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ТЕРМІНОЗНАВСТВО

ЧАСТИНА 1

Міністерство освіти і науки України
Вінницький національний технічний університет

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ЧАСТИНА 1

Затверджено Вченою радою Вінницького національного технічного університету як навчальний посібник для студентів напрямів підготовки 0804, 0915, 0160 з поглибленим вивченням іноземної мови. Протокол N 5 від 24 листопада 2005 р.

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Р 93 **Термінознавство.** Навчальний посібник для студентів напрямів підготовки 0804, 0915, 0160 з поглибленим вивченням іноземної мови. Частина 1. - Вінниця: ВНТУ, 2006. - 92с.

Навчальний посібник знайомить студентів зі спеціалізованими термінами з комп'ютерної техніки, що дає змогу розуміти фахову літературу та спілкуватися на теми за фахом.

В посібнику використовуються різноманітні вправи роботи з лексикою. Підбір завдань відкриває широкі можливості як для використання посібника на заняттях, так і для самостійної роботи студентів.

Навчальний посібник призначений для студентів, які вивчають комп'ютери, комп'ютерні технології, програмування, та широкого кола бажаючих оволодіти комп'ютерною лексикою.

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CONTENTS

INTRODUCTION

This textbook is designed as an ESP course (English for Specific Purposes) for students whose future specialty is connected with computer sciences, computer engineering, computer technologies, programming, etc., and who will need English for occupational purposes.

The purpose of this textbook is to provide the students with knowledge of computer terms and practice of speaking and discussing topical issues in their field of specialization. There is a great social demand for specialists competent in their field of training and fully proficient in the language they use. This course emphasizes the vocabulary connected with computers. It consists of fourteen chapters, which are divided into two parts. It does not just contain language exercises; it is a kind of attempt to combine language learning and computer studying. Designed for students studying computer sciences, computer engineering, computer technologies, programming, this textbook is far from regarding the aim of training specialists in English in the field of their specialization. It is intended for those who have already acquired the fundamental knowledge connected with computers and computer technologies. But it implies further development of students' knowledge in their field of study, discussing urgent issues of the computer world and computer technologies.

Every chapter consists of three parts. The PRE-READING part makes the students recollect everything connected with the topic of the chapter in their native language what helps them both to focus on the needed technical terms, to study them, and to focus on the information presented in the texts. The next part READING contains texts and sentences for translation from English into Ukrainian, and from Ukrainian into English, a lot of exercises helping memorize terms, and preparing the students for discussion. The activities and exercises provide with extended practice on a given topic. The chapters contain many activities for studying specialized terms to instill the desire to speak, to express opinions. DISCUSSING is a part of the chapter that sums up what the students learnt in the chapter. It makes the students discuss the issues, encourage the students to develop their knowledge using Internet and other sources of information. Although terms and expressions play an important role in providing the students with tools they need, they should be viewed only as tools subordinate to the major purpose – the largest block of time is devoted to allowing the students freedom to express themselves in meaningful practice.

The pace of development of computer technologies is very fast, that's why there is the opportunity in one of the tasks to reconsider the information presented in the chapter and to discuss the problems with the group mates. A lot of texts, exercises, the glossary and dictionaries of computer terms turn this course into informative one, as well as practical one for students, teachers and specialists dealing with computer technologies, computer engineering, programming and dealing with computers in general.

UNIT 1

COMPUTER EVOLUTION

I PRE-READING

1. Recollect everything you studied concerning the topic, make notes. Write down the list of words in the Ukrainian language you think you will need while speaking on the topic.

2. a). Read the text and try to guess whether there are words from your list in it.

b). If you don't know the words, translate them using the dictionaries.

c). Choose the words from the list which are the most relevant for this topic.

d). If you don't know the meaning of any words or abbreviations, find their explanations in the Glossary.

e). Which words from exercises 1, 2c may be considered as general notions and which ones as technical terms?

f). Give explanations of several terms, using the Glossary.

Modern computing can probably be traced back to the 'Harvard Mk I' and Colossus (both of 1943). Colossus was an electronic computer built in Britain at the end 1943 and designed to crack the German coding system - Lorenz cipher. The 'Harvard Mk I' was a more general-purpose electro-mechanical programmable computer built at Harvard University with backing from IBM. These computers were among the first of the 'first generation' computers. First generation computers were normally based around wired circuits containing vacuum valves and used punched cards as the main (non-volatile) storage medium. Another general-purpose computer of this era was 'ENIAC' (Electronic Numerical Integrator and Computer) which was completed in 1946. It was typical of first generation computers, it weighed 30 tones contained 18,000 electronic valves and consumed around 25KW of electrical power. It was, however, capable of an amazing 100,000 calculations a second.

The next major step in the history of computing was the invention of the transistor in 1947. This replaced the inefficient valves with a much smaller and more reliable component. Transistorized computers are normally referred to as 'Second Generation' and dominated the late 1950s and early 1960s. Despite using transistors and printed circuits these computers were still bulky and strictly the domain of Universities and governments.

The explosion in the use of computers began with 'Third Generation' computers. These relied Jack St. Claire Kilby's invention - the integrated circuit or microchip; the first integrated circuit was produced in September 1958 but computers using them did not begin to appear until 1963. While large 'mainframes' such as the I.B.M. 360 increased storage and processing capabilities further, the integrated circuit allowed the development of Minicomputers that began to bring computing into many smaller businesses. Large-scale integration of circuits led to the development of very small processing units, an early example of this is the processor used for analyzing flight data in the US Navy's F14A `TomCat' fighter jet. This processor was developed by Steve Geller, Ray Holt and a team from AiResearch and American Microsystems.

On November 15, 1971, Intel released the world's first commercial microprocessor, the 4004. Fourth generation computers developed, using a microprocessor to locate much of the computer's processing abilities on a single (small) chip. Coupled with one of Intel's inventions - the RAM chip (Kilobits of memory on a single chip) - the microprocessor allowed fourth generation computers to be even smaller and faster than ever before. The 4004 was only capable of 60,000 instructions per second, but later processors (such as the 8086 that all of Intel's processors for the IBM PC and compatibles is based) brought ever increasing speed and power to the computers. The microprocessor allowed the development of microcomputers, personal computers that were small and cheap enough to be available to ordinary people.

II READING

1. Read and translate the text into Ukrainian.

The first mechanical calculating machine was developed by Blaise Pascal in the mid- 1600s. It was based on the decimal system and operated by a series of rotating gears. Gottfried Wilhelm von Leibniz later improved the machine so that it could perform multiplication, division, and figure square roots. Neither machine was widely used.

Charles Babbage was the first to conceptualize the modern computer. The machine he first designed was the difference engine. Later, in collaboration with Augusta Ada Byron, he designed a machine called the analytical engine which was the first machine to use the binary number system. The machine also processed information using punched cards, a concept taken from Joseph Marie Jacquard who had programmed a loom with punched cards in the early 1800s.

In the 1880s, Dr. Herman Hollerith developed a mechanical method of tabulating census results. His machine read and sorted data coded on punched

cards in Hollerith code. Electrical circuits were completed when brushes passed over holes punched in the cards. Hollerith formed the Tabulating Machine Company which later became IBM.

Howard H. Aiken built the Mark I in the 1930s. The Mark I was a primitive design, but the U. S. Navy used it to do ballistics calculations through the end of World War II.

The first electronic digital computer was the Atanasoff-Berry Computer (ABC). It used vacuum tubes for storage and arithmetic-logic functions.

ENIAC was the first general-purpose electronic computer. It had 18,000 vacuum tubes. It was used to study weather, cosmic rays, and atomic energy. Scientists of the time felt that seven ENIACs could supply all the computing power the world would ever need.

The EDSAC was the first stored-program computer. The EDVAC was finished a short time later. These were the first calculating machines that could run without human intervention. Improvements made since the EDSAC and EDVAC have focused on speed, size, and cost.

First-generation computers were large and slow, and since they used vacuum tubes, they were undependable (one tube would fail every fifteen minutes or so). The UNIVACI was a first-generation computer. The IBM 650 was developed to compete with the UNTVAC I.

During this time, Commodore Grace Murray Hopper of the U.S. Navy developed the first language-translator program. It used mnemonics to represent the 0s and 1s of machine language. The first high-level programming languages, starting with FORTRAN, were developed shortly thereafter.

Four advances in hardware led to the second-generation computers: the transistor, magnetic core storage, magnetic tapes, and magnetic disks. The transistor replaced vacuum tubes making the new computers smaller and much more reliable. Internal memory was converted from magnetic drum to magnetic core, reducing access time dramatically. Magnetic tape provided the first external storage and allowed for batch processing of data. Magnetic disks allowed direct access to externally stored data.

In the late sixties, Jack S.Kilby developed the integrated circuit. These circuits were much more reliable than vacuum tubes and provided more computing power and speed than the original transistors. Gene Amdahl introduced the family concept of computers with the IBM System/360 series. These advances, along with the introduction of minicomputers developed by Digital Equipment Corporation, ushered in the third generation of computers.

The integrated circuit continued to be improved by packing more and more circuits onto a single silicon chip. This process became known as large-scale integration. Ted Hoff developed a "computer on a chip," called a microprocessor, which allowed everything from toasters to space ships to be computerized. The microprocessor, the principal stepping-stone into the fourth generation of computers, spawned the microcomputer. John Roach of Radio Shack, Jack Tramiel of Commodore, and Steven Jobs and Stephen Wozniak of Apple are among the innovators in the field of microcomputers. Recently, very-large-scale integration has lead to the development of extraordinarily fast supercomputers.

A proposed fifth generation of computers based on artificial intelligence would allow computers to imitate human characteristics such as creativity, judgment, and intuition. This technology is still very much in the experimental stages, however.

Since the advent of the microcomputer, people have used them imaginatively for a host of applications. They have been used for designing weaving patterns, fighting arson, and composing music among other things. With the technological advances and market expansion occurring now, there is no telling what the future of microcomputing might hold.

2. Make up the logical scheme of the text and render the content of the text on the basis of the scheme.

3. Fill in the gaps with the words from the list.

a. ENIAC	g. COBOL
b. transistor	h. Marvin Minsky
c. Augusta Ada Byron	i. FORTRAN
d. Joseph Marie Jacquard	j. EDS AC
e. Jack S.Kilby	k. Hollerith
f. time-sharing	1. analytical engine

1. Machine programming was first implemented by_____who programmed a loom using punched cards.
2 The special code that is used in reading and writing punched cards is the_____ code.
3. The first calculating machine to use the binary number system was the_____.
4. _____ was the first stored-program computer.
5. The_____ replaced the vacuum tube in second-generation computers.
6. Dr. Thomas Kurtz developed _____ software that made interactive processing possible.
7. _____ developed the integrated circuit.

8. Computation: Finite and Infinite Machines is a standard reference work in artificial intelligence written by_____.

9. The first high-level programming language was _____.

10. Charles Babbage's collaborator on the analytical engine was _____.

4. Translate the sentences into the Ukrainian language. Take into consideration the information presented in the sentences. It may be helpful to you while doing the next exercises and discussing the topic.

1. Blaise Pascal designed the Pascaline in the mid-1600s to help his father compile tax reports for the French government. 2. The ABC was the first computer to use vacuum tubes. 3. Commodore Hopper and her staff developed programs that would translate codes consisting of mnemonics into machine language. 4. Vacuum tubes produce a great deal of heat, so large vacuum tube computers required air conditioning. 5. Dr. Kemeny and Dr. Kurtz developed time-sharing software so their students would not have to wait so long for results from programming assignments. 6. Kilby discovered that rather than wiring together hundreds of electronic circuits, he could etch them onto small chips of silicon. 7. The shorter the distance that electrical current has to travel over computer circuitry, the faster processing is. 8. The microprocessor allowed items such as wristwatches and toasters to be computerized because of its small size and very low cost. 9. Cray computers are used in weather forecasting and aircraft design as well as for military purposes such as nuclear weapons research. 10. Expert systems are programs that approximate artificial intelligence today.

5. Choose the right answer.

1. The first mechanical calculating machine was called _____.
   a. Napier's Bones
   b. the Pascaline
   c. the difference engine
   d. the analytical engine

2. The first calculating machine to use the binary number system was the _____.
   a. Pascaline
   b. difference engine
   c. analytical engine
   d. Mark I

3. The first electronic digital computer was the_____.
   a. Atanasoff-Berry Computer
   b. Mark I
   c. ENIAC
   d. UNIVACI

4. The_____ was used to work on the hydrogen bomb at Los Alamos in 1946.
   a. Mark I
   b. EDSAC
   c. EDVAC
   d. ENIAC

5. The EDSAC was the first _____computer.

a. machine-language
b. stored-program
c. transistorized
d. real-time

6. Commodore Grace Murray Hopper developed_____.
   a. the first high-level programming language
   b. the transistor
   c. a language-translator program
   d. the integrated circuit

7. The primary electronic components of first-generation computers were_____.
   a. vacuum tubes
   b. transistors
   c. integrated circuits
   d. microprocessors

8. Dr. John Kemeny and Dr.Thomas Kurtz developed _____software.
   a. direct-access
   b. operating systems
   c. artificial intelligence
   d. time-sharing

9. _____ developed the integrated circuit.
   a. Commodore Grace Murray Hopper
   b. William Shockly
   c. Jack S. Kilby
   d. John Bardeen

10. The IBM System/360 series of computers was designed by_____.
   a. Jack S. Kilby
   b. Jack Tramiel
   c. Ted Hoff
   d. Gene Amdahl

11. The technique by which many circuits are packed onto a single silicon chip is known as_____.

   a. large-scale integration
   b. circuit consolidation
   c. microprocessing
   d. integrated circuitry

12. Ted Hoff managed to pack the arithmetic and logic circuitry necessary for computations on a single chip. This chip is known as the_____.
   a. integrated circuit
   b. microprocessor
   c. very-large-scale integrated circuit
   d. silicon chip

13 Supercomputers were developed by_____.
   a. Jack Tramiel
   b. Stephen Wozniak
   c. Seymour Cray
   d. John McCarthy

14. The fifth generation of computers may be based on_____.
   a. supercomputers
   b. microcomputers
   c. very-large-scale integration
   d. artificial intelligence

15. The _____ was a third-generation development by Digital Equipment Corporation that allowed many smaller businesses to obtain computer power.

a. microcomputer
b. minicomputer
c. System/360
d. microprocessor

6. Translate the words and word-combinations into English.

Арифметична функція, десяткова система числення, ЕОМ четвертого покоління, машинна мова, операційна система, мікросхема на кремнієвій основі, електронна лампа, пам’ять, перфокарта, інтеграція високого рівня, інтегральна схема, прямий доступ, двійкова система числення, пакетне опрацювання, штучний інтелект, мова асемблера, універсальний ЕОМ, код Голлеріта, сумісний, магнітний диск.

7. Say true or false and explain.

1. T F Napier's bones was the first mechanical calculating device.
2. T F The Atanasoff-Berry Computer was the first electronic digital computer.
3. T F Scientists predicted that seven computers like the Mark I could perform all the calculations the world would ever need.
4. T F First-generation computers required air-conditioning because their vacuum tubes generated a great deal of heat.
5. T F Commodore Grace Murray Hopper developed the first language-translator program.
6. T F Second-generation computers used transistors to overcome the heat problems associated with vacuum tubes.
7. T F Seymour Cray's supercomputers are smaller than mainframes because of miniaturization but are much more powerful.
8. T F Artificial intelligence programs are also called expert systems.
9. T F Ted Hoff developed the microprocessor.
10. T F Commodore Business Machines Inc. was financed at the start with money Steven Jobs and Stephen Wozniak made selling a Volkswagen and a scientific calculator.

III DISCUSSING

1. Give the short answer.

1. Give a brief history of the punched card.
2. Why was Augusta Ada Byron's suggestion that Charles Babbage utilize the binary number system in the analytical engine so important?
3. Explain the advantages of transistors over vacuum tubes.

4. Why was Commodore Grace Murray Hopper's development of the first language-translator program significant?
5. What were the hardware advances that led to the second generation of computers?
6. Describe minicomputers.
7. Scientists once said that seven computers like the primitive ENIAC would handle any processing needs that the world would ever need. What are the current uses of supercomputers?
8. What effect did the development of the microprocessor have on the computer?
9. Name some innovative uses for the microcomputer.
10. What are scientists hoping to develop in the next generation of computers?

2. Prepare reports using Internet or other sources (catalogues, magazines, books, etc.) about the latest news, achievements in the field concerning the topic of the chapter.

3. Summarize everything you have learnt on the topic.

4. Answer the question, taking into consideration quick pace of the latest achievements and developments in computer engineering and programming and information presented in the reports, what information from the texts of the Chapter should be reconsidered, changed, added, etc..

5. It's interesting to know…

History of the Internet

The internet's history can be traced back to ARPANET - which was started by the US Dept. of Defense for research into networking sometime in 1969. Many people wanted to put their ideas into the standards for communication between the computers that made up this network, so a system was devised for putting forward ideas. You wrote your ideas in a paper called a 'Request for Comments' (RFC for short), and let everyone else read it. People commented on and improved your ideas in new RFCs. The first RFC (RFC0001) was written on April 7, 1969 - that this is probably the closest thing to a 'start date' for the internet. There are now well over 2000 RFCs, describing every aspect of how the internet functions.

ARPAnet was opened to non-military users later in the 1970s, and early takers were the big universities - although at this stage it resembled nothing like the internet we know today. International connections (i.e. outside America) started in 1972, but the internet was still just a way for computers to talk to each other and for research into networking, there was no World-Wide-Web and no emails as we now know it.

It was not until the early to mid 1980s that the services we now use most on the internet started appearing. The concept of 'domain names', things like 'microsoft.com', and special `Domain Name Servers' wasn't even introduced until 1984 - before that all the computers were just addressed by their IP addresses (numbers). Most protocols used for email and other services appeared after this - although email itself had been around much longer the way it was sent between institutions was less standardized. The part of the internet most people are probably most familiar with is the World-Wide-Web. This is a collection of hyperlinked pages of information distributed over the internet via a network protocol called HTTP (hyper-text-transfer-protocol). This was invented by Tim Berners-Lee in 1989. He was a physicist working at CERN, the European Particle Physics Laboratory, and wanted a way for physicists to share information about their research - the World-Wide-Web was his solution. Therefore, the web was started, although at this time it was text-only. Graphics came later with a browser called NCSA Mosaic. Both Microsoft's Internet Explorer and Netscape were originally based on NCSA Mosaic. The graphical interface opened up the internet to novice users and in 1993 it's use exploded as people were allowed to 'dial-in' to the internet using their computer at home and a modem to ring up an 'Internet Service Provider' (ISP) to get their connection to this (now huge) network. Before this the only computers connected were at Universities and other large organizations that could afford to hire cables between each other to transfer the data over - but now anyone could use the internet and it evolved into the 'Information Superhighway' that we know and (possibly) love today.

History of Windowing Systems

The first concept of a windowing (or WIMP - windows, icons, menus and pointers) system appeared inside the Xerox Palo Alto Research Center (PARC) in 1973. The 'Alto' computer was only availably internally; it was not until 1981 that Xerox released the refined version to the world: the 8010 ('Star') system. This idea was then used by Apple, first for the Apple 'LISA', and then again in 1984 as they developed the MacOS operating system for use on their Apple Macintosh. Finally, Microsoft wrote the first version of Microsoft Windows in 1985. Windows was a GUI (graphic user interface) for their own operating system (MS-DOS) that had been shipped with IBM PC and compatible computers since 1981. Windows was designed to look a bit like MacOS but unfortunately, it was so similar that Apple decided to take Microsoft to court over it … a court case that was to run for many years.

