый
brief [bri:f] *a* краткий
bring [briŋ] **(brought, brought)** *v* приносить, привозить, доставлять
broadcast ['brɔ:dka:st] *n* (радио)вещание
bug [bʌg] *n* *амер. разг.* ошибка, неисправность
build [bild] **(built, built)** *v* строить, создавать
build up накапливаться, возрастать
bulb [bʌlb] *n* лампочка
bulky ['bʌlki] *a* громоздкий
burden ['bə:dn] *n* тяжесть, бремя
v обременять, отягощать
bureau [bju(ə)'rou] *n* бюро
burglar ['bə:glə] *n* грабитель, взломщик

burner ['bə:nə] *n* горелка
bus [bʌs]: **data bus** шина данных
button ['bʌtn] *n* кнопка

C

cabling ['keɪblɪŋ] *n* укладка кабеля
calculate ['kælkjuleɪt] *v* вычислять, подсчитывать, рассчитывать
calculator ['kælkjuleɪtə] *n* калькулятор, счетная машина
call [kɔ:l] *v* звать, называть
call for требовать, предусматривать, обязывать
call up вызывать
cam [kæm] *n* кулачок, эксцентрик
canal [kə'næl] *n* канал
cancel ['kæns(ə)l] *v* стирать, аннулировать, вычеркивать
capability [,keɪpə'bɪlɪtɪ] *n* возможность; способность
capable ['keɪpəbl] *a* способный, пригодный
capacitor [kə'pæsɪtə] *n* конденсатор
capacity [kə'pæsɪtɪ] *n* способность; емкость, мощность
capture ['kæptʃə] *n* сбор *(данных, информации)*
card [kɑ:d] *n* карточка
cardiogram ['kɑ:dɪougræm] *n* кардиограмма
careless ['kɛəlɪs] *a* небрежный; беззаботный
carrier ['kærɪə] *n* носитель
carry ['kærɪ] *v* нести, переносить
carry out выполнять
cartridge ['kɑ:trɪdʒ] *n* кассетный блок
case [keɪs] *n* коробка; футляр; кожух; корпус
v заключать в оболочку
cash [kæʃ] *n* наличные деньги
cassette [kə'set] *n* кассета
casting ['kɑ:stɪŋ] *n* литье
cause [kɔ:z] *v* вызывать, причинять; заставлять
caveman ['keɪvmən] *n* пещерный человек
cell [sel] *n* ячейка
certain ['sə:tn] *a* определенный
certificate [sə'tɪfɪkɪt] *n* свидетельство
chairman ['tʃɛəmən] *n* председатель
change [tʃeɪndʒ] *n* изменение
channel ['tʃænəl] *n* канал
character ['kærɪktə] *n* знак, символ, цифра, буква
characteristic [,kærɪktə'rɪstɪk] *n* характеристика
charcoal ['tʃɑ:koul] *n* древесный уголь; угольный карандаш
charge [tʃɑ:dʒ] *n* заряд
v заряжать; обвинять
chart [tʃɑ:t] *n* диаграмма
chat [tʃæt] *v* болтать
cheap [tʃi:p] *a* дешевый
check [tʃek] *n* контроль, проверка
v проверять
chemical ['kemɪk(ə)l] *n* химический препарат, химикат
chew [tʃu:] *v* жевать
chin [tʃɪn] *n* подбородок
chip [tʃɪp] *n* полупроводниковый кристалл с микросхемой, чип
choice [tʃɔɪs] *n* выбор
choose [tʃu:z] **(chose, chosen)** *v* выбирать
chuck [tʃʌk] *v* бросать, кидать, швырять
circuit ['sə:kɪt] *n* схема
integrated circuit интегральная схема
circumstances ['sə:kəmstənsɪz] *n pl* обстоятельства, условия
civilization [,sɪvɪl(a)ɪ'zeɪʃ(ə)n] *n* цивилизация
claim [kleɪm] *v* утверждать, претендовать
class [klɑ:s] *n* класс; урок, занятие
classify ['klæsɪfaɪ] *v* классифицировать
clear [klɪə] *v* очищать; стирать *(изображение, запись)*
clever ['klevə] *a* умный, ловкий, искусный
close [klous] *a* тесный
close to близко
clue [klu:] *n* ключ *(к решению задачи)*

clumsy ['klʌmzɪ] *a* громоздкий, неуклюжий, тяжеловесный

coat [kout] *v* покрывать слоем *(чего-либо)*

coaxial [,kou'æksɪəl] *a* коаксиальный *(с центральной экранированной жилой)*

code [koud] *n* код

coin [kɔɪn] *n* монета

collect [kə'lekt] *v* собирать

college ['kɔlɪdʒ] *n* колледж

teachers' training college педагогический институт

commit [kə'mɪt] *v* совершать; передавать, поручать

commitment [kə'mɪtmənt] *n* вручение, передача

commonly ['kɔmənlɪ] *adv* обычно

communications [kə,mju:nɪ'keɪʃ(ə)nz] *n pl* связь

company ['kʌmpənɪ] *n* компания, фирма

comparatively [kəm'pærətɪvlɪ] *adv* сравнительно

compare [kəm'pɛə] *v* сравнивать

comparison [kəm'pærɪsn] *n* сравнение

compatible [kəm'pætɪbl] *a* совместимый, сочетаемый

competition [,kɔmpɪ'tɪʃ(ə)n] *n* соревнование, конкурс

competitor [kəm'petɪtə] *n* соперник, конкурент

compile [kəm'paɪl] *v* составлять, компилировать

complementary [,kɔmplɪ'ment(ə)rɪ] *a* дополнительный, добавочный

complete [kəm'pli:t] *v* заканчивать, завершать; комплектовать

a полный, законченный, исчерпывающий

complex ['kɔmpleks] *a* сложный, составной, комплексный

complicate ['kɔmplɪkeɪt] *v* осложнять, запутывать

component [kəm'pounənt] *n* составная часть, деталь, компонент

composite ['kɔmpəzɪt] *n* смесь, соединение

composition [,kɔmpə'zɪʃ(ə)n] *n* состав

compute [kəm'pju:t] *v* вычислять, считать, подсчитывать

computer [kəm'pju:tə] *n* ЭВМ, компьютер

compact computer мини-компьютер

computer-assisted управляемый посредством ЭВМ

computer-controlled управляемый посредством ЭВМ

computerization [kəm,pju:tərɪ'zeɪʃən] *n* компьютеризация

concede [kən'si:d] *v* уступать

concentrate ['kɔnsəntreɪt] *v* сосредоточиваться

concept ['kɔnsept] *n* концепция, представление

concern [kən'sə:n] *v* касаться; относиться

conclude [kən'klu:d] *v* заключать; решать, принимать решение

conclusion [kən'klu:ʒ(ə)n] *n* заключение

condense [kən'dens] *v* сгущать, конденсировать

condition [kən'dɪʃ(ə)n] *n* условие, состояние

conditioning [kən'dɪʃənɪŋ] *n* кондиционирование

conduct [kən'dʌkt] *v* проводить *(электричество)*

conductivity [,kɔndək'tɪvɪtɪ] *n* проводимость

conductor [kən'dʌktə] *n* проводник

conference ['kɔnf(ə)r(ə)ns] *n* конференция

confident ['kɔnfɪd(ə)nt] *a* уверенный

conform [kən'fɔ:m] **(to)** *v* соответствовать, согласоваться

confuse [kən'fju:z] *v* перепутать, смешать

congratulate [kən'grætjuleɪt] *v* поздравлять

conjunction [kən'dʒʌŋ(k)ʃ(ə)n] *n* соединение

connect [kə'nekt] *v* (под)соединять

connector [kə'nektə] *n* соединитель, штепсельный разъем

consequence ['kɔns(ı)kwəns] *n* (по)-следствие
  in consequence of вследствие, как результат
consequently ['kɔns(ı)kwəntlı] *adv* следовательно
consider [kən'sıdə] *v* рассматривать, учитывать, принимать во внимание
considerable [kən'sıd·(ə)rəbl] *a* существенный, значительный
consideration [kən,sıdə'reıʃ(ə)n] *n* рассмотрение, обсуждение; соображение
  under consideration рассматриваемый, обсуждаемый
consignment [kən'saınmənt] *n* партия товара
consistent [kən'sıstənt] *a* последовательный
console [kən'soul] *a* консольный, (смонтированный) на стойке
constituent [kən'stıtjuənt] *a* составной, составляющий
construction [kən'strʌkʃ(ə)n] *n* постройка, создание, строительство
consume [kən'sju:m] *v* потреблять
consumer [kən'sju:mə] *n* потребитель
consumption [kən'sʌm(p)ʃ(ə)n] *n* потребление, расход
contact ['kɔntækt] *n* контакт
contain [kən'teın] *v* охватывать, содержать, заключать
continuous [kən'tınjuəs] *a* непрерывный, сплошной
control [kən'troul] *n* контроль, управление, регулирование; *pl* ручки управления
controller [kən'troulə] *n* управляющее устройство, регулятор
controversial [,kɔntrə'və:ʃ(ə)l] *a* спорный
convenient [kən'vi:njənt] *a* удобный
conventional [kən'venʃənl] *a* обычный, традиционный
conversational [,kɔnvə'seıʃənl] *a* диалоговый, разговорный
conversion [kən'və:ʃ(ə)n] *n* преобразование
convert [kən'və:t] *v* преобразовывать
convertor [kən'və:tə] *n* преобразователь
cooker ['kukə] *n* плита, печь
cool [ku:l] *v* охлаждать
cope [koup] **(with)** *v* справляться (с)
copy ['kɔpı] *n* копия
correspond [,kɔrıs'pɔnd] **(to)** *v* соответствовать
cost [kɔst] *n* стоимость
  v стоить
costly ['kɔstlı] *a* дорогостоящий
council ['kauns(ı)l] *n* совет
count [kaunt] *n* счет, подсчет
  v считать, подсчитывать, принимать во внимание (в расчет)
counterpart ['kauntəpa:t] *n* двойник
countless ['kauntlıs] *a* бессчетный
course [kɔ:s] *n* курс, ход
  in course of в ходе
cover ['kʌvə] *v* покрывать
crack [kræk] *n* щель
crater ['kreıtə] *n* кратер
crazy ['kreızı] *a* сумасшедший
create [krı'eıt] *v* создавать
crisp [krısp] *a* резкий, отчетливый
crossing ['krɔsıŋ] *n* пересечение
crossroads ['krɔsroudz] *n pl* перекресток
crude [kru:d] *a* грубый, неотесанный
cruel [kruəl] *a* жестокий
crystal ['krıstl] *n* кристалл
crystal-based ['krıstl'beıst] *a* построенный на кристалле
crystalline ['krıstəlaın] *a* кристаллический
culmination [,kʌlmı'neıʃ(ə)n] *n* кульминация, наивысшая точка
current ['kʌr(ə)nt] *n* ток
  a текущий, существующий, наличный, действующий
custom-built ['kʌstəmbılt] *a* сделанный на заказ
customer ['kʌstəmə] *n* покупатель, заказчик, клиент
cutter ['kʌtə] *n* резец

