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From Abacus to Computer

Учебное пособие

Смоленск, 2014

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Пособие предназначено для студентов факультетов компьютерных технологий.
Цель данного пособия - подготовить студентов к практической деятельности – умению работать с литературой по специальности, а также обучение устным формам общения по научной тематике на материале предложенных текстов и упражнений.
Учебное пособие разработано на основе аутентичных текстов, представляющих практический и познавательный интерес для студентов факультетов компьютерных технологий и всех пользователей ПК, желающих улучшить свой английский.
Следует отметить наличие в пособии разнообразных текстов по истории вычислительной техники, что, безусловно, способствует расширению кругозора студентов.
Таким образом, считаю, что данное учебное пособие Зуевой И.К. «From Abacus to Computer» можно рекомендовать для издания в Смоленском гуманитарном университете**.**

UNIT I

PART I

Read the text

What is a Computer?

A computer is a machine with an intricate network of electronic circuits that operate switches. The switches, like the cores, are capable of being in one of two possible states, that is, on or off. The machine is capable of storing and manipulating numbers, letters and characters. The basic idea of a computer is that we can make the machine do what we want by inputting signals that turn certain switches on and turn the others off.

The basic job of computers is the processing of information. For this reason, computers can be defined as devices which accept information in the form of instructions called a program and characters called data, perform mathematical and/or logical operations on the information, and then supply results of these operations. The program, or part of it, which tells the computer what to do and the data, which provide the information needed to solve the problem, are kept inside the computer in a place called memory.

Computers are thought to have many remarkable powers. However, most computers, whether large or small have three basic capabilities. First, computers have circuits for performing arithmetic operations, such as: addition, subtraction, division, multiplication and exponentiation. Second, computers have a means of communicating with the user. After all, if we couldn't feed information in and get results back, these machines wouldn't be of much use. However, certain computers (commonly minicomputers and microcomputers) are used to control directly things such as robots, aircraft navigation systems, medical instruments, etc.

Some of the most common methods of inputting information are to use punched cards, magnetic tape, disks, and terminals. The computer's input device (which might be a card reader, a tape drive or disk drive, depending on the medium used in inputting information) reads the information into the computer. For outputting information, two common devices are a printer which prints the new information on paper, or a CRT display screen which shows the results on a TV-like screen.

Third, computers have circuits which can make decisions. The kinds of decisions which computer circuits can make are not of the type: "Who would win a war between two countries?" or "Who is the richest person in the world?" Unfortunately, the computer can only decide three things, namely: Is one number less than another? Are two numbers equal? and Is one number greater than another?

A computer can solve a series of problems and make hundreds, even thousands of logical decisions without becoming tired or bored. It can find the solution to a problem in a fraction of the time it takes a human being to do the job. A computer can replace people in dull, routine tasks, but it has no originality; it works according to the instructions given to it and can not exercise and value judgments. There are times when a computer seems to operate like a mechanical "brain", but its achievements are limited by the minds of human beings. A computer cannot do anything unless a person tells it what to do and gives it the appropriate information; but because electric pulses can move at the speed of light, a computer can carry out vast numbers of arithmetic-logical operations almost instantaneously. A person can do everything a computer can do, but in many cases that person would be dead long before the job was finished.

1. Which of the statements expresses the main idea best? Why do you think so?

1) Computers have changed the way in which many kinds of jobs are done.
2) Instructions and data must be given to the computer to act on.
3) Computers are machines capable of processing and outputting data.
4) Without computers, many tasks would take much longer to do.

2. Look back in the text. Decide if the sentences are true or false, and rewrite the false ones to make them true.

1) A computer can store or handle any data even if it hasn't received information to do so.
2) All computers accept and process information in the form of instructions and characters.
3) The information necessary for solving problems is found in the memory of the computer.
4) Not all computers can perform arithmetic operations, make decisions, and communicate in some way with the user.
5) Computers can still be useful machines even if they can't communicate with the user.
6) There are many different types of devices for feeding information into a computer.
7) There aren't as many different types of devices used for giving results as there are for accepting information.
8) Computers can make any type of decision they are asked to.

9) Computers can work endlessly without having to stop to rest unless there is a breakdown.

3. Find the passage and the line in it where the following ideas are expressed:

1) Computers accept information, perform mathematical and/or logical operations then supply new information.
2) All computers have three basic capabilities.
3) A computer is a machine that can be made to operate by receiving signals.
4) A computer cannot work without being told what to do.
5) A computers can make three types of decisions.
6) The fundamental job of a computer is processing information.
7) A computer can do the work of hundreds of people in a very short time.
8) The memory of a computer is used for storing information.