This first version of Windows wasn't very powerful and so not incredibly popular. Microsoft Windows 2 came out in 1987, and was a bit more popular that the original version. The first really popular version of Windows was version 3.0, released in 1990. This benefited from the improved graphics

available on PCs by this time, and from the 80386 processor, which allowed 'true' multitasking of the Windows applications. This made it more efficient and more reliable when running more than one piece of software at a time. It would even allow you to run and multitask older MS-DOS based software. Windows 3 made the IBM PC a serious piece of competition for the Apple Mac. Various improvements - Windows 3.1 and Windows 3.11 were released, although they did not really provide many significant improvements to the way windows looked or worked. Also available at a similar time to Windows 3 was IBM's OS/2 (which was actually written in partnership with Microsoft). OS/2 Warp was also released which was a full 32 bit operating system - it came out long before Windows 95, and boasted many similar features. Unfortunately, IBM failed to market it successfully enough and it did not catch on.

Windows 95 was released in 1995 (no surprises there) in August. Although it shared much code with Windows 3 and even MS-DOS, Windows 95 had 2 big advantages. First, it was an entire Operating System, you no longer needed to buy MS-DOS and then install Windows on top of it. Second, it was specially written for 80386 and better processors and made 'full' use of the 32 bit facilities. In this respect, Windows 95 moved closer to Windows NT.

Windows NT (New Technology) was developed alongside Windows for use on servers and businesses. It is designed to be more reliable and secure than Windows 95, but as a trade-off it is less compatible with older MS-DOS based software (crucially for the home market it will not run many video games). 1998 (June 25) saw the release of Windows 98, which is very similar to Windows 95, except that it provided an improved filing system (which controls the way data is stored on disks), the improvements made it efficient and allowed it to support disks larger than the 2 GB allowed by the first release of Windows 95. Windows 98 also brought support for USB and AGP. It was Microsoft's aim - with Windows 2000 - to merge the two versions of Windows (Windows 95/8 and Windows NT) into one product, but they failed. Because of the memory protection (which helps provide reliability and security), Windows 2000 is unable to run some of the 'legacy software' (in particular games) that Windows 95 and 98 can - so Windows Millennium Edition (ME) was born. Windows 2000 is basically NT version 5 with a slightly prettier interface and a more exciting name than previous members of the NT series, while Windows ME is the latest in the 95/98 family. The next major release of Microsoft Windows was 'Windows XP', this again attempts to bring together the NT/2000 and 95/98/ME versions of the operating system. XP stands a better chance of succeeding, partially because of the improved technology, largely because as time (6 years or more) has passed since the first release of Windows 95 much of the 'legacy' MS-DOS/non-Windows software (and in particular games) that caused problems with Windows 2000 has been rewritten or replaced.

UNIT 2

THE ROLE OF COMPUTERS IN TODAY'S SOCIETY

I PRE-READING

1. Recollect everything you studied concerning the topic, make notes. Write down the list of words in the Ukrainian language you think you will need while speaking on the topic.

2. a). Read the text and try to guess whether there are words from your list in it.

b). If you don't know the words, translate them using the dictionaries.

c). Choose the words from the list which are the most relevant for this topic.

d). If you don't know the meaning of any words or abbreviations, find their explanations in the Glossary.

e). Which words from exercises 1, 2c may be considered as general notions and which ones as technical terms?

f). Give explanations of several terms, using the Glossary.

People use computers in a wide variety of ways. In business, computers track inventories with bar codes and scanners, check the credit status of customers, and transfer funds electronically. In homes, tiny computers embedded in the electronic circuitry of most appliances control the indoor temperature, operate home security systems, tell the time, and turn videocassette recorders on and off. Computers in automobiles regulate the flow of fuel, thereby increasing gas mileage. Computers also entertain, creating digitized sound on stereo systems or computer-animated features from a digitally encoded laser disc.

Computer programs, or applications, exist to aid every level of education, from programs that teach simple addition or sentence construction to advanced calculus. Educators use computers to track grades and prepare notes; with computer-controlled projection units, they can add graphics, sound, and animation to their lectures.

Computers are used extensively in scientific research to solve mathematical problems, display complicated data, or model systems that are too costly or impractical to build, such as testing the airflow around the next generation of space shuttles. The military employs computers in sophisticated communications to encode and unscramble messages, and to keep track of personnel and supplies.

II READING

1. Read and translate the text into Ukrainian.

Computers are used in almost every aspect of business today. The banking industry uses computers to process enormous numbers of paper documents such as checks and deposit slips. Newer applications include electronic funds transfer, which, in some areas, even allows banking to be done at home.

In manufacturing, computer-aided design and computer-aided manufacturing provide engineers with the tools to increase productivity through simulation of both product design and the manufacturing process.

Industrial robots are providing increasingly efficient labor for manufacturers. New, second-generation robots can even identify, by touch and sight, specific items that are mixed with others in a bin.

In the business office, word processors handle document production and reproduction much more easily than traditional typing methods. Communications can be handled by electronic mail. Teleconferencing cuts travel time and costs for executives. Telecommuting allows employees to work at home on computer terminals connected to the office via telephone lines.

The single largest user of computer systems is the U.S. government. The military uses computers to simulate battle situations. NORAD uses computers and satellites to monitor missile launchings from any place on earth. The IRS has enormous data banks containing information on citizens' finances. National Weather Service forecasting requires several computers to perform extremely complex calculations. The FBI and CIA, in conjunction with other law enforcement agencies, have developed computer networks to store information on criminals and people considered to be threats to public figures. The National Crime Information Center uses a national network of computer terminals to keep track of police and law enforcement information.

In the field of medicine, computers help perform multiphasic health testing, computerized axial topography, and nuclear magnetic resonance scanning. These computerized diagnostic methods take the place of more dangerous and expensive surgery. Artificial limbs are also being controlled by microprocessors.

The use of computers in education has grown dramatically. Computer literacy has become a major concern of educators, and high schools are offering more and more computer classes. CAI, computer-assisted instruction, is a form of programmed learning that allows students to use computers and educational software to learn at their own pace. The three types of programmed learning are drills, tutorials and simulations.

There are many worries about the growing scope of computer use. Because of large data bases set up by government agencies and private industry, particularly the credit industry, people often feel as though their privacy is being invaded. Various congressional acts passed in the 1970s were efforts to protect the citizens' privacy.

Computer crime is keeping pace with the growth of the computer industry. These crimes can be classified in four categories: sabotage, theft of services, property crimes, and financial crimes. It is estimated that between two and forty billion dollars is lost per year to computer criminals.

The effects of the microcomputer are becoming increasingly evident in day-to-day activities. Businesses and schools often require employees and students to use microcomputers. Vacations are spent at computer camps. College students are expected to learn to use computers and, in some instances, to buy them when they enroll. Microcomputers are also providing employment and other opportunities for the elderly and for the disabled.

2. Make up the logical scheme of the text and render the content of the text based on the scheme.

3. Fill in the gaps with the words from the list.

a. privacy
b. telecommuting
c. EFT
d. CAI
e. computer ethics
f. computer morals
g. teleconferencing
h. CAT
i. second-generation robots
j. data-collection program (DCP)
k. NMR
1. first-generation robots

1. Accounts involved in a(n)_____transaction are adjusted simply by communication between computers.

2. _____enables people in different geographical locations to participate in a meeting at the same time.
3. _____can feel how tightly they are gripping an object.
4. Disabled people are provided with employment opportunities as a result of_____.
5. A _____placed on a buoy, ship, airplane, or weather balloon provides data to the National Weather Service.
6. A _____scan can provide clear pictures of cross-sections of the body.
7. _____ scanning uses X-rays combined with evaluations of X-ray pictures.
8. _____involves an individual's ability to determine what, how, and when personal information is communicated to others.
9. _____ teaches by programmed learning (drilling).

10. A term used to refer to the standard of moral conduct in computer use is_____.

4. Translate the sentences into the Ukrainian language. Take into consideration the information presented in the sentences. It may be helpful to you while doing the next exercises and discussing the topic.

1. Many banks now offer automated services such as direct deposit of checks into customers' accounts and automatic payment of utility bills. 2. Using CAD, an engineer can design and draft a product model in color and three dimensions on a video terminal. 3. First-generation robots possess mechanical dexterity but no external sensory ability. 4. Nuclear magnetic resonance (NMR) scanning may replace CAT scanning in the future. 5. CAI stands for computer-assisted instruction. CAI software consists of drills, simulations, and tutorials. 6. Approximately 75 percent of the companies in the United States use some form of word processing. 7. Producing and reproducing documents is much easier with word-processing than with traditional typing methods. 8. White-collar crime is the most prevalent kind of computer crime because professional people generally have easier access to computers than others. 9. Personal ethics is generally thought of as being the only means of controlling computer crime since these crimes are so difficult to monitor. 10. Computer ethics determine attitudes toward the use of data base data, job behavior, and toward the copying of software.

5. Choose the right answer.

1. A cashless method of managing money that involves making account adjustments by electronic communication between computers is called_____.
   a. CAD
   b. EFT
   c. CAM "
   d. CAT

2. The process of designing, drafting, and analyzing a prospective product using computer graphics on a video terminal is called _____.
   a. CAD
   b. EFT
   c. CAM
   d. CAT

3. Second-generation robots possess _____.
   a. external sensory ability but no mechanical dexterity
   b. mechanical dexterity but no external sensory ability
   c. both mechanical dexterity and external sensory ability
   d. common sense thinking

4. The term applied to the processes that integrate computer and communication technology with traditional office procedures is _____.
   a. ergonomics
   b. telecommuting
   c. office automation
   d. teleconferencing

5. _____ allows employees to work on a terminal at home while connected to the office via phone lines
   a. Teleconferencing
   b. Telecomputing
   c. Telecommuting
   d. Electronic mail

6. A diagnostic tool that uses a combination of X-rays and computerized evaluations of the X-ray pictures is _____.
   a. multiphasic health testing
   b. computerized axial tomography
   c. nuclear magnetic resonance scanning
   d. multiphasic X-ray testing

7. Computers are used by military planners to _____wars.
   a. pretend
   b. simulate
   c. practice
   d. plan

8. What is a criticism of the National Crime Information Center?
   a. It makes too many mistakes in the information it keeps about criminals.
   b. The operating costs do not justify the benefits.
   c. The design of the system does not permit adequate sharing of information.
   d. Some fear innocent people may be damaged if their names accidentally become part of the network.

9. In_____ computer equipment aids in performing a series of tests, stores the results of the tests, and reports the results to doctors.
   a. computerized axial tomography
   b. multiphasic health testing
   c. nuclear magnetic resonance scanning
   d. multiphasic X-ray testing

10. The standard of moral conduct in computer use is referred to as _____.
   a. computer morality
   b. user ethics
   c. user behavior
   d. computer ethics

11. Computer crimes" are often committed by professional people, so they are referred to as_____ crimes.
   a. white-collar
   b. executive
   c. steel-collar
   d. clerical

12. Second-generation robots with "senses" of sight and touch are called _____robots.
   a. steel-collar
   b. tactile
   c. common sense
   d. bin-picking

13. The office automation technology used most often is _____.
a. word processing
b. local area networking
c. electronic mail
d. teleconferencing

14. What is CAI?
a. A type of medical testing involving computers and X-rays.
b. A design process that combines computers and specialized software.
c. Programmed learning using a computer and appropriate software.
d. The use of a computer to simulate or monitor the steps of a manufacturing process.

15. _____ is a computerized diagnostic tool that allows doctors to find internal problems without resorting to surgery or using methods involving radiation.
a. Multiphasic health testing
b. Computerized axial tomography
c. PIMS
d. Nuclear magnetic resonance scanning

6. Translate the words and word-combinations into English.

Прикладна програма, комп'ютерна грамотність, електронна пошта, автоматизація діловодства, телеконференція, текстовий редактор, база даних, мікропроцесор, автоматизоване проектування, програмне забезпечення, процес, комп'ютеризоване навчання, мікрокомп'ютер, реальний час, робот, технічне забезпечення, комп'ютерна томографія, незаконне користування комп'ютером, моделювати, термінал.

7. Say true or false and explain.

1. T F Second-generation robots can be said to have "common sense."

2. T F Computer-aided design uses X-rays, high-frequency sound waves, and laser beams to inspect the interiors of products without damaging them.

3. T F The largest user of computers in the United States is the auto industry.

4. T F The U.S. Justice Department is using the National Crime Information Center's computer network to keep track of people they consider to be threats to public figures even though these people may be innocent of any crime.

5. T F CAI software consists of drills, tutorials, and learning simulations.

6. T F Nuclear magnetic resonance (NMR) scanning uses magnetic pulses to "see" into the body, even through bones.

7. T F Telecommuting is a method of working at home and communicating via electronic machines and telecommunications facilities.

8. T F In 1982, Drexel University began requiring that their students buy personal computers.

9. T F Computer ethics is a term used to refer to the standard of moral conduct in computer use.

10. T F More than 70 percent of computer crimes result in convictions and jail sentences.

III DISCUSSING

1. Give the short answer.

1. What makes a robot a second-generation robot?
2. Who are people who benefit from telecommuting and how do they benefit?
3. Why do military planners use computers to simulate wars?
4. Why are people who are concerned with civil liberties worried about the Justice Department's monitoring of people deemed threats to public figures?
5. List some of the functions that hospital computers perform.
6. Why is it likely that nuclear magnetic resonance scanning (NMR) will take the place of CAT scanning in the future?
7. What are the provisions of the Privacy Act of 1974?
8. What is electronic mail? Describe a simple electronic mail system.
9. What is word processing?
10. What are the main concerns of the privacy issue?

2. Prepare reports using Internet or other sources (catalogues, magazines, books, etc.) about the latest news, achievements in the field concerning the topic of the chapter.

3. Summarize everything you have learnt on the topic.

4. Answer the question, taking into consideration quick pace of the latest achievements and developments in computer engineering and programming and information presented in the reports, what information from the texts of the Chapter should be reconsidered, changed, added, etc..

5. It's interesting to know…

Computer Applications

A student learns French by playing a computer game in which the object is to successfully rent an apartment in Paris.

Instead of building a physical model, an aerospace engineer saves millions of dollars and thousands of hours by testing an airframe concept on a computer.

His electronics-industry counterpart, using powerful computer-aided-design (CAD) tools, creates a computer that would have required the work of 40 engineers two decades ago.

A production manager uses an off-the-shelf expert system to help her troubleshoot a complex piece of machine-tool manufacturing equipment.

A marketing executive stores thousands of data points from a massive survey of consumer preferences and correlates them with a list of product characteristics.

A publishing executive has begun a survey of computer technology, because he senses a market for new kinds of information products.

Each of these people (and thousands more like them) has a vital interest in knowing what computers can (and cannot) do; if these managers and professionals are to succeed, they also need to know when the various rich promises of the technology will be realized in usable programs and devices. For the electronics and aerospace engineers, improvements in computer speed are extremely important. The production manager would like to know when she will have a diagnostic system that can learn different malfunction patterns as they evolve. The publishing executive faces a question of when and how to get on the technology curve: he must decide whether to convince skeptical and traditionally minded colleagues to embark on the development of software products for hardware that has only just begun to reach the market. The answers to these questions and many other challenges will unfold as computer science evolves. But that is too late for the men and women in business, government, the professions and academic life who must make plans now for how computers will be used. After all these managers and professionals, although generally aware of the potential of computers, are not computer experts or even literate in the simplest computer languages and uses.

The number of different computer applications is truly staggering. There are more different programs today than there are words in the English language. There are very few, if any, human activities that do not or could not use computers effectively. Supercomputers, which process information 100 million times faster than ordinary personal computers, have revolutionized the design of aircraft and automobiles. Instead of building expensive physical prototypes, engineers and designers can test designs through computer simulation saving millions of dollars and thousands of hours. Yet as Albert M. Erisman and Kenneth W. Neves of Boeing point out, the machines hold an exciting potential that remains to be realized to the benefit of both the industry and its customers.

Supercomputers (and in the not too distant future parallel processors) simulate large-scale and mesoscale climate and weather changes; atmospheric physicists and climatologists are beginning to gain confidence in their ability to understand the forces that determine climate. Their eventual success will have great scientific value and provide strong economic leverage in transportation, agriculture and other industries.

As computer technology matures, systems will play an increasingly important role in education and in the acquisition and maintenance of professional skills.

Until recently, the rapid technological growth of computers was the dominant driving force; application developers eagerly awaited the arrival of new software and the next, even faster machine. Today the proliferation of personal computers, the development of more convenient user interfaces and the discovery of powerful application-driven models such as spreadsheets have begun to swing the pendulum in the other direction. Now needs are beginning to drive .technological developments.

In the future, we are likely to see this trend strengthen. Imagine, for example, a computational laboratory in which you can experiment with chemical reactions, model astronomical phenomena or test business strategies for growth in an appropriate environment—all before trying them out in the real world. To achieve such power, gigantic simulators of small corners of our universe will have to contain many special circuits that are optimized to rapidly execute very specific applications. Comparable trends are likely to take place as the growing arsenal of better algorithms, more intelligent techniques and more powerful computational tools is marshaled at the service of office work, marketing, legal and financial advising, clinical decision making, tutoring and various forms of recreation.

This discussion of research thrusts has been an optimistic and hopeful assessment of the future of computing. To many people this kind of wide-eyed technological optimism is naive. I disagree! This does not mean that the field of computers is clear of evil. Individual privacy has been violated. Data banks have been broken into and their contents altered. Computer viruses, information terrorists that sabotage innocent software, have been planted. Humans have avoided responsibility by blaming incomprehensible programs.

UNIT 3

DATA PROCESSING AND COMPUTER HARDWARE

I PRE-READING

1. Recollect everything you studied concerning the topic, make notes. Write down the list of words in the Ukrainian language you think you will need while speaking on the topic.

2. a). Read the text and try to guess whether there are words from your list in it.

b). If you don't know the words, translate them using the dictionaries.

c). Choose the words from the list which are the most relevant for this topic.

d). If you don't know the meaning of any words or abbreviations, find their explanations in the Glossary.

e). Which words from exercises 1, 2c may be considered as general notions and which ones as technical terms?

f). Give explanations of several terms, using the Glossary.

Digital computers are based on manipulating discrete binary digits (1s and 0s). They are generally more effective than analog computers for four principal reasons: they are faster; they are not so susceptible to signal interference; they can transfer huge data bases more accurately; and their coded binary data are easier to store and retrieve than the analog signals.

A digital computer is a complex system of four functionally different elements: 1) the central processing unit (CPU), 2) input devices, 3) memory-storage devices called disk drives, 4) output devices. These physical parts and all their physical components are called hardware.

The central processing unit is the heart of a computer. In addition to performing arithmetic and logic operations on data, it controls the rest of the system. Sometimes the CPU consists of several linked microchips, each performing a separate task, but most computers require only a single microchip as the CPU.

Input devices let users enter commands, data, or programmes for processing by the CPU. Information typed at the computer keyboard, which is much like typewriter, is translated into a series of binary numbers the CPU can manipulate. The mouse is another widely used mechanical input device. To move the cursor on the display screen, the user moves the mouse, selects operations and activates commands on the screen by pressing buttons on the top of the mouse.

The power of computers greatly depends on the characteristics of memory-storage devices. Most digital computers store data both internally, in what is

called main memory, and externally, on auxiliary storage units. As a computer processes data and instructions, it temporarily stores information internally on special memory microchips. Auxiliary storage units supplement the main memory when programmes are too large and they also offer a more reliable method for storing data. There exist different kinds of auxiliary storage devices, removable magnetic disks being the most widely used. They can store up to 100 megabytes of data on one disk, a byte being known as the basic unit of data storage.

Output devices let the user see the results of the computer's data processing. Being the most commonly used output device, the monitor accepts video signals from a computer and shows different kinds of information such as texts, formulas and graphics on its screen. With the help of various printers information stored in one of the computer's memory systems can be easily printed on paper in a desired number of copies.