D

damage ['dæmıdʒ] *n* поломка, повреждение

dangerous ['deɪndʒrəs] *a* опасный
dashboard ['dæʃbɔ:d] *n* приборная панель
data ['deɪtə] *n pl* данные, информация
day-to-day ['deɪtə'deɪ] *a* повседневный
deadline ['dedlaɪn] *n* предельный, конечный срок; завершающий этап
deal [di:l] **(dealt, dealt) (with)** *v* иметь дело (с)
dealer ['di:lə] *n* агент по продаже
decade ['dekeɪd] *n* десятилетие
decipher [dɪ'saɪfə] *v* расшифровывать
decision [dɪ'sɪʒ(ə)n] *n* решение
decode [dɪ'koud] *v* декодировать, расшифровывать
decrease [dɪ'kri:s] *v* уменьшаться
dedicated ['dedɪkeɪtɪd] *a* посвященный; специализированный
deduction [dɪ'dʌkʃ(ə)n] *n* вычет, удержание
deficiency [dɪ'fɪʃ(ə)nsɪ] *n* отсутствие, нехватка, дефицит, недостаток
define [dɪ'faɪn] *v* определять
degree [dɪ'gri:] *n* степень
demonstrate ['demənstreɪt] *v* демонстрировать, показывать
density ['densɪtɪ] *n* плотность
deny [dɪ'naɪ] *v* отрицать; отказывать
department [dɪ'pɑ:tmənt] *n* отдел; кафедра
dependent [dɪ'pendənt] **(on)** *a* зависящий, зависимый (от)
deposit [dɪ'pɔsɪt] *n* вклад
v наносить *(что-л.)* осаждением
derive [dɪ'raɪv] *v* получать, извлекать
description [dɪs'krɪpʃ(ə)n] *n* описание, наименование
desert[1] ['dezət] *n* пустыня
desert[2] [dɪ'zə:t] *v* покидать
deserve [dɪ'zə:v] *v* заслуживать
design [dɪ'zaɪn] *n* разработка, проект; конструкция; чертеж, эскиз
v проектировать, разрабатывать, конструировать
designation [,dezɪg'neɪʃ(ə)n] *n* обозначение, знак, название; маркировка; предназначение, цель
designer [dɪ'zaɪnə] *n* проектировщик, разработчик
desire [dɪ'zaɪə] *v* желать, хотеть
desk-top ['desk,tɔp] *a* настольный
despite [dɪs'paɪt] *adv* вопреки, несмотря на
destroy [dɪs'trɔɪ] *v* разрушать, уничтожать
destruction [dɪs'trʌkʃ(ə)n] *n* разрушение, уничтожение
detachable [dɪ'tætʃəbl] *a* съемный, отсоединяемый
detail ['di:teɪl] *n* деталь
deter [dɪ'tə:] *v* сдерживать
determine [dɪ'tə:mɪn] *v* решать, определять
determined [dɪ'tə:mɪnd] *a* определенный; закоренелый, отпетый
develop [dɪ'veləp] *v* развивать(ся); разрабатывать; проявлять *(фотопленку)*
development [dɪ'veləpmənt] *n* развитие; нововведение
device [dɪ'vaɪs] *n* устройство
devise [dɪ'vaɪz] *v* разрабатывать, проектировать
diagnose ['daɪəgnouz] *v* ставить диагноз
diagnosis [,daɪəg'nousɪs] *n* диагноз
dial ['daɪəl] *n* диск набора
dictate [dɪk'teɪt] *v* диктовать
die [daɪ] *n* пресс-форма
difference ['dɪfr(ə)ns] *n* различие, разница
diffusion [dɪ'fju:ʒ(ə)n] *n* диффузия
digit ['dɪdʒɪt] *n* цифра
digital ['dɪdʒɪt(ə)l] *a* цифровой
dilute [dɪ'lju:t] *v* растворять
dimension [dɪ'menʃ(ə)n] *n* размер
diode ['daɪo(u)d] *n* диод
direct [d(a)ɪ'rekt] *a* прямой
direction [d(a)ɪ'rekʃ(ə)n] *n* направление
directory [dɪ'rekt(ə)rɪ] *n* руководство, справочник, указатель
disadvantage [,dɪsəd'vɑ:ntɪdʒ] *n* недостаток
disappear [,dɪsə'pɪə] *v* исчезать

disappoint [ˌdɪsəˈpɔɪnt] *v* разочаровывать

disassemble [ˌdɪsəˈsembl] *v* разбирать, демонтировать

disbelief [ˈdɪsbɪˈliːf] *n* недоверие

discharge [dɪsˈtʃɑːdʒ] *v* разряжать; выбрасывать

disconnect [ˈdɪskəˈnekt] **(with, from)** *v* разъединять, отключать

discount [dɪsˈkaunt] *n* скидка

discrete [dɪsˈkriːt] *a* дискретный, раздельный, состоящий из отдельных частей

discuss [dɪsˈkʌs] *v* обсуждать, дискутировать

disease [dɪˈziːz] *n* заболевание

displace [dɪsˈpleɪs] *v* вытеснять, заменять

display [dɪsˈpleɪ] *n* дисплей; индикатор, табло; отображение, вывод (данных) *v* отображать, представлять

dispute [dɪsˈpjuːt] *v* обсуждать; оспаривать

dissimilar [dɪˈsɪmɪlə] *a* непохожий

dissipation [ˌdɪsɪˈpeɪʃən] *n* рассеяние

distract [dɪsˈtrækt] *v* отвлекать

distribute [dɪsˈtrɪbjuːt] *v* распределять, распространять

district [ˈdɪstrɪkt] *n* район

disturb [dɪsˈtəːb] *v* мешать, беспокоить

diverse [daɪˈvəːs] *a* различный

doll [dɔl] *n* кукла

domestic [dəˈmestɪk] *a* домашний

dot [dɔt] *n* точка

double [ˈdʌbl] *v* удваивать(ся)

double-sided [ˈdʌblˈsaɪdɪd] *a* двусторо́нний

drawback [ˈdrɔːbæk] *n* недостаток

drawing-room [drɔːɪŋrum] *n* гостиная

drill [drɪl] *n* повторение, тренировка

drive [draɪv] *n* дисковод, лентопротяжное устройство; кампания, движение

drop [drɔp] *v* падать, снижаться

duty [ˈdjuːtɪ] *n* (служебная) обязанность

E

earphone [ˈɪəfoun] *n* головной телефон; *pl* наушники

ear-splitting [ˈɪəˈsplɪtɪŋ] *a* оглушительный

ease [iːz] *v* облегчать

economics [ˌiːkəˈnɔmɪks] *n* экономика

economy [i(ː)ˈkɔnəmɪ] *n* экономика, хозяйство; экономия

edit [ˈedɪt] *v* редактировать

education [ˌedju(ː)ˈkeɪʃ(ə)n] *n* образование

efficiency [ɪˈfɪʃ(ə)nsɪ] *n* продуктивность, эффективность

efficient [ɪˈfɪʃ(ə)nt] *a* эффективный; квалифицированный

effort [ˈefət] *n* усилие; попытка

either [ˈaɪðə] *adv* также, тоже *(в отриц. предложениях)*

elaborate 1. [ɪˈlæb(ə)rɪt] *a* тщательно, детально разработанный
2. [ɪˈlæbəreɪt] *v* тщательно детально разрабатывать

elect [ɪˈlekt] *v* выбирать

electrode [ɪˈlektroud] *n* электрод

electron [ɪˈlektrɔn] *n* электрон

element [ˈelɪmənt] *n* элемент

elevator [ˈelɪveɪtə] *n амер.* лифт

eliminate [ɪˈlɪmɪneɪt] *v* устранять, исключать

else [els] *adv* еще

embarrass [ɪmˈbærəs] *v* смущать, ставить в неловкое положение

embed [ɪmˈbed] *v* заделывать *(во что-л.)*

embrace [ɪmˈbreɪs] *v* обнимать; включать в себя, охватывать

emerge [ɪˈməːdʒ] *v* появляться

emergence [ɪˈməːdʒəns] *n* появление

emit [ɪˈmɪt] *v* испускать, излучать

employ [ɪmˈplɔɪ] *v* использовать, применять

empty [ˈem(p)tɪ] *a* пустой

enable [ɪˈneɪbl] *v* давать возможность; делать возможным

encounter [ɪnˈkauntə] *v* встречать; сталкиваться

encourage [ɪn'kʌrɪdʒ] *v* поощрять, поддерживать
energy-consuming ['enədʒɪkən'sju:mɪŋ] *a* энергоемкий
engineer [,en(d)ʒɪ'nɪə] *n* инженер
engineering [,en(d)ʒɪ'nɪərɪŋ] *n* техника, машиностроение
enhance [ɪn'hɑ:ns] *v* увеличиваться, возрастать
enjoy [ɪn'dʒɔɪ] *v* наслаждаться; пользоваться
ensure [ɪn'ʃuə] *v* обеспечивать, гарантировать
enter ['entə] *v* входить; вводить; поступать, вступать
enterprise ['entəpraɪz] *n* предприятие
entertainment [,entə'teɪnmənt] *n* развлечение
enthusiast [ɪn'θju:zɪæst] *n* энтузиаст
entirely [ɪn'taɪəlɪ] *adv* полностью, целиком
entrant ['entrənt] *n* абитуриент
entrepreneur [,ɔntrəprə'nə:] *n* предприниматель
envelope ['envɪloup] *n* конверт
environment [ɪn'vaɪər(ə)nmənt] *n* окружающая среда
envisage [ɪn'vɪzədʒ] *v* предусматривать; предвидеть
equation [ɪ'kweɪʃ(ə)n] *n* уравнение
equipped [ɪ'kwɪpt] *a* оборудованный
equipment [ɪ'kwɪpmənt] *n* оборудование
test equipment пробное (анализирующее) устройство, анализатор
equivalent [ɪ'kwɪvələnt] *n* эквивалент *a* эквивалентный, равноценный
era ['ɪərə] *n* эра, эпоха
erase [ɪ'reɪz] *v* стирать
erratic [ɪ'rætɪk] *a* беспорядочный; неустойчивый; неравномерный
error ['erə] *n* ошибка
esoteric [,eso(u)'terɪk] *a* понятный лишь посвященным
essence ['esns] *n* суть, сущность
essential [ɪ'senʃ(ə)l] *a* важный, необходимый, существенный, основной
essentially [ɪ'senʃ(ə)lɪ] *adv* в сущности, по существу
establish [ɪs'tæblɪʃ] *v* устанавливать
estimate ['estɪmeɪt] *v* оценивать
etch [etʃ] *v* гравировать, травить
evaluate [ɪ'væljueɪt] *v* оценивать, определять
evaporate [ɪ'væpəreɪt] *v* выпаривать, испарять(ся)
eventually [ɪ'ventjuəlɪ] *adv* в конце концов, в конечном счете
exactly [ɪg'zæktlɪ] *adv* точно
examination [ɪg,zæmɪ'neɪʃ(ə)n] *n* исследование, изучение
except [ɪk'sept] *adv* за исключением, кроме
excessive [ɪk'sesɪv] *a* излишний
exchange [ɪks'tʃeɪn(d)ʒ] *n*: **telephone exchange** коммутатор, телефонная подстанция
excitement [ɪk'saɪtmənt] *n* возбуждение, волнение
exciting [ɪk'saɪtɪŋ] *a* возбуждающий, захватывающий
execution [,eksɪ'kju:ʃ(ə)n] *n* исполнение
executive [ɪg'zekjutɪv] *n* руководитель, администратор
exhaust [ɪg'zɔ:st] *n* выхлоп; выхлопные газы
exist [ɪg'zɪst] *v* существовать
exotic [ɪg'zɔtɪk] *a* редкий, экзотический
expand [ɪks'pænd] *v* расширять, наращивать
expansion [ɪks'pænʃən] *n* расширение
expect [ɪks'pekt] *v* ожидать
expensive [ɪks'pensɪv] *a* дорогостоящий, дорогой
experience [ɪks'pɪərɪəns] *n* опыт
experienced [ɪks'pɪərɪənst] *a* квалифицированный, опытный
expert ['ekspə:t] *n* специалист
exploration [,eksplɔ:'reɪʃ(ə)n] *n* исследование
explosive [ɪks'plousɪv] *a* взрывной
expose [ɪks'pouz] *v* выставлять, подвергать действию света
express [ɪks'pres] *v* выражать
extend [ɪks'tend] *v* расширять, увеличивать, распространять

