MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

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COMPUTER ENGINEERING

A Coursebook of Professional English

ODESA 2020

UDC 811.11:004.7(075) Plan of EMP 2020

Recommended as a coursebook by the Academic Council of ONAT named after O.S. Popov (Protocol No3 from 29 /10 /2020).

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Veretennikova V.P. Computer Engineering. A coursebook of professional English: coursebook/ V.P. Veretennikova – Odesa: IE M.O. Bondarenko, 2020. – 162 p.

The textbook « Computer Engineering. A Coursebook of Professional English» contains original texts borrowed from English and American popular scientific publications and is accompanied by lots of lexical and grammatical exercises. It is aimed to train students for literature reading and topics discussion related to many challenges of Computer Engineering as part of computer science in which several kinds of methods, thoughts and techniques are used for getting the skills development of the oral and written language as well as to keep students motivated with contemporary and professional topics. The skills learned from this course will be useful for those preparing to start work and for those already in work.

The main purpose of this coursebook is intended to be used as the coursebook for students specializing in the field of computer engineering, as well as for graduate students and researchers preparing for passing their examination in English to obtain the Ph.D. degree.

Approved by the Department of Language Training and recommended for publication Protocol No.2 from 24/09/2020.

ISBN

First printing 2020

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COMPUTER ENGINEERING

I. Note the pronunciation of the following:

convergence [kən'vɜːdʒəns]
graduates ['grædjʊəts]
engineer [,ɛndʒɪ'nɪə]
high-tech ['haɪ-tɛk]
microelectronics [,maɪkrəʊɪlɛk'trɒnɪks]
miniaturization [,mɪnɪtʃ(ə)raɪ'zeɪʃ(ə)n]
reliability [rɪˌlaɪə'bɪlɪti]
specialization [,spɛʃəlaɪ'zeɪʃən]

II. Read Text One and get ready to discuss it in the classroom:

Text 1
COMPUTER ENGINEERING AS a DISCIPLINE

Computer engineering provides some background of the field and shows how it evolved over time. It is important for graduates to have a proper sense of professionalism to ensure a proper perspective in the practice of computer engineering. Computer engineering is defined as the discipline that embodies the science and technology of design, construction, implementation, and maintenance of software and hardware components of modern computing systems and computer-controlled equipment.

Computer engineering has traditionally been viewed as a combination of both computer science (CS) and electrical engineering (EE). It has evolved over the past three decades as a separate, although intimately related, discipline. Computer engineering is solidly grounded in the theories and principles of computing, mathematics, science, and engineering and it applies these theories and principles to solve technical problems through the design of computing hardware, software, networks, and processes. Historically, the field of computer engineering has been widely viewed as "designing computers." In reality, the design of computers themselves has been the province of relatively few highly skilled engineers whose goal was to push forward the limits of computer and microelectronics technology. The successful miniaturization of silicon devices and their increased reliability as system building blocks has created an environment in which computers have replaced the more conventional electronic devices. These applications manifest themselves in the proliferation of mobile telephones, personal digital assistants, location-aware devices, digital cameras, and similar products. It also reveals itself in the myriad of applications involving embedded systems, namely those computing systems that appear in applications such as automobiles, large-scale electronic devices, and major appliances. Increasingly, computer engineers are involved in the design of computer-based systems to address highly specialized and specific application needs. Computer engineers work in most industries, including the computer, aerospace, telecommunications, power production, manufacturing, defense, and electronics industries. They design high-tech devices ranging from tiny microelectronic integrated-circuit chips, to powerful systems that utilize those chips and efficient telecommunication systems that interconnect those systems. Applications include consumer electronics (CD and DVD players, televisions, stereos, microwaves, gaming devices) and advanced microprocessors, peripheral equipment, systems for portable, desktop and client/server computing, and communications devices (cellular phones, pagers, personal digital assistants).

A wide array of complex technological systems, such as power generation and distribution systems and modern processing and manufacturing plants, rely on computer systems developed and designed by computer engineers. Technological advances and innovation continue to drive computer engineering. There is now a convergence of several established technologies (such as television, computer, and networking technologies) resulting in widespread and ready access to information on an enormous scale. This has created many opportunities and challenges for computer engineers. This convergence of technologies and the associated innovation lie at the heart of economic development and the future of many organizations.

As noted previously, computer engineering evolved from the disciplines of electrical engineering and computer science. Initial curricular efforts in computer engineering commonly occurred as a specialization within EE programs, extending digital logic design to the creation of small-scale digital systems and, eventually, the design of microprocessors and computer systems. The evolution may take many forms, including (a) an expanded content from computer science, (b) collaboration with the emerging software engineering discipline on application-focused projects and embedded systems with a greater emphasis on design and analysis tools to manage complexity, or (c) re-integration with electrical engineering, as computer-based systems become dominant in areas such as control systems and telecommunications.

(From *Computer Engineering Curriculum Guidelines for Undergraduate Degree Programs in Computer Engineering*)

Commentary

EE stands for Electrical Engineering, the branch of engineering science that studies the uses of electricity and the equipment for power generation and distribution and the control of machines and communication. The Department of Electrical Engineering offers a variety of programs for graduate study. For instance, students who complete their BS (Bachelor of Science) in EE gain a basic understanding of electrical engineering built on a foundation of physical science, mathematics, computing, and technology. Coursework prepares students for careers in government agencies, the corporate sector, or for future study in graduate or professional schools.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following word combinations and write them out:

небольшие цифровые системы; продвигать пределы; эта сходимость технологий; встроенные системы; микроэлектронные кристаллы интегральной схемы; в огромном масштабе; обеспечивает некоторые предпосылки; как отмечено ранее; прочно обоснована в теориях; огромное количество сложных систем; высококвалифицированные инженеры; несметное число приложений; глубоко связанный; как системные стандартные блоки; миниатюризация кремниевых устройств; быстрое увеличение количества мобильных телефонов; фокусируемые на приложении проекты; много возможностей и проблем; начальные учебные усилия; осведомлённые о расположении устройства.

II. Find in the above text synonyms of the following words:

countless number, lucky chance, progressive, right, prevailing, determine, alike, pioneer work.

III. Look through the text again and find the answers to the following questions:

1. Why is it important for graduates to have a proper sense of professionalism to ensure a proper perspective in the practice of computer engineering? 2. How can you define computer engineering? 3. What theories and principles is computer engineering grounded in? 4. What has the field of computer engineering been widely viewed historically as? 5. What has created an environment in which computers have replaced the more conventional electronic devices? 6. Where can computer engineers work? 7. Who designs high-tech devices ranging from tiny microelectronic integrated-circuit chips to powerful systems? 8. What drives computer engineering? 9. What does the convergence of several established technologies result in? 10. What disciplines did computer engineering evolve from? 11. What forms may the evolution of computer engineering take?

IV. Retell the above text using as many of the word combinations from Exercise I as you can.

WORKING ON WORDS

I a). Study the table and learn phrasal verbs with "*push*".

Push ahead means to continue, especially when something is difficult.
Push around means to tell someone to do something in a rude way.
Push forward means to move forward; to move onward toward a goal.
Push in means to get in a queue without waiting; to make trouble for someone.
Push out means to force someone to leave a job or activity.
Push through means to force something to be accepted or legal.

b). Choose the correct preposition or adverb to complete each of the following sentences:

ahead *around* *forward* *in* *out* *through*

1. The young man just pushed ….. the queue in front of us at the supermarket checkout. 2. We pushed the regulations in the computing field ….. despite the opposition. 3. I wanted to halt the project, but the chief computer engineer decided to push ….. . 4. Mike was very angry when I pushed ….. and was served before him. 5. Computer professionals have had a few problems but they have decided to push ….. . 6. She felt she was pushed ….. of the group because she didn't agree with them on everything. 7. The department of Electrical Engineering pushed ….. measures to improve the professional schools. 8. When I was young I was pushed ….. by my elder sister. 9. We are pushing ….. , hoping to complete our project on high-tech devices on time. 10. Don't push me ….. ! I'm fed up of you telling me what to do. 11. He was urged to push ….. with the reforms in electronics industry. 12. Her brother is the type of man who will push ….. anywhere. 13. Our programmer didn't resign from his last job, he was pushed ….. . 14. They wanted to push their son ….. the world.

c). Find in the above text and copy out the sentence containing the phrasal verb "*push*".

II. Complete the sentences with the words from the box:

based as well as requirement operating related differ involved

1. Computer engineering is the process of analyzing and designing all hardware, software, and ….. systems for a computer system. 2. Computer science and engineering are often confused as being the same, but these two fields ….. greatly. 3. We must utilize our knowledge and understanding of the design of logic and microprocessor systems, ….. computer architecture and computer interfacing. 4. Many reasons prompt new designs such as seeking to exploit new developments in …. technologies or to develop improvements on existing products. 5. Computer engineering technologists support engineers by installing and operating computer-….. products, and maintaining those products. 6. Computer engineers are ….. in many hardware and software aspects of computing, from the design of individual microcontrollers, microprocessors, personal computers, and supercomputers, to circuit design. 7. A key element of this process is a ….. that each program engage in an ongoing process of self-assessment and continuous improvement.

WRITTEN PRACTICE

I. Choose the correct preposition to complete each of the following sentences:

within with to on of in(2)

1. The current engineering criteria are intended to ensure that all accredited programs satisfy a minimum set of criteria common ….. all engineering disciplines and criteria specific to each discipline. 2. I must have a strong background and understanding of mathematics and science to major ….. this field. 3. He applied the theories and principles ….. science and mathematics to design hardware and to solve technical problems. 4. Undergraduate programs in computer engineering must

include not only basic knowledge ….. the field, but the ability to apply it to the solution of realistic projects. 5. Programs should demonstrate that all graduates achieve a set of program outcomes based ….. the program's educational objectives. 6. Our students will be creative and innovative ….. their application of the principles covered in the curriculum. 7. The benchmarking defines both threshold (minimal) and modal (average) expectations ….. respect to demonstrated student knowledge, skills, and judgment.

II. Choose the necessary verb form from the box and translate the sentences:

chosen consist be able to solve to major associated possess made to deal learn

1. During their work, computer engineers may find themselves with answers ….. computer dilemmas, creating the next big technological solution. 2. You also need good communication skills, because a computer engineer often needs to go outside the lab ….. with customers, and other professionals. 3. While his responsibilities ….. more of electrical and software engineering, he must be trained in software design and the integration of hardware and software. 4. We must ….. strong detail orientation, teamwork, and analytical skills. 5. Our engineer had to apply the theories and principles of science and mathematics to design hardware and ….. technical problems. 6. Because of the rapid pace of change in the computing field, computer engineers must be life-long learners to maintain their knowledge and skills within their ….. discipline. 7. An important distinction should be ….. between computer engineers, electrical engineers, other computer professionals, and engineering technologists. 8. Computer engineering students must …..to integrate theory, professional practice, and social constructs in their engineering careers. 9. Graduates of our Academy should have an understanding of the responsibilities ….. with engineering practice, including the professional, societal, and ethical context in which they do their work. 10. You will ….. to contribute significantly to the analysis, design, and development of complex systems.

III. Find in the above text the sentences with the present perfect active or passive and translate them.

COMMUNICATIVE SITUATIONS

I. Discuss the following questions. Share opinions.

1. Have you ever failed at an exam? In what subject did you fail? Why?
2. What features of people's character contribute to their success in research work?