II READING

1. Read and translate the text into Ukrainian.

There are two types of computers. Analog computers measure continuous physical or electrical amounts, such as pressure, temperature, or voltage. Digital computers represent data by discrete "on" and "off states of their electronic circuitry. As far as business and scientific applications are concerned, *computer* generally refers to digital computers.

Computers are capable of performing only three basic functions: performing arithmetic operations, comparing values, and storing and retrieving data. These are all operations that humans can perform, but computers justify their use by being faster, more accurate, and having a vast memory capacity. The speed is limited only by the switching speed of the circuits and the distance electrical current has to travel. Accuracy depends on the reliability of electrical circuits which are virtually error free; errors occur as a result of faulty input (garbage in-garbage out).

Data processing, the collection, manipulation, and dissemination of data, becomes much more efficient when computerized (electronic data processing). Data processing converts data to information. Before processing, the data must be organized into fields (data items), records (collections of related fields), and files (collections of related records).

The three steps in data processing are: (1) input, the collecting, verifying, and coding of data; (2) processing, which may include classifying, sorting, calculating, summarizing, and storing data; and (3) output, the information retrieved from the computer and converted to a form understandable to the user. Processing can be batch (all at once) or interactive (entered, as output is required). Data may be

entered for processing online, through a device connected directly to the computer, or offline, through a device not directly connected to the computer.

The control unit and the arithmetic-logic unit, along with primary storage, make up the central processing unit (CPU) of a computer. The control unit maintains order in the CPU, the arithmetic/logic unit performs arithmetic and logical operations, and primary storage holds data and instructions needed for processing. This storing of data and instructions, called the stored-program concept, eliminates the need for any human intervention in processing.

There are several forms of primary storage in computers. Older computers used magnetic cores as a storage medium. The predominate form of storage now is semiconductor memory, which uses circuitry on silicon chips. Another type of storage is bubble memory. Magnetic spots, or domains, are created on a film of semiconductor material to store bits of data.

Memory space in the CPU to be used in processing is called RAM (random-access memory). ROM, (read-only memory) is part of the hardware of the computer containing instructions for permanent functions. ROM that can be programmed once is called programmable read-only memory (PROM). ROM that can be programmed more than once is called erasable programmable read-only memory (EPROM).

Data is represented in a computer by 1s and 0s (binary representation) which stand for "on" and "off states of electrical current running through its circuits. Special codes are used to allow combinations of the 1s and 0s to represent characters or numbers. The 4-bit binary coded decimal system uses four digits to represent the numbers 0-9. Other codes allowing the representation of many more characters are the 6-bit BCD, EBCDIC, A5СП-8, and A5СП-7.

To help programmers simplify the process of locating errors, the binary number system is often converted to octal (base 8) or hexadecimal (base 16) notation. This reduces considerably the number of figures that must be read to discover an error. Parity bits and check digits are other means employed in coding systems to help detect errors.

New, more powerful microcomputers are rapidly approaching mainframes in their capabilities. Memory expansion cards allow personal computer users access to millions of bytes of internal storage. One of the advantages of the microcomputer is that it is generally dedicated to one person and his or her tasks. This eliminates the waiting often necessary when using time on community mainframes.

2. Make up the logical scheme of the text and render the content of the text based on the scheme.

3. Fill in the gaps with the words from the list.

a. capacitors	g. instruction set
b. analog computers	h. microprograms
c. binary	i. byte
d. business	j. data
e. hexadecimal	k. opcode
f. information	1. operand

1. In digital computers, data is represented by a code of 1s and 0s which stand, respectively, for "on" and "off states of electrical current. This code is called _____representation.

2. Continuous physical and electrical magnitudes are measured by_____.

3. The instructions required to direct a computer in performing its basic functions are called the_____.

4. Raw facts that have been collected but not organized are known as_____.

5. The _____of a machine language instruction indicates primary memory locations of data to be processed.
6. Electrical charges are held by _____on semiconductors.
7. Sequences of instructions built into ROM that carry out functions frequently needed are called _____.
8. In the _____number system, 16 symbols represent the numbers 0 through 15.
9. A _____is a fixed number of bits operated on as a unit.
10. 512K of primary memory is needed to run complex _____software.

4. Translate the sentences into the Ukrainian language. Take into consideration the information presented in the sentences. It may be helpful to you while doing the next exercises and discussing the topic.

1. The equipment needed for data processing includes input devices, a central processing unit, output devices, and some kind of secondary storage device. 2. All a computer can do is to manipulate data and instructions entered by human operators. 3. Online data entry allows processing to take place while data is being entered. 4. Offline data entry requires batch processing of data items that have been collected over a period of time and entered on an entry device not connected directly to the computer. 5. Cache memory works as a buffer holding data and instructions that are frequently used by the CPU. 6. Magnetic cores worked by creating magnetic fields in either a clockwise (for an "on" condition) or counterclockwise (for an "off condition) direction. 7. Programmable read-only memory (PROM) allows users to program permanent functions into their computers to meet unique needs. 8. A parity bit is an extra bit at each storage location used to

check for internal errors. 9. The bit cells on a semiconductor are arranged in matrices of eight rows by eight columns. 10. Batch processing is also the most convenient method of manipulating data stored on magnetic tape.

5. Choose the right answer.

1. Before processing can occur, a digital computer must convert all its input into _____ form.
   a. binary
   b. decimal
   c. octal
   d. hexadecimal

2. A_____ is not an example of an analog computer.
   a. gasoline pump
   b. pressure gauge
   c. microprocessor
   d. speedometer

3. If programs or data fed to a computer are incorrect, the results will be meaningless. This illustrates the principle of_____.
   a. user garbage
   b. waste processing
   c. trash in-trash out
   d. garbage in-garbage out

4. Collecting raw data, verifying the data's accuracy, and coding the data into a form the computer can read are all steps in the _____phase of data processing.
   a. processing
   b. input
   c. output
   d. feedback

5. Data is entered _____when the entry device is connected directly to the computer.
   a. online
   b. offline
   c. interactively
   d. in a batch

6. Data is manipulated in the _____unit of the CPU.
   a. control
   b. arithmetic/logic
   c. primary storage
   d. ROM

7. A part of primary storage that serves as a temporary storage area for instructions and data is _____.
   a. a register
   b. an accumulator
   c. cache memory
   d. bubble memory

8. The type of primary storage used by second- and third-generation computers was _____memory.
   a. semiconductor
   b. bubble
   c. external
   d. magnetic core

9. A form of memory built into the hardware of a computer that can be programmed only once by the user is _____.
   a. RAM
   b. ROM
   c. PROM
   d. EPROM

10. _____ refer to storage locations in primary memory.
   a. Operands
   b. Addresses
   c. Variables
   d. Words

11. The _____ is a coding scheme developed in a cooperative effort by several computer manufactures.
   a. Extended Binary Coded Decimal Interchange Code
   b. American Standard Code for Information Interchange
   c. 4-bit BCD
   d. 6-bit BCD

12. A method of error detection performed in the computer's circuits makes use of a _____.
   a. parity bit
   b. check digit
   c. parity digit
   d. check bit

13. The locations where data is stored on semiconductors are called _____.
   a. transistors
   b. addresses
   c. words
   d. bit cells

14. A series of instructions placed in memory is called a_____.
   a. cache program
   b. control program
   c. stored program
   d. RAM program

15. In _____processing, data items are collected over a period of time and processed all at once.
   a. interactive
   b. batch
   c. online
   d. offline

6. Translate the words and word-combinations into English.

Арифметико-логічний пристрій, бульбашкова пам’ять, центральний процесор, опрацювання даних, електронне опрацювання даних, зворотний зв’язок, система числення, код операції, розряд парності, оперативна пам'ять, програмована постійна пам’ять, постійна пам'ять, біт зони, напівпровідникова пам'ять, двійковий розряд, байт, система команд, діалогове опрацювання, програміст, завантажена програма**.**

7. Say true or false and explain.

1. T F In analog computers data is represented by discrete "on" and "off states of electrical current.
2. T F Garbage in-garbage out refers to the results of processing incorrect data.
3. T F Input, processing, and feedback constitute the basic flow of data processing.
4. T F Nondestructive read/destructive write is the basic characteristic of ROM.
5. T F RAM is volatile, or nonpermanent.
6. T F Bubble memory preserves stored data even in the event of a power failure.
7. T F Binary representation is used by programmers when trying to detect errors in programs because octal and hexadecimal number systems are much more complicated.
8. T F The Extended Binary Coded Decimal Interchange Code (EBCDIC) was developed as a standard coding system for all computers.
9. T F Check digits are extra bits at each storage location in primary memory used to check for internal errors.
10. T F In coding systems for data representation, zone bits are used in combination with numeric bits to represent numbers, letters, and special characters.

III DISCUSSING

1. Give the short answer.

1. Distinguish between digital and analog computers.
2. What types of manipulations are involved in the processing phase of data processing?
3. Briefly explain the principle of garbage in-garbage out.
4. What is a central processing unit of a computer, and what are its functions?
5. To what does nondestructive read/destructive write refer?
6. What is bubble memory, and what are its strengths and weaknesses?
7. Explain the different versions of ROM.
8. What is the hexadecimal number system and for what is it used?
9. What is the significance of the development of semiconductor memory?
10. Explain briefly, why the differences between microcomputers and the larger mainframes are blurring.

2. Prepare reports using Internet or other sources (catalogues, magazines, books, etc.) about the latest news, achievements in the field concerning the topic of the chapter.

3. Summarize everything you have learnt on the topic.

4. Answer the question, taking into consideration quick pace of the latest achievements and developments in computer engineering and

programming and information presented in the reports, what information from the texts of the Chapter should be reconsidered, changed, added, etc..

5. It's interesting to know…

How Computer Memory Works

Although memory is technically any form of electronic storage, it is used most often to identify fast, temporary forms of storage. If your computer's CPU had to constantly access the hard drive to retrieve every piece of data it needs, it would operate very slowly. When the information is kept in memory, the CPU can access it much more quickly. Most forms of memory are intended to store data temporarily.

The CPU accesses memory according to a distinct hierarchy. Whether it comes from permanent storage (the hard drive) or input (the keyboard), most data goes in random access memory (RAM) first. The CPU then stores pieces of data it will need to access, often in a cache, and maintains certain special instructions in the register.

All of the components in your computer, such as the CPU, the hard drive and the operating system, work together as a team, and memory is one of the most essential parts of this team. From the moment, you turn your computer on until the time you shut it down, your CPU is constantly using memory. Let's take a look at a typical scenario:

- You turn the computer on.
- The computer loads data from read-only memory (ROM) and performs a power-on self-test (POST) to make sure all the major components are functioning properly. As part of this test, the memory controller checks all of the memory addresses with a quick read/write operation to ensure that there are no errors in the memory chips. Read/write means that data is written to a bit and then read from that bit.
- The computer loads the basic input/output system (BIOS) from ROM. The BIOS provides the most basic information about storage devices, boot sequence, security, Plug and Play (auto device recognition) capability and a few other items.
- The computer loads the operating system (OS) from the hard drive into the system's RAM. Generally, the critical parts of the operating system are maintained in RAM as long as the computer is on. This allows the CPU to have immediate access to the operating system, which enhances the performance and functionality of the overall system.
- When you open an application, it is loaded into RAM. To conserve RAM usage, many applications load only the essential parts of the program initially and then load other pieces as needed.

- After an application is loaded, any files that are opened for use in that application are loaded into RAM.
- When you save a file and close the application, the file is written to the specified storage device, and then it and the application are purged from RAM.

In the list above, every time something is loaded or opened, it is placed into RAM. This simply means that it has been put in the computer's temporary storage area so that the CPU can access that information more easily. The CPU requests the data it needs from RAM, processes it and writes new data back to RAM in a continuous cycle. In most computers, this shuffling of data between the CPU and RAM happens millions of times every second. When an application is closed, it and any accompanying files are usually purged (deleted) from RAM to make room for new data. If the changed files are not saved to a permanent storage device before being purged, they are lost.

The Need for Speed

One common question about desktop computers that comes up all the time is, "Why does a computer need so many memory systems?" A typical computer has: level 1 and level 2 cashes, normal system RAM, virtual memory, a hard disk.

Fast, powerful CPUs need quick and easy access to large amounts of data in order to maximize their performance. If the CPU cannot get to the data it needs, it literally stops and waits for it. Modern CPUs running at speeds of about 1 gigahertz can consume massive amounts of data - potentially billions of bytes per second. The problem that computer designers face is that memory that can keep up with a 1-gigahertz CPU is extremely expensive - much more expensive than anyone can afford in large quantities. Computer designers have solved the cost problem by "tiering" memory - using expensive memory in small quantities and then backing it up with larger quantities of less expensive memory. The cheapest form of read/write memory in wide use today is the hard disk. Hard disks provide large quantities of inexpensive, permanent storage. You can buy hard disk space for pennies per megabyte, but it can take a good bit of time (approaching a second) to read a megabyte off a hard disk. Because storage space on a hard disk is so cheap and plentiful, it forms the final stage of a CPUs memory hierarchy, called virtual memory.

The bit size of a CPU tells you how many bytes of information it can access from RAM at the same time. For example, a 16-bit CPU can process 2 bytes at a time (1 byte = 8 bits, so 16 bits = 2 bytes), and a 64-bit CPU can process 8 bytes at a time.

Megahertz (MHz) is a measure of a CPU's processing speed, or clock cycle, in millions per second. So, a 32-bit 800-MHz Pentium III can potentially process 4 bytes simultaneously, 800 million times per second (possibly more based on pipelining)! The goal of the memory system is to meet those requirements.

A computer's system RAM alone is not fast enough to match the speed of the CPU. That is why you need a cache (see the next section). However, the faster RAM is the better. Most chips today operate with a cycle rate of 50 to 70 nanoseconds. The read/write speed is typically a function of the type of RAM used, such as DRAM, SDRAM, and RAMBUS. System RAM speed is controlled by bus width and bus speed. Bus width refers to the number of bits that can be sent to the CPU simultaneously, and bus speed refers to the number of times a group of bits can be sent each second. A bus cycle occurs every time data travels from memory to the CPU. For example, a 100-MHz 32-bit bus is theoretically capable of sending 4 bytes (32 bits divided by 8 = 4 bytes) of data to the CPU 100 million times per second, while a 66-MHz 16-bit bus can send 2 bytes of data 66 million times per second. If you do the math, you will find that simply changing the bus width from 16 bits to 32 bits and the speed from 66 MHz to 100 MHz in our example allows for three times as much data (400 million bytes versus 132 million bytes) passing through to the CPU every second. In reality, RAM doesn't usually operate at optimum speed. Latency changes the equation radically. Latency refers to the number of clock cycles needed to read a bit of information. For example, RAM rated at 100 MHz is capable of sending a bit in 0.00000001 seconds, but may take 0.00000005 seconds to start the read process for the first bit. To compensate for latency, CPUs uses a special technique called burst mode.

Burst mode depends on the expectation that data requested by the CPU will be stored in sequential memory cells. The memory controller anticipates that whatever the CPU is working on will continue to come from this same series of memory addresses, so it reads several consecutive bits of data together. This means that only the first bit is subject to the full effect of latency; reading successive bits takes significantly less time. The rated burst mode of memory is normally expressed as four numbers separated by dashes. The first number tells you the number of clock cycles needed to begin a read operation; the second, third and fourth numbers tell you how many cycles are needed to read each consecutive bit in the row, also known as the word line. For example, 5-1-1-1 tells you that it takes five cycles to read the first bit and one cycle for each bit after that. Obviously, the lower these numbers are, the better the performance of the memory. Burst mode is often used in conjunction with pipelining, another means of minimizing the effects of latency. Pipelining organizes data retrieval into a sort of assembly-line process. The memory controller simultaneously reads one or more words from memory, sends the current word or words to the CPU and writes one or more words to memory cells. Used together, burst mode and pipelining can dramatically reduce the lag caused by latency.

So why wouldn't you buy the fastest, widest memory you can get? The speed and width of the memory's bus should match the system's bus. You can use memory designed to work at 100 MHz in a 66-MHz system, but it will run at the

66-MHz speed of the bus so there is no advantage, and 32-bit memory won't fit on a 16-bit bus.

Cache and Registers

Even with a wide and fast bus, it still takes longer for data to get from the memory card to the CPU than it takes for the CPU to actually process the data. Caches are designed to alleviate this bottleneck by making the data used most often by the CPU instantly available. This is accomplished by building a small amount of memory, known as primary or level 1 cache, right into the CPU. Level 1 cache is very small, normally ranging between 2 kilobytes (KB) and 64 KB.

The secondary or level 2 cache typically resides on a memory card located near the CPU. The level 2 cache has a direct connection to the CPU. A dedicated integrated circuit on the motherboard, the L2 controller, regulates the use of the level 2 cache by the CPU. Depending on the CPU, the size of the level 2 cache ranges from 256 KB to 2 megabytes (MB). In most systems, data needed by the CPU is accessed from the cache approximately 95 percent of the time, greatly reducing the overhead needed when the CPU has to wait for data from the main memory. Some inexpensive systems dispense with the level 2 cache altogether. Many high performance CPUs now have the level 2 cache actually built into the CPU chip itself. Therefore, the size of the level 2 cache and whether it is onboard (on the CPU) is a major determining factor in the performance of a CPU.

A particular type of RAM, static random access memory (SRAM), is used primarily for cache. SRAM uses multiple transistors, typically four to six, for each memory cell. It has an external gate array known as a bistable multivibrator that switches, or flip-flops, between two states. This means that it does not have to be continually refreshed like DRAM. Each cell will maintain its data as long as it has power. Without the need for constant refreshing, SRAM can operate extremely quickly. However, the complexity of each cell make it prohibitively expensive for use as standard RAM. The SRAM in the cache can be asynchronous or synchronous. Synchronous SRAM is designed to exactly match the speed of the CPU, while asynchronous is not. That little bit of timing makes a difference in performance. Matching the CPU's clock speed is a good thing, so always look for synchronized SRAM.

The final step in memory is the registers. These are memory cells built right into the CPU that contain specific data needed by the CPU, particularly the arithmetic and logic unit (ALU). An integral part of the CPU itself, they are controlled directly by the compiler that sends information for the CPU to process.

UNIT 4

INPUT AND OUTPUT DEVICES

I PRE-READING

1. Recollect everything you studied concerning the topic, make notes. Write down the list of words in the Ukrainian language you think you will need while speaking on the topic.

2. a). Read the text and try to guess whether there are words from your list in it.

b). If you don't know the words, translate them using the dictionaries.

c). Choose the words from the list which are the most relevant for this topic.

d). If you don't know the meaning of any words or abbreviations, find their explanations in the Glossary.

e). Which words from exercises 1, 2c may be considered as general notions and which ones as technical terms?

f). Give explanations of several terms, using the Glossary.

Input devices, such as a keyboard or mouse, permit the computer user to communicate with the computer. Other input devices include a joystick, a rod like device often used by game players; a scanner, which converts images such as photographs into binary information that the computer can manipulate; a light pen, which can draw on, or select objects from, a computer's video display by pressing the pen against the display's surface; a touch panel, which senses the placement of a user's finger; and a microphone, used to gather sound information.

Once the CPU has executed the program instruction, the program may request that information be communicated to an output device, such as a video display monitor or a flat liquid crystal display. Other output devices are printers, overhead projectors, videocassette recorders (VCRs), and speakers.

II READING

1. Read and translate the text into Ukrainian.

Punched cards provide a means of entering data into computers. A special code using an 80 column by 12- row format, the Hollerith code, is used to store data on the cards with a keypunch device. For most applications, punched cards have been replaced by more efficient methods of data entry.

Magnetic tape and magnetic disks provide very efficient means of entering data. Unlike punched cards, these media are reusable. They use only a fraction of the space that punched cards use to store data, and processing is also a great deal faster with magnetic media. Key-to-tape and key-to-disk devices are used to store data on magnetic media.