extension [ɪks'tenʃ(ə)n] *n* продолжение, распространение

extensive [ɪks'tensɪv] *a* обширный

external [ɪks'tə:nl] *a* внешний

extraction [ɪks'trækʃ(ə)n] *n* извлечение

extreme [ɪks'tri:m] *n* крайность

extremely [ɪks'tri:mlɪ] *adv* чрезвычайно, весьма

eye [aɪ] *n* ушко *(иголки)*

F

fabrication [ˌfæbrɪ'keɪʃ(ə)n] *n* изготовление

facilitate [fə'sɪlɪteɪt] *v* облегчать

facility [fə'sɪlɪtɪ] *n pl* средства, оборудование

fact [fækt] *n* факт

in fact действительно

factory ['fækt(ə)rɪ] *n* фабрика, завод

fail [feɪl] *v* выходить из строя; не удаваться

failure-free ['feɪljə'fri:] *a* надежный, не выходящий из строя

fairy-tale ['fɛərɪ'teɪl] *n* (волшебная) сказка

familiar [fə'mɪljə] *a* знакомый, обычный, привычный

fan [fæn] *n* вентилятор

fare [fɛə] *n* плата за проезд

fashion ['fæʃ(ə)n] *v* придавать форму, выделывать

fast [fɑ:st] *a* быстрый

fatigue [fə'ti:g] *n* утомление, усталость

faulty ['fɔ:ltɪ] *a* неисправный, дефектный

favour ['feɪvə] *v* отдавать предпочтение

feasible ['fi:zəbl] *a* возможный, реальный, выполнимый

feature ['fi:tʃə] *n* особенность, характерная черта

feed [fi:d] *v* подавать; снабжать, обеспечивать; задавать; питать; подводить, вводить

feedback ['fi:dbæk] *n* обратная связь

female ['fi:meɪl] *a* женский

field [fi:ld] *n* поле данных, область

figure ['fɪgə] **(out)** *v* подсчитывать, вычислять

file [faɪl] *n* файл, массив данных

v закладывать данные в память машины

film [fɪlm] *n* пленка, кинофильм

finally ['faɪnəlɪ] *adv* в конечном счете

finance [faɪ'næns] *v* финансировать

finger-tip ['fɪŋgətɪp] *n* кончик пальца

fit [fɪt] *v* снабжать

fit out оборудовать

fix [fɪks] *v* устанавливать; фиксировать, укреплять

flash [flæʃ] *v* сверкать; вспыхивать

flaw [flɔ:] *n* изъян, недостаток, дефект

flexibility [ˌfleksɪ'bɪlɪtɪ] *n* гибкость

flood [flʌd] *v* наводнять

flow [flou] *n* поток

v течь, литься

folder ['fouldə] *n* папка, скоросшиватель

follow ['fɔlou] *v* следовать; руководствоваться

as follows как указано ниже

footstep ['futstep] *n* шаг

foreigner ['fɔrɪnə] *n* иностранец

forgery ['fɔ:dʒərɪ] *n* подлог, подделка *(документов)*

forgetful [fə'getf(u)l] *a* забывчивый

forging ['fɔ:dʒɪŋ] *n* ковка

form [fɔ:m] *n* бланк

formulation [ˌfɔ:mju'leɪʃ(ə)n] *n* формулировка

framework ['freɪmwə:k] *n* каркас; рамка, пределы

free [fri:] *v* освобождать, выпускать (на свободу)

French [frentʃ] *n* французский язык

frequency ['fri:kwənsɪ] *n* частота, частотность

frequent ['fri:kwənt] *a* частый

fresh [freʃ] *a* свежий; новый

fruit [fru:t] *n pl* результаты *(труда)*

frustrate [frʌ'streɪt] *v* расстраивать, нарушать, сводить на нет, делать тщетным

fuel [fjuəl] *n* топливо

fugitive ['fju:dʒɪtɪv] *n* беглец

full-stroke ['ful'strouk] *n* полный ход (шаг)

fume [fju:m] *n* дым; испарения

fun [fʌn] *n* шутка, веселье, забава

function ['fʌŋ(k)ʃ(ə)n] *n* функция
v функционировать

fundamental [,fʌndə'mentl] *a* основной, существенный

funds [fʌndz] *n pl* фонды, деньги, средства

funeral ['fju:n(ə)r(ə)l] *n* похороны

funny ['fʌnɪ] *a* забавный, смешной; странный

furnace ['fə:nɪs] *n* печь

furnish ['fə:nɪʃ] *v* снабжать, предоставлять, доставлять; укомплектовывать; обставлять

further ['fə:ðə] *a* дальнейший

furthermore ['fə:ðəmɔ:] *adv* более того

G

gain [geɪn] *n* выход, выдача
v приобретать

game [geɪm] *n* игра

gear [gɪə] *n* механизм, приспособление
v приводить в движение; снабжать приводом

generate ['dʒenəreɪt] *v* порождать

generation [,dʒenə'reɪʃ(ə)n] *n* поколение

generous ['dʒen(ə)rəs] *a* щедрый

gentle ['dʒentl] *a* пологий

German ['dʒə:mən] *n* немецкий язык

germanium [dʒə:'meɪnɪəm] *n хим.* германий

gleaming ['gli:mɪŋ] *a* блестящий, сверкающий

glaring ['glɛərɪŋ] *a* яркий, ослепительный; бросающийся в глаза, грубый, вопиющий

glisten ['glɪsn] *v* блестеть, сверкать

glow [glou] *v* светиться, сверкать, блистать

govern ['gʌv(ə)n] *v* управлять

government ['gʌvnmənt] *n* правительство

grab [græb] *v* хватать

graduate ['grædjueɪt] **(from)** *v* заканчивать *(вуз)*; выпускать *(специалистов)*

granulate ['grænjuleɪt] *v* гранулировать

grating ['greɪtɪŋ] *n* решетка

groove [gru:v] *n* канавка

guess [ges] *v* угадывать

guidance ['gaɪd(ə)ns] *n* руководство; *тех.* управление

guide [gaɪd] *n* справочник, руководство
v вести, руководить

guilty ['gɪltɪ] *a* виновный

gut [gʌt] *v* потрошить

H

habitation [,hæbɪ'teɪʃ(ə)n] *n* жилище; селение

hairline ['hɛəlaɪn] *n* тонкая, волосная линия

half-size ['hɑ:f'saɪz] *a* половинного размера

handful ['hæn(d)ful] *n* кучка, группа

handle ['hændl] *v* обращаться; управлять, оперировать, манипулировать; обрабатывать
data handling обработка данных

handy ['hændɪ] *a* легко доступный, под рукой

hard [hɑ:d] *a* трудный, тяжелый

hardcopy ['hɑ:d'kɔpɪ] *n* печатная копия

hardly ['hɑ:dlɪ] *adv* едва

hardware ['hɑ:dwɛə] *n* аппаратура, аппаратные средства

hare [hɛə] *n* заяц

hastily ['heɪstɪlɪ] *adv* поспешно, в спешке

hate [heɪt] *v* ненавидеть

hazard ['hæzəd] *n* риск, опасность; шанс

heading ['hedɪŋ] *n* заголовок, заглавие, рубрика

head-phones ['hedfounz] *n pl* наушники, головной телефон

health [helθ] *n* здоровье

heart [hɑ:t] *n* сердце

heat [hi:t] *n* тепло

hence [hens] *adv, cj* следовательно; отсюда

hero ['hıərou] *n* герой

Hero of Socialist Labour Герой Социалистического труда

highlight ['haılaıt] *v* ярко освещать

high-performance ['haıpə'fɔ:məns] *a* высококачественный, высокоэффективный

high-tech ['haı'tek] = **high technology**

hint [hınt] *v* намекать; давать общее представление

hit [hıt] **(hit, hit)** *v* ударять *(по клавишам)*

hit upon наткнуться на

hold [hould] **(held, held)** *v:* **hold out** протягивать

holder ['houldə] *n* владелец, обладатель

hole [houl] *n* отверстие, дыра

hollow ['hɔlou] *a* пустой, полый

homogeneous [,hɔmə'dʒi:njəs] *a* однородный

honest ['ɔnıst] *a* честный, правдивый

hood [hud] *n* капот, кожух

hook [huk] *v* петлять, подцепить

hook-up ['hukʌp] *n* подсоединение, подключение

hop [hɔp] *n* прыжок, скачок

hospital ['hɔspıtl] *n* больница

however [hau'evə] *adv* однако

huddle ['hʌdl] *v* сбиваться в кучу

human ['hju:mən] *a* человеческий

hurry ['hʌrı] *n* спешка, торопливость, поспешность

hurt [hə:t] **(hurt, hurt)** *v* повредить, причинить вред, ущерб, ранить

hydroscheme ['haıdro(u)ski:m] *n* гидросистема

hysteresis [,hıstə'ri:sıs] *n* время запаздывания

I

idea [aı'dıə] *n* мысль, идея

identify [aı'dentıfaı] *v* отождествлять, опознавать, определять

ignore [ıg'nɔ:] *v* пренебрегать, игнорировать

image ['ımıdʒ] *n* изображение; образ

imaginable [ı'mædʒ(ı)nəbl] *a* вообразимый, мыслимый

imagination [ı,mædʒı'neıʃ(ə)n] *n* воображение

imagine [ı'mædʒın] *v* воображать, представлять себе

imitation [,ımı'teıʃ(ə)n] *n* имитация, подделка

immediate [ı'mi:djət] *a* немедленный; непосредственный

impact ['ımpækt] *n* влияние, воздействие

imperative [ım'perətıv] *a* настоятельный, необходимый

implement ['ımplıment] *v* выполнять, осуществлять

imply [ım'plaı] *v* подразумевать, предполагать

impose [ım'pouz] *v* накладывать

impression [ım'preʃ(ə)n] *n* впечатление; оттиск, отпечаток

improve [ım'pru:v] *v* улучшать(ся)