DATA STRUCTURES AND ALGORITHMS

I. Note the pronunciation of the following:

algebra [ˈælʤɪbrə]
algorithm [ˈælgərɪðəm]
circumference [səˈkʌmfərəns]
character [ˈkærɪktə]
constant [ˈkɔnstənt]
diameter [daɪˈæmɪtə]
equivalent [ɪˈkwɪvələnt]
hierarchy [ˈhaɪərɑːki]
intuitive [ɪnˈtjuːɪtɪv]
mnemonic [niːˈmɔnɪk]
pi [ˈpaɪ]

II. Read Text Two and get ready to discuss it in the classroom:

Text 2
DATA STRUCTURES AND ALGORITHMS

Data structures and algorithms are the materials out of which programs are constructed. Furthermore, the computer itself consists of nothing other than structures and algorithms. The built-in data structures are the registers and memory words where binary values are stored; the hard-wired algorithms are the fixed rules, embodied in electronic logic circuits, by which stored data are interpreted as instructions to be executed. Thus at the most fundamental level a computer can work with only one kind of data, namely individual bits, or binary digits, and it can act on the data according to only one set of algorithms, those defined by the instruction set of the central processing unit.

The problems people undertake to solve with the aid of a computer are seldom expressed in terms of bits. Instead the data take the form of numbers, characters, texts, events, symbols and more elaborate structures such as sequences, lists and trees. The algorithms employed to solve the problems are even more varied; indeed, there are at least as many algorithms as there are computational problems. The computer is a truly general-purpose device, whose nature can be transformed altogether by the program given it. The underlying principle was first set forth by John von Neumann. A stream of information is at one moment data being processed by a program, and at the next moment the same information is interpreted as a program in its own right. Hence a program is formulated in terms of familiar notions convenient to the problem at hand; then another program, called an assembler or a compiler, maps those notions onto the facilities available in the computer. In this way it is possible to construct systems of extraordinary complexity. The programmer sets up a hierarchy of abstractions, viewing the program first in broad outline and then attending to one part at a time while ignoring the internal details of other parts. Without higher level abstractions a program could not be understood fully even by its creator.

Among the facilities provided by almost all programming languages is the ability to refer to an item of data by assigning it a name, or identifier. Some of the named quantities are constants, which have the same value throughout the segment of the program in which they are defined; for example, *pi* might be assigned the value 3.14159. Other named quantities are variables, which can be assigned a new value by statements within the program, so that their value cannot be known until the program is run. The variables *diameter* and *circumference* might take on new values each time a calculation is done.

The name of a constant or a variable is a mnemonic aid to the programmer, but it has no meaning to the computer. The compiler that translates a program text into binary code merely associates each identifier with an address in memory. If an instruction calls for multiplying *diameter* by *pi,* the computer fetches whatever numbers are stored at the specified addresses and calculates the product; if the result is to become the new value of *circumference,* it is stored in memory at the address corresponding to that label.

The naming of constants and variables in programming is similar to the use of symbolic expressions in algebra, but for a computer to handle the process some additional information must be supplied. The information gives the «type» of each named quantity. A person working a problem by hand has an intuitive grasp of data types and the operations that are valid for each type; it is known, for example, that one cannot take the square root of a word or capitalize a number. One reason such distinctions are easily made is that words, numbers and various other symbols are represented quite differently. For the computer, however, all types of data ultimately resolved into a sequence of bits, and the type distinctions must be made explicit.

Suppose in the course of some operation the seven-bit binary value 1010011 has been read into a register in the central processing unit of a computer. How is the value to be interpreted? One possibility is that it represents a cardinal, or counting, number, in which case the equivalent in decimal notation would be 83. In many programming languages the value could also represent a signed integer equal to decimal — 45. The same binary data could encode not a number but a character; in the American Standard Code for Information Interchange (ASCII) binary 1010011 specifies the letter S.

The data types recognized by common programming languages include cardinal numbers, integers, real numbers (approximated as decimal fractions), sets, characters and strings of characters. Information on each variable's type is needed not only to interpret the binary representation but also to set aside the correct amount of space in storage. In many modern computer systems a single character is allocated eight bits, or one byte, of memory, whereas a cardinal or an integer might be given two or four bytes and a real number might take up as many as eight bytes.

(*From Algorithms & Data Structures by Niklaus Wirth*)

Commentary

Niklaus Emil Wirth (born 15 February 1934) is a Swiss computer scientist, best known for designing several programming languages, including Pascal, and for pioneering several classic topics in software engineering. In 1984 he won the Turing Award, generally recognized as the highest distinction in computer science, for developing a sequence of innovative computer languages.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following word combinations and write them out:

отображать понятия на объекты; извлечь квадратный корень; в общем; строки символов; логическая схема; вычислительная задача; аппаратно-реализованный алгоритм; формулировать в терминах привычных понятий; другие именованные величины; действительны для каждого типа; базовый принцип; десятичная система счисления; пространство в устройстве хранения данных; операторами в программе; вручную; регистры и слова памяти; выражаются в битах; требует умножения диаметра на число *пи*; знаковое целое число; прописать число; двоичное представление; вычисляет произведение.

II. Study the following word combinations:

to run the program; to encode a character; a set of algorithms; familiar notion; a mnemonic aid to the programmer; a stream of information; the built-in data structures; binary values; instructions to be executed; a general-purpose device; systems of extraordinary complexity; throughout the segment of the program; the address corresponding to that label; resolved into a sequence of bits; in the course of some operation; the central processing unit of a computer; embodied in electronic logic circuits.

III. Answer the following questions using the words and word combinations from Exercises I and II:

1. What are programs constructed of? 2. Where are binary values stored? 3. What do you know about hard-wired algorithms? 4. What level at can a computer work with only one kind of data, namely individual bits, or binary digits? 5. Who was the underlying principle first set forth by? 6. Which terms is a program formulated in? 7. How does a programmer set up a hierarchy of abstractions? 8. In which case couldn’t a program be understood fully? 9. What quantities have the same value throughout the segment of the program in which they are defined? 10. What can you say about variables? 11. What is a mnemonic aid to the programmer? 12. What does the compiler that translates a program text into binary code associate each identifier with? 13. What is similar to the use of symbolic expressions in algebra? 14. Are words, numbers and various other symbols represented quite differently? 15. What do the data types recognized by common programming languages include? 16. How many bytes might a real number take up?

WORKING ON WORDS

I. Complete the sentences with the words from the box:

structure	computer	approaches	programs	software	data
mark-sweep	values				

1. There are often many ….. to solving a problem. 2. An integer is a simple type because its ….. contain no subparts. 3. An abstract data type is the realization of a data type as a ….. component. 4. A data ….. is a systematic way of organizing and accessing data and an algorithm is a step-by-step procedure for performing some task in a finite amount of time. 5. A tree is an abstract ….. type that stores elements hierarchically. 6. A classic algorithm for garbage collection is the ….. algorithm. 7. In order to implement any data structure on an actual computer, we need to use ….. memory. 8. It should go without saying that people write ….. to solve problems.

II a). Study the table and learn phrasal verbs with "*set*".

Set against means to balance one thing against another or to compare one thing with another.

Set aside means to not consider something, because other things are more important; to use something, often time or money, for a specific purpose.

Set back means to cause a delay by a particular time.

Set forth means to state or outline an opinion.

Set up means to prepare equipment, software etc., for use.

(From the Oxford Advanced Learner's Dictionary)

b). Choose the correct preposition or adverb to complete each of the following sentences:

against *aside* *back* *forth* *up*

1. The programmer's infectious disease set …... the executing the computer program by several weeks. 2. These algebraic results have been disappointing set ….. predetermined ones. 3. Our technician set ….. the computer experiments perfectly. 4. The whole operation has been set ….. by the late solving some computational problems. 5. The investigator set …. his ideas in his scientific laws. 6. Bad weather was the reason that the launch of the computer experiment was set ….. until Thursday. 7. These are relatively small points when set ….. my expertise on so many other mathematical issues embodied in the computer program. 8. There will be a risk of computation that could set …..formulation of the hypothesis. 9. They set….. the simulations of a real situation to be carried out quickly. 10. They have set ….. representational schemes to employ one of two basic approaches. 11. My colleague will set ….. her ideas of accessing data. 12. We agreed to set ….. our differences and work together in a computer experiment. 13. We can set ….. a meeting with everyone concerned to discuss all urgent problems more in detail.

c). Find in the above text and copy out the sentences containing the phrasal verb "*set*".

III. Find in the above text and copy out sentences in which linking expressions *however*, *thus*, *namely* and *hence* are used. Translate the sentences with them. Say which of these linking expressions:

a) introduces clarification?

b) introduces a contrast?

c) expresses results and conclusions?

WRITTEN PRACTICE

I. Choose the proper verb form and translate the sentences.

1. Trees provide a natural organization for data, and consequently ….. ubiquitous structures in file systems, graphical user interfaces, databases, Web sites, and other computer systems. 2. Huffman's algorithm for producing an optimal variable-length prefix code for X ….. on the construction of a binary tree T that represents the code. 3. Once a programmer ….. the principles of clear program design and implementation, the next step is to study the effects of data organization and algorithms on program efficiency. 4. The running time of an algorithm or data structure operation ….. with the input size, although it may also vary for different inputs of the same size. 5. The development of efficient algorithms for the minimum spanning tree problem ….. the modern notion of computer science itself. 6. The study of many complex systems, which ….. analysis by traditional mathematical methods, is consequently being made possible through computer experiments and computer models. 7. In order to represent an algebraic expression in a computer program, most systems ….. to store the minimum information needed to specify the expression uniquely. 8. This expression ….. as an inverted treelike structure in which the leaves are the operands. 9. Most algorithms ….. to be implemented as computer programs.

(***Missing verbs***: has learned, are intended, is based, predates, is represented, have become, seek, increases, have resisted)

II. Fill in prepositions:

1. The main advantage of using randomization ….. data structure and algorithm design is that the structures and functions that result are usually simple and efficient. 2. The Huffman code saves space ….. a fixed-length encoding by using short code-word strings to encode high-frequency characters and long code-word strings to encode low-frequency characters. 3. A trie (pronounced "try") is a tree-based data structure ….. storing strings in order to support fast pattern matching. 4. This key is a pointer ….. memory where a string resides. 5. An algorithm can be considered to be any sequence of operations that can be simulated ….. a Turing-complete system. 6. Stored data are regarded as part ….. the internal state of the entity performing the algorithm. 7. The study of many complex systems is consequently being made possible ….. computer experiments and computer models.

Keys: *for, through, in, by, over, to, of.*

III. State functions of the past participles in the following sentence:

The built-in data structures are the registers and memory words where binary values are stored; the hard-wired algorithms are the fixed rules, embodied in electronic logic circuits, by which stored data are interpreted as instructions to be executed.

IV. Find in the above text and copy out sentences containing modal verbs with the Infinitive Passive.

V. Put the verb in brackets into present simple passive:

1. The magnetic field under investigation (to specify) by a set of numbers stored in a computer. 2. The objects in a computer experiment (to bind) by the laws of nature. 3. Scientific laws (to construct) conventionally in terms of a particular set of mathematical functions and constructs. 4. This report (to devote) to an expanded discussion on professional practice and responsibilities. 5. The numbers and symbols (to modify) in the way specified by the scientific laws. 6. In this approach an expression (to represent) as an inverted treelike structure in which the leaves are the operands. 7. The concept of *algorithm* also (to use) to define the notion of decidability (logic).

VI. a) Study the grammar table and learn.

We use relative clauses to postmodify a noun – to make clear which person or thing we are talking about. In these clauses we can have the relative pronoun *who*, *which*, *whose* or *that*.

who → when we talk about people

which → when we talk about things or an idea, and to ask about choices. (*Which* is often surrounded by commas if a group of words adds information.)

whose → instead of his/her or their, etc.

that → when we talk about both a person and a thing/idea. (*That* is used if it limits the set of things you're talking about.)

We also use <u>*that*</u> for <u>*who/which*</u>.

That and *which* are the relative pronouns that we use to talk about things. The main difference between *who* and *that* or *which* is that you should only use *who* to refer to a person or people – *who* is never used to refer to things.