A new approach that saves much time in the data entry stage of data processing is source-data automation which involves collecting data about an event when and where the event takes place and in a computer-readable form. Methods of implementing source-data automation include magnetic-ink character recognition, used by banks in coding checks and other documents; optical recognition, used to read bar codes such as the UPC found on products in supermarkets; and remote input which provides online data entry through devices such as POS terminals, wand readers, and touch-tone devices. Intelligent terminals are also used as remote input devices. Intelligent terminals can be programmed with stored instructions; editing and other manipulating functions can be performed on data before it is sent to the central computer.

Computer printers produce permanent copies of processing results in a form readable by humans. There are two types of printers-impact printers and nonimpact printers.

Impact printers use print elements that are physically pressed against paper. They are divided into two categories: character-at-a-time printers and line-at-a-time printers. Character-at-a-time printers include: (1) printer-keyboards which are similar to typewriters, (2) dot-matrix printers which can print up to 900 characters per minute, and (3) daisy-wheel printers which can produce up to 50 characters per second. The principle types of line-at-a-time printers are: (1) print-wheel printers (up to 150 lines per minute), (2) chain printers (up to 2,000 lines per minute), and (3) drum printers (up to 3,000 lines per minute).

Nonimpact printers do not use printing elements that strike paper. They are quieter than impact printers and are typically faster. Electrostatic printers use electrical charges to form character patterns on pages. Electrothermal printers use heat and heat-sensitive paper to generate patterns. Ink-jet printers shoot a stream of ink through an electrical field to create characters. Xerographic printers print using the same methods as photocopying machines. Laser printers use laser beams to burn characters onto photographic paper. Laser printers are capable of generating up to 21,000 lines per minute and are often used to print books.

Special-purpose input and output devices allow special formatting of information. Visual display terminals show data on CRTs. They provide soft-copy, or temporary, output. Plotters are printing devices that can produce complex charts and graphs in hard-copy, or permanent form. Computer output microfilm consists of miniature photographic images produced by a computer. A great deal of data can

be stored in a small amount of space with microfilm. Voice input and output devices allow computers to understand human speech patterns and read aloud output in a synthesized human voice. Graphics tablets allow users to draw pictures that can be viewed on a CRT. Spatial digitizers allow three-dimensional images to be produced on a computer screen. Touch screens are computer screens that allow certain operations to be initiated by simply touching the screen. A mouse is a small, hand-moveable device mat allows quick and easy movement of the cursor on a computer screen.

A recent innovation in microcomputing is a pressure-sensitive, membrane-covered keyboard, which is particularly useful with computers used by children and the disabled. Spoolers are devices that serve as buffers, allowing users to continue entering data while printing operations are being carried out.

2. Make up the logical scheme of the text and render the content of the text on the basis of the scheme.

3. Fill in the gaps with the words from the list.

a. electrothermal
b. source-data automation
c. fixed scanners
d. voice response unit
e. intelligent terminal
f. touch screen
g. voice recognition system
h. optical-mark recognition
i. optical character recognition
j. spatial digitizer
k. daisy-wheel
1. plotter

1. The speed, accuracy, and efficiency of data-processing operations are improved by_____ which eliminates intermediate steps involving preparing data for entry.
2. Machine scoring of multiple-choice exams involves the use of a(n) _____device.
3. POS terminals often have_____ that read the UPC stamped on items.
4. A remote input device that can be programmed with stored instructions is a(n) _____.
5. A(n) _____ printer uses a flat disk with petal-like projections to print characters.
6. Heat and heat sensitive paper are used to print with _____printers.
7. An output device that converts information from the computer into hard-copy graphics form is a(n) _____.
8. A(n) _____allows data to be entered into the computer by speaking to it.
9. A(n) _____is sensitive to touch and allows choices to be made by making contact with the screen.
10. Three-dimensional graphics can be generated on a CRT through the use of a(n) _____.

4. Translate the sentences into the Ukrainian language. Take into consideration the information presented in the sentences. It may be helpful to you while doing the next exercises and discussing the topic.

1. Punched cards were used for data processing even before the digital computer was developed. 2. Holes punched in the cards using a special code, the Hollerith code, can store data that is read when the computer senses the positions of the holes. 3. Source-data automation improves speed, accuracy, and thus the efficiency of data processing by removing intermediate steps in the operation. 4. Optical-character recognition devices recognize characters by their shapes rather than by the positions of marks. 5. Nonimpact printers use electrical charges, heat, spray nozzles, photographic techniques, and laser beams to generate copies. 6. Computer output microfilm provides a very efficient means of storing information that would otherwise need to be stored in paper files. 7. A pencil like device is used to draw on the surface of the graphics tablet. 8. Voice responses units "speak" by arranging prerecorded voice sounds into the message to be delivered. 9. The digitizer has an arm or pointer with which the user traces an object, allowing the device to determine its X, Y, and Z coordinates. 10. The membrane keyboard is also in industrial settings where dust can cause a problem.

5. Choose the right answer.

1. Which of these was used first as a means of entering data for data processing?
   a. magnetic tape
   b. magnetic disks
   c. magnetic cores
   d. punched cards

2. In _____data is collected about an event when and where it takes place and in computer-readable form.
   a. remote terminal automation
   b. source-data automation
   c. remote optical recognition
   d. remote input

3. What method is used to implement source-data automation in check processing by the banking industry?
   a. magnetic-ink character recognition
   b. optical-mark recognition
   c. optical-character recognition
   d. remote input

4. _____ devices "see" characters and recognize them by their shapes.
   a. Magnetic-ink character recognition
   b. Optical-mark sensing
   c. Optical-character recognition
   d. Remote input

5. A permanent, readable version of computer output is called_____.
   a. hard copy
   b. soft copy
   c. paper output
   d. hardware

6. Print elements are not pressed against paper in _____printers.
   a. dot-matrix
   b. electrostatic
   c. daisy-wheel
   d. drum

7. _____printers can print at speeds of up to 21,000 lines per minute and are often used to print books.
   a. Xerographic
   b. Electrothermal
   c. Drum
   d. Laser

8. A_____ is a hard-copy output device for graphics.
   a. graphics tablet
   b. graphic display device
   c. plotter
   d. spatial digitizer

9. When large amounts of information need to be printed and stored, _____ is often used to save space and make future accessing faster.
   a. computer output microfilm
   b. magnetic film
   c. photo miniaturization
   d. magnetic tape

10. A device that allows the user to draw on a board like surface and see on a CRT what she or he has drawn, is a_____.
   a. spatial digitizer
   b. touch screen
   c. mouse
   d. graphics tablet

11. A device used in supermarkets to verbally inform the customer of the amount of each purchase is a_____.
   a. voice recognition system
   b. voice response unit
   c. wand reader
   d. bar code reader

12. Three-dimensional graphics can be generated by use of a_____.
   a. graphics tablet
   b. light pen
   c. plotter
   d. spatial digitizer

13. A _____ controls the movement of the computer's cursor by rolling on a flat surface.
   a. light pen
   b. mouse
   c. joystick
   d. plotter

14. A device for microcomputers that allows a user to continue entering data while printing operations are being carried out is called a_____.
   a. spooler
   b. printer by-pass
   c. register
   d. print cache

15. A type of keyboard for microcomputers designed for use by children and disabled people is the_____.
   a. touch-tone device
   b. membrane keyboard
   c. touch board
   d. touch screen

6. Translate the words and word-combinations into English.

Сканер штрихового коду, електронно-променева трубка**,** сенсорний екран, система розпізнавання голосу, пристрій перемотування, пелюстковий друкарський пристрій, мембранна клавіатура, касовий термінал, оптичне розпізнавання символів, безконтактний друкарський пристрій, лазерний друкарський пристрій, пристрій струменевого друку, графічний дисплей, барабанний друкарський пристрій, редагування, електричний заряд, документальна копія, лазерний промінь, магнітний носій (даних), сканер.

7. Say true or false and explain.

1. T F Punched cards have been rendered completely obsolete by magnetic media data entry.

2. T F The purpose of source-data automation is to collect data about an event in computer-readable form when and where the event takes place.

3. T F Magnetic-ink character recognition is used by the banking industry in check processing.

4. T F Dumb terminals are terminals that cannot be used in conjunction with voice response units.
5. T F Nonimpact printers are typically faster than impact printers.
6. T F Electrothermal printers are often used in situations where high noise levels would create a problem.
7. T F Plotters are used to generate three-dimensional graphics on CRTs.
8. T F Computer output microfilm involves a computerized photographic miniaturization process.
9. T F The mouse is a device used to move the cursor around on computer display screens.
10. T F Graphics tablets are very similar to memory expansion cards in that they are simply inserted into the computer's hardware.

III DISCUSSING

1. Give the short answer.

1. What is the current function of punched cards?
2. What advantage does source-data automation offer over collecting data for processing later?
3. What are methods of implementing source-data automation?
4. Describe an intelligent terminal and what it can do.
5. Compare impact and nonimpact printers.
6. Why might an engineer need a plotter rather than a printer?

7. Voice recognition systems and voice response units allow users to interface vocally with computers. What are some practical uses for this technology?
8. What is computer output microfilm and why is it used?
9. To whom would membrane keyboards be particularly useful?
10. What is a spooler and why is it necessary?

2. Prepare reports using Internet or other sources (catalogues, magazines, books, etc.) about the latest news, achievements in the field concerning the topic of the chapter.

3. Summarize everything you have learnt on the topic.

4. Answer the question, taking into consideration quick pace of the latest achievements and developments in computer engineering and programming and information presented in the reports, what information from the texts of the Chapter should be reconsidered, changed, added, etc…

5. It's interesting to know…

Input/Output Devices (External)

Input and output devices are similar in operation but perform opposite functions. It is through the use of these devices that the computer is able to communicate with the outside world. Input data may be in any one of three forms:

- Manual inputs from a keyboard or console
- Analog inputs from instruments or sensors
- Inputs from a source on or in which data has previously been stored in a form intelligible to the computer

Computers can process hundreds of thousands of computer words or characters per second. Thus, a study of the first method (manual input) reflects the inability of human-operated keyboards or keypunches to supply data at a speed that matches the speed of digital computers. A high average speed for keyboard operation is two or three characters per second, mat, when coded to form computer words, would reduce the data input rate to the computer to less than a computer word per second. Since mainframe computers are capable of reading several thousand times this amount of information per second, it is clear that manual inputs should be minimized to make more efficient use of computer time. However, as a rule, the keyboard is the normal input media for microcomputers.

Input data that has previously been recorded on paper tapes, magnetic tapes, magnetic disks, or floppy disks in a form understood by the program may also be entered into the computer. These are much faster methods than entering data manually from a keyboard. The most commonly used input devices in this

category are magnetic tape units, magnetic disk drive units, and floppy disk drive units.

Output information is also made available in three forms:

- Displayed information: codes, numbers, words, or symbols presented on a display device like a cathode-ray screen
- Control signals: information that operates a control device, such as a lever, aileron, or actuator
- Recordings: information that is stored in a machine language or human language on tapes, disks, or printed media

Devices that display, store, or read information include magnetic tape units, magnetic disk drive units, floppy disk drive units, printers, and display devices.

Printers (Output)

Printers are widely used output devices that express coded characters on hard (paper document) copy. They print out computer program results as numbers, letters, words, symbols, graphics, or drawings. Printers range from electronic typewriters to high-speed printers. High-speed printers are usually used on mainframes and minis to prepare supply requisitions, paychecks, inventory, or financial reports at 10 lines per second and faster. The types of printers we'll discuss are daisy-wheel, dot matrix, ink jet, and laser. These are the ones commonly used with personal computers.

Daisy-wheel printers have the most professional-looking, pleasing-to-the-eye print of all the printers in the character-at-a-time impact printer class. Daisy-wheel printers are often used in an office or word processing environment, where crisp, sharp, high-quality (letter quality) characters are a must. The daisy-wheel printer uses a round disk, with embossed characters located at the end of each petal-like projection (one character per petal), similar to the petals of a daisy. A drive motor spins the wheel at a high rate of speed. When the desired character spins to the correct position, the print hammer strikes that character causing it to be printed on the paper. Once printed, the daisy wheel continues to move, searching out the next character to be printed, until the line is completed. The speeds of daisy-wheel printers range from 30 to 60 characters per second (cps).

Dot-Matrix Printers

Dot-matrix printers, (also known as the wire matrix printers) create characters in much the same way you see numbers on the Scoreboard at a baseball or football game. In contrast to the daisy-wheel printers, dot-matrix printers use an arrangement of tiny pins or hammers, called a dot matrix, to generate characters a dot-at-a-time. A dot-matrix print head builds characters out of the dots created by the pins in the matrix.

The dot matrix is defined in terms of rows and columns of dots. A 5 by 7 matrix uses up to five vertical columns of seven dots to create a character. The size of dot matrixes varies from a 5 by 7 matrix to as large as a 58 by 18 matrix.

A number of dot-matrix printers use a single vertical column of pins to print characters. The characters are printed by moving (stepping) the print head a small amount and printing the vertical columns one at a time until the character is printed.

The size of the matrix determines the quality of the printed character. In other words, the more dots used to print a character, the better the character is filled in and the higher its print quality. Dot-matrix printers are faster than the daisy-wheel printers with speeds ranging from 60 to 350 cps, but their print quality is not as good.

Ink Jet Printers

Ink jet printers employ a technique very similar to the way we use a can of spray paint and a stencil. A spray of electrically charged ink is shot (under pressure) toward the paper. Before reaching the paper, the ink is passed through an electrical field which forms the letters in a matrix form. The print resulting from this process consists of easy to read, high-quality characters. Some manufacturers use large droplets of ink for faster printing, while others use small droplets for better clarity but with slightly reduced printing speeds. These printers can print up to 300 cps.

Laser Printers

Laser printers direct a beam of light through a rotating disk containing the full range of print characters. The appropriate character image is directed onto photographic paper, which is then put through a toner, developed, and used to make additional copies. The print resulting from this process consists of sharp, clean images that are easy on the eyes. These printers can print up to 20, 000 plus lines per minute, or 26, 666 cps (characters per second).

Keyboards (Input)

A keyboard is nothing more than an array of switches called key switches. Keyboards are designed to input a code to the computer when a key switch is depressed. Each key switch, or key, on the keyboard is assigned a particular code value; and it is usually imprinted with a legend to identify its function.

The primary purpose of a keyboard is to enter or input alphanumeric (numbers, letters, and special characters) character codes. The major grouping of key switches on a keyboard will be in one of the two styles of a typewriter keyboard arrangement (QWERTY or DVORAK).

Other groupings of key switches are used for special purposes, such as number entry (calculator) keypads, special function switches (F1-F12), and cursor control keys. The special function switches allow an operator to use the special functions designed in the software. For example, in a word processing program, you can use them to spell check a document, search for a particular portion of text, move text from one place to another, and to print hard copies of

a document. These are but a few of the functions allowed; however, as you become more familiar with computers you will learn them all. The cursor control key allows you to move to different locations on the screen.

The design of keyboards varies from device to device and is dependent on the requirements of the system in which the keyboards are installed.

Keyboards are generally used with nontactical computer systems. However, the newer tactical display system consoles have optional keyboards for data entry. A keyboard may be built into the display device, or it may be a separate component connected only by a communication cable.

Display Devices

Display devices are the crts and other displays that are part of computer terminals, computer consoles, and microcomputers. They are designed to project, show, exhibit, or display softcopy information (alphanumeric or graphic symbology).

The information displayed on a display device screen is not permanent. That is where the term soft-copy comes from. The information is available for viewing only as long as it is on the display screen. Two types of display devices used with personal/microcomputers are the raster scan crt's and the flat panel displays.

Raster Scan Crts

Raster scan crts (tv scan video monitors or display monitors) are used extensively in the display of alphanumeric data and graphics. They are used primarily in nontactical display applications such as SNAP II user terminals and desktop computers.

The raster is a series of horizontal lines crossing the face of the crt screen. Each horizontal line is made up of one trace of the electron beam from left to right. The raster starts at the top left corner of the crt screen. As each horizontal line is completed, the blanked electron beam is rapidly returned or retraced to the left of the screen.

Vertical deflection moves the beam down, and the horizontal sweep repeats. When the vertical sweep reaches the bottom line of the raster, a vertical blanked retrace returns the sweep to the starting position of the raster, and the process is repeated.

Each completed raster scan is referred to as a field; two fields make up a frame. The display rate of fields and frames determines the amount of flicker in the display that is perceived by the human eye. Each field is made up of approximately 525 horizontal lines. The actual number of horizontal lines varies from device to device. A frame consists of the interlaced lines of two fields. The horizontal lines of the two fields are interlaced to smooth out the display. A display rate of 30 frames per second produces a smooth, flicker-free raster and corresponding display on the screen.

PICTURE ELEMENTS - the actual display of data results from the use of picture elements. A picture element is a variable dot of light derived from video signals input to the display monitor. The picture elements, often called pixels, are contained in the horizontal scan lines crossing the face of the crt screen. The horizontal and vertical sweeps are continuous and repetitive in nature.

Pictures with alphanumeric characters and graphics can be created and displayed by varying the intensity or brightness of the picture element dots. This is done in conjunction with the phosphor coating on the face of the crt.

The number of picture elements in each horizontal line varies from device to device. The actual number of picture elements is dependent on the frequency bandwidth of the video monitor, the number of characters to be displayed on a line, and the physical size of the screen.

Each picture element is addressable by a row and column address. Picture elements are numbered from left to right on each horizontal line (column number). Each horizontal line has a row number. Picture elements, at a minimum, will have off (blanked) or on (full intensity) states. Many display devices have the capability to display picture elements at varying degrees of intensity for the display of graphics.

Characters are assembled on the screen in much the same way as a dot-matrix print head prints a character. It takes several horizontal lines and picture elements on each line to create a character.

Approximately 640 picture elements per horizontal line are required for the display of an 80-character line. Therefore, you can expect 140, 000 picture elements on a raster scan display screen (80 alphanumeric characters per line and 25 lines).

HORIZONTAL AND VERTICAL RESOLUTION - horizontal resolution is defined in terms of the number of picture elements that can be displayed on the horizontal line without overlapping or running into each other. It is often stated in terms of lines of resolution. In other words, a monitor with a horizontal resolution of 1, 000 lines can display 1, 000 vertical lines using 1, 000 picture elements per line.

Vertical resolution depends on the number of horizontal scan lines used by the particular display raster. Generally, the greater the number of scan lines, the easier it is to resolve a horizontal line of display. This characteristic remains true up to a point, called the merge point, where the variation between the lines cannot be detected by the human eye.

DISPLAYING DATA ON RASTER SCAN SCREENS - raster scan displays are repetitive in nature. The raster frame is displayed approximately 30 times a second. The basic video monitor does nothing more than display the video signals it receives. If no video signals are received, then all the picture elements remain blanked, and the screen is blank in each frame. For data to be displayed accurately, each and every frame must blank and unblank the same picture elements.

The (digital logic that drives video monitors is designed to take advantage of the repetitive nature of frames. There can only be a fixed number of picture elements on the screen of a display; therefore, the contents of the display screen are organized into a data unit called a page.

The page contains the status of every picture element on the display screen. The page is usually stored in some form of random-access memory, RAM chips being the most common. The contents of page memory, or, as it is sometimes called, video memory, are continually scanned by the video generation logic and used to develop the video signals for the picture element display. The picture element locations in page memory are read in time to develop the video signals for the picture element display on the horizontal lines.

If the display is to be changed, the contents of page memory must be changed. The display on the screen changes as new data is stored in page memory. Two addressing methods are used with page memory.

Unformatted Displays. Displays that reference page memory by picture element address are called unformatted or fully populated displays. These displays are more commonly used for graphics rather than alphanumeric characters.

Formatted Displays. Often displays are organized by character position and line number. These displays are known as formatted displays. This display method is used with devices displaying alphanumeric characters only or those with an alternate graphic capability.