impurity [ım'pjuərıtı] *n* примесь

inadvertently [,ınəd'və:t(ə)ntlı] *adv* небрежно; ненамеренно

inch [ıntʃ] *n* дюйм

inclined [ın'klaınd] *a* наклонный; предрасположенный, склонный *(к чему-л.)*

include [ın'klu:d] *v* содержать, включать в себя

inclusion [ın'klu:ʒən] *n* включение

incorporate [ın'kɔ:pəreıt] *v* включать, содержать; объединять, заключать в себе

increase [ın'kri:s] *v* увеличиваться, возрастать

independent [,ındı'pendənt] *a* независимый

index ['ındeks] *n* алфавитный список, каталог; индекс; показатель

indication [,ındı'keıʃ(ə)n] *n* указание, индикация

indispensable [,ındıs'pensıbl] *a* незаменимый

individual [ˌɪndɪ'vɪdjuəl] *n* личность, человек

industrialist [ɪn'dʌstrɪəlɪst] *n* промышленник

industry ['ɪndəstrɪ] *n* промышленность

influence ['ɪnfluəns] *n* влияние
v оказывать влияние

initial [ɪ'nɪʃ(ə)l] *a* начальный, исходный

initially [ɪ'nɪʃəlɪ] *adv* вначале, ранее, на первом этапе

injection [ɪn'dʒekʃən] *n тех.* вдувание, впрыскивание, нагнетание

innards ['ɪnədz] *n pl* внутренности

innocently ['ɪnəsntlɪ] *adv* невинно

input ['ɪnput] *n* ввод информации; вводимая информация
v вводить

inquire [ɪn'kwaɪə] *v* спрашивать; запрашивать

inscribe [ɪn'skraɪb] *v* записывать

insect ['ɪnsekt] *n* насекомое

insert [ɪn'sə:t] *v* вставлять, вкладывать

inside [ɪn'saɪd] *adv, prep* внутри, внутрь

inspection [ɪn'spekʃ(ə)n] *n* технический контроль

install [ɪn'stɔ:l] *v* устанавливать, помещать, размещать

installation [ˌɪnstə'leɪʃ(ə)n] *n* установка, оборудование

instance ['ɪnstəns] *n* пример
for instance например

instant ['ɪnstənt] *n* мгновение, момент
a немедленный, мгновенный

instead [ɪn'sted] *adv* вместо

instruct [ɪn'strʌkt] *v* учить; давать указания

instruction [ɪn'strʌkʃ(ə)n] *n* команда; *тех.* руководство

instrumentation [ˌɪnstrumen'teɪʃən] *n* контрольно-измерительные приборы

insulate ['ɪnsjuleɪt] *v* изолировать

insulator ['ɪnsjuleɪtə] *n* изолятор; изоляционный материал

intelligence [ɪn'telɪdʒ(ə)ns] *n* ум, интеллект

intend [ɪn'tend] **(for)** *v* предназначать

intensity [ɪn'tensɪtɪ] *n* интенсивность

intention [ɪn'tenʃ(ə)n] *n* намерение

interact [ˌɪntər'ækt] *v* взаимодействовать

interaction [ˌɪntər'ækʃ(ə)n] *n* взаимодействие

interactive [ˌɪntər'æktɪv] *a* диалоговый

interconnection [ˌɪntəkə'nekʃ(ə)n] *n* взаимосвязь

interface ['ɪntəfeɪs] *n* устройство связи (сопряжения)

intermediate [ˌɪntə'mi:djət] *a* промежуточный

internal [ɪn'tə:nl] *a* внутренний

interoffice ['ɪntər'ɔfɪs] *a* межучрежденческий

interpretation [ɪnˌtə:prɪ'teɪʃ(ə)n] *n* интерпретация; выполнение в режиме интерпретации

interrelationship ['ɪntərɪ'leɪʃ(ə)nʃɪp] *n* взаимная связь; соотнесенность

interrogate [ɪn'terəgeɪt] *v* спрашивать; допрашивать

interrogation [ɪnˌterə'geɪʃ(ə)n] *n* опрос; допрос

interruption [ˌɪntə'rʌpʃ(ə)n] *n* прерывание

intervention [ˌɪntə'venʃ(ə)n] *n* вмешательство

intricate ['ɪntrɪkɪt] *a* сложный, замысловатый

introduce [ˌɪntrə'dju:s] *v* вводить *(в действие)*

introduction [ˌɪntrə'dʌkʃ(ə)n] *n* введение, ввод

invade [ɪn'veɪd] *v* завоевывать, заполнять

invent [ɪn'vent] *v* изобретать

invention [ɪn'venʃ(ə)n] *n* изобретение

inventiveness [ɪn'ventɪvnɪs] *n* изобретательность

inventor [ɪn'ventə] *n* изобретатель

invert [ɪn'və:t] *v* переворачивать, переставлять; менять

investigate [ɪn'vestɪgeɪt] *v* исследовать, изучать

invoice ['ɪnvɔɪs] *n* счет, фактура
involve [ɪn'vɔlv] *v* включать в себя; вызывать, повлечь за собой
irritation [,ɪrɪ'teɪʃ(ə)n] *n* раздражение
issue ['ɪsju:] *n* выпуск, издание; вопрос
v подавать *(команду)*
item ['aɪtem] *n* пункт; параграф; статья; единица информации; вопрос; отдельный предмет; сообщение
itemize ['aɪtemaɪz] *v* уточнять, детализировать

J

jacket ['dʒækɪt] *n* обложка; папка; чехол, кожух
jail [dʒeɪl] *n* тюрьма
Japan [dʒə'pæn] *pr n* Япония
jet [dʒet] *n разг.* реактивный самолет
job [dʒɔb] *n* работа, место службы
join [dʒɔɪn] *v* связывать, соединять
jointly ['dʒɔɪntlɪ] *adv* совместно
jolt [dʒoult] *n* удар, толчок
judgement ['dʒʌdʒmənt] *n* оценка, мнение
jump [dʒʌmp] *n* прыжок
junior ['dʒu:njə] *a* младший
just [dʒʌst] *adv* всего лишь, как раз, только

K

key [ki:] *n* ключ; клавиша
keyboard ['ki:bɔ:d] *n* клавиатура
keypad ['ki:pæd] *n* клавиатура *(компьютера)*
kick [kɪk] *v* пинать
kind [kaɪnd] *n:* **a kind of** нечто вроде, наподобие
knapsack ['næpsæk] *n* рюкзак
knob [nɔb] *n тех.* ручка, головка, кнопка
know-how ['nou'hau] *n* умение, знание дела; секрет производства
knowledge ['nɔlɪdʒ] *n* знание

L

label ['leɪbl] *n* ярлык, бирка, табличка
v назвать
labour ['leɪbə] *n* работа, труд
labyrinthine [,læbə'rɪnθaɪn] *a книжн.* запутанный
laminate ['læmɪneɪt] *v* расслаивать(ся)
landing ['lændɪŋ] *n* посадочная площадка
largely ['lɑ:dʒlɪ] *adv* в большой мере
large-scale ['lɑ:dʒ'skeɪl] *a* крупномасштабный, большой
last [lɑ:st] *v* длиться, продолжаться; соединяться; выдерживать
latch [lætʃ] *n* схема-защелка, фиксатор
v запирать, защелкивать
latter ['lætə] *a* последний *(из двух упомянутых)*
law [lɔ:] *n* закон
lawsuit ['lɔ:sju:t] *n* судебный процесс
layer ['le(ɪ)ə] *n* слой
layout ['leɪ'aut] *n* размещение, компоновка, схема, план, макет, чертеж
leading ['li:dɪŋ] *a* ведущий
lean [li:n] **(leant, leant) (on)** *v* опираться (на)
learner ['lə:nə] *n* учащийся
leave [li:v] **(left, left)** *v* оставлять, покидать
legal ['li:g(ə)l] *a* судебный, правовой
lens [lenz] *n* линза, лупа
level ['levl] *n* уровень
liar ['laɪə] *n* лгун, лжец
lifeboat ['laɪfbout] *n* спасательная лодка
lift [lɪft] *v* поднимать
light [laɪt] *n* свет
likewise ['laɪkwaɪz] *adv* так же, таким же образом
limitation [,lɪmɪ'teɪʃ(ə)n] *n* ограничение
limiting ['lɪmɪtɪŋ] *a* лимитирующий, ограничивающий
limits ['lɪmɪts] *n pl* рамки
line [laɪn] *n* линия; строка; очередь
link [lɪŋk] *v* подсоединять, подключать
list [lɪst] *n* список, перечень
v перечислять, регистрировать; заносить в список
literally ['lɪt(ə)rəlɪ] *adv* буквально

load [loud] *n* груз, тяжесть, нагрузка
working load рабочая нагрузка
v вводить, загружать, заряжать
locate [lo(u)'keit] *v* устанавливать местонахождение
location [lo(u)'keiʃ(ə)n] *n* место, местонахождение
lock [lɔk] *n* запор, замок
loss [lɔs] *n* потеря
loudspeaker ['laud'spi:kə] *n* динамик, громкоговоритель
low-cost ['lou'kɔst] *a* недорогой
low-power ['lou'pauə] *a* потребляющий мало энергии

M

magnifier ['mægnifaiə] *n* усилитель
magnifying ['mægnifaiŋ] *a* увеличительный
magnitude ['mægnitju:d] *n* величина; абсолютное значение
maintain [men'tein] *v* обслуживать, содержать в исправности
maintenance ['meint(i)nəns] *n* обслуживание
corrective maintenance профилактический ремонт
major ['meidʒə] *a* главный
majority [mə'dʒɔriti] *n* большинство
maker ['meikə] *n* изготовитель
male [meil] *a* мужской
manage ['mænidʒ] *v* справляться; суметь
manager ['mænidʒə] *n* руководитель, управляющий
manipulate [mə'nipjuleit] *v* манипулировать
manipulation [mə,nipju'leiʃ(ə)n] *n* обращение, манипуляция; *зд.* счисление
manner ['mænə] *n* метод, способ
manpower ['mæn,pauə] *n* рабочая сила
manual ['mænjuəl] *n* руководство, инструкция
manufacture [,mænju'fæktʃə] *v* изготовлять, производить
march [ma:tʃ] *v* маршировать; вести строем
market ['ma:kit] *n* рынок (сбыта); сбыт, продажа
stock market биржа
v продавать, сбывать
match [mætʃ] *v* соответствовать
material [mə'tiəriəl] *n* материал
background material исходный материал
matrix ['meitriks] *a* матричный
maze [meiz] *n* лабиринт
mean [mi:n] **(meant, meant)** *v* означать; предназначать; хотеть сказать, иметь в виду
meaning ['mi:niŋ] *n* значение
means [mi:nz] *n pl* средство
meantime ['mi:n(ə)taim] *n*: **in the meantime** тем временем
measure ['meʒə] *v* измерять; иметь размеры
measurement ['meʒəmənt] *n* измерение
media ['mi:djə] *n pl* средства (массовой информации)
storage media носитель информации
medicine ['meds(i)n] *n* лекарство
medley ['medli] *n* смесь
melt [melt] *n* расплав
memo ['memou] *n* памятная записка
memorize ['meməraiz] *v* запоминать
memory ['meməri] *n* память; запоминающее устройство
from memory по памяти
mental ['mentl] *a* умственный; производимый в уме
merge [mə:dʒ] *v* сливаться, соединяться
message ['mesidʒ] *n* сообщение; поручение
metal ['metl] *n* металл
meter ['mi:tə] *n* измерительный прибор
method ['meθəd] *n* метод, способ
middle ['midl] *n* середина
military ['milit(ə)ri] *a* военный
mine [main] *v* производить горные выработки
miniature ['minjətʃə] *a* малых размеров, миниатюрный
miniaturization [,minjətʃəri'zeiʃ(ə)n] *n*