To understand when to use *that* or *which*, it's important to understand clauses. A defining clause (also called an essential clause or a restrictive clause) gives information essential to the meaning of the sentence. *That* is used in defining clauses.

Which introduces non-defining clauses. Unlike defining clauses, non-defining clauses (also called nonessential or nonrestrictive clauses) don't limit the meaning of the sentence. You might lose interesting details if you remove them, but the meaning of the sentence wouldn't change.

Here are some examples:

The results **that** I obtained may invoke positive social change. (The results (**that**) I obtained may invoke positive social change.)
I have found the article, **which** I have been looking for.

b). Find in the text and copy out sentences containing whose/that/ which.

VII. Translate the following sentences having relative pronouns:

1. Algorithm design is a challenging intellectual activity that provides a rich source of observation. 2. The goal of the project is to create an automatic design system that can apply existing design principles as well as exhibit some creativity. 3. A computer scientist is a mathematician who only knows how to prove things by induction. 4. Computer security is a branch of computer technology, whose objective includes protection of information from unauthorized access, disruption, or modification. 5. We seek algorithms that are correct and efficient, while being easy to implement. 6. Correct algorithms usually come with a proof of correctness, which is an explanation of why we know that the algorithm must take every instance of the problem to the desired result. 7. You cannot simultaneously accept two jobs whose intervals overlap. 8. There is a set of assumptions of things which are taken to be true. 9. I know the student who was studying the definition of all these classic algorithm problems. 10. Programming language theory is a branch of computer science that deals with the design, implementation, analysis, characterization, and classification of programming languages.

VIII. Translate the following sentences into English using the words and word combinations of the topical vocabulary:

1. Структура представляет собой дерево, листьями которого являются элементы исходного массива. 2. При измерении сложности алгоритмов и структур данных мы обычно говорим о количестве операций, требуемых для завершения работы (вычислительная сложность), и объёме ресурсов, который необходим алгоритму (пространственная сложность). 3. Алгоритм, который выполняется в десять раз быстрее, но использует в десять раз больше места, может вполне подходить для серверной машины с большим объёмом памяти. 4. Сложность алгоритма растёт с увеличением размера входных данных. 5. Если линейный алгоритм обрабатывает один элемент пять миллисекунд, то мы можем ожидать, что тысячу элементов он обработает за пять секунд. 6. Структуры данных формируются с помощью типов данных, ссылок и операций над ними на выбранном языке программирования. 7. Чтобы доказать, что данный алгоритм работает верно, мы используем метод математической индукции по номеру разряда.

TOPICS FOR DISCUSSION

I. What is your opinion on the following problem?

Why does a serious programmer need to know about algorithms and data structures?

II. Imagine yourself in the following situation:

Take your new computer back to the department store where you got it. The sound doesn't work.

COMPUTATION THEORY

I. Note the pronunciation of the following:

architecture ['ɑːkɪtɛkʧə]
dichotomy [daɪ'kɒtəmi]
procedure [prə'siːʤə]
finite ['faɪnaɪt]
function ['fʌŋkʃən]
idealized [aɪ'dɪəlaɪzd]
linear ['lɪnɪə]
measure ['mɛʒə]
multiply ['mʌltɪplaɪ]
quantum ['kwɒntəm]
polynomial [,pɒlɪ'nəʊmiəl]
proportional [prə'pɔːʃənl]

II. Read Text Three and get ready to discuss it in the classroom:

Text 3
COMPUTATION THEORY

A computer is a physical device that helps us process information by executing algorithms. An algorithm is a well-defined procedure, with finite description, for realizing an information-processing task. An information-processing task can always be translated into a physical task.

When designing complex algorithms and protocols for various information-processing tasks, it is very helpful, perhaps essential, to work with some idealized computing model. However, when studying the true limitations of a computing device, especially for some practical reason, it is important not to forget the relationship between computing and physics. Real computing devices are embodied in a larger and often richer physical reality than represented by the idealized computing model.

Quantum information processing is the result of using the physical reality that quantum theory tells us about for the purposes of performing tasks that were previously thought impossible or infeasible. Devices that perform quantum information processing are known as quantum computers. Quantum computers can be used to solve certain problems more efficiently than can be done with classical computers and also this can be done reliably even when there is a possibility for errors to occur.

We are often interested in the amount if resources used by a computer to solve a problem, and we refer to this as the complexity of the computation. An important resource for a computer is time. Another resource is space, which refers to the amount of memory used by the computer in performing the computation. We measure the amount of a resource used in a computation for solving a given problem as a function of the input length of an instance of that problem. For example, if the problem is to multiply two *n* bit numbers, a computer might solve this problem using up to $2n^2 + 3$ units of time (where the unit of time may be seconds, or the length of time required for the computer to perform a basic step).

Of course, the exact amount of resources used by a computer executing an algorithm depends on the physical architecture of the computer. A different computer multiplying the same numbers mentioned above might use up to time $4n^3 + n + 5$ to execute the same basic algorithm. This fact seems to present a problem if we are interested in studying the complexity of algorithms themselves, abstracted from the details of the machines that might be used to execute them. In theoretical computer science, an algorithm is considered to be efficient with respect to some resource if the amount of that resource used in the algorithm is in $O(n^k)$ for some *k*. In this case we say that the algorithm is polynomial with respect to the resource. If an algorithm's running time is in $O(n)$, we say that it is linear, and if the running time is in $O(\log n)$ we say that it is logarithmic. Since linear and logarithmic functions do not grow faster than polynomial functions, these algorithms are also efficient. Algorithms that use $\Omega(c^n)$ resources, for some constant *c*, are said to be exponential, and are considered not to be efficient. If the running time of an algorithm cannot be bounded above by any polynomial, we say its running time is superpolynomial. The term 'exponential' is often used loosely to mean superpolynomial.

One advantage of this coarse measure of complexity is that it appears to be robust against reasonable changes to the computing model and how resources are counted. For example one cost that is often ignored when measuring the complexity of a computing model is the time it takes to move information around. For example, if the physical bits that are arranged along a line, then to bring together two bits that are *n*-units apart will take time proportional to *n* (due to special relativity, if nothing else). Ignoring this cost is in general justifiable, since in modern computers, for an *n* of practical size, this transportation time is negligible. Furthermore, properly accounting for this time only changes the complexity by a linear factor (and thus does not affect the polynomial versus superpolynomial dichotomy).

Computers are used so extensively to solve such a wide variety of problems that questions of their power and efficiency are of enormous practical importance, aside from being of theoretical interest.

(From *Introduction to the Theory of Computation*. *By Michael Sipser*)

III. Learn reading the following mathematical symbols and expressions:

$2n^2 + 3$ – two sub *n* square plus three;

$4n^3 + n + 5$ – four sub n cubed plus *n* plus five;

$O(n^k)$ – o round brackets opened, *n* to the k^{th} power, round brackets closed;

$O(\log n)$ – o round brackets opened, logarithm of *n*, round brackets closed;

$\Omega(c^n)$ – omega, round brackets opened, *c* to the *n-th* power, round brackets closed.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following word combinations and write them out:

пример задачи; время транспортировки; линейный множитель; продолжительность эксплуатации; по отношению к; для выполнения одного и того же базового алгоритма; задача обработки информации; ранее считались невозможными или неосуществимыми; часто используется свободно; полиномиальные функции.

II. Memorize the following word combinations and make up your own sentences or situations with them:

to execute algorithms, to work with an idealized computing model, a coarse measure of complexity, to perform quantum information processing, by a linear factor, with respect to some resource.

III. Answer the following questions using the words and word combinations of the topical vocabulary:

1. In what way does a computer help us process information? 2. When is it essential to work with some idealized computing model? 3. Why is it important when studying the true limitations of a computing device not to forget the relationship between computing and physics? 4. Can quantum computers be used to solve certain problems more efficiently than can be done with classical computers? 5. How do we usually measure the amount of a resource used in a computation for solving a given problem? 6. What does the exact amount of resources used by a computer executing an algorithm depend on? 7. In which case can we say that the algorithm is polynomial with respect to the resource? 8. What algorithms are said to be exponential, and are considered not to be efficient? 9. When will it take time proportional to *n* to bring together two bits that are *n*-units apart?

IV. Retell the above text using as many of the word combinations from Exercises I and II as you can.

WORKING ON WORDS

I. Find in the above text and copy out phrases in which the preposition *by* is used. Translate them.

II. Choose the correct preposition to complete each of the following sentences:

on with (2) into by for at of (2) to

1. A RAM machine can perform elementary computational operations including writing inputs ….. its memory and elementary arithmetic operations on values stored in its memory. 2. In this case I can say that the algorithm is polynomial with respect ….. the resource. 3. An example ….. such a problem is that of finding

square roots modulo a prime. 4. Our proof is based ….. the idea involving the concept of a *census* function. 5. The well-ordering principle states that every set is in one-to-one correspondence ….. some ordinal. 6. The exact amount of resources used ….. a computer executing an algorithm depends on the physical architecture of the computer. 7. These results are useful ….. studying the complexity of problems with a natural alternating structure, such as games or logical theories. 8. This makes the calculation of the probabilities ….. events easier. 9. Then we transform a simple Boolean formula B into an arithmetic expression A by replacing the Boolean operators …. arithmetic operators. 10. Workers use handheld computing devices to collect data ….. a customer site, to control inventory, and to serve as desktop organizers.

III. Put one suitable preposition in each space.

1. He will use several different computational models, depending ….. the features he wants to focus on. 2. The controller moves from state to state with respect ….. the input it receives. 3. Determination of the truth or falsity of a mathematical statement depends ….. a mathematical proof. 4. One model, called the finite automaton, refers ….. text processing, compilers, and hardware design. 5. I am interested ….. the objective to classify problems as easy ones and hard ones. 6. The development of ideas with respect ….. theoretical models of computers led to the construction of actual computers. 7. Boolean logic refers ….. a mathematical system built around the two values *True* and *False*. 8. Depending ….. the application, we can be satisfied with a procedure that runs quickly. 9. An undirected graph refers ….. a set of points with lines connecting some of the points. 10. People are interested ….. mobile computing in every aspect of life, whether it is to send a quick email, upload and share photos or read entire books.

IV. Complete the sentences with the words from the box:

alphabet	studying	features	beginning	ability	another	term	technique

1. Enhanced security ….. provide teacher control of student access to courseware, teacher records and all program information. 2. All these models are computationally equivalent in the sense that they can simulate one ….. . 3. The computation of a deterministic machine can be described as a sequence of configurations ….. with the start configuration. 4. This result illustrates the use of a counting ….. to show lower complexity bounds. 5. Language theory is a branch of mathematics concerned with describing languages as a set of operations over an ….. . 6. The computation terminates only if the final ….. gives the value of the recursive function applied to the inputs. 7. Different models of computation have the ….. to do different tasks. 8. Our engineers are interested in ….. the complexity of algorithms themselves.

WRITTEN PRACTICE

I. Ask questions to the parts of the sentence in italics.

1. *To avoid this problem* we must use a more coarse measure of complexity. 2. A probabilistic Turing machine can *efficiently* simulate any realistic model of computation. 3. We can write a computer program *for our universal Turing machine*. 4. You can conclude *that √ 2 is irrational*. 5. *He* has to prove that the theorem is true for n + 1. 6. You are able *to see* that this machine accepts every binary string that ends with a 1. 7. If the automaton is in state q_2, then it can switch to state q_3 *without reading a symbol*. 8. The automaton can only read the input string once, *from left to right.* 9. We can always store a finite amount of data *in the finite control*. 10. The machine must not exceed the *stated* bounds. 11. I can save *a file* in many different locations in my computer.

II. Fill in the blank with the passive voice of the verb in brackets after the given modal verb. Translate the sentences.