The video generation logic of these types of displays scans the entire page memory, as before, to generate the display picture elements. The difference is in the way the new data is written into the page memory. Individual picture element addresses are not used. Character addresses are used to reference page memory.

The screen is organized into character lines. Each line is made up of a fixed number of character positions or columns. A fixed number of character lines can be displayed. A common arrangement found on display screens is twenty five 80-character lines, or 2, 000 characters.

The character set that can be displayed on a device's formatted screen is stored in ROMs or PROMS. That is, the dot-matrix (picture element) patterns for each individual character to be displayed are stored. Different character sets may be displayed by simply replacing the appropriate ROM or PROM chips with new chips containing different character patterns appropriate character position in the page memory. The desired character is than displayed at the correct position. Other display devices store the codes in page memory and convert the codes to picture element dots when scanning memory to refresh or redisplay the i characters on the screen. The use of formatted displays greatly simplifies the programming requirements for the display of alphanumeric data.

Flat Panel Displays

A number of display methods are in use that are designed to reduce the depth of the crt display caused by the length of the tube. These devices are collectively known as flat panel displays. Three types of flat panel displays commonly in use with computer systems are liquid crystal displays (LCDs), gas plasma displays (GPDs), and electroluminescent displays (ELDs).

The screens of these flat panel displays are made up of pairs of electrodes. Each pair of electrodes is used to generate one picture element.

The liquid crystal display differs from the gas plasma and electroluminescent displays in that it does not generate its own light for the picture elements. The LCD requires an external light source, often called a backlight, for computer applications. The liquid crystal material between the charged electrodes becomes translucent when voltage is applied and allows the backlight to shine through as a picture element.

In the gas plasma and electroluminescent displays, the picture element light is generated by ionizing a gas (neon or neon argon) between the charged electrodes (gas plasma display) or by stimulating a luminescent material in the same manner (electroluminescent display). In either case, the picture element only emits light when the electrodes have voltage applied to them.

One of the advantages of flat panel displays is that smaller voltages are required for their operation than for a crt. Gas plasma displays use approximately 200 volts to charge the electrodes, and electroluminescent displays require only 20 volts.

The picture elements in these displays are addressed by the row and column method. Displays with as many as 737,280 picture elements (960 rows by 768 columns) have been developed.

The picture elements on flat panel displays are not lighted continually. This would require a large amount of power and generate excessive heat. A sequential scan similar to a crt raster is used. Once again, a page memory is required. The picture element electrodes are on and off as the scan sequentially addresses page memory.

Those picture elements that are to display a dot are momentarily turned on and off starting with the first picture element in the top row, or line, and ending with the last picture element on the bottom row. The picture elements are turned on and off at a high enough frequency that the human eye cannot detect the flicker of the off-on-off cycle.

The sequential scan used to light the picture elements is continuous and repetitive. Once again, the page memory must be changed to change the display. Flat panel displays may be formatted or unformatted in the same manner as crt displays.

UNIT 5

STORAGE DEVICES

I PRE-READING

1. Recollect everything you studied concerning the topic, make notes. Write down the list of words in the Ukrainian language you think you will need while speaking on the topic.

2. a). Read the text and try to guess whether there are words from your list in it.

b). If you don't know the words, translate them using the dictionaries.

c). Choose the words from the list which are the most relevant for this topic.

d). If you don't know the meaning of any words or abbreviations, find their explanations in the Glossary.

e). Which words from exercises 1, 2c may be considered as general notions and which ones as technical terms?

f). Give explanations of several terms, using the Glossary.

To process information electronically, data are stored in a computer in the form of binary digits, or bits, each having two possible representations (0 or 1). If a second bit is added to a single bit of information, the number of representations is doubled, resulting in four possible combinations: 00, 01, 10, or 11. A third bit added to this two-bit representation again doubles the number of combinations, resulting in eight possibilities: 000, 001, 010, 011, 100, 101, 110, or 111. Each time a bit is added, the number of possible patterns is doubled. Eight bits is called a byte; a byte has 256 possible combinations of 0s and 1s. See also Expanded Memory; Extended Memory.

A byte is a useful quantity in which to store information because it provides enough possible patterns to represent the entire alphabet, in lower and upper cases, as well as numeric digits, punctuation marks, and several character-sized graphics symbols, including non-English characters such as p. A byte also can be interpreted as a pattern that represents a number between 0 and 255.

A kilobyte—1024 bytes—can store about 1000 characters; a megabyte can store about 1 million characters; a gigabyte can store about 1 billion characters; and a terabyte can store about 1 trillion characters.

The physical memory of a computer is either random access memory (RAM), which can be read or changed by the user or computer, or read-only memory (ROM), which can be read by the computer but not altered. One way to store memory is within the circuitry of the computer, usually in tiny

computer chips that hold millions of bytes of information. The memory within these computer chips is RAM. Memory also can be stored outside the circuitry of the computer on external storage devices, such as magnetic floppy disks, which can store about 2 megabytes of information; hard drives, which can store thousands of megabytes of information; and CD-ROMs (compact discs), which can store up to 630 megabytes of information. A single CD-ROM can store nearly as much information as 700 floppy disks can.

II READING

1. Read and translate the text into Ukrainian.

Computers store data in either primary storage or secondary storage. Primary storage is a part of the CPU, and semiconductor memory is the principle form of primary storage. Secondary storage is used when primary storage is not sufficient for the amount of data needed for a program or set of programs. Secondary storage is not a part of the CPU and, thus, provides slower access to data. Secondary storage is, however, considerably less expensive than primary storage. There are two types of secondary storage, sequential-access and direct-access.

In order to access data in sequential-access storage systems, the computer must always begin at the start of a tape and read all the data up to the point where it finds what it needs. Magnetic tape is a sequential-access medium.

Magnetic tape is mounted on a tape drive when stored data is needed. A read/write head enters data onto the tape or reads data already there to the CPU. Magnetized spots on the tape's surface represent data, which is usually coded into a nine-track coding scheme like 8-bit EBCDIC (with a ninth track for a parity bit). Some tape densities allow up to 6,250 characters to be stored per inch.

Tape cassettes provide another form of sequential-access storage. They are popular for small computer systems that do not need a lot of secondary storage.

With direct-access storage media, the computer can access data without having to read the data that comes before it. Records are located by referring to their addresses. Direct access is much faster than sequential access. Magnetic disks and floppy disks are direct-access storage media.

Magnetic disks are metal platters that store data in concentric circles on their surfaces. Usually several disks are assembled in a disk pack which can accommodate from 5 to 100 disks. Disk packs are either removable or permanently mounted on the disk drive. All disk surfaces in a disk pack may be used to store data except the top and bottom surfaces, which are subject to

scratches and nicks. Usually there are 20 tracks per surface and each track can store over 7,000 characters.

Floppy disks work on the same principle as magnetic disks. They are smaller (available in 8, 5 1/4, and 3 1/2 inches) and less expensive and are popular methods of secondary storage for microcomputers.

When very large amounts of data need to be stored, mass storage devices are used. Cartridge tapes, cassettes, and floppy disks are media used for mass storage. Mass storage offers considerably slower access time than primary or secondary storage, but is much less expensive than either.

Innovations in data storage include charge-coupled devices, laser technology, RAM disks, and the Josephson junction. Charge-coupled devices are made of silicon-like semiconductor memory and provide very fast access time though slower than semiconductor RAM.

Laser storage systems store huge amounts of data very cheaply. Laser storage is immune to the affects of time, electromagnetic radiation, or power failure. Optical disks utilize laser technology to permanently store vast amounts of data while allowing faster access than hard disks.

RAM disks are the only type of storage that can approximate the microprocessor's speed. RAM storage devices connect to the CPU just like disk drives and the computer cannot tell the difference between the two. RAM disks are actually a part of RAM that functions as a disk. RAM disks, like RAM, require a continuous power source.

The Josephson junction is a primary memory device now being developed that houses circuitry in liquid helium. This eliminates the resistance to electrical flow found in semiconductor memory. Josephson junction memory will offer access at ten times the speed of semiconductor memory.

Floppy disks are the most popular form of secondary storage for microcomputers. The format for floppy disk storage can be single-sided/single-density, single-sided/double-density, double-sided/single-density, or double-sided/double-density. Hard disks can also be used with microcomputers for applications with very large storage requirements.

2. Make up the logical scheme of the text and render the content of the text on the basis of the scheme.

3. Fill in the gaps with the words from the list.

a. iron oxide
b. tracks
g. sequential-access
h. silicon

c. direct-access
d. analog
e. cylinder
f. electromagnet
i. access mechanism
j. helium
k. high-density
1. digital

1. Hard disks provide _____storage.
2. A read/write head is a(n) _____.
3. The concentric circles on a magnetic disk are referred to as_____.
4. All of the number one circles on the magnetic disks in a disk pack form a(n) _____.
5. All of the read/write heads in a disk drive are connected to a(n) _____.
6. Mass storage systems often use_____ magnetic tape.
7. Charge-coupled devices are made of _____.
8. In laser storage systems, reflected laser beams turn data into _____bit streams.
9. The electrical circuits in a Josephson junction are housed in to_____ eliminate resistance to the flow of electrical current.
10. Magnetic tape is coated with _____.

4. Translate the sentences into the Ukrainian language. Take into consideration the information presented in the sentences. It may be helpful to you while doing the next exercises and discussing the topic.

1. Using CAD, an engineer can design and draft a product model in color and three dimensions on a video terminal. 2. Second-generation robots possess tactile sense or crude vision in addition to mechanical dexterity. 3. Telecommuting reduces an organization's need for office space, thus reducing rent costs and also provides employment opportunities for the disabled and for working parents. 4. Computerized axial tomography, or CAT scanning, can provide pictures of cross sections of the body and three-dimensional composites of bones or organs. 5. In multiphasic health testing, physical examinations and tests are performed by trained technicians and paramedics using computer equipment. 6. Computer ethics determine attitudes toward the use of data base data, job behavior, and toward the copying of software. 7. Personal ethics is generally thought of as being the only means of controlling computer crime since these crimes are so difficult to monitor. 8. White-collar crime is the most prevalent kind of computer crime because professional people generally have easier access to computers than others. 9. CAI software consists of drills, simulations, and tutorials. 10. Teachers realize the advantages of allowing students to use CAI because students learn at their own rates, receive immediate feedback, and feel comfortable with an impersonal computer as a teacher.

5. Choose the right answer.

1. Magnetic tape provides _____storage.
   a. sequential-access
   b. direct-access
   c. primary
   d. interrecord

2. An electromagnet that creates and detects magnetized spots on magnetic tape is called a _____.

   a. tope drive
   b. read/write head
   c. access mechanism
   d. track head

3. _____ separate individual records on magnetic tope.
   a. Interrecord blocks
   b. Interblock gaps
   c. Interrecord gaps
   d. Intergap blocks

4. The_____connects all of the read/write heads on a disk drive.
   a. disk pack
   b. disk arm
   c. track arm
   d. access mechanism

5. The _____was originally developed to replace punched cards as a medium for data entry.
   a. tope cassette
   b. floppy disk
   c. hard disk
   d. tope cartridge

6. Data on a magnetic disk is located by its_____.
   a. disk surface number
   b. track number
   c. record number
   d. disk address

7. _____storage has the slowest access time.
   a. Primary
   b. Floppy disk
   c. Mass
   d. Tape

8. In a _____data are reflected into a digital bit stream.
   a. laser storage system
   b. RAM storage device
   c. Josephson junction
   d. charge-coupled device

9. A storage device made of silicon much like semiconductor memory is the _____.
   a. Josephson junction
   b. charge-coupled device
   c. ROM disk
   d. helium-neon laser device

10. Presently the only storage device that can approach the speed of microprocessors is the_____.

   a. Josephson junction
   c. optical disk

b. charge-coupled device d. RAM disk

11. In a _____memory circuits will be housed in liquid helium.
a. charge-coupled device c. Josephson junction
b. helium-neon laser device d. RAM disk device

12. In nine-track recording schemes for magnetic tape, the ninth bit is used for _____.
a. tape address c. buffer
b. parity d. storing data

13. When records are grouped together on magnetic tape to reduce the amount of stopping and accelerating by the tape drive, the groups are separated by _____.
a. interrecord gaps c. interrecord blocks
b. interblock gaps d. parity bits

14. A disk pack with ten disks has _____usable recording surfaces.
a. twenty c. ten
b. eighteen d. nine

15. The format for data storage on floppy disks may follow one of _____format options.
a. five c. three
b. two d. four

6. Translate the words and word-combinations into English.

Механізм доступу, електричний потік, запам’ятовувальний пристрій великого обсягу, оптичний диск, джерело живлення, дисковод, міжблоковий проміжок, віртуальний диск, запам’ятовувальний пристрій з послідовним доступом, доріжка, опір, вихід з ладу системи живлення, лазерна пам'ять, з’єднання, електричний потік, електричні кола, система кодування, тривалість доступу, блок, магнітна стрічка.

7. Say true or false and explain.

1. T F Primary storage is much more expensive than secondary storage.
2. T F Sequential-access storage is provided by magnetic tape and cassette tape.
3. T F The purpose of interrecord and interblock gaps is to provide space for parity bits to verify the accuracy of data.
4. T F Each read/write head in a disk drive for disk packs has its own access mechanism.

5. T F The floppy disk was originally introduced to replace punched cards as a medium for data entry.
6. T F Magnetic disk is a less expensive medium for data storage than magnetic tape.
7. T F The circuitry of charge-coupled devices is housed in liquid helium to eliminate the resistance to electrical flow that exists in semiconductor memory.
8. T F A RAM disk is actually storage space in RAM that functions as a disk.
9. T F The Josephson junction is currently a popular storage device with large computer systems because of its speed which is ten times that of semiconductor memory.
10. T F There are no hard disk storage systems yet for microcomputers.

III DISCUSSING

1. Give the short answer.

1. What is the advantage of having data stored in primary rather than secondary storage?
2. What distinguishes sequential-access from direct-access storage systems? What are the storage media for each?
3. What is a read/write head and what are its functions?
4. Why are interblock gaps (IBGs) preferable to interrecord gaps (IRGs) on magnetic tapes with very short records?
5. Floppy disks are, in effect, miniature magnetic disks. Conventional magnetic disks are made of metal and are 14 inches in diameter. How do floppy disks compare to conventional magnetic disks in these respects?
6. On a magnetic disk, what constitutes a data item's disk address?
7. What are some advantages that laser storage has over magnetic storage media?
8. What are the advantages and disadvantages of using RAM disks?
9. Why will the Josephson junction be a major technological advance in primary storage?
10. When are mass storage techniques called for?

2. Prepare reports using Internet or other sources (catalogues, magazines, books, etc.) about the latest news, achievements in the field concerning the topic of the chapter.

3. Summarize everything you have learnt on the topic.

4. Answer the question, taking into consideration quick pace of the latest achievements and developments in computer engineering and

programming and information presented in the reports, what information from the texts of the Chapter should be reconsidered, changed, added, etc..

5. It's interesting to know…

Hard Disk Basics

Hard disks were invented in the 1950s. They started as large disks up to 20 inches in diameter holding just a few megabytes. They were originally called "fixed disks" or "Winchesters" (a code name used for a popular IBM product). They later became known as "hard disks" to distinguish them from "floppy disks." Hard disks have a hard platter that holds the magnetic medium, as opposed to the flexible plastic film found in tapes and floppies.At the simplest level, a hard disk is not that different from a cassette tape. Both hard disks and cassette tapes use the same magnetic recording techniques Hard disks and cassette tapes also share the major benefits of magnetic storage - the magnetic medium can be easily erased and rewritten, and it will "remember" the magnetic flux patterns stored onto the medium for many years.

Let's look at the big differences between cassette tapes and hard disks:

- The magnetic recording material on a cassette tape is coated onto a thin plastic strip. In a hard disk, the magnetic recording material is layered onto a high-precision aluminum or glass disk. The hard-disk platter is then polished to mirror-type smoothness.
- With a tape, you have to fast-forward or reverse to get to any particular point on the tape. This can take several minutes with a long tape. On a hard disk, you can move to any point on the surface of the disk almost instantly.
- In a cassette-tape deck, the read/write head touches the tape directly. In a hard disk, the read/write head "flies" over the disk, never actually touching it.
- The tape in a cassette-tape deck moves over the head at about 2 inches (about 5.08 cm) per second. A hard-disk platter can spin underneath its head at speeds up to 3,000 inches per second (about 170 mph or 272 kph)!
- The information on a hard disk is stored in extremely small magnetic domains compared to a cassette tape's. The size of these domains is made possible by the precision of the platter and the speed of the medium.

Because of these differences, a modern hard disk is able to store an amazing amount of information in a small space. A hard disk can also access any of its information in a fraction of a second.

A typical desktop machine will have a hard disk with a capacity of between 10 and 40 gigabytes. Data is stored onto the disk in the form of files. A file is

simply a named collection of bytes. The bytes might be the ASCII codes for the characters of a text file, or they could be the instructions of a software application for the computer to execute, or they could be the records of a data base, or they could be the pixel colors for a GIF image. No matter what it contains, however, a file is simply a string of bytes. When a program running on the computer requests a file, the hard disk retrieves its bytes and sends them to the CPU one at a time.

There are two ways to measure the performance of a hard disk:

- Data rate - The data rate is the number of bytes per second that the drive can deliver to the CPU. Rates between 5 and 40 megabytes per second are common.
- Seek time - The seek time is the amount of time between when the CPU requests a file and when the first byte of the file is sent to the CPU. Times between 10 and 20 milliseconds are common.

The other important parameter is the capacity of the drive, which is the number of bytes it can hold.

Magnetic Tape Units (Input/Output)

The purpose of any magnetic tape unit (drive or device) is to write data on or read data from a magnetic tape. Tape stores data in a sequential manner. In sequential processing, the computer must begin searching at the beginning and check each record until the desired data is found. Like a tape cassette with recorded music, to play the fifth song recorded, you must play or fast forward the tape past the first four songs before you can play the fifth.

Two reels are used, tape moves from a supply reel to a take-up reel (both are mounted on hubs). The magnetic oxide coated side of the tape passes directly over the read/write head assembly, making contact with the heads. The magnetic tape unit reads and writes data in parallel channels or tracks along the length of the tape. Each channel or track is used by a read/write head (one for each channel), as the tape moves across the magnetic gap of the head. Read/write heads may be either one gap or two gaps. The one-gap head has only one magnetic gap at which both reading and writing occur.

The two-gap head has one gap for reading and another for writing. Although the one gap is satisfactory, the two-gap head gives increased speed by checking while writing. For example, a tape being written on passes over the write gap where the data is recorded, and then the data is read as it passes over the read gap to make a comparison. With this method, errors are detected almost instantly.

The major differences between magnetic tape units are the speed at which the tape is moved past the read/write head and the density of the recorded information. You know that density describes the number of binary digits, bytes,

or frames we can record on an inch of tape. The most common tape densities are 800 and 1, 600 BPI (or FPI). Tape speed (or tape movement) varies to a great extent, from less than 50 inches per second to more than 100 inches per second. How fast a tape unit reads and writes is specified as the character transfer rate which is calculated by multiplying the speed of the magnetic tape unit by the character density.

Magnetic Disk Drive Units (Input/Output)

Magnetic disk drive units are storage devices that read and write information on the magnetized surfaces of rotating disks. The disks are made of thin metal, coated on each side so that data can be recorded in the form of magnetized spots. As the disks spin around like music records, characters can be stored on them or retrieved in a direct manner. This direct accessing of data has a big advantage over the sequential accessing of data. It gives us fast, immediate access to specific data without having to examine each and every record from the beginning. You can direct the disk drive to begin reading at any point. This is like the phonograph record, you can place the needle at any point and begin playing at any point.