уменьшение размеров, миниатюризация

miniaturize ['mınjətʃəraız] *v* уменьшать размеры

minuscule [mı'nʌskju:l] *a* крохотный

mislead [mıs'li:d] **(misled, misled)** *v* вводить в заблуждение

misplace ['mıs'pleıs] *v* положить, поставить не на место

miss [mıs] *v* обнаружить отсутствие, пропажу

misuse ['mıs'ju:z] *n* неправильное употребление

mix [mıks] *v* смешивать

mode [moud] *n* режим; метод

modification [,mɔdıfı'keıʃ(ə)n] *n* (видо)изменение

modify ['mɔdıfaı] *v* (видо)изменять

modular ['mɔdjulə] *a* модульный

moisture ['mɔıstʃə] *n* влага

moment ['moumənt] *n* момент

for the moment в настоящее время

monitor ['mɔnıtə] *n* устройство визуального отображения, монитор

v обследовать, следить, контролировать

monitoring ['mɔnıtərıŋ] *n* текущий контроль

monolithic [,mɔno(u)'lıθık] *a* монолитный

motherless ['mʌðəlıs] *n* лишенный матери

motion ['mouʃ(ə)n] *n* движение

motionless ['mouʃ(ə)nlıs] *a* неподвижный

motivate ['moutıveıt] *v* побуждать, мотивировать

moulding ['mouldıŋ] *n* формовка, отливка

injection moulding литье под давлением

move [mu:v] *v* двигать, перемещать

movement ['mu:vmənt] *n* движение, перемещение

multiple ['mʌltıpl] *a* составной, сложный; множественный

multiply ['mʌltıplaı] *v* умножать

multitude ['mʌltıtju:d] *n* множество

muscle ['mʌsl] *n* мускул, мышца

mute [mju:t] *a* немой, безмолвный

mutter ['mʌtə] *v* бормотать

mystery ['mıst(ə)rı] *n* тайна, загадка

N

name [neım] *v* называть

narrow ['nærou] *a* узкий

natural ['nætʃr(ə)l] *a* естественный

nearly ['nıəlı] *adv* почти

necessary ['nesıs(ə)rı] *a* необходимый

need [ni:d] *v* нуждаться, иметь потребность *(в чем-л.)*

needle ['ni:dl] *n* иголка

negative ['negətıv] *a* отрицательный; отрицательно заряженный

neighbouring ['neıb(ə)rıŋ] *a* соседний

nod [nɔd] *v* кивать

non-programmer ['nɔn'prougræmə] *n* пользователь ЭВМ *(не программист)*

nostril ['nɔstrıl] *n* ноздря

notation [no(u)'teıʃ(ə)n] *n* обозначение

note [nout] *v* замечать

noteworthy ['nout,wə:ðı] *a* заслуживающий внимания

noticeable ['noutısəbl] *a* заметный; примечательный

notify ['noutıfaı] *v* давать сведения; отмечать; регистрировать

novel ['nɔv(ə)l] *n* роман

a новый

novelty ['nɔv(ə)ltı] *n* новшество

nowadays ['nauədeız] *adv* ныне, в настоящее время

nowhere ['nouwɛə] *adv* нигде; никуда

noxious ['nɔkʃəs] *a* вредный, нездоровый

number ['nʌmbə] *n*: **a large number** множество

numeric [nju(:)'merık] *a* цифровой

numerous ['nju:m(ə)rəs] *a* многочисленный

nurse [nə:s] *n* медицинская сестра

O

obey [ə'beı] *v* выполнять, исполнять, повиноваться

object ['ɔbdʒıkt] *n* вещь, предмет

oblong ['ɔblɔŋ] *a* продолговатый

observation [,ɔbzə(:)'veɪʃ(ə)n] *n* наблюдение

obtain [əb'teɪn] *v* получать, достигать, добиваться

obvious ['ɔbvɪəs] *a* очевидный

occur [ə'kə:] *v* случаться, происходить; приходить в голову

odour ['oudə] *n* запах, аромат

offer ['ɔfə] *n* предложение
v предлагать

office ['ɔfɪs] *n* учреждение

official [ə'fɪʃ(ə)l] *n* чиновник, служащий, должностное лицо

on-board ['ɔn,bɔ:d] *a* бортовой

ongoing ['ɔn,go(u)ɪŋ] *a* наступающий

only ['ounlɪ] *a* единственный

operate ['ɔpəreɪt] *v* действовать, работать; управлять

operation [,ɔpə'reɪʃ(ə)n] *n* операция, действие

operator ['ɔpəreɪtə] *n* оператор

opinion [ə'pɪnjən] *n* мнение

opportunity [,ɔpə'tju:nɪtɪ] *n* возможность

optimise ['ɔptɪmaɪz] *v* оптимизировать, выбирать наиболее выгодное решение

optimum ['ɔptɪməm] *a* оптимальный

optional ['ɔpʃənl] *a* дополнительный, предлагаемый на выбор

oral ['ɔ:r(ə)l] *a* устный

ordinary ['ɔ:dɪnrɪ] *a* обычный, непримечательный

ore [ɔ:] *n* руда

organization [,ɔ:gən(a)ɪ'zeɪʃ(ə)n] *n* организация

orientation [,ɔ:rɪen'teɪʃ(ə)n] *n* ориентация

original [ə'rɪdʒɪnl] *a* исходный; первоначальный

orthographic [,ɔ:θə'græfɪk] *a* орфографический

otherwise ['ʌðəwaɪz] *adv* иначе, в противном случае

ounce [auns] *n* унция

outdoor ['autdɔ:] *a* находящийся на открытом воздухе

outer ['autə] *a* внешний

outlying ['aut,laɪɪŋ] *a* отдаленный; наружный

output ['autput] *n* выход, выходные данные; вывод данных; результат, выводное устройство
v выводить

outrace ['autreɪs] *v* перегонять в беге

overflow ['ouvəflou] *n* переполнение
v переполнять; быть в избытке

overlook [,ouvə'luk] *v* не заметить, проглядеть

overrun [,ouvə'rʌn] **(overran, overrun)** *v* переливаться через край

oversize ['ouvəsaɪz] *n* завышение размера, допуска
v превосходить по размерам

overview ['ouvəvju:] *n* общее представление, беглый обзор

owe [ou] *v* быть обязанным

own [oun] *a* собственный

owner ['ounə] *n* владелец

oxidation [,ɔksɪ'deɪʃ(ə)n] *n* окисление

oxide ['ɔksaɪd] *n* окисел

P

pace [peɪs] *n* темп, скорость

pack [pæk] *v* паковать

package ['pækɪdʒ] *n* упаковка
v амер. упаковывать, размещать

pad [pæd] *n* контактная площадка, клавишная панель

paint [peɪnt] *n* краска

painting ['peɪntɪŋ] *n* живопись; картина

pair [pɛə] *n* пара

parity ['pærɪtɪ] *n* равенство

parlance ['pɑ:ləns] *n* язык, жаргон

part [pɑ:t] *n* деталь; часть

particle ['pɑ:tɪkl] *n* частица

particular [pə'tɪkjulə] *a* отдельный, конкретный, частный
in particular в частности

pass [pɑ:s] *v* проходить, следовать

past [pɑ:st] *n* прошлое

patching ['pætʃɪŋ] *n* мелкий ремонт

patent ['peɪt(ə)nt] *n* патент

path [pɑ:θ] *n* путь
patient ['peɪʃ(ə)nt] *n* больной, пациент
pattern ['pæt(ə)n] *n* рисунок, узор; образец, трафарет; структура
pendulum ['pendjuləm] *n* маятник
penetration [,penɪ'treɪʃ(ə)n] *n* проникновение
per [pə:] *prep указывает на количество, приходящееся на определенную единицу,* в, на, с, за
perfectly ['pə:fɪktlɪ] *adv* совершенно, вполне
perform [pə'fɔ:m] *v* делать, выполнять, исполнять
performance [pə'fɔ:məns] *n* выполнение; характеристика работы, производительность, интенсивность
perhaps [pə'hæps] *adv* возможно, может быть
peripheral [pə'rɪfərl] *a* внешний
permanent ['pə:mənənt] *a* постоянный
permit [pə'mɪt] *v* разрешать, позволять
person ['pə:sn] *n* человек, индивидуум
personage ['pə:snɪdʒ] *n* важная персона; персонаж
pertinent ['pə:tɪnənt] *a* уместный, подходящий, относящийся к делу
petrol ['petr(ə)l] *n* бензин
philosophy [fɪ'lɔsəfɪ] *n зд.* основные законы или положения *(проектирования или построения системы)*
phonetic [fo(u)'netɪk] *a* фонетический
photocopier ['fouto(u)'koupjə] *n* ксерограф, светокопировальное устройство
photoengrave ['fouto(u)en'greɪv] *v* фототипировать
photo-etching ['fouto(u)'etʃɪŋ] *n* фототравление
photographically [,fouto(u)'græfɪk(ə)lɪ] *adv* фотоспособом
photo-multiplier ['fouto(u)'mʌltɪplaɪə] *n* фотоумножитель
photosensitive ['fouto(u)'sensɪtɪv] *a* светочувствительный
phrase [freɪz] *n* фраза, выражение, оборот
physical ['fɪzɪk(ə)l] *a* физический
physics ['fɪzɪks] *n* физика
pick-up ['pɪkʌp] *n тех.* захватывающее устройство
pictorial [pɪk'tɔ:rɪəl] *a* изобразительный
piece [pi:s] *n* кусок, штука
pioneer [,paɪə'nɪə] *v* быть пионером, первооткрывателем
pixel ['pɪksəl] *n* элемент изображения
place [pleɪs] *v* помещать
plaintiff ['pleɪntɪf] *n* истец
planar ['pleɪnə] *a мат.* плоскостной
plastic ['plæstɪk] *a* пластичный, пластмассовый
play [pleɪ] *v:* **play back** воспроизводить, проигрывать
plotter ['plɔtə] *n* графическое регистрирующее устройство, графопостроитель
pluck [plʌk] *v* срывать
plug-in ['plʌg'ɪn] *a* сменный, съемный
plumbing ['plʌmɪŋ] *n* водопроводная система, водопровод; слесарно-водопроводное дело
pocket ['pɔkɪt] *n* карман
point [pɔɪnt] *v:* **point out** указывать
pointer ['pɔɪntə] *n* указатель
policy ['pɔlɪsɪ] *n* политика
politely [pə'laɪtlɪ] *adv* вежливо
polymer ['pɔlɪmə] *n* полимер
popular ['pɔpjulə] *a* широко распространенный; народный, массовый; ходовой
port [pɔ:t] *n* устройство ввода-вывода, порт
portable ['pɔ:təbl] *a* переносной, портативный
position [pə'zɪʃ(ə)n] *n* положение
positive ['pɔzɪtɪv] *a* положительный; положительно заряженный
possess [pə'zes] *v* обладать
possibility [,pɔsə'bɪlɪtɪ] *n* возможность
possible ['pɔsəbl] *a* возможный
potential [pə'tenʃ(ə)l] *n* потенциал *a* потенциальный
power ['pauə] *n* энергия; мощность; степень
powerful ['pauəful] *a* сильный, могучий, мощный