1. This computing problem …… on any computer (can/solve). 2. Efficient fault-tolerant error-correcting techniques …… to deal with realistic error models (must/ find). 3. The Theory of Computation …… into the following three areas: Complexity Theory, Computability Theory, and Automata Theory (can/divide). 4. These mathematical problems…... in a systematic way (can/solve). 5. A direct proof…… by providing a factorization of $a^n - b^n$ (can/give). 6. These algorithms that use $\Omega(c^n)$ resources ….... not to be efficient (must/consider). 7. The amount of a resource used in a computation for solving a given problem…… as a function of the input length of an instance of that problem (must/measure). 8. It…… that the Turing 'machine' is a mathematical abstraction and not a physical device (should/ emphasize). 9. These data constitute the total information that …… across a vertical line drawn at some position *i* in the input string as the input head passes over that line (can/transfer). 10. Information …...in some physical medium and manipulated by some physical process (must/store). 11. These functions ….. usually ….. as functions of a single numeric variable *n* standing for the length of the input string(can/write). 12. The computation of a deterministic machine …… as a sequence of configurations beginning with the start configuration (can/describe).

III. Find in the above text and copy out sentences containing modal verbs with the Infinitive Passive.

IV. Ask all types of questions to the following sentences:

1. Simulations of one computer by another can also involve a trade-off between resources of different kinds, such as time and space.

2. To be useful information must be stored in some physical medium and manipulated by some physical process.

V. a) Study the grammar table and learn.

As an adverbial modifier of time the present participle may be preceded by the conjunctions **when** and **while**: When listening to him I understood that he was upset. While crossing the street you must be very attentive.

b) Find in the above text and copy out sentences containing the present participle in the function of an adverbial modifier.

COMMUNICATIVE SITUATIONS

I. Comment and expand on the following:

In 1936, when he was just twenty-four years old, Alan Turing wrote a remarkable paper in which he outlined the theory of computation, laying out the ideas that underlie all modern computers. This groundbreaking and powerful theory now forms the basis of computer science.

II. Discuss the arguments for the following problem. Explain why it is so.

In theoretical computer science and mathematics, the theory of computation is the branch that deals with how efficiently problems can be solved on a model of computation, using an algorithm.

III. Imagine you are an expert of a great modern computer scientist. Note down 5 pieces of factual information about the design of computational systems, the theory of computation and the practical technique of the scientist. Your fellow student will ask you questions to find out what you know about your subject. Use the topical vocabulary.

INTEGRATED CIRCUITS

I. Note the pronunciation of the following:

aluminium [ˌæləˈmɪniəm]
appliance [əˈplaɪəns]
arsenide [ˈaːs(ə)ˌnaɪd]
gallium [ˈgælɪəm]
inextricable [ɪnˈɛkstrɪkəbl]
integrated circuit [ˈɪntɪgreɪtɪd ˈsɜːkɪt]
magnitude [ˈmægnɪtjuːd]
monolithic [ˌmɒnəʊˈlɪθɪk]
photolithography [ˌfəʊtəʊlɪˈθɒgrəfi]
planar [ˈpleɪnə]

II. Read Text Four and get ready to discuss it in the classroom:

Text 4
INTEGRATED CIRCUITS

An integrated circuit or monolithic integrated circuit (also referred to as an IC, a chip, or a microchip) is a set of electronic circuits on one small flat piece (or "chip") of semiconductor material, normally silicon. The integration of large numbers of tiny transistors into a small chip resulted in circuits that are orders of magnitude smaller, cheaper, and faster than those constructed of discrete electronic components. The IC's mass production capability, reliability and building-block approach to circuit design ensured the rapid adoption of standardized ICs in place of designs using discrete transistors. ICs are now used in virtually all electronic equipment and have revolutionized the world of electronics. Computers, mobile phones, and other digital home appliances are now inextricable parts of the structure of modern societies, made possible by the small size and low cost of ICs.

ICs were made possible by experimental discoveries showing that semiconductor devices could perform the functions of vacuum tubes, and by mid-20th-century technology advancements in semiconductor device fabrication. Since their origins in the 1960s, the size, speed, and capacity of chips has increased enormously, driven by technical advances that allow more and more transistors on chips of the same size – a modern chip may have several billion transistors in an area of a human fingernail in size. These advances, roughly following Moore's law, allow a computer chip of 2016 to have millions of times the capacity and thousands of times the speed of the computer chips of the early 1970s.

Semiconductor ICs are fabricated in a planar process which includes three key process steps – imaging, deposition and etching. The main process steps are supplemented by doping and cleaning.

Mono-crystal silicon wafers (or for special applications, silicon on sapphire or gallium arsenide wafers) are used as the substrate. Photolithography is used to mark different areas of the substrate to be doped or to have polysilicon, insulators or metal (typically aluminium or copper) tracks deposited on them.

Integrated circuits are composed of many overlapping layers, each defined by photolithography, and normally shown in different colors. Some layers mark where various dopants are diffused into the substrate (called diffusion layers), some define where additional ions are implanted (implant layers), some define the conductors (polysilicon or metal layers), and some define the connections between the conducting layers (via or contact layers). All components are constructed from a specific combination of these layers.

ICs have two main advantages over discrete circuits: cost and performance. Cost is low because the chips, with all their components, are printed as a unit by photolithography rather than being constructed one transistor at a time. Furthermore, packaged ICs use much less material than discrete circuits. Performance is high because the IC's components switch quickly and consume little power (compared to their discrete counterparts) because of their small size and close proximity. The main disadvantage of ICs is the high cost to design them and fabricate the required photomasks. This high initial cost means ICs are only practical when high production volumes are anticipated.

(From *Wikipedia, the free encyclopedia*)

Commentary

Moore's law: Moore's law is the observation that, over the history of computing hardware, the number of transistors in a dense integrated circuit doubles approximately every two years. The law is named after Gordon E. Moore, co-founder of Intel Corporation, who described the trend in his 1965 paper.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following word combinations and write them out:

много накладывающихся слоёв; принцип компоновки из стандартных блоков; крошечные транзисторы; полупроводниковые устройства; изготовить необходимые фотошаблоны; монокристаллические кремниевые пластины; набор электронных схем; стоимость и производительность; человеческий ноготь; различные примеси; на порядок меньше, дешевле и быстрее; неразъёмные части; дополняются легированием и очисткой.

II. Study the following word combinations and use them in sentences of your own:

discrete electronic components; to refer to as an IC; to result in circuits; semiconductor device fabrication; to ensure the rapid adoption; to be driven by technical advances; to consume little power, many overlapping layers.

III. Answer the following questions using the word combinations and phrases of the topical vocabulary:

1. What is an integrated circuit or monolithic integrated circuit? 2. What did the integration of large numbers of tiny transistors into a small chip result in? 3. Where are ICs now used? 4. What experimental discoveries were ICs made possible by? 5. How many transistors may a modern chip have in an area of a human fingernail in size? 6. How are semiconductor ICs fabricated? 7. What are the main process steps supplemented by? 8. What is used as the substrate? 9. What is photolithography used for? 10. Why are overlapping layers shown in different colors? 11. Are all components constructed from a specific combination of these layers? 12. What advantages do ICs have over discrete circuits? 13. Is there any disadvantage in ICs?

IV. Retell the above text using as many of the word combinations from Exercises I and II as you can.

WORKING ON WORDS

I. Find in the above text and copy out phrases in which the preposition *into* is used. Translate them.

II. Find in Text 4 synonyms of the following words:
minute, quick, diverse, determine, needed, fulfill, unsolvable.

III. Complete the sentences with the words from the box:

smaller	Greek	vacuum	within	lack	thin	only

1. The pioneers of microelectronics tried many strategies to supplant …... tubes, and they delivered a host of semiconductors and chip designs: germanium, silicon, aluminum, gallium arsenide, PNP, CMOS, and so on. 2. There is a ….. of flexibility in an IC i.e., it is generally not possible to modify the parameters within which an integrated circuit will operate. 3. The crystal is cut by a diamond saw into many ….. wafers. 4. An integrated circuit ….. than a fingernail can hold millions of circuits. 5. If a single component ….. an IC fails, the complete IC is replaced. 6. Digital ICs operate at….. a few defined levels or states, rather than over a continuous range of signal amplitudes. 7. The word monolithic is from ….. and means “one stone.”

IV. Explain in English the meaning of:
reliability, photolithography, inextricable, insulator, semiconductor.

WRITTEN PRACTICE

I. Choose the proper verb form and translate the sentences.

1. Integrated circuits ….. the increased reliability due to lesser number of connections. 2. Monolithic ICs are by far the most common type ….. in practice. 3. When inductors are needed, they are ….. externally to an IC. 4. An integrated circuit usually ….. only transistors, diodes and resistors. 5. This week we shall ….. our attention to the construction of this type of ICs only. 6. The various components in an IC are so small that they cannot ….. seen with a naked eye. 7. The fundamental building blocks of digital ICs are logic gates, which ….. with binary data. 8. One side of wafer is ….. to get rid of surface imperfections.

(***Missing verbs***: connected, polished, possess, confine, work, used, contains, be)

II. Choose the correct preposition to complete each of the following sentences:

by at into with over in of on

1. We cannot get ….. an IC to repair its internal circuitry. 2. A monolithic IC is one in which all circuit components and their inter-connections are formed ….. a single thin wafer called the substrate. 3. It is usually very difficult to form inductors ….. an IC. 4. The terminals are processed ….. etching the oxide layer at the desired locations. 5. Four basic types of constructions are employed in the manufacture ….. integrated circuits. 6. A gas mixture of silicon atoms and pentavalent atoms is passed ….. the wafers. 7. One or more diodes are formed by diffusing one or more small n-type deposits ….. appropriate locations on the substrate. 8. The oxygen atoms combine ….. silicon atoms to form a layer of silicon dioxide.

III. Ask questions to which the following statements may serve as the answers.

1. A cylindrical p-type silicon crystal has typical dimensions 25 cm long and 2.5 cm diameter. 2. The high-resistance resistors are long and narrow while low-resistance resistors are short and of greater cross-section. 3. In order to protect ICs from external environment and to provide mechanical protection, various forms of encapsulation are used for integrated circuits. 4. The interconnection of the circuit elements is accomplished by extending the metallic deposits from terminal to terminal of adjacent components. 5. A logarithmic amplifier produces an output voltage that is proportional to the logarithm of the input voltage. 6. Before any impurity is added to the substrate, the oxide layer (i.e. SiO2 layer) is etched. 7. The simultaneous mass production is the reason for the low cost of integrated circuits.

IV. State functions of the past participles in the following sentence.

Integrated circuits are composed of many overlapping layers, each defined by photolithography, and normally shown in different colors.

V. Translate the following sentences into English:

1. Основным элементом аналоговых микросхем являются транзисторы. 2. В ближайшем будущем большинство сложных ИС будут изготовляться на основе совмещенной технологии в связи с непрерывным развитием и совершенствованием как полупроводниковой, так и тонкоплёночной технологий. 3. Часто под интегральной схемой понимают кристалл или плёнку с электронной схемой. 4. Цифровые интегральные микросхемы по большей части состоят из транзисторов. 5. Триггеры предназначены для запоминания двоичной информации. 6. Размеры компонентов постоянно уменьшаются благодаря развитию технологий. 7. Использование триггеров позволяет реализовывать устройства оперативной памяти (то есть памяти, в которой информация хранится только на время вычислений). 8. Аналоговые интегральные схемы также содержат резисторы и конденсаторы.