4. Fill in the gaps using the given words in the singular or plural form (some words can be used more than once):

core, device, data, circuit, terminal, switch, program, memory, medium, CRT display

1) Every computer has … for performing arithmetic operations, operating … or magnetized … .
2) A … with a screen is normally referred to as a … unit.
3) A computer is a … that processes information in the form of … and can store this information in a… .
4) Card readers, tape drives, or disk drives are different … for inputting information.

5. Using the information of the text and your own knowledge and experience tell the group what a computer is.

PART II History of Computing

Read the text

In The Beginning...

The history of computers starts out about 2000 years ago, at the birth of the abacus, a wooden rack holding two horizontal wires with beads strung on them. When these beads are moved around, according to programming rules memorized by the user, all regular arithmetic problems can be done. Another important invention around the same time was the Astrolabe, used for navigation.

Blaise Pascal is usually credited for building the first digital computer in 1642. It added numbers entered with dials and was made to help his father, a tax collector. In 1671, Gottfried Wilhelm von Leibniz invented a computer that was built in 1694. It could add, and, after changing some things around, multiply. Leibniz invented a special stepped gear mechanism for introducing the addend digits, and this is still being used.

The prototypes made by Pascal and Leibniz were not used in many places, and considered weird until a little more than a century later, when Thomas of Colmar (A.K.A. Charles Xavier Thomas) created the first successful mechanical calculator that could add, subtract, multiply, and divide. A lot of improved desktop calculators by many inventors followed, so that by about 1890, the range of improvements included:

Accumulation of partial results

Storage and automatic reentry of past results (A memory function)
Printing of the results

Each of these required manual installation. These improvements were mainly made for commercial users, and not for the needs of science.

1. Give English equivalents:

цифровой компьютер; пользователь; изобретение; прибавлять; вычитать; умножать; делить; усовершенствование; накопление частичных результатов; автоматическое извлечение из памяти сохранённых результатов.

2. Answer the following questions:

1) How old is the computer?
2) What is the abacus and how was it used?
3) Who built the first digital computer? What was it made for?
4) What could the first mechanical calculator do?
5) What did the range of improvements include?
6) What was the purpose of these improvements?

3. Translate into English:

1) Первая цифровая вычислительная машина складывала числа, которые вводились при помощи набора.
2) К 1980 году вычислительная машина уже умела складывать, вычитать, умножать, делить, накапливать частичные результаты, сохранять их, автоматически воспроизводить и распечатывать.

4. Give a summary of the text.

UNIT II

PART I

Read the text

Computer Capabilities and Limitations

Like all machines, a computer needs to be directed and controlled in order to perform a task successfully. Until such time as a program is prepared and stored in the computer's memory, the computer "knows" absolutely nothing, not even how to accept or reject data. Even the most sophisticated computer, no matter how capable it is, must be told what to do. Until the capabilities and the limitations of a computer are recognized, its usefulness cannot be thoroughly understood.

In the first place, it should be recognized that computers are capable of doing repetitive operations. A computer can perform similar operations thousands of times, without becoming, bored, tired, or even careless.

Secondly, computers can process information at extremely rapid rates, for example, modern computers can solve certain classes of arithmetic problems millions of times faster than a skilled mathematician. Speeds for performing decision-making operations are comparable to those for arithmetic operations but input-output operations, however, involve mechanical motion and hence require more time. On a typical computer system, cards are read at an average speed of 1000 cards per minute and as many as 1000 lines can be printed at the same rate.

Thirdly, computers may be programmed to calculate answers to whatever level of accuracy is specified by the programmer. In spite of newspaper headlines such as "Computer Fails", these machines are very accurate and reliable especially when the number of operations they can perform every second is considered. Because they are man-made machines, they sometimes malfunction or break down and have to be repaired. However, in most instances when the computer fails, it is due to human error and not the fault of the computer at all.

In the fourth place, general-purpose computers can be programmed to solve various types of problems because of their flexibility. One of the most important reason why computers are so widely used today is that almost every big problem can be solved by solving a number of little problems - one after another.

Finally, a computer, unlike a human being, has no intuition. A person may suddenly find the answer to a problem without working out too many of the details, but a computer can only process as it has been programmed to.

Using the very limited capabilities possessed by a11 computers, the task of producing a university payroll, for instance, can be done quite easily. The following kinds of things need to be done for each employee on the payroll. First: input information about the employee such as wage rate, hours worked, tax rate, unemployment insurance, and pension deductions. Second: Do some simple arithmetic and decision making operations. Third: Output a few printed lines on a cheque. By repeating this process over and over again, the payroll will eventually be completed.