precede [pri(:)'si:d] *v* предшествовать
precise [prɪ'saɪs] *a* точный, определенный
precision [prɪ'sɪʒ(ə)n] *n* точность
predetermined ['pri:dɪ'tə:mɪnd] *a* предопределенный
preliminary [prɪ'lɪm(ɪ)nərɪ] *a* предварительный
pre-planning [(')pri:'plænɪŋ] *n* предварительное планирование
pre-prepare [(')pri:prɪ'pɛə] *v* готовить заранее
preschool ['pri:'sku:l] *a* дошкольный
presence ['prezns] *n* присутствие
present ['preznt] *a* имеющийся налицо
preservation [,prezə'veɪʃ(ə)n] *n* сохранение
pre-set ['pri:'set] *v* заранее задавать, устанавливать
pressure ['preʃə] *n* давление; настоятельная необходимость; трудное положение
  arterial pressure артериальное давление
pretend [prɪ'tend] *v* притворяться
prevent [prɪ'vent] *v* предотвращать, не давать
previous ['pri:vjəs] *a* предыдущий
previously ['pri:vjəslɪ] *adv* предварительно, заранее
price [praɪs] *n* цена
primary ['praɪmərɪ] *a* (перво)начальный, исходный, элементарный, основной, первичный
principal ['prɪnsəp(ə)l] *a* главный, основной
printer ['prɪntə] *n* печатающее устройство, принтер
printout ['prɪnt'aut] *n* распечатка выходных данных
prior ['praɪə] *prep:* **prior to** до, перед
private ['praɪvɪt] *a* частный
probe [proub] *v* проводить испытание; зондировать
procedure [prə'si:dʒə] *n* процедура
process ['prouses] *n* процесс
processor [prə'sesə] *n* процессор
produce [prə'dju:s] *v* производить
product ['prɔdəkt] *n* изделие, продукт
production [prə'dʌkʃ(ə)n] *n* производство
productivity [,prɔdʌk'tɪvɪtɪ] *n* производительность
programmable ['prougræməbl] *a* программируемый
programming ['prougræmɪŋ] *a* программирование
progress ['prougres] *n* прогресс, успехи; продвижение вперед
prohibit [prə'hɪbɪt] *v* запрещать
project ['prɔdʒekt] *n* проект, заказ
promote [prə'mout] *v* продвигать; способствовать
prompt [prɔm(p)t] *v* подсказывать
promptly ['prɔm(p)tlɪ] *adv* немедленно, быстро
pronounce [prə'nauns] *v* произносить
proof [pru:f] *n* доказательство
propagate ['prɔpəgeɪt] *v* распространяться, проходить *(о сигнале)*
proper ['prɔpə] *a* правильный, надлежащий
properly ['prɔpəlɪ] *adv* как полагается, должным образом
property ['prɔpətɪ] *n* свойство
proportional [prə'pɔ:ʃənl] *a* пропорциональный
proposal [prə'pouz(ə)l] *n* предложение
proposition [,prɔpə'zɪʃ(ə)n] *n* предложение; *лог.* суждение
prospective [prəs'pektɪv] *a* предполагаемый, ожидаемый
protect [prə'tekt] *v* предохранять, защищать
protective [prə'tektɪv] *a* защитный
prototype ['proutətaɪp] *n* прототип
provide [prə'vaɪd] *v* обеспечивать; снабжать
provision [prə'vɪʒ(ə)n] *n* обеспечение
proximity [prɔk'sɪmɪtɪ] *n* соседство, близость
psychological [,saɪkə'lɔdʒɪk(ə)l] *a* психологический
psychologist [saɪ'kɔlədʒɪst] *n* психолог
public ['pʌblɪk] *a* общественный
publish ['pʌblɪʃ] *v* публиковать

pulse [pʌls] *n* импульс
punch [pʌntʃ] *v* перфорировать
punctuate ['pʌŋ(k)tjueɪt] *v* расставлять знаки препинания
purchase ['pə:tʃəs] *n* покупка, приобретение, закупка
v приобретать, покупать
pure [pjuə] *a* чистый *(без примесей)*
purpose ['pə:pəs] *n* цель, намерение
push [puʃ] *v:* **push on** продвигаться вперед
push-button нажимная кнопка, клавиша
puzzle ['pʌzl] *n* загадка
v озадачивать

Q

quality ['kwɔlɪtɪ] *n* качество
quantity ['kwɔntɪtɪ] *n* количество; величина
quarter ['kwɔ:tə] *n* четверть; квартал
quicken ['kwɪk(ə)n] *v* ускорять(ся)

R

radio ['reɪdɪou] *n* радиоприемник
ramp [ræmp] *n* пандус
range [reɪndʒ] *v* колебаться в определенных пределах
rapid ['ræpɪd] *a* быстрый
rate [reɪt] *n* скорость, темп
rather ['rɑ:ðə] *adv* скорее, нежели
ratio ['reɪʃɪou] *n* (со)отношение
rattle ['rætl] *v* греметь, бренчать
reach [ri:tʃ] *v* достигать
react [ri(:)'ækt] *v* реагировать
readability [,ri:də'bɪlɪtɪ] *n зд.* удобство считывания *(с дисплея)*
reader ['ri:də] *n зд.* устройство считывания
reading ['ri:dɪŋ] *n зд.* показания, данные
readout ['ri:daut] *n* считывание данных
realization [,rɪəl(a)ɪ'zeɪʃ(ə)n] *n* осуществление, выполнение; понимание
realize ['rɪəlaɪz] *v* осуществлять; понять
reason ['ri:zn] *n* причина
reasonable ['ri:znəbl] *a* разумный; приемлемый
recall [rɪ'kɔ:l] *v* вызывать обратно; вспоминать
receive [rɪ'si:v] *v* получать; принимать; воспринимать
receiver [rɪ'si:və] *n* приемник
recent ['ri:snt] *a* недавний, современный
recognize ['rekəgnaɪz] *v* распознавать, различать, узнавать
reconciliation [,rekənsɪlɪ'eɪʃ(ə)n] *n* урегулирование, улаживание
record ['rekɔ:d] *n* запись; структурная единица информации
recorder [rɪ'kɔ:də] *n:* **chart recorder** диаграммный самописец
recording [rɪ'kɔ:dɪŋ] *n* запись
recover [rɪ'kʌvə] *v* получать обратно, возвращать себе; восстанавливать; возрождать; возмещать
rectifier ['rektɪfaɪə] *n* выпрямитель тока
redial ['ri:'daɪəl] *v* набирать повторно
reduce [rɪ'dju:s] *v* уменьшать, снижать
reel [ri:l] *n* катушка, бобина
v наматывать
refer [rɪ'fə:] *v* относиться, ссылаться; отсылать
reference ['refr(ə)ns] *n* ссылка, рекомендация, сноска, упоминание; эталон, опорный сигнал
regardless [rɪ'gɑ:dlɪs] *adv* безотносительно
region ['ri:dʒ(ə)n] *n* область, район, край
register ['redʒɪstə] *v* регистрировать
regular ['regjulə] *a* обычный, постоянный
reject [rɪ'dʒekt] *v* отказывать, отвергать
relate [rɪ'leɪt] *v* относиться, иметь отношение
related [rɪ'leɪtɪd] *a* связанный, родственный
relation [rɪ'leɪʃ(ə)n] *n* отношение
relatively ['relətɪvlɪ] *adv* сравнительно, относительно

relay [rɪ'leɪ] *n* реле
reliability [rɪ,laɪə'bɪlɪtɪ] *n* надежность
reliable [rɪ'laɪəbl] *a* надежный
relics ['relɪks] *n pl уст.* останки
rely [rɪ'laɪ] **(on, upon)** *v* полагаться (на)
remain [rɪ'meɪn] *v* оставаться
remarkable [rɪ'mɑːkəbl] *a* замечательный, выдающийся
remember [rɪ'membə] *v* помнить
remind [rɪ'maɪnd] **(of)** *v* напоминать (о)
removable [rɪ'muːvəbl] *a* съемный, отделяемый
rename [rɪ'neɪm] *v* переименовывать
reorder [riː'ɔːdə] *v* перепланировать, перестраивать
repair [rɪ'pɛə] *n* ремонт, починка
repairman [rɪ'pɛəmæn] *n* ремонтник
repetitive [rɪ'petɪtɪv] *a* повторяющийся
replace [rɪ'pleɪs] *v* замещать, заменять
report [rɪ'pɔːt] *n* сообщение, доклад; заметка
v докладывать
represent [,reprɪ'zent] *v* представлять; воспроизводить
representative [,reprɪ'zentətɪv] *n* представитель
reproduce [,riːprə'djuːs] *v* воспроизводить
republic [rɪ'pʌblɪk] *n* республика
request [rɪ'kwest] *v* запрашивать
require [rɪ'kwaɪə] *v* требовать
requirement [rɪ'kwaɪəmənt] *n* требование
resemble [rɪ'zembl] *v* походить, иметь сходство
reservation [,rezə'veɪʃ(ə)n] *n* оговорка
reserve [rɪ'zəːv] *v* резервировать, бронировать
reset [riː'set] *n* сброс, восстановление, возврат
resistor [rɪ'zɪstə] *n* резистор, катушка сопротивления
resolution [,rezə'ljuːʃ(ə)n] *n* разрешение (проблемы); разрешающая способность
resolve [rɪ'zɔlv] *n* решение
resource [rɪ'sɔːs] *n* средство, возможность; находчивость, изобретательность
respect [rɪs'pekt] *n* отношение, касательство
respectively [rɪs'pektɪvlɪ] *adv* соответственно
response [rɪs'pɔns] *n* реакция, ответ
responsive [rɪs'pɔnsɪv] *a* легко реагирующий
restrict [rɪs'trɪkt] *v* ограничивать
result [rɪ'zʌlt] **(in; from)** *v* происходить в результате, проистекать из; приводить к результату
retail [riː'teɪl] *n* розничная торговля
retrieval [rɪ'triːv(ə)l] *n* извлечение, поиск *(информации)*
retrieve [rɪ'triːv] *v* искать, извлекать *(информацию)*
return [rɪ'təːn] *v* возвращаться
revise [rɪ'vaɪz] *v* исправлять, пересматривать
ribbon ['rɪbɔn] *n* лента
right [raɪt] *adv* прямо, непосредственно
rigid ['rɪdʒɪd] *a* жесткий
rivalry ['raɪv(ə)lrɪ] *n* конкуренция, соперничество
roast [roust] *v* жарить
robotics [rou'bɔtɪks] *n* робототехника
romance [rə'mæns] *n* романтика
rotation [ro(u)'teɪʃ(ə)n] *n* вращение
rough [rʌf] *a* грубый, шершавый
round [raund] *v* скруглять
roundness ['raundnɪs] *n* сферичность
routine [ruː'tiːn] *n* установившаяся практика, шаблон, заведенный порядок
ruin ['ruːɪn] *v* разрушать
run [rʌn] **(ran, run)** *v* обслуживать, управлять, приводить в действие, пускать в ход
n работа, ход; цикл работы ЭВМ
rural ['ruər(ə)l] *a* сельский