COMMUNICATIVE SITUATION

I. Discuss the relative advantages and disadvantages of ICs over a discrete assembly.

TYPES OF CIRCUITS

I. Note the pronunciation of the following:

assembly	[əˈsɛmbli]
automatically	[ˌɔːtəˈmætɪkəli]
extremely	[ɪksˈtriːmli]
micro-circuit	[ˈmaɪkrəʊ-ˈsɜːkɪt]
miniature	[ˈmɪnəʧə]
miniaturized	[ˈmɪnɪʧ(ə)raɪzd]
semiconductor	[ˌsɛmɪkənˈdʌktə]
surface	[ˈsɜːfɪs]

II. Read Text Five and get ready to discuss it in the classroom:

Text 5
TYPES OF CIRCUITS

The circuits consisted of *separately* manufactured components (e.g. resistors, capacitors, diodes, transistors etc.) joined by wires or plated conductors on printed boards are known as discrete circuits because each component added to the circuit is discrete (i.e. distinct or separate) from the others. Discrete circuits have two main disadvantages. *Firstly*, in a large circuit (e.g. TV circuit, computer circuit) *there* may be hundreds of components and *consequently* a discrete assembly would occupy a large space. *Secondly*, there will be hundreds of soldered points posing a considerable problem of reliability. To meet these problems of space conservation and reliability, engineers started a drive for miniaturized circuits. This led to the development of microelectronics in the late 1950s.

Microelectronics is the branch of electronics engineering which deals with micro-circuits. A micro-circuit is *simply* a miniature assembly of electronic components. One type of such circuit is the integrated circuit, *generally* abbreviated as IC. An integrated circuit has various components such as resistors, capacitors, diodes, transistors etc. fabricated on a small semiconductor chip. How circuits containing hundreds of components are fabricated on a small semiconductor chip to produce an IC is a fascinating feat of microelectronics. This has not *only* fulfilled the *ever* increasing demand of industries for electronic equipment of smaller size, lighter weight and low power requirements, but it has also resulted in high degree of reliability.

An integrated circuit consists of a number of circuit components and their interconnections in a single small package to perform a complete electronic function. The following points are worth noting about integrated circuits: (1) In an IC, the various components are *automatically* part of a small semi-conductor chip and the individual components cannot be removed or replaced. This is in contrast to a discrete assembly in which individual components can be removed or replaced if necessary. (2) The size of an IC is *extremely* small. In fact, ICs are *so* small that you *normally* need a microscope to see the connections between the components. It is possible to produce circuits containing many transistors, diodes, resistors etc. on the surface of this small chip. (3) No components of an IC are seen to project above the surface of the chip. This is because all the components are formed within the chip.

Integrated circuits free the equipment designer from the need to construct circuits with individual discrete components such as transistors, diodes and resistors. With the exception of a few *very* simple circuits, the availability of a large number of low-cost integrated circuits has *largely* rendered discrete circuitry obsolete. Integrated circuits have the significant advantages over discrete circuits. *However*, integrated circuits have some disadvantages and continuous efforts are on to overcome them.

(From *Wikipedia, the free encyclopedia*)

WORKING ON THE TEXT

I. Memorize the following word combinations and make up your own sentences or situations with them:

Separately manufactured components; to occupy a large space; soldered points; to deal with micro-circuits; a small semiconductor chip; a fascinating feat; a single small package; low power requirements; high degree of reliability; to remove the individual components; to have the significant advantages over; to be obsolete; to overcome disadvantages.

II. Look through the text again and find the answers to the following questions:

1. What did the circuits consist of? 2. Which circuits are known as discrete ones? 3. What disadvantages do discrete circuits have? 4. Why did engineers start a drive for miniaturized circuits? 5. What does microelectronics deal with? 6. What kind of components does an integrated circuit have? 7. Do a number of circuit components and their interconnections in a single small package allow an integrated circuit to perform a complete electronic function? 8. Why cannot individual components be removed in an IC? 9. Can individual components be removed or replaced in a discrete assembly? 10. Why aren't components of an IC seen to project above the surface of the chip?

III. Retell the above text using as many of the word combinations from Exercise I as you can.

WORKING ON WORDS

I. Study the following word combinations and use them in sentences of your own:

To pose a considerable problem of reliability, to meet these problems, to lead to the development; to be worth noting; to fulfill the ever increasing demand; to free the equipment designer; the availability of a large number of low-cost integrated circuits; to be in contrast to.

II. Complete the sentences with the words from the box:

incredibly directly improved different specific tiny inseparably

1. Scientists are using computer modeling to design ….. alloys for IC manufacturing processes. 2. By the process of diffusion, appropriate materials are added to the substrate at ….. locations to produce diodes, transistors, resistors and capacitors. 3. The notable feature of an IC is that it comprises a number of circuit elements ….. associated in a single small package to perform a complete electronic function. 4. While the IC itself is tiny, the wafers of a semiconductor and layers of copper it consists of are ….. thin. 5. Each outer connection on the die is connected via a ….. piece of gold wire to a pad or pin on the package. 6. Sometimes, instead of soldering ….. to the IC, it's a good idea to socket the chip. 7. Just as sound travels faster through water than through air, electron velocity is ….. through each type of semiconductor material.

III. Put one suitable preposition in each space.

1. This IC audio amplifier consists…..6 transistors, 2 diodes and 17 resistors. 2. The success of ICs has led ….. the integration of other technologies, in the attempt to obtain the same advantages of small size and low cost. 3. Microelectronics deals ….. the study and manufacture of very small electronic designs and components. 4. An integrated circuit is a small semiconductor-based electronic device consisting ….. fabricated transistors, resistors and capacitors. 5. Calculations can be made very quickly, depending….. the speed (clock frequency) of the microprocessor. 6. A digital signal is an analog waveform that has been converted ….. a series of binary numbers for quick manipulation. 7. Engineers must use special design techniques to deal ….. the physics of high-frequency microelectronic interactions. 8. Based…..the intended application, the ICs are classified as analog integrated circuits, digital integrated circuits and mixed integrated circuits. 9. The integration of digital, multiple analog and RF functions on a single chip resulted …these mixed integrated circuits.

IV. Fill in the blanks with corresponding adjectives from the list below.

1. This package integrates ….. systems, such as document management, financial accounting, general administration, electronic settlements, and staff salaries. 2. All packages fall into one of two ….. types: through-hole or surface-mount. 3. The value of a capacitor formed depends upon the dielectric constant of SiO_2 layer and the area of the cross-section of the ….. of the two electrodes. 4. Transistors are formed by using the ….. principle as for diodes. 5. ….. semiconductor chips have billions of components, and are too complex to be designed by hand. 6. The wafer must be cut into chips so that ….. chip area represents one circuit. 7. The idea of the integrated

circuit was conceived by Geoffrey Dummer (1909–2002), a radar scientist ….. for the Royal Radar Establishment of the British Ministry of Defence. 8. Circuits meeting can be constructed using many ….. technologies, including thin-film transistor, thick-film technology, or ….. integrated circuit. 9. An IC chip may contain as ….. as 100,000 semiconductor devices or other components. 10. It is a three terminal device with terminals ….. as input, output and ground terminal.

Modern, labeled, mounting, working, multiple, large, same, each, different, smaller, hybrid

WRITTEN PRACTICE

I. Translate the following sentences into English:

1. В основе цифровых интегральных микросхем лежат транзисторные ключи, способные находиться в двух устойчивых состояниях: открытом и закрытом. 2. Микросхема объединяет в себе электронную схему, где все элементы и электрические соединения между ними конструктивно выполнены на одном кристалле. 3. Полупроводниковая микросхема выполняется на одном полупро-водниковом кристалле, например, кремния. 4. Существует множество вариантов корпусов микросхем, различающихся по количеству выводов микросхемы, методу монтажа и условиям эксплуатации. 5. Широкое применение микросхем позволяет повысить технические характеристики и надёжность аппаратуры. 6. Цифровые интегральные микросхемы служат для преобразования и обработки сигналов, выраженных в двоичном или другом цифровом коде. 7. Аналоговые микросхемы характеризуются тем, что входная и выходная электрические величины могут иметь любые значения в заданном диапазоне.

II. Read the following sentences and comment on the functions of the infinitive in the sentence.

1. To meet these problems of space conservation and reliability, engineers started a drive for miniaturized circuits. 2. An integrated circuit consists of a number of circuit components and their interconnections in a single small package to perform a complete electronic function. 3. Semiconductor devices could perform the functions of vacuum tubes. 4. Integrated circuits free the equipment designer from the need to construct circuits with individual discrete components such as transistors, diodes and resistors. 5. ICs are so small that you normally need a microscope to see the connections between the components. 6. It is possible to produce circuits containing many transistors, diodes, resistors on the surface of a small chip. 7. No components of an IC are seen to project above the surface of the chip. 8. However, integrated circuits have some disadvantages and continuous efforts are on to overcome them. 9. To handle negative inputs, you should reverse the direction of the diode. 10. It is profitable to know technical advances about the fabrication of ICs.

III. Study the grammar table and learn.

Adverbs of manner describe how something is done. These adverbs describe the manner of an action or the way of the occurrence of an action. **Adverbs of degree** tell us the level or extent that something is done or happens. **Adverbs of frequency** give an idea about the frequency of the occurrence of an action. **Adverbs of place** describe where something is done. **Linking adverbs** show a relationship between two clauses or sentences (e.g. a sequence in time, cause and effect, contrast between two things).

IV. Find in the above text and copy out the italicized adverbs. Say what kind each one is.

V. Ask all types of questions to the following sentence:

The value of resistor is determined by the material, its length and area of cross-section.

COMMUNICATIVE SITUATIONS

I. Discuss the following questions. Use the topical vocabulary.

1. How can electronic circuit consisting of different components be constructed in a monolithic IC?
2. How will you make a monolithic IC?

II. Comment upon the following statement. Share opinions.

The integrated circuit is nothing more than a very advanced electric circuit.

III. You are at the conference. The theme of your report is *The History of the Integrated Circuit*.

IV. Say what would have happened if advances of integrated circuits hadn't been put into practice.

MICROCONTROLLER

I. Note the pronunciation of the following:

engine [ˈɛnʤɪn]
ferroelectric [ˈfɛrəʊ ɪˈlɛktrɪk]
implantable [ɪmˈplɑːntəbl]
interrupt [ˌɪntəˈrʌpt]
microcontroller [ˈmaɪkrəʊkənˈtrəʊlə]
nanowatt [ˈnænəʊwɒt]
programmable [ˈprəʊgræməbl]
routine [ruːtˈiːn]
solenoid [ˈsəʊlɪnɔɪd]

II. Read Text Six and get ready to discuss it in the classroom:

Text 6
MICROCONTROLLER

A microcontroller (or MCU, short for a microcontroller unit) is a small computer (SoC) on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM or NOR flash is also often included on a chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

Some microcontrollers may use four-bit words and operate at frequencies as low as 4 kHz, for low power consumption (single-digit milliwatts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

A typical home in a developed country is likely to have only four general-purpose microprocessors but around three dozen microcontrollers. A typical midrange automobile has as many as 30 or more microcontrollers. They can also be found in many electrical devices such as washing machines, microwave ovens, and telephones.

Embedded design

A microcontroller can be considered a self-contained system with a processor, memory and peripherals and can be used as an embedded system. The majority of microcontrollers in use today are embedded in other machinery, such as automobiles, telephones, appliances, and peripherals for computer systems.

While some embedded systems are very sophisticated, many have minimal requirements for memory and program length, with no operating system, and low software complexity. Typical input and output devices include switches, relays, solenoids, LED's, small or custom liquid-crystal displays, radio frequency devices, and sensors for data such as temperature, humidity, light level etc. Embedded systems usually have no keyboard, screen, disks, printers, or other recognizable I/O devices of a personal computer, and may lack human interaction devices of any kind.