Located within each disk drive unit is a drive motor that rotates the disk at a constant speed, normally 3, 600 revolutions per minute (rpm); or, if you prefer, 60 revolutions per second. The rotational speed for floppy disks is usually between 300 and 400 rpm because of their plastic base. Data is written on the tracks of a spinning disk surface and read from the surface by one or more (multiple) read/write heads. When reading from and writing to hard disks (rigid disks), the read/write heads float on a cushion of air and do not actually touch the surface of the disk. The distance between the head and the surface varies from a millionth of an inch to one-half millionth of an inch. This distance is called the flying height. When multiple disks (platters) are packaged together as a unit in a disk pack, a number of access arms and read/write heads are used to access both surfaces of each platter. The disk pack shown consists of six metal disks mounted on a central spindle. Data can be recorded on all surfaces except the top surface of the top disk, and the bottom surface of the bottom disk. These two surfaces are intentionally left blank for protection.

Floppy Disk Drive Units (Input/Output)

Floppy disk drive units are physically smaller than magnetic disk drive units and are typically used with personal (desktop) computers. The unit consists of a disk drive in which the disk rotates and a controller containing the electronic circuitry that feeds signals onto and from the disk. The disk (diskette) is a thin, flexible platter (floppy disk) coated with magnetic material so characters can be recorded on the surface in the form of magnetized spots. Floppy disks come in several sizes from 3 to 8 inches in diameter. The most common are the 8-inch disk, the 5 1/4-inch disk, and the 3 1/2-inch i disk.

UNIT 6

DATA STRUCTURES AND FILE DESIGN

I PRE-READING

1. Recollect everything you studied concerning the topic, make notes. Write down the list of words in the Ukrainian language you think you will need while speaking on the topic.

2. a). Read the text and try to guess whether there are words from your list in it.

b). If you don't know the words, translate them using the dictionaries.

c). Choose the words from the list which are the most relevant for this topic.

d). If you don't know the meaning of any words or abbreviations, find their explanations in the Glossary.

e). Which words from exercises 1, 2c may be considered as general notions and which ones as technical terms?

f). Give explanations of several terms, using the Glossary.

A database is information set with a regular structure.

Any set of information may be called a database. Nevertheless, the term was invented to refer to computerized data, and is used almost exclusively in computing. Sometimes it is used to refer to not yet computerized data, but usually in the process of planning its possible computerization.

Software created to manage generalized databases is usually called a database management system or DBMS. Several software architectures are possible: For smaller single user databases, often all functions are managed by one program. In larger and multiple user databases usually a number of programs are involved and most commonly a client-server architecture is adopted.

The DBMS front-end (i. e., the clients) is concerned mainly with data entry, enquiry and reporting. The back-end (i. e. the server) is the set of programs that actually control data storage, responding to requests from the front-end. Searching and sorting is usually performed by the server. There is a wide variety of database implementations, from simple tables stored in a single file each to very large databases with many millions of records, stored in rooms full of disk drives or other peripheral electronic storage devices.

Databases resembling modern versions were first developed in the 1960s. A pioneer in the field was Charles Bachman. Two key data models arose at this time: the network model (developed by CODASYL) followed by the hierarchical model (as implemented in IMS). These were later usurped by the relational model, which was contemporary with the so-called flat model

designed for very small tasks. Another contemporary of the relational model is the object-oriented database (OODB).

While the relational model is based on set theory, one proposed modification suggests fuzzy set theory (based on fuzzy logic) as an alternative.

II READING

1. Read and translate the text into Ukrainian.

The logical relationships among elements in computer files are called data structures. There are a number of different types of data structures.

A hierarchical data structure has a primary element with many secondary elements connected to it at various levels. Parent (higher) elements can be connected to many child (lower) elements, but a child element can be connected to only one parent. A network data structure allows any element to be related to any other element (child elements can have relationships with more than one parent element). In relational data structures, data items are placed in tables with rows and columns which represent records and fields respectively. Data items are related to other items sharing the same row or column.

Data in files needs to be organized in a manner meaningful to the user so that inquiries can be handled quickly. Pointers, chains, and lists (simple, linked, ring, and inverted) are all aids in organizing data logically.

When designing a data file, factors that must be considered include the type of logical record to be used, how the data will be accessed, and how the file is to be organized. Establishing a logical record involves deciding what data fields are necessary for the file and how long the fields can be. The length of records in files can be fixed or variable. Fixed-length records waste space when records shorter than the fixed length are entered, but they are easy to design and use. Variable-length records eliminate that waste. Choosing the right data field to serve as a key is also important.

Data can be accessed in a batch or online. Batch accessing requires that transactions be gathered over a set period of time for processing at once; data is not available until after a batch is processed. With online accessing, data is available at any time.

When batch processing methods are used, a sequential file design is necessary. A master file contains data ordered sequentially by a key field. Transactions are stored on a transaction file. In processing, the two are matched against each other and an entirely new master file is created.

If online processing is used, a direct-access file design is called for. Records are located by a key field, as in sequential accessing, but the records in a direct-access file are in no particular order and can be located individually without the preceding records having to be read. The computer keeps track of records by randomizing to transform keys into addresses or by referring to a directory of record addresses.

When both sequential processing and online processing need to be performed on a file, an indexed-sequential file design is used. Records are stored in sequence according to unique primary keys. Secondary keys, which may not be unique, are also established. Records can be accessed randomly by using primary or secondary keys, or they can be read sequentially according to the primary keys.

Databases allow organizations to collect and store information centrally for use by all of their departments. Duplication of data is eliminated this way and efficiency is increased since changes to data items need only be made once. Data-base management systems are often used by organizations to help set up a data base. A DBMS is a set of programs providing a way to arrange data so that duplication is prevented, to make changes to data easily, and to handle direct inquiries.

Security is a problem with microcomputers. Since organizations typically have a number of microcomputers hooked into a database, controlling access to that information is very difficult. There are methods to secure data base data including passwords, callback modems, audit trails, and data encryption, but they are often difficult to use with microcomputers.

2. Make up the logical scheme of the text and render the content of the text on the basis of the scheme.

3. Fill in the gaps with the words from the list.

a. online	g. redundant
b. primary	h. index
c. batch	i. encryption
d. field	j. pointer
e. transaction	k. directory
f. subscripts	1. secondary

1. Row and column numbers in relational data structure tables are called_____.

2. An extra field in a record indicating the position of the next record in the sequence is a(n) _____.

3. A chain is the logical path linking records according to one common_____.
4. An inverted list uses a(n) _____ to link records.

5. An indexed-sequential file design can be used if _____ file access is needed.
6. A(n) _____file contains changes to be made to existing sequential files.
7. Record keys and their addresses are stored in a(n)_____.
8. In a company's indexed-sequential employee file, zip codes could be used as a(an) _____ key.
9. The data-base approach minimizes the storing of _____data.
10. Data in data bases is often protected by data_____.

4. Translate the sentences into the Ukrainian language. Take into consideration the information presented in the sentences. It may be helpful to you while doing the next exercises and discussing the topic.

1. Hierarchical structures allow higher-level elements to be connected to many lower elements, but lower elements can only be connected to one higher element. 2. A pointer contains no data relating to the record of which it is a field; it simply points to the next record in the file that will be needed for a given task. 3. The computer locates records by searching for their keys. 4. Online file access makes information available to a system user at any time. 5. An entirely new master file is written placing the new transactions into their proper places in the master file sequence. 6. If an accident causes a current master file to be lost in sequential processing, the master file can be reconstructed from copies of an old master and transaction files. 7. The address generated by randomizing is generally a number that is related to the physical characteristics of the storage medium. 8. Data bases are set up according to the needs of an entire organization rather than a particular department. 9. A DBMS helps an organization set up a database. 10. Information is only stored once, so data is not duplicated.

5. Choose the right answer.

1. Which is not a common data structure?
   a. hierarchical c. parent
   b. network d. relational

2. A primary data element is called a_____element.
   a. parent " c. main
   b. child d. field

3. Row and column numbers in a table are called_____.
   a. superscripts c. addresses
   b. subscripts d. keys

4. A_____ is an extra field in a file that, after one record has been accessed, indicates the next record's location.
   a. chain c. key
   b. link d. pointer

5. A(n) _____list has pointer fields with the last record containing a pointer back to the first record in the chain.

a. ring
b. linked
c. simple
d. inverted

6. A data field chosen to be the identifying element of a record is called a_____.

a. link
b. key
c. pointer
d. chain

7. _____ can waste space in a data file.

a. Long fields
b. Abbreviated records
c. Fixed-length records
d. Variable-length records

8. _____file access is used in airline reservation systems.

a. Batch
b. Sequential
c. Online
d. Indexed-sequential

9. Data files requiring batch file access best have a(n) _____file design.

a. sequential
b. indexed-sequential
c. direct-access
d. relational

10. For security purposes, in sequential processing two generations of old master files are often kept. The first generation, or oldest of these, is called a _____ backup copy.

a. primary
b. secondary
c. father
d. grandfather

11. Sequential processing is suitable for applications with high_____ and low_____.

a. volatility, activity
b. activity, volatility
c. frequency, volumn
d. volumn, activity

12. In direct-access files, addresses are often generated through a mathematical process known as_____.

a. directory generation
b. key generation
c. randomizing
d. key conversion

13. Organizations often have one collection of related data items that can be used for all of their information needs. This collection is known as a_____.

a. file base
b. database
c. system base
d. data network

14. A _____system is a set of programs serving as the interface between the database and the programmer, operating system, and users.

a. data-base management
b. data-analyst
c. data-base development
d. data-base communication

15. Why has security for microcomputers used in database management systems not been a high priority to date?
a. Microcomputers aren't used often enough for this application.
b. The cost of security measures for microcomputers is too high.
c. Most DBMSs don't contain sensitive material.
d. There are no security systems available for microcomputers.

6. Translate the words and word-combinations into English.

Пакет, модем зворотного зв'язку, шифрування даних, елемент даних, запит, запис фіксованої довжини, клавіша, логічний запис, мережева структура даних, первинний ключ, реляційна структура даних, послідовне виконання, файл змін, запис змінної довжини, програміст бази даних, ієрархічна структура даних, основний файл, пароль, енергозалежність, командний файл.

7. Say true or false and explain.

1. T F Hierarchical data structures allow child elements to have only one parent element.
2. T F Relational data structures allow any element to be connected to any other element.
3. T F A chain is a logical path connecting records according to one common field.
4. T F An inverted list is sequenced from back to front to facilitate quick accessing while a file is being read forward or backward.
5. T F Individual data items in a record are called keys.
6. T F Fixed-length records eliminate wasted space in data files.
7. T F Sequential processing involves the creation of a new master file each time transactions are processed.
8. T F Hashing is another term for data encryption.
9. T F One problem with data bases is that data is frequently duplicated.
10. T F Database management systems provide privacy controls to prevent unauthorized access of data-base data.

III DISCUSSING

1. Give the short answer.

1. Explain the differences between parent and child elements in hierarchical and network data structures.
2. What are the types of lists and how do they differ?
3. What are keys in a file?
4. What would be a solution to the problem associated with fixed length records?

5. Sequential processing is suitable for applications with high activity and low volatility. To what do these terms refer (activity and volatility)?
6. When would an indexed-sequential file design be appropriate for an organization?
7. How does a database increase efficiency?
8. What are the functions that a database management system (DBMS) can perform?
9. What are the responsibilities of a database analyst?
10. Discuss briefly problems with data security when microcomputers are used in a system.

2. Prepare reports using Internet or other sources (catalogues, magazines, books, etc.) about the latest news, achievements in the field concerning the topic of the chapter.

3. Summarize everything you have learnt on the topic.

4. Answer the question, taking into consideration quick pace of the latest achievements and developments in computer engineering and programming and information presented in the reports, what information from the texts of the Chapter should be reconsidered, changed, added, etc…

5. It's interesting to know…

Database Models

Various techniques are used to model data structure. Certain models are more easily implemented by some types of database management systems than others. For any one logical model, various physical implementations may be possible. An example of this is the relational model: In larger systems, the physical implementation often has indexes, which point to the data - this is similar to some aspects of common implementations of the network model. But in small relational databases the data is often stored in a set of files, one per table, in a flat, unindexed structure. There is some confusion below and elsewhere in this article as to logical data model vs its physical implementation.

The flat (or table) model consists of a single, two-dimensional array of data elements, where all members of a given column are assumed to be similar values, and all members of a row are assumed to be related to one another. For instance, columns for name and password might be used as a part of a system security database. Each row would have the specific password associated with a specific user. Columns of the table often have a type associated with them, defining them as character data, date or time information, integers, or floating point numbers. This model is the basis of the spreadsheet.

The network model allows multiple datasets to be used together through the use of pointers (or references). Some columns contain pointers to different tables

instead of data. Thus, the tables are related by references, which can be viewed as a network structure. A particular subset of the network model, the hierarchical model, limits the relationships to a tree structure, instead of the more general directed graph structure implied by the full network model.

The relational model was introduced in an academic paper by E. F. Codd in 1970 as a way to make database management systems more independent of any particular application. It is a mathematical model defined in terms of predicate logic and set theory.

Although the basic idea of relational database management systems has been very popular, relatively few people understand the mathematical definition and only a few, obscure DBMSs implement it completely and without extension. Oracle, for example, can be used in a purely relational way but it does allow tables to be defined, which allow duplicate rows. In common English usage, a database is called relational if it is in some way inspired by the relational model, not if it conforms to any particular standard. The following is an informal, non-technical explanation of how "relational" database management systems commonly work.

A relational database contains multiple tables, each similar to the one in the "flat" database model. However, unlike network databases, the tables are not linked by pointers. Instead, "keys" are used to match up rows of data in different tables. A key is just one or more columns in a table. Any of the columns in a table can be a key, or multiple columns can be grouped together into a single key. Unlike pointers, it's not necessary to define all the keys in advance; a column can be used as a key even if it wasn't originally intended to be one.

When a key consists of data that has an external, real world meaning (such as a person's name, a book's ISBN, or a car's serial number), it's called a "natural" key. If no natural key is suitable, an arbitrary key can be assigned (such as by giving employees ID numbers). In practice, most databases have both generated and natural keys, because generated keys can be used internally to create links between rows that can't break, while natural keys can be used, less reliably, for searches and for integration with other databases. (For example, records in two independently developed databases could be matched up by social security number, except when the social security numbers are incorrect, missing, or have changed.)

You request data from a relational database by sending it a query that's written in a special language, usually a dialect of SQL. Although SQL was originally intended for end-users, it's much more common for SQL queries to be embedded into software that provides an easier user interface. (Many web sites perform SQL queries when generating pages.)

In response to a query, the database returns a result set, which is just a list of rows containing the answers. The simplest query is just to return all the rows from a table, but more often, the rows are filtered in some way to return just the answer wanted. Often, data from multiple tables is combined into one, by doing

a "join". Conceptually, this is done by taking all possible combinations of rows (the "cross-product"), and then filtering out everything except the answer. In practice, relational database management systems rewrite ("optimize") queries to perform faster, using a variety of techniques: In the "join" the primary optimization is obtained through the use of indexes to prevent the building of the complete cross-product which would otherwise be necessary.

The flexibility of relational databases allows programmers to write queries that were not anticipated by the database designers. As a result, relational databases can be used by multiple applications in ways the original designers did not foresee, which is especially important for databases that might be used for decades. This has made the idea and implementation of relational databases very popular with businesses.

Implementations and indexing

All of these kinds of database can take advantage of indexing to increase their speed. The most common kind of index is a sorted list of the contents of some particular table column, with pointers to the row associated with the value. An index allows a set of table rows matching some criterion to be located quickly. Various methods of indexing are commonly used, b-trees, hashes, and linked lists are all common indexing techniques.

Relational DBMSs have the advantage that indices can be created or dropped without changing existing applications, because applications don't use the indices directly. Instead, the database software decides on behalf of the application which indices to use. The database chooses between many different strategies based on which one it estimates will run the fastest.

Relational DBMSs utilize many different algorithms to compute the result of an SQL statement. The RDBMs will produce a plan of how to execute the query, which is generated by analyzing the run times of the different algorithms and selecting the quickest. Some of the key algorithms that deal with joins are Nested Loops Join, Sort-Merge Join and Hash Join.

Mapping objects into databases

In recent years, the object-oriented paradigm has been applied to databases as well, creating a new programming model known as object databases. These databases attempt to overcome some of the difficulties of using objects with the SQL DBMSs. An object-oriented program allows objects of the same type to have different implementations and behave differently, so long as they have the same interface (polymorphism). This doesn't fit well with a SQL database where user-defined types are difficult to define and use, and where the Two Great Blunders prevail: the identification of classes with tables (the correct

identification is of classes with types, and of objects with values), and the usage of pointers.

A variety of ways have been tried for storing objects in a database, but there is little consensus on how this should be done. Implementing object databases undo the benefits of relational model by introducing pointers and making ad-hoc queries more difficult. This is because they are essentially adaptations of obsolete network and hierarchical databases to object-oriented programming. As a result, object databases tend to be used for specialized applications and general-purpose object databases have not been very popular. Instead, objects are often stored in SQL databases using complicated mapping software. At the same time, SQL DBMS vendors have added features to allow objects to be stored more conveniently, drifting even further away from the relational model.

Applications of databases

Databases are used in many applications, spanning virtually the entire range of computer software. Databases are the preferred method of storage for large multiuser applications, where coordination between many users is needed. Even individual users find them convenient, though, and many electronic mail programs and personal organizers are based on standard database technology.

Transactions and concurrency

In addition to their data model, most practical databases attempt to enforce a database transaction model that has desirable data integrity properties. Ideally, the database software should enforce the ACID rules, summarized here:

- Atomicity - either all or no operations are completed. (Transactions that can't be finished must be completely undone.)
- Consistency - all transactions must leave the database in consistent state.
- Isolation - transactions can't interfere with each other's work and incomplete work isn't visible to other transactions.
- Durability - successful transactions must persist through crashes.

In practice, many DBMSs allow most of these rules to be relaxed for better performance.

Concurrency control is a method used to ensure transactions are executed in a safe manner and follows the ACID rules. The DBMS must be able to ensure only serializable, recoverable schedules are allowed, and that no actions of committed transactions are lost while undoing aborted transactions.

UNIT 7

DATA COMMUNICATION

I PRE-READING

1. Recollect everything you studied concerning the topic, make notes. Write down the list of words in the Ukrainian language you think you will need while speaking on the topic.

2. a). Read the text and try to guess whether there are words from your list in it.

b). If you don't know the words, translate them using the dictionaries.

c). Choose the words from the list which are the most relevant for this topic.

d). If you don't know the meaning of any words or abbreviations, find their explanations in the Glossary.

e). Which words from exercises 1, 2c may be considered as general notions and which ones as technical terms?

f). Give explanations of several terms, using the Glossary.

Computers can communicate with other computers through a series of connections and associated hardware called a network. The advantage of a network is that data can be exchanged rapidly, and software and hardware resources, such as hard-disk space or printers, can be shared.

One type of network, a local area network (LAN), consists of several PCs or workstations connected to a special computer called the server. The server stores and manages programs and data. A server often contains all of a networked group's data and enables LAN workstations to be set up without storage capabilities to reduce cost.

Mainframe computers and supercomputers commonly are networked. They may be connected to PCs, workstations, or terminals that have no computational abilities of their own. These "dumb" terminals are used only to enter data into, or receive output from, the central computer.

Wide area networks (WANs) are networks that span large geographical areas. Computers can connect to these networks to use facilities in another city or country. For example, a person in Los Angeles can browse through the computerized archives of the Library of Congress in Washington, D.C. The largest WAN is the Internet, a global consortium of networks linked by common communication programs. The Internet is a mammoth resource of data, programs, and utilities. It was created mostly by American computer scientist Vinton Cerf in 1973 as part of the United States Department of Defence

Advanced Research Projects Agency (DARPA). In 1984 the development of Internet technology was turned over to private, government, and scientific agencies. The World Wide Web is a system of information resources accessed primarily through the Internet. Users can obtain a variety of information in the form of text, graphics, sounds, or animations. These data are extensively cross-indexed, enabling users to browse (transfer from one information site to another) via buttons, highlighted text, or sophisticated searching software known as search engines.