S

safety ['seɪftɪ] *n* безопасность
sail [seɪl] *v* плыть

sale [seil] *n* продажа, сбыт
sample ['sɑːmpl] *n* образец
sampling ['sɑːmpliŋ] *n* взятие пробы (образца)
sandwich ['sænwidʒ] *n* бутерброд
satellite ['sætəlait] *n* искусственный спутник
satisfactory [,sætis'fækt(ə)ri] *a* удовлетворительный, достаточный
satisfy ['sætisfai] *v* удовлетворять, отвечать требованиям, соответствовать
save [seiv] *v* экономить
saving ['seiviŋ] *n* экономия, сбережение
energy saving энергоснабжение
scale [skeil] *v*: **scale down** сокращать
scales [skeilz] *n* весы
scan [skæn] *v* просматривать, искать, сканировать
scanner ['skænə] *n* сканирование; просмотровое устройство
scare [skɛə] *v* пугать, устрашать
schedule ['ʃedjuːl] *n* план, график
scholar ['skɔlə] *n* ученый
science ['saiəns] *n* наука
social sciences общественные науки
information science информатика
scientific [,saiən'tifik] *a* научный
scientist ['saiəntist] *n* ученый
scope [skoup] *n* область, сфера
scout [skaut] *n* разведчик
screen [skriːn] *n* экран
screening ['skriːniŋ] *n* экранирование
screwdriver ['skruː,draivə] *n* отвертка
scroll [skroul] *v* украшать завитками
seal [siːl] *v* запечатывать
search [səːtʃ] *v* искать
secondary ['sek(ə)nd(ə)ri] *a*: **secondary school** средняя школа
section ['sekʃ(ə)n] *n* секция, отдел
sectoring ['sektəriŋ] *n* разбивка на секторы
securely [si'kjuəli] *adv* надежно
seemingly ['siːmiŋli] *adv* с виду, на первый взгляд, казалось бы
select [si'lekt] *v* выбирать
selection [si'lekʃ(ə)n] *n* выбор, подбор
sell [sel] **(sold, sold)** *v* продавать
semantics [si'mæntiks] *n pl* семантика, смысл, значение
semiconductor ['semikən,dʌktə] *n* полупроводник
send [send] **(sent, sent)** *v* посылать
senseless ['senslis] *a* бессмысленный
separate ['sep(ə)rit] *a* отдельный
separation [,sepə'reiʃ(ə)n] *n* отделение
sequence ['siːkwəns] *n* последовательность
sequential [si'kwenʃ(ə)l] *a* последовательный
serial ['siəriəl] *a* серийный
serve [səːv] *v* служить
service ['səːvis] *n* служба; обслуживание
servomotor ['səːvə'moutə] *n* серводвигатель
servo ['səːvou] *n* сервомеханизм
set [set] *n* набор, комплект
television set телевизор
set-up ['set'ʌp] *n* устройство, схема, структура
set up устанавливать; образовывать; учреждать
settlement ['setlmənt] *n* решение
sex [seks] *n* пол
shade [ʃeid] *n* оттенок
shadow ['ʃædou] *n* тень
shaft [ʃɑːft] *n* ствол, вал, ось
shape [ʃeip] *n* очертание, форма
share [ʃɛə] *v* совместно участвовать, разделять
sharply ['ʃɑːpli] *adv* резко
shell [ʃel] *n* оболочка, футляр
shelve [ʃelv] *v* класть на полку
shift [ʃift] *n* рабочая смена
v сдвигать
shock [ʃɔk] *n* удар, потрясение
v потрясать
shot [ʃɔt] *n* снимок
shout [ʃaut] *v* кричать, восклицать
shrug [ʃrʌg] *v* пожимать плечами
sign [sain] *n* знак
significant [sig'nifikənt] *a* существенный
silent ['sailənt] *a* молчаливый
silicon ['silikən] *n* кремний

similar ['sɪmɪlə] *a* подобный, сходный, аналогичный
simple ['sɪmpl] *a* простой
simplicity [sɪm'plɪsɪtɪ] *n* простота
simplify ['sɪmplɪfaɪ] *v* упрощать
simultaneously [,sɪm(ə)l'teɪnjəslɪ] *adv* одновременно
since [sɪns] *prep, adv* с тех пор, с, от; поскольку, так как
single ['sɪŋgl] *a* единый
single-side ['sɪŋgl,saɪd] *a* односторонний
sink [sɪŋk] **(sank, sunk)** *v* опускаться, падать
sintering ['sɪntərɪŋ] *n* спекание
situation [,sɪtju'eɪʃ(ə)n] *n* положение, ситуация
emergency situation авария, ЧП
size [saɪz] *n* размер
skid [skɪd] *v* тормозить
skill [skɪl] *n* умение, навык
skylight ['skaɪlaɪt] *n* слуховое окно
sleek [sli:k] *a* гладкий
slice [slaɪs] *n* ломтик; пластинка *v* нарезать
slide-rule ['slaɪd,ru:l] *n* логарифмическая линейка
slight [slaɪt] *a* легкий, слабый
slightly ['slaɪtlɪ] *adv* слегка
slim [slɪm] *a* тонкий
slim-line ['slɪm,laɪn] *a* обтекаемый
sling [slɪŋ] **(slung, slung)** *v* кидать, бросать
slip [slɪp] *v:* **slip through** проскальзывать
slit [slɪt] *n* щель
slope [sloup] *v* иметь наклон
slot [slɔt] *n* гнездо, выемка
slow [slou] *v:* **slow down** замедлять
smooth [smu:ð] *a* гладкий; плавный
snap [snæp] *v* вставлять на место *(деталь)*
snatch [snætʃ] *v* похитить, украсть, стащить
sneak [sni:k] *v* проникать, забираться
socket ['sɔkɪt] *n* гнездо, панель
software ['sɔftwɛə] *n* программное обеспечение
soldering ['sɔld(ə)rɪŋ] *n* пайка
sole [soul] *a* одиночный
solely ['soullɪ] *adv* только
solid-state ['sɔlɪd'steɪt] *a* полупроводниковый
solution [sə'lju:ʃ(ə)n] *n* решение
solve [sɔlv] *v* решать; разрешать
someday ['sʌmdeɪ] *adv* когда-нибудь
sophisticated [sə'fɪstɪkeɪtɪd] *a* сложный, хитроумный
sophistication [sə,fɪstɪ'keɪʃ(ə)n] *n* сложность, изощренность
sound [saund] *n* звук
source [sɔ:s] *n* источник
southward ['sauθwəd] *adv* к югу, на юг
space [speɪs] *n* площадь; пространство
spacesuit ['speɪs,sju:t] *n* скафандр
Spanish ['spænɪʃ] *n* испанский язык
speak [spi:k] **(spoke, spoken)** *v:* **speak up** высказываться
specialized ['speʃəlaɪzd] *a* специализированный
specifications [,spesɪfɪ'keɪʃ(ə)nz] *n pl* спецификации, технические характеристики
specify ['spesɪfaɪ] *v* обусловливать, регламентировать, уточнять
specimen ['spesɪmɪn] *n* образец
spectator [spek'teɪtə] *n* зритель
speculation [,spekju:'leɪʃ(ə)n] *n* размышление; предположение
speech [spi:tʃ] *n* речь, выступление
spell [spel] **(spelt, spelt)** *v:* **spell out** расшифровывать, разбирать
spend [spend] **(spent, spent)** *v* тратить, расходовать
sphere [sfɪə] *n* сфера, область
spidery ['spaɪdərɪ] *a* паукообразный; тонкий
spin [spɪn] **(spun, spun)** *v* вращаться
spit [spɪt] **(spat, spat)** *v:* **spit out** выплевывать
spool [spu:l] *n* катушка, шпулька
spray [spreɪ] *v* разбрызгивать
spread [spred] **(spread, spread)** *v:* **spread out** простирать, вытягивать
square [skwɛə] *a* квадратный
squat [skwɔt] *v* приседать

squeak [skwi:k] *v* пищать, скрипеть
stable ['steibl] *n* конюшня, стойло
stack [stæk] *n* куча; масса, множество
staff [stɑ:f] *n* штат, персонал, состав
standardize ['stændədaiz] *v* стандартизировать
standpoint ['stæn(d)pɔint] *n* точка зрения
start [stɑ:t] *v* запустить
statement ['steitmənt] *n* утверждение, суждение
station ['steiʃ(ə)n] *n* устройство, блок, терминал
cosmic station космическая станция
pumping station насосная станция
v помещать, размещать
statistician [,stætis'tiʃ(ə)n] *n* статистик
statistics [stə'tistiks] *n* статистика; статистические данные
status ['steitəs] *n* статус; режим; состояние
steal [sti:l] **(stole, stolen)** *v* воровать, красть, похищать
step [step] *n* шаг
stepbrother ['step,brʌðə] *n* сводный брат
stepfather ['step,fɑ:ðə] *n* отчим
still[1] [stil] *a* неподвижный
still[2] [stil] *adv* все еще
stirring ['stə:riŋ] *n* волнение, возбуждение
stock [stɔk] *n* запас *(товаров)*, фонд
stock-still ['stɔk'stil] *a* неподвижный
storage ['stɔ:ridʒ] *n* хранение; накопление; память
store [stɔ:] *v* накапливать; запасать; хранить
story-teller ['stɔ:ri,telə] *n* рассказчик
stove [stouv] *n* печь
stream [stri:m] *n* поток
streamlined ['stri:mlaind] *a* обтекаемый
strength [streŋθ] *n* сила; эффективность
stretch [stretʃ] *v* простирать(ся); вытягивать(ся); напрягать(ся)
strike [straik] **(struck, struck)** *v* ударять, бить; поражать
structure ['strʌktʃə] *n* здание, сооружение
study ['stʌdi] *n* изучение
stumble ['stʌmbl] **(across)** *v* натыкаться (на)
stupid ['stju:pid] *a* глупый, бестолковый, дурацкий
subject ['sʌbdʒikt] *n* предмет, тема
submit [səb'mit] *v* представлять, сдавать
subscriber [səb'skraibə] *n* абонент
subscription [səb'skripʃ(ə)n] *n* подпись; подписка
subsequent ['sʌbsikwənt] *a* последующий; являющийся результатом *(чего-л.)*
substantial [səb'stænʃ(ə)l] *a* существенный
substitute ['sʌbstitju:t] *v* заменять
substrate ['sʌbstreit] *n* основание, основа, подложка
subtle ['sʌtl] *a* тонкий, нежный
subtraction [səb'trækʃ(ə)n] *n* вычитание
suburban [sə'bə:b(ə)n] *a* пригородный
successor [s(ə)k'sesə] *n* преемник
sue [sju:] *v* подавать в суд
sufficient [s(ə)'fiʃ(ə)nt] *a* достаточный
suggest [sə'dʒest] *v* предлагать, высказывать *(мысль)*
suggestion [sə'dʒestʃ(ə)n] *n* предложение; предположение; совет; намек; указание
suit [sju:t] *v* удовлетворять, устраивать, быть пригодным
suitable ['sju:təbl] *a* соответствующий; пригодный; применимый; удобный
summary ['sʌməri] *n* краткое изложение
a краткий, суммарный
summon ['sʌmən] *v* призывать
superintend [,sju:prin'tend] *v* руководить, управлять
superior [sju:'piəriə] *a* лучший, высшего качества
supermarket [,sju:pə'mɑ:kit] *n* крупный универсам

supply [sə'plaı] *n* питание; снабжение; подача
v поставлять, снабжать; прилагать
support [sə'pɔ:t] *v* поддерживать, обеспечивать
suppose [sə'pouz] *v* предполагать, полагать
sure [ʃuə] *adv* конечно, безусловно
surface ['sə:fıs] *n* поверхность
work surface рабочая поверхность
surpass [sə'pɑ:s] *v* превосходить
suspect [səs'pekt] *v* подозревать
swing [swıŋ] **(swung, swung)** *v* качаться, раскачиваться
switch [swıtʃ] *n* выключатель, переключатель
synergy ['sınɔ:dʒı] *n* синергия; согласование; соответствие
synonymous [sı'nɔnıməs] *a* синонимичный
syntax ['sıntæks] *n* синтаксис
synthesize ['sınθısaız] *v* синтезировать
synthesizer [,sınθı'saızə] *n* синтезатор (речи)
system ['sıstım] *n:* **bit slice microprocessor system** разрядно-секционированная система
nervous system нервная система *(органы чувств)*