Interrupts

Microcontrollers must provide real-time (predictable, though not necessarily fast) response to events in the embedded system they are controlling. When certain events occur, an interrupt system can signal the processor to suspend processing the current instruction sequence and to begin an interrupt service routine (ISR, or "interrupt handler") which will perform any processing required based on the source of the interrupt, before returning to the original instruction sequence. Possible interrupt sources are device dependent, and often include events such as an internal timer overflow, completing an analog to digital conversion, a logic level change on an input such as from a button being pressed, and data received on a communication link. Where power consumption is important as in battery devices, interrupts may also wake a microcontroller from a low-power sleep state where the processor is halted until required to do something by a peripheral event.

(*From Wikipedia, the free encyclopedia*)

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following word combinations and write them out:

процессорное ядро; исходная последовательность команд; большинство используемых сегодня микроконтроллеров; переполнение внутреннего таймера; четырёхбитовые слова; для встроенных приложений; из маломощного состояния сна; интегрируя аналоговые компоненты; предсказуемый, хотя и не обязательно быстрый; для управления нецифровыми электронными системами; приостановить обработку; вероятно, будет иметь только четыре микропроцессора общего назначения; работать на частотах; в отличие от микропроцессоров; низкая сложность программного обеспечения; для длительных применений батарей; сохранить функциональность; система прерываний.

II. Give the adjective of each of the following nouns:

reliability, experiment, program, dependency, reality, possibility, recognition, origin, electricity, electron, economy, digit, prediction, necessity, type, minimum, person, certainty, variety.

III. Ask your own questions to the text for class discussion.

IV. Retell the above text using as many of the word combinations from Exercise I as you can.

WORKING ON WORDS

I. Explain in English the meaning of:

a real-time response, the instruction sequence, embedded applications, an analog to digital conversion, memory.

II. Find in the above text and copy out phrases in which the preposition *for* is used. Translate them.

III. Complete the sentences with the words from the box:

almost	math	inside	output	several	ones	one	widely

1. Microcontrollers are embedded ….. some other device so that they can control the features or actions of the product. 2. Responding to immediate challenges, the conference passed ….. resolutions from different microcontrollers to using information technologies. 3. Microcontrollers are dedicated to ….. task and run one specific program. 4. A desktop computer is ….. always plugged into a wall socket and might consume 50 watts of electricity. 5. The microcontroller inside a TV takes input from the remote control and displays ….. on the TV screen. 6. The actual processor used to implement a microcontroller can vary ….. . 7. Microcontrollers traditionally do not have a ….. coprocessor, so floating point arithmetic is performed by software. 8. Some microcontrollers allow higher priority interrupts to interrupt lower priority ….. .

IV. Find in the above text and copy out sentences in which linking expressions *such as*, *as well as* and *in contrast to* are used. Translate the sentences with them. Say which of these linking expressions:

a) introduces an addition?
b) introduces clarification?
c) expresses a clear contrast?

WRITTEN PRACTICE

I. Choose the proper verb form and translate the sentences.

1. Since the emergence of microcontrollers, many different memory technologies ….. . 2. Microcontrollers ….. an operating system. 3. Microcontrollers ….. part of the reason the Internet of Things is possible and successful today. 4. A microcontroller also ….. input from the device it is controlling and controls the device by sending signals to different components in the device. 5. Manufacturers have often produced special versions of their micro-controllers in order ….. the hardware and software development of the target system. 6. Micro-controllers ….. to be highly popular in embedded systems since their introduction in the 1970s. 7. Highlighting these achievements, our manager also noted that a lot remains ….. to ensure the reliability of mixed signal microcontrollers.

(***Missing verbs***: are, have proved, have been used, to be done, can't run, to help, takes)

II. Memorize the following word combinations and make up your own sentences or situations with them:

to retain functionality; to digitally control devices and processes; to return to the original instruction sequence; to suspend processing; to be embedded in; to be well suited for.

III. a). Study the grammar table and learn.

Comparison construction as…..as We use *as + adjective/adverb + as* to make comparisons when the things we are comparing are equal in some way: *The weather this winter is as cold as last year.* Remember that the structure as…as cannot be used to measure things of unequal proportion.

b). Translate the following sentences paying special attention to the construction as …. as.

1. The experiment didn't take quite as long as it did last time. 2. Power consumption of this circuit is as low as in equivalent separate circuits. 3. I answered this difficult question as well as I could. 4. We need the information about the special version of their micro-controllers quickly, so let us know as soon as possible. 5. He always says how tiring his job is, but I work just as hard as he does. 6. At first I thought the embedded system was reliable but really it was as bad as that one. 7. Micro-controllers in embedded systems are as popular as they were in the 1970s.

c). Find in the text and copy out sentences containing *as* + *adjective* + *as*.

IV. Ask all types of questions to the following sentence:

A microcontroller can be considered a self-contained system with a processor, memory and peripherals.

V. State functions of the past participles in the following sentences.

1. A microcontroller is a computer present in a single integrated circuit which is dedicated to perform one task and execute one specific application. 2. An embedded device is a highly specialized device meant for one or very few specific purposes and is usually included within another object or as part of a larger system. 3. Electronics provides the best and most powerful solutions based on a wide selection of microcontrollers and microprocessors. 4. Many embedded microprocessors include a variety of timers as well. 5. A micro-controller instruction set usually has many instructions intended for bit manipulation to make control programs more compact. 6. Microcontrollers were originally programmed only in assembly language, but various high-level programming languages, such as C and JavaScript, are now also in common use to target microcontrollers and embedded systems. 7. Recent microcontrollers are often integrated with on-chip debug circuitry that allows debugging of the firmware with a debugger. 8. The given instruction set includes instructions to perform a variety of operations on the register directly.

COMMUNICATIVE SITUATIONS

I. Develop the idea.

How would you feel, if your friend achieved an unexpected result in the fabrication of the newer microcontroller feature, which permits the integration of touch screen interfaces?

II. Discuss the problems of the present-day scientific research considering foreign competitors in the telecommunications market.

Pulse width modulation and interrupts

I. Note the pronunciation of the following:

average [ˈævərɪʤ]
comparator [ˈkəmpəreɪtə]
comparison [kəmˈpærɪsn]
inertial [ɪˈn ɜːʃjə l]
instantiations [ˌɪnst(ə)ntɪˈeɪʃənz]
oscillator [ˈɒsɪleɪtə]
pulse width [pʌls wɪdθ]
rectangular [rɛkˈtæŋgjʊlə]
resolution [ˌrɛzəˈluːʃən]

II. Read Text Seven and get ready to discuss it in the classroom:

Text 7

Pulse width modulation and interrupts

Pulse width modulation (PWM), or pulse-duration modulation (PDM), is a method of reducing the average power delivered by an electrical signal, by effectively chopping it up into discrete parts. The average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and off at a fast rate. The longer the switch is on compared to the off periods, the higher the total power supplied to the load. Along with MPPT maximum power point tracking, it is one of the primary methods of reducing the output of solar panels to that which can be utilized by a battery. PWM is particularly suited for running inertial loads such as motors, which are not as easily affected by this discrete switching, because they have inertia to react slowly. The PWM switching frequency has to be high enough not to affect the load, which is to say that the resultant waveform perceived by the load must be as smooth as possible.

The term duty cycle describes the proportion of 'on' time to the regular interval or 'period' of time; a low duty cycle corresponds to low power, because the power is off for most of the time. Duty cycle is expressed in percent, 100% being fully on. When a digital signal is on half of the time and off the other half of the time, the digital signal has a duty cycle of 50% and resembles a "square" wave. When a digital signal spends more time in the on state than the off state, it has a duty cycle of >50%.

Pulse-width modulation uses a rectangular pulse wave whose pulse width is modulated resulting in the variation of the average value of the waveform.

The simplest way to generate a PWM signal is the intersective method, which requires only a sawtooth or a triangle waveform (easily generated using a simple oscillator) and a comparator. When the value of the reference signal (the sine wave) is more than the modulation waveform, the PWM signal is in the high state, otherwise it is in the low state.

Many digital circuits can generate PWM signals (e.g., many microcontrollers have PWM outputs). They normally use a counter that increments periodically (it is connected directly or indirectly to the clock of the circuit) and is reset at the end of every period of the PWM. When the counter value is more than the reference value, the PWM output changes state from high to low (or low to high). This technique is referred to as time proportioning, particularly as time-proportioning control – which proportion of a fixed cycle time is spent in the high state.

The incremented and periodically reset counter is the discrete version of the intersecting method's sawtooth. The analog comparator of the intersecting method becomes a simple integer comparison between the current counter value and the digital (possibly digitized) reference value. The duty cycle can only be varied in discrete steps, as a function of the counter resolution. However, a high-resolution counter can provide quite satisfactory performance.

The pulse-width modulator feature is very common in embedded systems. It provides a way to generate a pulse periodic waveform for motor control or can act as a digital-to-analog converter with some external components. This PWM peripheral is basically a timer with a period counter and a first-phase duration comparator, where bit width of the period and first-phase duration are both programmable.

The PWM has the following features:

• 32-bit period counter

• 32-bit first-phase duration counter

• Configurable to operate in either one-shot mode, which generates a single interrupt at the end of operation, or continuous mode, which generates an interrupt per period.

• 8-bit repeat counter for one-shot operation. One-shot operation will produce N + 1 periods of the waveform, where N is the repeat counter value.

• One-shot operation can be triggered by the CCD VSYNC output of the video processing subsystem to allow any of the PWM instantiations to be used as a CCD timer.

• Configurable PWM output pin inactive state.

• Interrupt and EDMA synchronization events.

• Emulation support for stop or free-run operation.

Each instance of the PWM peripheral has a single output signal, PWMn. The output signal is driven based on the state of the PWM as described below:

• Inactive state: When the PWM is idle, the output pin is driven to its inactive output level. This inactive logic state is determined by configuring the INACTOUT bit in the PWM configuration register (CFG).

• First-phase active state: During the first phase of an active PWM period, the output signal is driven to the state defined in the P1OUT bit in the PWM configuration register (CFG). The duration of the first phase is controlled by the PWM first-phase duration register (PH1D). The duration of the entire period is controlled by the PWM period register (PER).

• Second-phase active state: After the first phase of the period is complete, the output signal is driven to the opposite state of the first phase for the remainder of the period (the second phase).

(From *Wikipedia, the free encyclopedia*)

Commentary

MPPT – Maximum power point tracking or sometimes just power point tracking (PPT) is a technique used commonly with wind turbines and photovoltaic solar systems to maximize power extraction under all conditions.

CCD stands for a charge-coupled device. It is a device for the movement of electrical charge, usually from within the device to an area where the charge can be manipulated, such as conversion into a digital value.

VSYNC means a vertical synchronization signal.

EDMA – Enhanced Direct Memory Access (Enhanced Direct Memory Access Controller: consists of the EDMA transfer controller (EDMATC) and the EDMA channel controller (EDMACC).

EDMA is a method of morphometric analysis that avoids superimposition and its drawbacks altogether.

INACTOUT = 0 (Inactive bus time-out is disabled).

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following word combinations and write them out:

дискретная версия пилообразного сигнала; рабочий цикл; опорный сигнал; эффективно измельчая его на отдельные части; на оставшуюся часть периода; работающие инерционные нагрузки; метод пересечения; неактивный выходной уровень; пилообразная или треугольная форма волны; подключён прямо или косвенно к тактовым сигналам схемы; одно прерывание; распределение времени; компаратор длительности первой фазы; однократный режим; значение счётчика повторений; для остановки или работы в автономном режиме; широтно-импульсная модуляция.

II. Memorize the following word combinations and make up your own sentences or situations with them:

To chop up into discrete parts; to be driven to an inactive output level; a high-resolution counter; to be suited for running inertial loads; the reference value.