1. Which of the statements expresses the main idea best? Why do you think so?

1) The most elaborate of computers must be programmed in order to be useful.
2) It is important to know what a computer can and cannot do.
3) A computer is useless without a programmer to tell it what to do.

2. Look back in the text. Decide if the sentences are true or false, and rewrite the false ones to make then true.

1) A computer cannot do anything until it has been programmed.
2) A computer is a useless machine if its capabilities and limitations are unknown.
3) A computer can repeat the same operation over and over again forever if permitted.
4) The speed at which different computer components function is considered to be one of the limitations of a computer.
5) Computers do not usually make mistakes unless they break down.
6) A computer can think and solve problems by itself.
7) A computer is a single-purpose machine in that it cannot be programmed to solve various types of problems.
8) Computers can solve big problems by following a series of simple steps.
9) A computer usually solves problems by doing some mathematical and decision-making operations.
10) Computers are used because they are fast and exact.

3. Find the passage and the line in it where the following ideas are expressed:

1) A computer can do the same operations millions of times without stopping.
2) A computer must work out the details of a problem before reaching a solution.
3) A computer needs to be told what to do.
4) Computers can solve all kinds of different problems.
5) Knowledge of a computer's capabilities and limitations is important.
6) A computer can process information very rapidly.
7) Computers are exact and dependable.
8) Input and output devices operate more slowly than the arithmetic and decision-making devices.

4. Match the words with the statements.

1) decision-making operations	a) can solve different types of problems
2) programmer	b) all the equipment needed input, process and output information
3) general-purpose computers	c) those which compare numbers
4) computer system	d) decides what the program is to be.

5. Decide which of the following statements are computer capabilities or limitations (C or L).

1) directed and controlled,
2) must be told what to do,
3) capable of doing repetitive operations,
4) never gets bored or tied,
5) fast and careful,
6) input-output operations are slower,
7) very accurate and dependable,
8) man-made machine,
9) can solve different types of problems,
10) finds a solution after working out all the details.
11) can't think for itself,
12) producing a payroll is an easy task.

6. Complete the table using passages 2,3,4,5,6 of the text "Computer Capabilities and Limitations".

Listing marker	Characteristics
1.	can do repetitive operations
2. Secondly	
3.	can calculate answers accurately
4.	can be programmed to solve different problems
5. Finally	

7. Discuss the problem "Computer Capabilities and Limitations'" using your own experience and information of the text.

PART II History of Computing

Read text

Babbage

While Thomas of Colmar was developing the desktop calculator, a series of very interesting developments in computers was started in Cambridge, England, by Charles Babbage (of which the computer store "Babbages" is named), a mathematics professor. In 1812, Babbage realized that many long calculations, especially those needed to make mathematical tables, were really a series of predictable actions that were constantly repeated. From this he suspected that it should be possible to do these automatically.

He began to design an automatic mechanical calculating machine, which he called a difference engine. By 1822, he had a working model to demonstrate with. With financial help from the British government, Babbage started fabrication of a difference engine in 1823. It was intended to be steam powered and fully automatic, including the printing of the resulting tables, and commanded by a fixed instruction program.

The difference engine, although having limited adaptability and applicability, was really a great advance. Babbage continued to work on it for the next 10 years, but in 1833 he lost interest because he thought he had a better idea -- the construction of what would now be called a general purpose, fully program-controlled, automatic mechanical digital computer. Babbage called this idea an Analytical Engine. The ideas of this design showed a lot of foresight, although this couldn't be appreciated until a full century later.

The plans for this engine required an identical decimal computer operating on numbers of 50 decimal digits (or words) and having a storage capacity (memory) of 1,000 such digits. The built-in operations were supposed to include everything that a modern general - purpose computer would need, even the all important Conditional Control Transfer Capability that would allow commands to be executed in any order, not just the order in which they were programmed.

The analytical engine was soon to use punched cards, which would be read into the machine from several different Reading Stations. The machine was supposed to operate automatically, by steam power, and require only one person there.

Babbage's computers were never finished. Various reasons are used for his failure. Most used is the lack of precision machining techniques at the time. Another speculation is that Babbage was working on a solution of a problem that few people in 1840 really needed to solve. After Babbage, there was a temporary loss of interest in automatic digital computers.

Between 1850 and 1900 great advances were made in mathematical physics, and it came to be known that most observable dynamic phenomena can be identified by differential equations (which meant that most events occurring in nature can be measured or described in one equation or another), so that easy means for their calculation would be helpful.