II READING

1. Read and translate the text into Ukrainian.

Telecommunications involves the combined use of communication facilities and data-processing equipment. Since large information systems typically involve people and equipment that are geographically dispersed, data must be transferred electronically from location to location over communication channels such as telephone lines, coaxial cables, and microwaves.

Data communication can be accomplished through analog or digital transmission. Analog transmission is in continuous wave form while digital transmission involves sending data as distinct "on" and "off pulses.

Data can only be transmitted in analog, or wave, form over phone lines which are the most common channels for data communication. Since computers operate digitally, a modem must be used to translate digital data into analog form (modulation) for transmission and back into digital form (demodulation) for processing on the receiving end.

Modems can be direct-connect, acoustic coupler, or internal. Different modems are also capable of different types of transmission. Simplex modems transmit data in one direction only. Half-duplex modems transmit in both directions, but only one direction at a time. Full-duplex modems can transmit in both directions at once. The most common speeds of data transmission with microcomputers are 300 and 1,200 baud (the number of bits per second that can be transmitted).

Each type of channel has its rate at which data can be transmitted. This rate is determined by the grade, or bandwidth, of the channel. Narrow bandwidth channels, such as telegraph lines, transmit at a rate of 45 to 90 baud. Voice-grade channels, such as standard telephone lines, can transmit at rates of 300 to 9,600 baud. Broadband channels can transmit at rates up to 120,000 baud. Coaxial cables, microwaves, and fiber optics are examples of broadband channels.

Multiplexers and concentrators are used to increase the number of input/output devices that can use a communication channel. This allows communication channels to be used to their full capacity.

Programmable communications processors are devices that take over, from the CPU, some of the tasks that communications systems require. They are used for message switching and front-end processing.

When several CPUs and terminals are linked via a communication system, they form a network. Networks allow users in different places to share data, devices, and programs. Remote networks cover large geographical areas. Local-area networks operate within a small, well-defined area such as an office building.

There are five basic configurations of networks: star, which routes all transactions through a central computer; ring, which has a number of computers linked in a single transmission line, allowing malfunctioning units to be bypassed without interrupting network operations; hierarchical, which consists of a group of small computers connected to a large central computing complex; bus, which has each computer in the network connected to a single bus cable running from station to station (used primarily in LANs); and fully distributed network configuration, which connects, through a single communications link, sets of nodes (end points such as CPUs, printers, etc.) that have their own processing capabilities with similar sets of nodes.

Distributed data processing (DDP) concerns processing that is done at a site independent of the central computer system. Companies with a decentralized managerial philosophy use DDP.

Satellite communication systems are increasingly being used as data communication channels. Network ranges can be expanded worldwide via satellite. Satellites also transmit data using a wide bandwidth so more data can be transmitted faster than through more conventional channels.

Because of large, commercial network services such as CompuServe, microcomputer users who subscribe to the service have at their fingertips libraries' worth of information. Shopping can be done, news can be investigated, and games can be played all through a microcomputer connected via phone lines to these services.

2. Make up the logical scheme of the text and render the content of the text based on the scheme.

3. Fill in the gaps with the words from the list.

a. baud
b. data communication
g. grade
h. modulation

c. electronic mail	i. propagation
d. networks	j. waves
e. pulses	k. demodulation
f. front-end processors	1. multiplexers

1. Transferring data from location to location electronically is referred to as_____.
2. Digital transmission involves transmitting data in_____.
3. The conversion of data from digital to analog form is called_____.
4. The number of bits per second that can be transmitted over communication lines is known as_____.

5. What determines the rate at which data can be transmitted across a channel?
6. The number of I/O devices using a communication channel can be increased by_____.
7. Message switching is accomplished through the use of_____.
8. Users at different locations can share files, devices, and programs through. _____.
9. Communication between members of a network can be provided by_____.
10. In satellite communication systems, time delays are often called _____delays.

4. Translate the sentences into the Ukrainian language. Take into consideration the information presented in the sentences. It may be helpful to you while doing the next exercises and discussing the topic.

1. Communication channels carry data from location to location allowing data to be exchanged between remote sites and the computer. 2. Analog transmission is transmission of signals in continuous wave form. 3. Demodulation is the process that a modem carries out after receiving data over phone lines before it can be sent to the CPU. 4. Modems convert digital pulses from a computer into waveform for transmission and from waveform into digital pulses for processing at the receiving end. 5. Terminal, or communication, software makes a computer a temporary part of a remote computer system with which it is communicating. 6. Multiplexers, increase the number of devices that can use a single communication channel. 7. Programmable communication processors are usually used for message switching or front-end processing. 8. When used for front-end processing, it performs message switching plus other operations like validating transmitted data and preprocessing data before it is sent to the CPU. 9. Nodes consist of CPUs, printers, terminals, storage devices, and other devices. 10. Companies with decentralized managerial philosophies use DDP since it allows processing to be done independently of the central computer.

5. Choose the right answer.

1. Telegraph lines, telephone lines, coaxial cables, microwave links, and communication satellites are examples of_____.
   a. data communication
   b. communication channels
   c. telecommunications
   d. bus channels

2. The use of communication facilities combined with data-processing equipment is referred to as _____.
   a. data communication
   b. communication channeling
   c. telecommunications
   d. networking

3. _____ refers to the way data is sent over normal telephone lines.
   a. Analog transmission
   b. Digital transmission
   c. Modulation
   d. Demodulation

4. The transferring of data in waveform to pulse form is called _____.
   a. modulation
   b. demodulation
   c. analog translation
   d. digital translation

5. The_____ connects to the computer by a cable, and two rubber caps built into the modem accommodate a standard telephone receiver.
   a. direct-connect modem
   b. acoustic-coupler modem
   c. internal modem
   d. simplex

6. _____"tricks" a central computer into acting as if a microcomputer connected via a communications channel is a part of the system.
   a. Terminal software
   b. A modem
   c. A programmable communications processor
   d. Modem software

7. The number of bits per second that can be transmitted over a given communication channel (the speed of transmission) is referred to as_____.
   a. grade
   b. bandwidth
   c. digital rate
   d. baud

8. A _____combines the input streams from a number of I/O devices into a single stream, which can be sent over a single channel to the computer.
   a. concentrator
   b. multiplexer
   c. programmable communication processor
   d. bus

9. _____ allows members of a network to communicate with each other.
   a. Network mail
   b. Electronic mail
   c. Local-area mail
   d. Message switching

10. Some of the tasks required of the CPU in a communication system can be taken over by a_____.

a. multiplexer
b. concentrator
c. programmable communication processor
d. node

11. _____networks operate within a small, well-defined area such as an office building.

a. Remote
b. Local-area
c. Bus
d. Star

12. The end points of a network are referred to as_____.

a. links
b. nodes
c. peripherals
d. terminals

13. The _____network configuration consists of a group of computers connected by a single transmission line.

a. ring
b. star
c. hierarchical
d. bus

14. Processing done at a site removed from the central computer system is called_____.

a. remote processing
b. hierarchical processing
c. distributed data processing
d. bus processing

15. On communications satellites, _____are amplifiers receiving signals from earth stations and reflecting them to appropriate receiving stations on earth.

a. propagation devices
b. dishes
c. nodes
d. transponders

6. Translate the words and word-combinations into English.

Акустичний модем, ширина смуги частот, канал зв’язку, передавання даних, модем з безпосереднім зв’язком, електронна пошта, комунікаційний процесор, дуплексний зв'язок, конфігурація мережі, локальна мережа, перемикання повідомлень, вузькосмуговий канал, віддалена мережа, супутник**,** телефонний канал, зіркова конфігурація, світлопровід, демодуляція, час простою, напівдуплексний зв'язок.

7. Say true or false and explain.

1. T F Analog transmission is the type of transmission used on standard telephone lines.
2. T F Demodulation is the process of converting digital data into analog form.

3. T F A simplex modem can transmit data in two directions, but only one direction at a time.

4. T F Broad-band channels are capable of transmitting data at rates of up to 1,200,000 baud.

5. T F Usually an I/O device using a communication channel won't use the channel to full capacity.

6. T F A bus configuration is used principally with local-area networks.

7. T F A star configuration allows network processing to continue even if the central computer is malfunctioning.

8. T F Downtime refers to time that a system is not working because of equipment problems.

9. T F Propagation devices are small amplifiers on communication satellites that receive and reflect signals from earth.

10. T F Satellites transmit data using a wide bandwidth.

III DISCUSSING

1. Give the short answer.

1. Since computers operate digitally, and since digital transmission is a more accurate means of transmitting data, why is analog transmission used at all?
2. Briefly discuss the modem and its function.
3. Classify common communication channels according to grade.
4. What is the difference between a multiplexer and a concentrator?
5. What would be the advantage of having a network set up in a ring configuration as opposed to having it set up in a star configuration?
6. Why might an organization with a number of microcomputers consider setting up a network?
7. Why are local-area networks so limited in size?
8. Why would distributed data processing be used more by a company with a decentralized managerial philosophy than by a company with a centralized managerial philosophy?
9. What are the advantages of using satellite system communication channels?
10. What are communications satellite channels used for besides television broadcasting?

2. Prepare reports using Internet or other sources (catalogues, magazines, books, etc.) about the latest news, achievements in the field concerning the topic of the chapter.

3. Summarize everything you have learnt on the topic.

4. Answer the question, taking into consideration quick pace of the latest achievements and developments in computer engineering and programming and information presented in the reports, what information from the texts of the Chapter should be reconsidered, changed, added, etc…

5. It's interesting to know…

Internet

Internet, computer-based worldwide information network. The Internet is composed of a large number of smaller interconnected networks. These networks may link tens, hundreds, or thousands of computers, enabling them to share information with each other and to share various resources, such as powerful supercomputers and databases of information. The Internet has made it possible for people all over the world to effectively and inexpensively communicate with each other. Unlike traditional broadcasting media, such as radio and television, the Internet is a decentralized system. Each connected individual can communicate with anyone else on the Internet, can publish ideas, and can sell products with a minimum overhead cost. The Internet has brought new opportunity for businesses to offer goods and services online. In the future, it may have an equally dramatic impact on higher education as more universities offer Internet-based courses.

The networks from which the Internet is composed are usually public access networks, meaning that the resources of the network can be shared with anyone logging on to, or accessing, the network. Other types of networks, called intranets, are closed to public use. Intranets are the most common type of computer network used in companies and organizations where it is important to restrict access to the information contained on the network. See *also* Local Area Network; Wide Area Network.

The Internet grew tremendously during the latter half of 1990s. Each year during that time period, more people used the Internet to access ever-increasing amounts of information. One survey found that there were 61 million Internet users worldwide at the end of 1996, 148 million at the end of 1998, and an estimated 320 million in 2000. Analysts estimate that more than 700 million people will use the Internet in 2001.

Uses of the Internet

From the late 1960s to the early 1990s, the Internet was a communication and research tool used almost exclusively for academic and military purposes. This changed radically with the introduction of the World Wide Web (WWW) in 1989. The WWW is a set of programs, standards, and protocols governing the way in which multimedia files (documents that contain a combination of text, photographs, graphics, video, and audio) are created and displayed on the Internet. The Internet contains the WWW and includes all the hardware

(computers, supercomputers, and connections) and non-WWW software and protocols on which the WWW runs. The difference between the Internet and the WWW is similar to the distinction between a computer and a multimedia program that runs on the computer. Many analysts attribute the explosion in use and popularity of the Internet to the graphics-intensive nature of the WWW.

Today individuals, companies, and institutions use the Internet in many ways. Businesses use the Internet to provide access to complex databases, such as financial databases. Companies carry out electronic commerce, including advertising, selling, buying, distributing products, and providing after-sales services. Businesses and institutions use the Internet for voice and video conferencing and other forms of communication that enable people to telecommute, or work from a distance. The use of electronic mail (see e-mail) over the Internet has greatly speeded communication between companies, among coworkers, and between other individuals. Media and entertainment companies use the Internet to broadcast audio and video, including live radio and television programs. They also offer online chat groups, in which people carry on discussions using written text, and online news and weather programs. Scientists and scholars use the Internet to communicate with colleagues, to perform research, to distribute lecture notes and course materials to students, and to publish papers and articles.

Individuals use the Internet for communication, entertainment, finding information, and to buy and sell goods and services.

How the Internet Works

The Internet is based on the concept of a client-server relationship between computers, also called client/server architecture. In a client/server architecture, some computers act as information providers (servers), while other computers act as information receivers (clients). The client/server architecture is not one-to-one—that is, a single client computer may access many different servers, and a single server may be accessed by a number of different client computers. Prior to the mid-1990s, servers were usually very powerful computers such as mainframe or supercomputers, with extremely high processing speeds and large amounts of memory. Personal computers and workstations, however, are now capable of acting as Internet servers due to advances in computing technology. A client computer is any computer that receives information from a server. A client computer may be a personal computer, a pared-down computer (sometimes called a Web appliance), or a wireless device such as a handheld computer or a cellular telephone.

To access information on the Internet, a user must first log on, or connect, to the client computer's host network. A host network is a network that the client computer is part of, and is usually a local area network (LAN). Once a connection has been established, the user may request information from a remote server. If the information requested by the user resides on one of the

computers on the host network, that information is quickly retrieved and sent to the user's terminal. If the information requested by the user is on a server that does not belong to the host LAN, then the host network connects to other networks until it makes a connection with the network containing the requested server. In the process of connecting to other networks, the host may need to access a router, a device that determines the best connection path between networks and helps networks to make connections.

Once the client computer makes a connection with the server containing the requested information, the server sends the information to the client in the form of a file. A special computer program called a browser enables the user to view the file. Examples of Internet browsers are Mosaic, Netscape, and Internet Explorer. Multimedia files can only be viewed with a browser. Their pared-down counterparts, text-only documents, can be viewed without browsers. Many files are available in both multimedia and text-only versions. The process of retrieving files from a remote server to the user's terminal is called downloading.

One of the strengths of the Internet is that it is structured around the concept of hypertext. The term hypertext is used to describe an interlinked system of documents in which a user may jump from one document to another in a nonlinear, associative way. The ability to jump from one document to the next is made possible through the use of hyperlinks-portions of the hypertext document that are linked to other related documents on the Internet. By clicking on the hyperlink, the user is immediately connected to the document specified by the link. Multimedia files on the Internet are called hypermedia documents.

Accessing the Internet

Access to the Internet falls into two broad categories: dedicated access and dial-up access. With dedicated access, the computer is directly connected to the Internet via a router, or the computer is part of a network linked to the Internet. With dial-up access, a computer connects to the Internet with a temporary connection, generally over a telephone line using a modem—a device that converts a computer's digital signals into signals that can be transmitted over traditional telephone lines. Digital signals are made up of discrete units, while most telephone lines are analog, meaning that they carry signals that are continuous instead of discrete. Once a signal has traveled over the telephone line, a second modem is required at the other end of the line to reconvert the transmitted signals from analog to digital. A great many companies, called Internet Service Providers (ISPs), provide dial-up or dedicated access to the Internet for a modest fee. Examples of ISPs are America Online (AOL), the Microsoft Network (MSN), and CompuServe.

Packaging Information

All data transmitted over the Internet is divided up into small units of information called packets, each of which is labeled with a unique number

indicating its place in the data stream—the flow of information between computing devices. When the various packets that make up a set of data arrive at their destination, they are re-assembled using the unique labels given them. If part of the network over which the packets are sent is malfunctioning, or down, special automatic features of the Internet's routing equipment re-route the packets so that they travel over functioning portions of the network. Other features make sure that all the data packets arrive intact, automatically requesting that missing or incomplete packets be re-sent from the source. This system, called packet-switching, uses a series of protocols, or rules, known as TCP/IP (Transmission Control Protocol/Internet Protocol).

Network Addressing

To be part of the Internet a computer must have a unique Internet Protocol (IP) network address so that messages can be correctly routed to and from the machine over the Internet. Internet addresses are called URLs (Uniform Resource Locators). Some URLs are a string of numbers, but because long strings of numbers are difficult for people to remember, other addressing conventions are also used. An example of this convention is: *http: //encarta. msn. com/downloads/pryearbk. asp.* The *http* indicates the protocol—in this instance the hypertext transfer protocol—used to access the particular location on the Internet. The name after the colon and double slash *(encarta. msn. com)* indicates the hostname, which is the name of a specific computer system connected to the Internet. The remaining names after the hostname indicate various files to which the specific URL points. In the example URL, the file *pryearbk* is located within the directory *downloads.* Other files located in the same directory will have a similar URL, the only difference being the name of the file, or files, at the end of the address. Special name servers map IP numbers to domain names *(msn. com* in the above URL) and guarantee that the correct IP number of the source and the destination are provided for all packets. See *also* Domain Name System

Electronic Mail

The most widely used tool on the Internet is electronic mail, or e-mail. E-mail is used to send written messages between individuals or groups of individuals, often geographically separated by large distances. E-mail messages are generally sent from and received by mail servers—computers that are dedicated to processing and directing e-mail. Once a server has received a message it directs it to the specific computer that the email is addressed to. To send email, the process is reversed. A very convenient and inexpensive way to transmit messages, e-mail has dramatically affected scientific, personal, and business communications.

E-mail is the basis of much organized exchange between groups of individuals. List servers, for example, make it possible to address a list of subscribers either

in one-way communication, as in keeping interested people up-to-date on a product, or two-way communication, as in online discussion groups.
Another use of e-mail is Usenet, in which discussions on a particular subject are grouped together into newsgroups. There are thousands of newsgroups covering an extremely wide range of subjects. Messages to a newsgroup are not posted directly to the user, but are accessible in the form of an ordered list on a dedicated local news server. The networking of these servers makes such discussions available worldwide. Associated software not only enables users to choose which messages they want to read, but also to reply to them by posting messages to the newsgroup.

Transmission Schemes

Before the introduction of the World Wide Web, various standards and types of software existed for transmitting data over the Internet. Many of these are still in use, with Telnet, File Transfer Protocol (FTP), and Gopher among the most popular. Telnet allows an Internet user to connect to a distant computer and use that computer as if he or she were using it directly. FTP is a method of moving files from one computer to another over the Internet, even if each computer has a different operating system or storage format. Gopher is an improvement on FTP, making it easier to list and retrieve files remotely. While these transmission protocols and software are still in use, the WWW is much easier to use and is used much more often than earlier transmission protocols.

Bandwidth

The amount of data that a computer network can transmit is called the bandwidth of the network and is usually measured in Kilobits per second (Kbps) or Megabits per second (Mbps). A bit—the smallest unit of information that computers can process—can have one of two values, either 0 or 1. A Kilobit is one thousand bits, while a Megabit is one million bits. The transportation of information between routers generally uses communication lines dedicated to this function, with capacities currently ranging from 64 Kbps up to as much as several hundred Mbps. The speed at which information can be transmitted across the Internet depends on the lowest information transporting capacity along the route and the number of people using that route at any given time. A narrow bandwidth somewhere along the route acts as a bottleneck to data transport, and the more people using the line, the less information each of them can transport at any one time

UNIT 8

COMPUTER SYSTEMS

I PRE-READING

1. Recollect everything you studied concerning the topic, make notes. Write down the list of words in the Ukrainian language you think you will need while speaking on the topic.

2. a). Read the text and try to guess whether there are words from your list in it.

b). If you don't know the words, translate them using the dictionaries.

c). Choose the words from the list which are the most relevant for this topic.

d). If you don't know the meaning of any words or abbreviations, find their explanations in the Glossary.

e). Which words from exercises 1, 2c may be considered as general notions and which ones as technical terms?

f). Give explanations of several terms, using the Glossary.