III. Find in Text 7 antonyms of the following words:

to decrease (in a numerical quantity), intermittent, the beginning, internal, active, incomplete, complicated.

IV. Outline the main ideas of the text and write a summary.

V. Retell the above text using the words and word combinations of the topical vocabulary.

WORKING ON WORDS

I. Complete the sentences with the words from the box:

switch	reference	voltage	interaction	technique	duty	output	signal

1. When the charging ….. of a battery reaches the regulation setpoint, the charging algorithm slowly reduces the charging current to avoid heating and gassing of the battery. 2. Pulse width modulation is a very powerful ….. which allows analog variables to be controlled from a purely digital output, and with only a single data connection. 3 In Pulse Width Modulation mode, a CCP module can be used to generate a timed ….. signal. 4. This function controls the power ….. , turning it "on" at the beginning of the period and turning it "off" when the ramp exceeds the voltage. 5. The PWM period T is determined by the ….. of the PR2 register and the eight bits of Timer 2. 6. PWM also works well with digital controls, which because of their on/off nature, can easily set the needed ….. cycle. 7. Every time the integral of the output ….. reaches one of the limits, the PWM signal changes state. 8. In delta-sigma modulation as a PWM control method, the output signal is subtracted from a ….. signal to form an error signal.

II. Find in the above text and copy out sentences in which linking expressions *otherwise*, *such as* and *however* are used. Translate the sentences with them. Say which of these linking expressions:

a) expresses a contrast?
b) introduces clarification?
c) introduces an alternative?

III. a) Study the table and learn phrasal verbs with "*chop*".

to chop (away) at means to aim blows at something with a heavy sharp tool such as an axe; to hit something with a sharp tool in order to cut it;

to chop down means to make something, such as a tree, fall by cutting it at the base with a sharp tool, to make a tree or tall plant fall down by cutting through it;

to chop off means to remove something by cutting it with a sharp tool;

to chop through something means to make a path through something by cutting; to cut a way/path/route through something;

to chop up means to cut something such as food or wood into pieces.

(From *the Oxford Advanced American Dictionary*)

b). Translate the following sentences having the phrasal verb "*chop*".

1. Brian chopped off the small branches before cutting down the tree. 2. There are concerns over how quickly the forests are being chopped down. 3. The boys chopped at the bushes with their knives. 4. An electrical signal wasn't chopped up effectively into necessary discrete parts. 5. The flakes are quite handy, as they are easy to measure and you don't need to chop up the block of solid wax before melting it. 6. My aunt tried to cut through the undergrowth. 7. You can chop down an audio clip to a section you want in superb detail.

c). Find in the above text and copy out the sentence containing the phrasal verb *"chop"*.

IV. Choose the correct preposition or adverb to complete each of the following sentences:

at down through off

1. He'll stab and slash and chop ….. their heads! 2. They had to chop their way ….. the undergrowth. 3. Dad and Grandpa went together to chop ….. the Christmas tree every year. 4. You must use a spade to chop ….. the smaller roots. 5. Then he turned and waded back into the wheat and chopped ….. it with a shovel. 6. He chopped his way ….. the jungle with a machete.

WRITTEN PRACTICE

I. Choose the correct preposition to complete each of the following sentences:

1. The elements ….. a block can be all located at the same address, at contiguous addresses, or at a configurable offset from one another. 2. Channel parameter sets can be triggered ….. various methods, including event trigger, chain trigger, or CPU trigger. 3. The element count has to be reloaded by the element count reload field (ELERLD) ….. the transfer entry. 4. The addresses of elements within a frame can be located ….. a specific distance apart, as determined by the element index (ELEIDX). 5. The vertical sync signal is a series ….. much longer pulses, indicating the start of a new field. 6. Pulse width modulation is used in a variety of applications particularly ….. control. 7. One of the advantages of PWM is that the signal remains digital all the way ….. the processor to the controlled system. 8. The PWM wave is generated continuously ….. the setup is completed.

Keys: of, after, within, from, in, at, by, for.

II. Fill in the blanks with corresponding adjectives from the list below.

1. The percentage duty cycle specifically describes the percentage of time a ….. signal is on over an interval or period of time. 2. Pulse width modulation (PWM) is a ….. technique for controlling analog circuits with a microprocessor's digital outputs. 3. The use of pulses in the PWM charge controller is also ….. for the batteries as it mixes the electrolyte cleaning of the lead plates and prevents sulfation. 4. The main advantage of PWM is that power loss in the switching devices is very ….. . 5. Although pulse width modulation of speech channel followed by frequency modulation has been used in an ….. system, most systems employ binary frequency shift keying or binary phase shift keying. 6. The duration of the ….. period is controlled by the PWM period register. 7. The PWM switching frequency has to be ….. enough not to affect the load. 8. A PWM output is basically a . waveform with a specified period and duty cycle. 9. Spectral databases are also included for ….. interpretation of results.

Low, earlier, powerful, simple, entire, digital, high, good, square.

III. a) Form the degrees of comparison of the following adjectives:
Idle, complete, inactive, fast, smooth, regular, intersective.

b) Find in the above text adjectives in the comparative and superlative degrees, write out phrases with them.

IV. Choose the necessary verb form from the box and translate the sentences:

will be using ranging reaches require are not used can accomplish includes required

1. Once a complete frame is transferred, the element count ….. 0. 2. Channel parameter sets that ….. as an active channel can also be used as a link entry. 3. The system ….. autocalibration and validation software to ensure data accuracy with one-shot operation. 4. PWM is employed in a wide variety of applications, ….. from measurement and communications to power control and conversion. 5. We have already specified the ….. period and duty cycle. 6. Most loads, inductive and capacitative alike, ….. a much higher modulating frequency than 10Hz. 7. We ….. a range of results in both applications because pulse width modulation allows us to vary how much time the signal is high in an analog fashion. 8. In this project, we ….. the output logic 1 level of the microcontroller which is +3.3 V.

TOPICS FOR DISCUSSION:

I. Discuss the following problems
1. What do you mean by modulation?
2. What is the need of pulse modulation?
3. How do you measure pulse width?
4. What are the disadvantages of PWM?
5. What is the difference between duty cycle and pulse width?

II. If you had enough some of money to spend on the development of methods of reducing the output of solar panels to that which can be utilized by a battery, what would you do? Give your reasons.

The PWM modes operation

I. Note the pronunciation of the following:

buffering [ˈbʌfərɪŋ]
duration [djʊəˈreɪʃən]
expire [ɪksˈpaɪə]
module [ˈmɒdjuːl]
peripheral [pəˈrɪfərəl]
polarity [pəʊˈlærɪti]
shadow [ˈʃædəʊ]
transition [trænˈsɪʒən]

II. Read Text Eight and get ready to discuss it in the classroom:

Text 8

The PWM modes operation

The PWM module can operate in either one-shot or continuous mode. In both modes, the PWM peripheral has a first-phase duration register (PH1D) and a period register (PER) to specify, respectively, the first-phase duration and period of the waveform. The first-phase output level can be configured to be either high or low in the P1OUT bit of the PWM configuration register (CFG) and the second phase output is automatically the opposite polarity of the first-phase level. The inactive state before and after the PWM operation can also be configured to be either a 0 or a 1 in the INACTOUT bit of CFG.

In one-shot mode operation, the PWM produces a series of periods but does not run continuously. The number of periods in the series is controlled by the repeat count contained in the PWM repeat count register (RPT). To select one-shot mode, configure the MODE bit in the PWM configuration register (CFG) to 1h. For one-shot mode operation, the PWM should first be configured for mode, period, and first-phase duration, along with other configuration options. The PWM uses the last programmed set of parameters once it is started by writing a 1 to the START bit in the PWM start register (START). Once started, the PWM asserts/deasserts the output as configured, driving to the first-phase output level during the first phase and the opposite level during the second phase. When the prescribed number of RPT + 1 periods of pulses expire, the peripheral sends an interrupt to the system (if the interrupt is enabled in CFG). The PWM then becomes inactive until the START bit is written a 1 again. The PWM is stopped during one-shot mode operation by changing the MODE bit to 0 (disable). When the PWM is disabled, the output is immediately driven to the configured inactive state.

In one-shot mode, the PWM senses a rising or falling transition on an event-trigger input signal to start the operation. This event trigger input is synchronized to the PWM clock inside the module and is driven by the video processing subsystem CCDC_VD output signal. This capability is provided to allow the PWM to be used as a CCD timer. The trigger event can be detected on the rising edge or the falling edge of CCDC_VD. After event triggering is enabled as part of the configuration process, a write to the PWM START register (START) starts the sensing circuitry in the PWM and after the first event the PWM starts the period counting.

In continuous mode operation, the PWM produces the repeating output waveforms continuously without stopping. For continuous mode operation, the PWM should first be configured for mode, period, and first-phase duration, along with other configuration options. The PWM uses the last programmed set of parameters once it is started by writing a 1 to the START bit in the PWM start register (START). Unlike the one-shot mode, the repeat count does not affect the continuous operation. To select the continuous mode, configure the MODE bit in the PWM configuration register (CFG) to 2h. Once started, the PWM asserts/deasserts the output as configured, driving to first-phase output level during the first phase and the opposite level during the second phase. Once a period expires, the next period starts. When a period starts, the PWM copies the period and first-phase duration registers into a set of internal shadow registers and maintains the counts there. An interrupt is also generated (if enabled) after the registers are copied. This buffering scheme and interrupt timing allows the CPU or EDMA to program the durations for the next period while the current period is running. The PWM is stopped during the continuous mode operation by either disabling it or by reconfiguring it to one-shot mode using the MODE bit. Whenever the PWM is disabled, the output is immediately driven to the configured inactive state. To allow the PWM to stop gracefully from continuous operation, upon an interrupt, configure the PWM to one-shot mode operation. The PWM then operates for RPT + 1 periods and stops by itself (sending an interrupt, if enabled). Note that unlike normal one-shot mode operation, another write to the START bit is not required for the one-shot mode operation to start. While operating in continuous mode, the minimum period for the PWM is 8 cycles.

There is a single interrupt from the CPU interrupt controller for each PWM instance. When the PWM is configured in one-shot mode and the interrupt bit (INTEN) in the PWM configuration register (CFG) is enabled, the peripheral generates an interrupt when RPT + 1 number of periods have been completed. When the PWM is configured in continuous mode and the interrupt bit (INTEN) in CFG is enabled, the PWM peripheral generates an interrupt every period after the first-phase duration register and period register values have been copied to the associated shadow registers. This event indicates it is safe to program the duration values for the next period.

(From *Texas Instruments,* August 2010)

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following word combinations and write them out:

запрограммированный набор параметров; переход нарастания или спада; противоположный уровень; схема буферизации; становится неактивным; запуск события включен как часть процесса конфигурации; или в однократном или непрерывном режиме; есть одно прерывание; набор внутренних теневых регистров; вход триггера события; не влияет на непрерывную работу.

II. Find in Text Eight synonyms of the following words:

breaking, inverse, to begin, scheme, right away, preassigned, continuance, to precise.

III. Answer the following questions using the word combinations and phrases of the topical vocabulary:

1. What modes can the PWM module operate in? 2. Why does the PWM peripheral have a first-phase duration register and a period register in both modes? 3. How can the first-phase output level be configured? 4. What does the PWM produce in one-shot mode operation? 5. What is the number of periods in the series controlled by? 6. Should the PWM be configured for mode, period, and first-phase duration along with other configuration options for one-shot mode operation? 7. When does the peripheral send an interrupt to the system? 8. What happens when the PWM is disabled? 9. What is the event trigger input synchronized to? 10. What can the trigger event be detected on? 11. What mode operation does the PWM produce the repeating output waveforms continuously without stopping in? 12. Does the repeat count affect the continuous operation? 13. What must you do to select the continuous mode? 14. When does the next period start? 15. What allows the CPU or EDMA to program the durations for the next period while the current period is running? 16. When is the output immediately driven to the configured inactive state? 17. What event indicates it is safe to program the duration values for the next period?