T

tailor ['teılə] *v* делать на заказ
taking ['teıkıŋ] *n* выручка, сбор
talented ['tæləntıd] *a* талантливый
tally ['tælı] *n* бирка, ярлык
tape [teıp] *n* (перфо)лента; магнитная пленка
punched paper tape перфолента
tape reader устройство считывания с перфоленты
tape-recorder ['teıprı,kɔ:də] *n* магнитофон
tapping ['tæpıŋ] *n* подключение к сети
tax [tæks] *n* налог
team [ti:m] *n* группа, бригада
v: **team (up)** объединяться, взаимодействовать
technique [tek'ni:k] *n* способ, метод; методика
technology [tek'nɔlədʒı] *n* технология
high technology электронно-вычислительная техника
tedious ['ti:djəs] *a* утомительный, нудный
telecommunications ['telıkə,mju(:)nı'keıʃ(ə)nz] *n* дистанционная передача данных, телекоммуникации, телесвязь
teller ['telə] *n* кассир *(в банке)*
tempo ['tempou] *n* темп
tend [tend] *v* иметь тенденцию, склонность, клониться, направляться
tentacle ['tentəkl] *n* щупальце
term [tə:m] *n* термин
terminal ['tə:mınl] *n* терминал, оконечное устройство, ввод, вывод
terrible ['terəbl] *a* ужасный, страшный
test [test] *n* проба, проверка
v проверять, контролировать, пробовать
textual ['tekstjuəl] *a* текстовой
than [ðæn] *adv* чем
theft [θeft] *n* хищение, кража
theme [θi:m] *n* тема
themselves [ðəm'selvz] *pron* сами
then [ðen] *adv* тогда, в то время
theory ['θıərı] *n* теория
thermocouple ['θə:mo(u),kʌpl] *n* термопара
thin [θın] *a* тонкий
threat [θret] *n* угроза
through [θru:] *prep* через, сквозь
throw [θrou] **(threw, thrown)** *v* бросать
thus [ðʌs] *adv* таким образом, так
tie [taı] *n* связь
tier [tıə] *n* ряд, ярус
tighten ['taıtn] *v* затягивать
till [tıl] *n* ящичек для денег, касса
tilt [tılt] *n* наклон
time [taım] *n* время; раз
at any time в любое время
time-consuming отнимающий много времени

time-table ['taım,teıbl] *n* график, расписание
timing ['taımıŋ] *n* синхронизация, согласование во времени
tiny ['taını] *a* крохотный, миниатюрный
tire ['taıə] *n* обод; *амер.* шина
tissue ['tısju:] *n* ткань
tone [toun] *n* тон
tool [tu:l] *n* орудие, инструмент
topmost ['tɔpmoust] *a* самый верхний; самый важный
torch [tɔ:tʃ] *n* фонарик; *тех.* газовый резак
total ['toutl] *n* общая сумма
a общий, суммарный
touch [tʌtʃ] *v* касаться, трогать
toy [tɔı] *n* игрушка
trace [treıs] *n* след; трассировка
v прослеживать, следить
track [træk] *n* дорожка *(перфорации на ленте)*, канал
trade [treıd] *n* профессия
traffic ['træfık] *n* (уличное) движение
train [treın] *v* обучать, тренировать
transaction [træn'zækʃ(ə)n] *n* входное сообщение
transcription [træns'krıpʃ(ə)n] *n* перепись *(данных)*; копия; запись; транскрипция
transducer [træns'dju:sə] *n* датчик, преобразователь
transfer [træns'fə:] *v* переносить
transistor [træn'zıstə] *n*: **junction transistor** переходный транзистор
transmission [trænz'mıʃ(ə)n] *n* передача
transmit [trænz'mıt] *v* передавать
transmitter [trænz'mıtə] *n* передатчик
tray [treı] *n* поднос
treat [tri:t] *v* обходиться, обращаться
treatment ['tri:tmənt] *n* обработка; обращение
tremendous [trı'mendəs] *a* огромный; чудовищный
trend [trend] *n* тенденция, направление
trial ['traıəl] *n* испытание, проба
trick [trık] *n* трюк; шутка; хитрость
trigger ['trıgə] *v* запускать, пускать в действие
true [tru:] *a* верный, справедливый
trust [trʌst] *n* доверие
v верить, доверять
truth [tru:θ] *n* правда, истинность, доверительность
try [traı] *v* испытывать
try out опробовать
tune [tju:n] *v* настраивать
turboprop ['tə:bo(u)'prɔp] *a* турбовинтовой
turn [tə:n] *v* вращать(ся), поворачивать
turn off выключать
turn out переворачивать, выворачивать
turn-round ['tə:n'raund] *n* время оборота, оборот
tutoring ['tju:tərıŋ] *n* обучение
type [taıp] *n* тип
v печатать
typewriter ['taıp,raıtə] *n* пишущая машинка
typical ['tıpık(ə)l] *a* характерный

U

unabridged ['ʌnə'brıdʒd] *a* несокращенный, полный
unattended ['ʌnə'tendıd] *a* необслуживаемый; автоматически или дистанционно управляемый
underlying [,ʌndə'laıŋ] *a* лежащий внизу, подстилающий
underneath [,ʌndə'ni:θ] *prep* под
undersized ['ʌndə'saızd] *a* заниженного размера
undertake [,ʌndə'teık] **(undertook, undertaken)** *v* предпринимать
unhappily [ʌn'hæpılı] *adv* уныло, с убитым видом
uniformity [,ju:nı'fɔ:mıtı] *n* единообразие, однородность
unique [ju(:)'ni:k] *a* уникальный, особенный
unit ['ju:nıt] *n* узел, блок
universal [,ju:nı'və:s(ə)l] *a* всеобщий; универсальный

universe ['ju:nivə:s] *n* вселенная
unlike ['ʌn'laik] *adv* в отличие от
unmanned ['ʌn'mænd] *a* без обслуживания; управляемый автоматически
unnatural ['ʌn'nætʃr(ə)l] *a* неестественный
until [ən'tıl] *cj* до
untrue ['ʌn'tru:] *a* ложный
unwise ['ʌn'waiz] *a* неумный, неразумный
update [ʌp'deıt] *v* приводить в соответствие с новыми данными
up-to-date ['ʌptə'deıt] *a* современный
upward ['ʌpwəd] *adv* вверх, вверху, кверху
urge [ə:dʒ] *v* понуждать; настаивать
use 1. [ju:s] *n* использование
2. [ju:z] *v* использовать
useful ['ju:sful] *a* полезный
useless ['ju:slıs] *a* бесполезный, никчемный; никуда не годный
user ['ju:zə] *n* пользователь
user-oriented ['ju:zər'ɔrıentıd] *a* ориентированный на пользователя
usher ['ʌʃə] *v* вводить
utilities [ju(:)'tılıtız] *n pl* коммунальные сооружения

V

valid ['vælıd] *a* действительный, действенный
valuable ['væljuəbl] *a* ценный, дорогостоящий
n pl ценности
value ['vælju:] *n* величина, значение
valve [vælv] *n* (радио)лампа
vapour ['veıpə] *n* пар
variable ['vɛərıəbl] *n* переменная (величина)
variation [,vɛərı'eıʃ(ə)n] *n* вариация
variety [və'raıətı] *n* разнообразие; множество
various ['vɛərıəs] *a* различный
vary ['vɛərı] *v* изменяться
verbal ['və:b(ə)l] *a* устный
versatile ['və:sətaıl] *a* разносторонний
version ['və:ʃ(ə)n] *n* вариант
vest [vest] *v* вкладывать
via ['vaıə] *adv* через, посредством
vice versa ['vaısı'və:sə] *adv лат.* наоборот
vicinity [vı'sınıtı] *n* соседство, близость, окрестность
videodisplay ['vıdıoudıs'pleı] *n* видеодисплей
view [vju:] *v* осматривать, обозревать, рассматривать
violation [,vaıə'leıʃ(ə)n] *n* нарушение; насилие
virtual ['və:tjuəl] *a* настоящий, фактический
vision ['vıʒ(ə)n] *n* зрение; ви́дение
viz. [vız] *лат.* а именно, то есть
vocabulary [və'kæbjulərı] *n* словарь; запас слов, словарный состав, лексика
vocational [vo(u)'keıʃənl] *a* профессиональный
vocational school профессионально-техническое училище
void [vɔıd] *a* недействительный
voltage ['voultıdʒ] *n* напряжение, вольтаж
volume ['vɔlju:m] *n* объем
vulnerable ['vʌln(ə)rəbl] *a* уязвимый

W

wafer ['weıfə] *n* пластина
war [wɔ:] *n* война
warn [wɔ:n] *v* предупреждать, предостерегать
waste [weıst] *v* растрачивать, транжирить
watchman ['wɔtʃmən] *n* сторож
wavelength ['weıvleŋθ] *n* длина волны
way [weı] *n:* **find one's way** проникать
wear [wɛə] *n* износ
weather ['weðə] *n* погода
weight [weıt] *n* вес
whenever [wen'evə] *cj* когда бы ни; каждый раз когда
while [waıl] *cj* в то время как
whopping ['wɔpıŋ] *a разг.* огромный

widely ['waɪdlɪ] *adv* широко
widespread ['waɪd,spred] *a* (широко) распространенный
wire ['waɪə] *n* провод
v связывать проводами
withdraw [wɪð'drɔ:] **(withdrew, withdrawn)** *v* забирать, изымать
within [wɪ'ðɪn] *prep* в, внутри
wobble ['wɔbl] *v* колебаться
woodcutter ['wud,kʌtə] *n* дровосек
word [wə:d] *n* слово
key word ключевое слово
work [wə:k] *n* работа
v **work (out)** разрабатывать, вырабатывать
workpiece ['wə:kpi:s] *n* обрабатываемое изделие
world-known ['wə:ld'noun] *a* всемирно известный
wrist [rɪst] *n* запястье
write [raɪt] **(wrote, written)** *v*: **write down** записывать, выписывать

Y

year [jə:] *n* год
for years в течение многих лет

Z

zero ['zɪərou] *n* нуль

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Учебное издание

ЭТА ЧУДЕСНАЯ СТРАНА КОМПЬЮТЕРЛЭНД

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К сведению учителя

В 1990 году в издательстве «Просвещение» выходит в свет третье издание книги Н. К. Крупской «О Владимире Ильиче Ленине» (перевод на английский язык М. Е. Бирман). Книга предназначена для чтения в старших классах средней школы и снабжена постраничными комментариями, англо-русским словарем и списком географических названий.

К сведению учителя

В 1989 году издательство «Просвещение» выпустило в свет второе издание книги «Подвиг во имя жизни» (составители М. С. Кайнов, И. В. Кайнова). Книга предназначена для чтения на английском языке в 11 классе средней школы. Она содержит рассказы, очерки и отрывки из художественных произведений советских и зарубежных писателей, повествующие о героизме Советской Армии и советского народа во Второй мировой войне.

Книга снабжена постраничными комментариями и словарем. Она доработана в соответствии с действующей программой по английскому языку для средней школы.