Moreover, from a practical view, the availability of steam power caused manufacturing (boilers), transportation (steam engines and boats), and commerce to prosper and led to a period of a lot of engineering achievements. The designing of railroads, and the making of steamships, textile mills, and bridges required differential calculus to determine such things as:

- center of gravity

- center of buoyancy
- moment of inertia
- stress distributions

Even the assessment of the power output of a steam engine needed mathematical integration. A strong need thus developed for a machine that could rapidly perform many repetitive calculations.

1. Give English equivalents:

настольный калькулятор; паровая энергия; ограниченное применение; потерять интерес к чему-либо; полностью контролируемый программой; оценить; десятичные числа; исполнять команды в любом порядке; перфокарта; считывающая станция; недостаток точности; решение проблемы; делать успехи; дифференциальное уравнение; производство паровых котлов; паровой двигатель; преуспевать (процветать); инженерные достижения; пароход; дифференциальное исчисление; центр тяжести; центр плавучести; момент инерции; распределение напряжения; повторные подсчёты.

2. Answer the questions:

1. What was the difference engine like? Who designed it?
2. Why did Babbage loose interest in difference engine?
3. What was the Analytical Engine like?
4. What did the plans for this Engine require?
5. Why were Babbage's computers never finished?
6. Which great advances in mathematical physics were made between 1850 and 1900?
7. What were the achievements caused by the availability of steam power?

3. Translate into Russian:

1. Первая в истории вычислительная машина была спроектирована в 1833 году Чарльзом Бебиджем.
2. Бебидж понял, что большинство длинных расчётов представляют у себя серию предсказуемых постоянно повторяющихся действий.
3. Вычислительная машина управлялась при помощи фиксированной программы инструкций.
4. Машина должна была иметь память объёмом 1.000 десятичных чисел и выполнять над ними арифметические операции по программе, вводимой с перфокарт.
5. Доступность паровой энергии подстегнуло развитие промышленности, транспорта, торговли.

4. Divide the text into four parts, title them and give a summary of the text.

UNIT III

PART I KINDS OF COMPUTERS

Read the text and write out computer terms:

Mainframes

Large computer systems, or mainframes, as they are referred to in the field of computer science, are those computer systems found in compute installation processing immense amounts of data. These powerful computers make use of very high speed main memories into which data and programs to be dealt with are transferred for rapid access. These powerful machines have a larger repertoire of more complex instructions which can be executed more quickly. Whereas smaller computers may take several steps to perform a particular operation, a larger machine may accomplish the same thing with one instruction.

These computers can be of two types: digital or analog. The digital computer or general-purpose computer as it is often known makes up about 90 % of the large computers now in use. It gets its name because the data that are presented to it are made of a code consisting of digits-single-character limbers. The digital computer is like a gigantic cash register in that it can do calculations in steps, one after another at tremendous speed and with great accuracy. Digital computer programming is by far the most commonly used in electronic data processing for business or statistical purposes. The analog computer works something like a car speedometer, in that it continuously works out calculations. It is used essentially for problems involving measurements. It can simulate, or imitate different measurements by electronic means. Both of these computer types - the digital and the analog are made up of electronic components that may require a large room to

accommodate them. At present, the digital computer is capable of doing anything the analog once did. Moreover, it is easier to program and cheaper to operate. A new type of a scientific computer system called the hybrid computer has now been produced that combines the two types into one.

Really powerful computers continue to be bulky and require special provision for their housing, refrigeration systems, air filtration and power supplies. This is because much more space is taken up by the input/output devices - the magnetic tape and disk units and other peripheral equipment - than by the electronic components that do not make up the bulk of the machine in a powerful installation. The power consumption of these machines is also quite high, not to mention the price that runs into hundreds of thousands of dollars. The future will bring great developments in the mechanical devices associated with computer systems. For a long time these have been the weak link, from the point of view of both efficiency and reliability.

1. Which of the statements expresses the main idea best? Why do you think so?

1) Hybrid computers are a combination of digital and analog computers.
2) Digital computers are used more than any other type of computers.
3) There are three types of mainframes.
4) Analog computers can do more varied work than digital or hybrid computers.

2. Look back in the text. Decide if the sentences are true or false, and rewrite the false ones to make them true.

1) A mainframe is a type of computer that can sit on the top of a desk.
2) Mainframes are very powerful and can execute jobs very rapidly and easily.
3) Digital computers are used more than analog computers.
4) The analog computer is far smaller than a digital computer and therefore occupies very little space.
5) The hybrid computer is a combination of both the digital and the analog computer.
6) The analog computer does its calculations one step at a time.
7) The digital computer continuously works out calculations.
8) Mainframes are huge powerful machines whose peripheral equipment takes up a lot of space.
9) Mainframe technology has reached the end of the road. No further development is needed.