Computers exist in a wide range of sizes and power. The smallest are embedded within the circuitry of appliances, such as televisions and wrist watches. These computers are typically pre-programmed for a specific task, such as tuning to a particular television frequency or keeping accurate time.

Programmable computers vary enormously in their computational power, speed, memory, and physical size. The smallest of these computers can be held in one hand and are called personal digital assistants (PDAs). They are used as notepads, scheduling systems, and address books; if equipped with a cellular phone, they can connect to worldwide computer networks to exchange information regardless of location.

Laptop computers and PCs are typically used in businesses and at home to communicate on computer networks, for word processing, to track finances, and to play games. They have large amounts of internal memory to store hundreds of programs and documents. They are equipped with a keyboard; a mouse, trackball, or other pointing device; and a video display monitor or liquid crystal display (LCD) to display information. Laptop computers usually have similar hardware and software as PCs, but they are more compact and have flat, lightweight LCDs instead of video display monitors.

Workstations are similar to personal computers but have greater memory and more extensive mathematical abilities, and they are connected to other workstations or personal computers to exchange data. They are typically found

in scientific, industrial, and business environments that require high levels of computational abilities.

Mainframe computers have more memory, speed, and capabilities than workstations and are usually shared by multiple users through a series of interconnected computers. They control businesses and industrial facilities and are used for scientific research. The most powerful mainframe computers, called supercomputers, process complex and time-consuming calculations, such as those used to create weather predictions. They are used by the largest businesses, scientific institutions, and the military. Some supercomputers have many sets of CPUs. These computers break a task into small pieces, and each CPU processes a portion of the task to increase overall speed and efficiency. Such computers are called parallel processors.

II READING

1. Read and translate the text into Ukrainian.

The distinction between minicomputers and mainframe computers has blurred over the years, as today's minicomputers are as powerful as mainframe computers ten years ago. The growth in minicomputer flexibility and capability has led to the concept of distributed processing and to the minicomputer's popularity.

Users can add to their minicomputer system in unlimited configurations as their needs grow. In order to keep costs down, many companies now link microcomputers to minicomputers rather than purchasing more large equipment. In many cases, companies use minicomputers with communication facilities to provide remote processing capabilities. Many companies have switched from one large computer to minicomputers located where processing is required.

Vendors realize that efficient software determines most minicomputer purchases. Many companies choose software written especially for their industry needs and purchase a minicomputer to operate that software. Software packages decrease a company's needs for in-house data-processing staff.

The term mainframe computer means a computer larger than a minicomputer. Mainframes process data at high speeds and can store millions of characters. Several mainframes of differing sizes but with the same processor built by one manufacturer comprise a family of computers. The software compatibility this offers can save user money. Entry into the mainframe industry requires a huge capital investment. Mainframe manufacturers distribute development costs among all of their hardware products to reduce unit cost.

Though mainframes once dominated the computer industry, they have lost their market share during the last decade. Changes away from centralized processing and

toward distributed processing have affected the demand for mainframe computers. Users now want smaller, more flexible systems and computer sales reflect this preference.

Vendor support of mainframes consists of more than just sales. Vendors frequently provide training and education for all levels of users.

Supercomputers, representing the most advanced computer technology, process data at up to 600 million operations per second. They sell for several million dollars to a limited market. Other countries have recently entered the world market. Cooperative efforts of government, universities, and corporations may help the United States remain the world leader in computer technology. Supercomputers' lightning fast operations are especially useful in aerodynamic design, scientific research, nuclear weapons development, weather forecasting, and energy conservation.

The overwhelming demand for software in the past decade has created a profitable market for software and consulting firms specializing in software. Data management software ranks as one of the most popular software packages. Increasing hardware purchases that result from declining hardware costs have led to escalating software demands. Software retail stores attempt to reach the small business and first-time users hardest hit by the "software crunch."

Service bureaus provide system development and computer operations. Time-sharing companies maintain computer facilities that they rent to users who do not want to incur the cost of owning a large computer system. Time-sharing customers can purchase communications access equipment and pay a monthly rate for CPU use. A time-sharing company can distribute system costs over many users nationwide. Service bureaus provide a variety of data-processing services tailored to the needs of each client. User companies will face more rental and purchase decisions as computer vendors vie for a bigger share of the market.

When selecting a computer configuration, a purchaser must consider: purchase versus rental price, maintenance costs, vendor support, software costs and capabilities, hardware capabilities, staff requirements, and system flexibility and compatibility.

The practice of linking microcomputers with minicomputers and mainframes has created new security problems. New products and routine security measures can reduce the risk of unauthorized entry into data bases.

2. Make up the logical scheme of the text and render the content of the text based on the scheme.

3. Fill in the gaps with the words from the list.

a. family of computers
b. security
c. mainframe
d. compatibility
e. bundled
f. flexibility
g. minicomputers
h. service bureau
i. software
j. supercomputers

1. The growth in _____applications has led to the concept of data processing.
2. The _____of minicomputers has led to their popularity.
3. Efficient _____is a primary key to selling hardware.
4. Several mainframe computers of differing sizes that have the same type processor are in the same _____.
5. _____allows a company to save money when purchasing new computer equipment.
6. The cost of maintaining large computer systems deters many firms from purchasing _____computers.
7. Only a few _____are produced each year.
8. Many companies that cannot afford their own system use a _____for data processing services.
9. Support services that are included in the purchase price of equipment are said to be _____.
10. As linking computers increases, _____problems increase.

4. Translate the sentences into the Ukrainian language. Take into consideration the information presented in the sentences. It may be helpful to you while doing the next exercises and discussing the topic.

1. Minicomputers can be used in an unlimited number of configurations and can support a full line of peripherals. 2. Mainframes, the heart of the large-scale computer, can process large amounts of data at very high speeds, hold millions of characters in primary storage, and support many input, output, and auxiliary storage devices. 3. A demand for smaller, more flexible systems replaced the demand for large, central computer systems as user needs grew and centrally located computers became overloaded. 4. Supercomputers are used by large corporations and government agencies that need large data bases and complex calculation capabilities. 5. Manufacturers in all market sectors provide software packages to accompany their equipment, but since their efforts do not meet the market demand for software, many firms specialize in software development. 6. Small business and first-time users do not have the staff to develop their own software and must rely on software firms to supply software programs. 7. Time-sharing customers can purchase sophisticated input/output devices and use them to access time-sharing company facilities. 8. Many manufacturers design their systems using a modular approach that permits the addition of components to a system as

an organization's needs change. 9. Software compatibility allows a user to purchase additional hardware without having to purchase additional software. 10. A configuration can include all types of computers, printers, terminals, modems, and storage and peripheral devices.

5. Choose the right answer.

1.Advances in technology have moved minicomputers toward mainframe computers in terms of _____.

a. capability, compatibility, and cost
b. capability, memory size, and processing power
c. compatibility, memory size, and processing power
d. compatibility, memory size, and cost

2. The _____of minicomputers has led to their popularity.
a. number of configurations
b. cost
c. full line of peripherals
d. flexibility

3. Many companies have replaced centrally located mainframe computers with minicomputers that are _____.
a. faster than mainframes
b. less flexible than mainframes
c. located where processing is required
d. replacing data processing staff

4. Today the term mainframe refers to a computer that is larger than a minicomputer. During the 1960s, the term was synonymous with a_____.
a. CPU
b. maxicomputer
c. very large computer system
d. family of computers

5. A trend in the computer industry has moved away from _____and toward_____.
a. centralized processing/data processing
b. mainframe computers/distributed processing
c. centralized processing/distributed processing
d. supercomputers/minicomputers

6. The cost of hardware has been declining at a rate of 15 to 20 percent a year while software and service costs _____.
a. have also declined
b. have continued to increase
c. have remained the same
d. at first rose then dropped significantly

7. A ____ requires many central processors to complete operations.
a. supercomputer
b. mainframe computer
c. complex program
d. data-processing service

8. _____ lead(s) the competition in computer research and development.
   a. The United States
   b. Several countries
   c. The United States and Japan
   d. Japan

9. During the 1980s, supercomputers are expected to reach a performance level of _____operations per second.
   a. ten million
   b. one billion
   c. one million
   d. two billion

10. The overwhelming demand for software has made it profitable for firms to_____.
   a. sell minicomputers
   b. develop distributed processing systems
   c. focus on retail sales
   d. specialize in software development

11. The increase in hardware purchases has _____.
   a. escalated software demand
   b. created a need for more research
   c. distracted from software development
   d. made the United States a leader in computer technology

12. Growth in the time-sharing industry is primarily due to _____.
   a. advances in communication equipment
   b. changing economic trends
   c. the large number of companies repeatedly requiring data-processing services
   d. the fact that electronic data processing is decreasing

13. _____provide data processing services such as system development.
   a. Software vendors
   b. Time-sharing companies
   c. Service bureaus
   d. Retail firms

14. The _____of CPUs and peripheral devices prohibit many firms from buying large computer systems.
   a. reliability
   b. quality and selection
   c. purchase prices
   d. limitations

15. The _____of a system is the degree to which it can be adapted to meet changing requirements.
   a. capability
   b. flexibility
   c. configuration
   d. diversity

6. Translate the words and word-combinations into English.

Здатність, гнучкість, універсальна ЕОМ, програмна сумісність, пакет програм, централізоване опрацювання, розподілене опрацювання, гнучка система, розробка системи, комп'ютерна мережа, локальна мережа, електронна пошта, постійна пам'ять, оперативна пам'ять, центральний процесор, двійкове зображення, операційна система, машинна мова, електронна схема, прямий доступ.

7. Say true or false and explain.

1. T F Minicomputers usually require air conditioning.

2. T F Many companies now link microcomputers with minicomputers to hold down costs.

3. T F Companies began the switch from centralized computer departments to minicomputers to hold down costs.

4. T F Efficient software is a primary key to selling hardware.

5. T F Many users develop their own software and purchase the right hardware to run it.

6. T F Mainframe computers of differing sizes but with the same type processor are said to be software compatible.

7. T F Mainframe computers represent the most advanced computer technology of our time.

8. T F Data management software is one of the most popular software packages.

9. T F Prepared software packages cost much less than developing software in-house.

10. T F Many large companies have taken a casual attitude toward microcomputer and software theft in the past.

III DISCUSSING

1. Give the short answer.

1. Describe how the flexibility of minicomputers has led to their popularity.
2. Why is efficient software the primary key to selling hardware?
3. How does software compatibility save user money?
4. Describe how a growing company might purchase computer equipment over a period of years.
5. State some of the uses of supercomputers.
6. Explain the market trend that has escalated software demands.
7. Explain the term configuration as it applies to computers.

8. Describe how manufacturers build flexibility into their hardware systems.
9. Explain one of the major security problems that can result from linking microcomputers with mainframes.
10. State some of the advantages of linking microcomputers with mainframes.

2. Prepare reports using Internet or other sources (catalogues, magazines, books, etc.) about the latest news, achievements in the field concerning the topic of the chapter.

3. Summarize everything you have learnt on the topic.

4. Taking into consideration quick pace of the latest achievements and developments in computer engineering and programming and information presented in the reports what information from the texts of the Chapter should be reconsidered, changed, added, etc..

5. It's interesting to know…

Supercomputers

Supercomputer, computer designed to perform calculations as fast as current technology allows and used to solve extremely complex problems. Supercomputers are used to design automobiles, aircraft, and spacecraft; to forecast the weather and global climate; to design new drugs and chemical compounds; and to make calculations that help scientists understand the properties of particles that make up atoms as well as the behavior and evolution of stars and galaxies. Supercomputers are also used extensively by the military for weapons and defense systems research, and for encrypting and decoding sensitive intelligence information.

Supercomputers are different than other types of computers in that they are designed to work on a single problem at a time, devoting all their resources to the solution of the problem. Other powerful computers such as mainframes and workstations are specifically designed so that they can work on numerous problems, and support numerous users, simultaneously. Because of their high cost—usually in the hundreds of thousands to millions of dollars—supercomputers are shared resources. Supercomputers are so expensive that usually only large companies, universities, and government agencies and laboratories can afford them.

How Supercomputers Work

The two major components of a supercomputer are the same as any other computer -a central processing unit (CPU) where instructions are carried out, and the memory in which data and instructions are stored. The CPU in a supercomputer is similar in function to a standard personal computer (PC) CPU,

but it usually has a different type of transistor technology that minimizes transistor-switching time. Switching time is the length of time that it takes for a transistor in the CPU to open or close, which corresponds to a piece of data moving or changing value in the computer. This time is extremely important in determining the absolute speed at which a CPU can operate. By using very high performance circuits, architectures, and, in some cases, even special materials/supercomputer designers are able to make CPUs that are 10 to 20 times faster than state-of-the-art processors for other types of commercial computers.

Supercomputer memory also has the same function as memory in other computers, but it is optimized so that retrieval of data and instructions from memory takes the least amount of time possible. Also important to supercomputer performance is that the connections between the memory and the CPU be as short as possible to minimize the time that information takes to travel between the memory and the CPU.

A supercomputer functions in much the same way as any other type of computer, except that it is designed to do calculations as fast as possible. Supercomputer-designers use two main methods to reduce the amount of time that supercomputers spend carrying out instructions - pipelining and parallelism. Pipelining allows multiple operations to take place at the same time in the supercomputer's CPU by grouping together pieces of data that need to have the same sequence of operations performed on them and then feeding them through the CPU one after the other. The general idea of parallelism is to process data and instructions in parallel rather than in sequence.

In pipelining, the various logic circuits (electronic circuits within the CPU that perform arithmetic calculations) used on a specific calculation are continuously in use, with data streaming from one logic unit to the next without interruption. For instance, a sequence of operations on a large group of numbers might be to add adjacent numbers together in pairs beginning with the first and second numbers, then to multiply these results by some constant, and finally to store these results in memory. The addition operation would be Step 1, the multiplication operation would be Step 2, and the assigning of the result to a memory location would be Step 3 in the sequence. The CPU could perform the sequence of operations on the first pair of numbers, store the result in memory and then pass the second pair of numbers through, and continue on like this. For a small group of numbers this would be fine, but since supercomputers perform calculations on massive groups of numbers this technique would be inefficient, because only one operation at a time is being performed.

Pipelining overcomes the source of inefficiency associated with the CPU performing a sequence of operations on only one piece of data at a time until the sequence is finished. The pipeline method would be to perform Step 1 on the

first pair of data and move it to Step 2. As the result of the first operation move to Step 2, the second pair of data move into Step 1. Step 1 and 2 are then performed simultaneously on their respective data and the results of the operations are moved ahead in the pipeline, or the sequence of operations performed on a group of data. Hence, the third pair of numbers are in Step 1, the second pair of numbers are in Step 2, and the first pair of numbers are in Step 3. The remainder of the calculations is performed in this way, with the specific logic units in the sequence are always operating simultaneously on data.

The example used above to illustrate pipelining can also be used to illustrate the concept of parallelism. A computer that parallel-processed data would perform Step 1 on multiple pieces of data simultaneously, then move these to Step 2, then to Step 3, each step being performed on the multiple pieces of data simultaneously. One way to do this is to have multiple logic circuits in the CPU that perform the same sequence of operations. Another way is to link together multiple CPUs, synchronize them (meaning that they all perform an operation at exactly the same time) and have each CPU perform the necessary operation on one of the pieces of data.

Pipelining and parallelism are combined and used to greater or lesser extent in all supercomputers. Until the early 1990s, parallelism achieved through the interconnection of CPUs was limited to between 2 and 16 CPUs connected in parallel. However, the rapid increase in processing speed of off-the-shelf microprocessors used in persona! computers and workstations made possible massively-parallel processing (MPP) supercomputers While the individual processors used in MPP supercomputers are not as fast as specially designed supercomputer CPUs, they are much less expensive and because of this, hundreds or even thousands of these processors can be linked together to achieve extreme parallelism.

Supercomputer Performance

Supercomputers are used to create mathematical models of complex phenomena. These models usually contain long sequences of numbers that are manipulated by the supercomputer with a kind of mathematics called matrix arithmetic. For example, to accurately predict the weather, scientists use mathematical models that contain current temperature, air pressure, humidity, and wind velocity measurements at many neighboring locations and altitudes. Using these numbers as data, the computer makes many calculations to simulate the physical interactions that will likely occur during the forecast period

When supercomputers perform matrix arithmetic on large sets of numbers, it is often necessary to multiply many pairs of numbers together and to then add up each of their individual products. A simple example of such a calculation is: (4 Ч 6) + (7 Ч 2) + (9 Ч 5) + (8 Ч 8) + (2 Ч 9) = 165. In real problems, the strings of numbers used in calculations are usually much longer, often containing hundreds

or thousands of pairs of numbers Furthermore, the numbers used are not simple integers but more complicated types of numbers called floating point numbers that allow a wide range of digits before and after the decimal point, for example 5.063.937.9120834.

The various operations of adding, subtracting, multiplying, and dividing floating-point numbers are collectively called floating-point operations. An important way of measuring a supercomputer's performance is in the peak number of floating-point operations per second (FLOPS) that it can do. In the mid-1990s, the peak computational rate for state-of-the-art supercomputers was between 1 and 200 Gigaflops (billion floating-point operations per second), depending on the specific model and configuration of the supercomputer.

In July 1995, computer scientists at the University of Tokyo, in Japan, broke the 1 teraflops (1 trillion floating-point operations per second) mark with a computer they designed to perform astrophysical simulations. Named GRAPE-4 (GRAvity PipE number 4), this MPP supercomputer consisted of 1692 interconnected processors. In November 1996, Cray Research debuted the CRAY T3E-900, the first commercially available supercomputer to offer teraflops performance. In 1997, the Intel Corporation installed the teraflop machine Janus at Sandia National Laboratories in New Mexico. Janus is composed of 9072 interconnected processors. Scientists use Janus for classified work such as weapons research as well as for unclassified scientific research such as modeling the impact of a comet on the earth.

The definition of what a supercomputer is constantly changes with technological progress. The same technology that increases the speed of supercomputers also increases the speed of other types of computers. For instance, the first computer to be called a supercomputer, the Cray-1 developed by Cray Research and first sold in 1976, had a peak speed of 167 megaflops. This is only a few times faster than standard personal computers today, and well within the reach of some workstations.

REFERENCES

1. Japan Annual Reviews in Electronics, Computers & Telecommunications. Editor: T Kitagawa, OHM. – Tokyo, 1988.
2. Oryal Tanir. Modeling Complex Computer & Communication Systems. A Domain – Oriented Design Framework . McGraw. – Hill, 1997.
3. Sarah E. Hutchinson, Glen J. Goulthard. MICROSOFT Access 7.0 for Windows 95. Irwin, 1996.
4. Sarah E. Hutchinson. Microcomputer Application Software. Second edition. Irwin. – Boston, 1989.
5. Stephen L. Nelson. Windows NT4 for Busy People. Osborne / McGraw. – Hill, 1996.
6. Software Engineering: A Practitioner's Approach. Second Education. (Roger S. Pressman, Ph D). McGraw. – Hill Publishing Company, 1987.
7. Англо-русский политехнический словарь./ Сост. Ю.Синдеев. – Ростов н/Д: Фенікс, 2002.
8. Англо-український словник з інформатики та обчислювальної техніки./ Лінгв.ред. О.Р. Микитюк. – Львів: СП "БаК", 1995.
9. Англо-українсько-російський словник з інформатики, програмування, обчислювальної техніки. /А.Б. Бортіков. – К.: Вища шк., 1995.
10. Новый англо-русский словарь./В.К. Мюллер, В.Л. Дашевская, В.А. Каплан и др. – 3-е изд., стереот. – М.: Рус.яз., 1996.
11. Л.П. Зайцева, М.А. Бух. Микроэлектроника: настоящее и будущее. – М.: "Высшая школа", 1990.
12. В.І. Карабан. Переклад англійської наукової і технічної літератури. – Вінниця: Нова книга, 2001.

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