3. Find the passage and the line in it where the following ideas are expressed:

1) Smaller computers may take longer to perform an operation.
2) More technological development is necessary in the mechanical devices associated with computer systems.
3) Mainframes can operate quickly and execute more complex instructions.
4) The hybrid computer is a combination of both the digital and the analog computers.
5) Digital computers are used more than analog computers.
6) Mainframes are large powerful computers.
7) An analog computer is comparable to a car speedometer in the way it operates.
8) Digital computers do calculations, one after another, quickly and exactly.

PART II History of Computing

I. Read the text

Electronic Digital Computers

The start of World War II produced a large need for computer capacity, especially for the military. New weapons were made for which trajectory tables and other essential data were needed. In 1942, John P. Eckert, John W. Mauchly, and their associates at the Moore school of Electrical Engineering of University of Pennsylvania decided to build a high - speed electronic computer to do the job. This machine became known as ENIAC (Electrical Numerical Integrator And Calculator)

The size of ENIAC's numerical "word" was 10 decimal digits, and it could multiply two of these numbers at a rate of 300 per second, by finding the value of each product from a multiplication table stored in its memory. ENIAC was therefore about 1,000 times faster then the previous generation of relay computers.

ENIAC used 18,000 vacuum tubes, about 1,800 square feet of floor space, and consumed about 180,000 watts of electrical power. It had punched card I/O, 1 multiplier, 1 divider/square rooter, and 20 adders using decimal ring counters, which served as adders and also as quick-access (.0002 seconds) read-write register

storage. The executable instructions making up a program were embodied in the separate "units" of ENIAC, which were plugged together to form a "route" for the flow of information.

These connections had to be redone after each computation, together with presetting function tables and switches. This "wire your own" technique was inconvenient (for obvious reasons), and with only some latitude could ENIAC be considered programmable. It was, however, efficient in handling the particular programs for which it had been designed.

ENIAC is commonly accepted as the first successful high - speed electronic digital computer (EDC) and was used from 1946 to 1955. A controversy developed in 1971, however, over the patentability of ENIAC's basic digital concepts, the claim being made that another physicist, John V. Atanasoff (left) had already used basically the same ideas in a simpler vacuum - tube device he had built in the 1930's while at Iowa State College. In 1973 the courts found in favor of the company using the Atanasoff claim.

1. Give English equivalents:

объём памяти; основные данные; высокоскоростная электронно-вычислительная машина; счётчик; поглощать электроэнергию; результаты умножения; заключать в отдельные разделы (ячейки); маршрут для потока информации; иск; в чью-либо пользу; вычисление; сумматор (блок суммирования); квадратный корень; регистр памяти считывание-запись.

2. Answer the questions based on the text:

1) What was ENIAC made for?
2) What were the main characteristics of this computer?
3) Were there any defects in ENIAC?
4) Why did the controversy over the patentability of ENIAC's based digital concepts develop in 1971?

3. Fill in the blanks with the words from the text

1)The military needed computers with large … .
1) ENIAC could … two of these numbers at a … of 300 per second.
2) ENIAC does the … by finding … of each … from a multiplication table stored in its … .
3) The … instruction making up a program were … in separate "units" of ENIAC.
4) These "units" were … together to form a " …" for the flow of information.
5) These … had to be redone after each … .

4. Match the words with their definitions:

1)an electrical calculating machine that can store and recall information and make calculations at very high speeds.
2)a frame holding wires on which small balls can be moved, used for counting
3)any of numbers from 0 to 9.
4)to join numbers so as to find the total
5)the method of combining two numbers by adding one of them to itself as many times as the other states
6)to find out how many times one number contains or is contained in another number.
7)based on number 10 (adjective)
8)a statement that two quantities are equal.
9)to keep somewhere for future use.

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abacus; to add; computer; decimal; digit; divide; equation; multiplication; to store.

5. Retell the text.

UNIT IV

PART I

Read the text and write out computer terms:

Minicomputers

Until the mid-1960s, digital computers were powerful and physically large and expensive. What was really needed though, were computers of less power, a smaller memory capacity and without such a large array of peripheral equipment- This need was partially satisfied by the rapid improvement in performance of the semiconductor devices (transistors), and their incredible reduction in size, cost and power; all of which led to the development of the minicomputer or mini for short. Although there is no exact definition of a minicomputer, it is generally understood to refer to a computer whose mainframe is physically small, has a fixed word length between 8 and 32 bits and costs less than U.S. $100,000 for the central processor. The amount of primary storage available optionally in minicomputer systems ranges from 38-512 Kbytes; however, some systems allow this memory to be expanded even further.