IV. Sum up your ideas of Text Eight.

WORKING ON WORDS

I. Complete the sentences with the words from the box:

frequency	inductor	interrupt	filter	zero	amount	level	devices

1. The process of PWM conversion is non-linear and it is generally supposed that low pass ….. signal recovery is imperfect for PWM. 2. PWM can be used to control the ….. of power delivered to a load without incurring the losses that would result from linear power delivery by resistive means. 3. The switching noise is usually filtered with an ….. and a capacitor. 4. PWM is a way to control analog ….. with a digital output. 5. The average voltage ….. can be a steady voltage or a moving target (dynamic/changing over time). 6. The higher the ….. of high pulses, the higher the average voltage and the faster the fan motor will spin. 7. Power loss, being the product of voltage and current, is thus in both cases close to ….. . 8. After RPT + 1 number of periods, the waveform stops and an ….. is generated.

II a). Study the grammar table and learn.

We use once [wʌns] as a conjunction meaning 'as soon as', 'after' or from the moment when: *I didn't know how I would cope with everything once the money had gone.*

b). Find in the text and copy out sentences containing *once* as a conjunction.

WRITTEN PRACTICE

I. Fill in prepositions:

1. The infinite bandwidth is caused ….. the nonlinear operation of the pulse-width modulator. 2. High frequency PWM power control systems are easily realizable ….. semiconductor switches. 3. There was almost no voltage drop ….. the switch. 4. Modern semiconductor switches such as MOSFETs or insulated-gate bipolar transistors (IGBTs) are well suited components ….. high-efficiency controllers. 5. The rate (or frequency) ….. which the power supply must switch can vary greatly depending on load and application. 6. In Figure 1 we can show the behavior of PWMn with different combination ….. active and inactive polarities. 7. Power flow ….. the supply is not constant and will require energy storage on the supply side in most cases. 8. An interrupt is also generated (if enabled) ….. the registers are copied.

Keys: with, from, by, after, of, for, at, across.

II. Translate the sentences and define the italicized verb forms.

1. You *must note* that each subsequent event *does not restart* period counting. 2. Events received within the PWM period *are ignored* as well. 3. PWM *has* also *been used* in certain communication systems where its duty cycle has been used to convey information over a communications channel. 4. We *want* to show the event-triggered one-shot mode operation in this Figure. 5. The polarity *must be configured* as inactive low, first phase high-then-low. 6. When a switch is off there is practically no current, and when it is on and power *is being transferred* to the load. 7. The number of periods in the series *is controlled* by the repeat count *contained* in the PWM repeat count register. 8. In this case the present clock time and program contents *will* also *be saved*.

III. Ask all types of questions to the following sentence:

There is a single interrupt from the CPU interrupt controller for each PWM instance.

IV. Study the grammar table and learn.

Already [ɔːl'redɪ] is an adverb.

We use already to emphasize that something was completed before something else happened. It is often used with the present perfect or past perfect:

e.g. The plane had already landed when the pilot announced that there would be a delay in getting to the gate.

Still = a situation or action is continuing. Still goes in the middle of the sentence with the verb.

e.g. He still lives with his mother.

Yet [jɛt] = when we ask if something has happened or has not happened. We use yet at the end in questions and negative sentences. **Yet** means up until the present or a specified or implied time; by now or then.

e.g. I haven't told anyone else yet.

V. Fill the spaces in the following sentences by using *already*, *still*, *yet*.

1. While the rheostat was one of several methods of controlling power a low cost and efficient power switching/adjustment method was ….. to be found. 2. The high-resolution counter has ….. provided quite satisfactory performance. 3. We have ….. avoided aliasing effects by limiting the bandwidth of the PWM kernel. 4. The number of pulses in the waveform is ….. equal to the number of Nyquist samples. 5. PWM is ….. used in efficient voltage regulators. 6. PWM signals are ….. used to control the speed of the robot by controlling the motors. 7. This method hasn't been used in the SACD format ….. . 8. A new class of audio amplifiers based on the PWM principle is …. becoming popular. 9. Sine–triangle pulse width modulation signals have ….. been used in micro-inverter design used in solar and wind power applications. 10. Why haven't you encoded each pulse position relative to the previous ….. ?

VI. Study the grammar table and learn.

Complex Object

Subject + Predicate + Complex Object (Noun/Pronoun + Infinitive)

The infinitive may be used as a part of a complex object after the following verbs:

1. to hear, to see, to watch, to feel, to let, to make, to observe. After these verbs the Infinitive has no particle 'to'.

2. to want, to expect, to know, to suppose, to consider, to believe. After these verbs the particle 'to' is used before the Infinitive.

VII. Complete the following sentences containing Complex Object using the Infinitive with or without *to*.

1. I want you (to know) that it doesn't matter. 2. I heard him (to describe) Nyquist samples. 3. They expected me (to use) the last programmed set of

parameters. 4. She thought him (to be) a qualified specialist. 5. I saw my friend (to control) the speed of the robot. 6. I think our semiconductor switch not (to be) good. 7. She believed him (to convey) information over a communications channel yesterday. 8. The teacher asked us (to listen) to his explanations. 9. This interrupt timing allows the CPU or EDMA (to program) the durations for the next period. 10. Mary's teacher advised her (to take part) in the conference devoted to the different modes operation. 11. We don't expect this problem (to be solved) within such a short period of time. 12. Our chief engineer observes us (to run) different mode operations continuously.

TOPIC FOR DISCUSSION

I. Decide on experiment you would like to do. Describe your experiment.

HARDWARE TROUBLESHOOTING

I. Note the pronunciation of the following:

adjust [ə'ʤʌst]
alternative [ɔːl'tɜːnətɪv]
circumstance ['sɜːkəmstəns]
diagnosing ['daɪəgnəʊzɪŋ]
eliminate [ɪ'lɪmɪneɪt]
evidence ['ɛvɪdəns]
experience [ɪks'pɪərɪəns]
failure ['feɪljə]
technician [tɛk'nɪʃən]
thoroughness ['θʌrənɪs]
troubleshooting ['trʌbəl,ʃʊtɪŋ]
undesirable [,ʌndɪ'zaɪərəbl]

II. Read Text Nine and get ready to discuss it in the classroom:

Text 9
HARDWARE TROUBLESHOOTING

Hardware troubleshooting is the process of reviewing, diagnosing and identifying operational or technical problems within a hardware device or equipment. It is a logical, systematic search for the source of a problem in order to solve it, and make the product or process operational again. Troubleshooting is needed to identify the symptoms. It aims to resolve physical and/or logical problems and issues within a computing hardware. Determining the most likely cause is a process of elimination – eliminating potential causes of a problem. Finally, troubleshooting requires confirmation that the solution restores the product or process to its working state. Hardware troubleshooting is done by hardware or technical support technician.

Hardware troubleshooting processes primarily aim to resolve mobile hardware problems using a systematic approach. The process starts by first identifying the problem and finding different issues that can cause such a problem and eventually leading to implementing a solution or alternative. Troubleshooting is a systematic approach to problem solving that is often used to find and correct issues with complex machines, electronics, computers and software systems.

Now, here is the basic procedure to repair a mobile phone step by step on hardware troubleshooting. Different mobile phones have different circuit designs and components. First thing to be familiar with is, how each circuit components or parts are mounted, connected, assembled or designed in your mobile.

The first step in troubleshooting is gathering information on the issue, such as an undesired behavior or a lack of expected functionality. Other important information includes related symptoms and special circumstances that may be required to reproduce the issue. Any unexpected or undesirable behavior is a symptom. Frequently the symptom is a failure of the product or process to produce any results. (Nothing was printed, for example). Corrective action can then be taken to prevent further failures of a similar kind.

Once the issue and how to reproduce it are understood, the next step might be to eliminate unnecessary components in the system and verify that the issue persists, to rule out incompatibility and third-party causes. Depending on the particular issue and the troubleshooter's experience, they may have some ideas. They may also check product documentation and/or conduct research on a support database or through a search engine. After common causes are ruled out, the troubleshooter may resort to the more systematic and logical process of verifying the expected function of parts of a system.

One common method is the split-half troubleshooting approach: With a problem resulting from a number of possible parts in series, one tests half-way down the line of components. If the middle component works, one goes to the middle of the remaining parts, approaching the end. If the test finds a problem at the mid-point, one does a split towards the start of the line until the problem part is found. The split-half process can save time in systems that depend on many components. Once the problem part is identified, it may be adjusted, repaired or replaced as needed.

Evidence of effective troubleshooting is indicated when the issue is no longer reproducible and function is restored one. The success of troubleshooting often depends on the thoroughness and experience of the troubleshooter. Preventative action is possible using failure mode and effects (FMEA) and fault tree analysis (FTA) before full-scale production, and these methods can also be used for failure analysis.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

наполовину диагностирующий подход; аппаратный поиск и устранение неисправностей; в зависимости от конкретной проблемы; процесс устранения; сначала идентифицируя проблему; анализ дерева отказов; зависит от тщательности аварийного монтёра; профилактическое действие; проблема сохраняется; устранение неисправностей требует подтверждения; устранить ненужные компоненты; рабочее состояние; первый шаг в поиске и устранении неисправностей; исключить несовместимость; постепенно; процесс разделения пополам; предотвращать дальнейшие отказы аналогичного вида; провести исследование; отсутствие ожидаемых функциональных возможностей; больше не воспроизводится.

II. Find in the text synonyms of the following words:

several, substitute, breakdown, investigation, to need, collecting, keep, bound.

III. Answer the following questions using the word combinations and phrases of the topical vocabulary:

1. What is called hardware troubleshooting? 2. What does troubleshooting require? 3. Who is hardware troubleshooting done by? 4. What approach do hardware troubleshooting processes primarily aim to resolve mobile hardware problems? 5. What does the first step in troubleshooting deal with? 6. Why can corrective action be taken then? 7. What next step might be once the issue and how to reproduce it are understood? 8. When may the troubleshooter resort to the more systematic and logical process of verifying the expected function of parts of a system? 9. What can you say about the split-half troubleshooting approach? 10 What does the success of troubleshooting often depend on?

IV. Retell the above text using as many of the word combinations from Exercise I as you can.

WORKING ON WORDS

I. Make up your own sentences or situations with the following word-combinations:

to find and correct issues; the source of a problem; to eliminate unnecessary components; an unexpected or undesirable behavior; to prevent further failures; a troubleshooter checks each component in a system one by one; the success of troubleshooting.

II. Complete the sentences with the words from the box:

to troubleshoot malfunction maintaining failures problem to prevent troubleshooting expected

1. Many problems occur as a result of multiple ….. or errors. 2. A system can be described in terms of its ….. , desired or intended behavior. 3. Corrective action can then be taken ….. further failure. 4. The problem is initially described as symptoms of ….. . 5. A basic principle in ….. is to start from the simplest and most probable possible problems first. 6. When problems arise, it's always good to know how ….. the issues. 7. He is troubleshooting a ….. on an unfamiliar network and he may not know what the address range should be. 8. Keeping a computer within a safe temperature is the key to ….. a stable system.

III. Find in the above text and copy out phrases containing adverbs with the suffix *–ly*. Say what adjectives are these derivative adverbs formed from, translate them.

WRITTEN PRACTICE

I. Choose the proper verb form and write down the translation of each sentence.

1. Troubleshooting is a form of problem solving, often applied to repair ….. products or processes on a machine or a system. 2. Troubleshooting is the identification or diagnosis of "trouble" in the management flow of a corporation or a system ….. by a failure of some kind. 3. Usually troubleshooting ….. to something that has suddenly stopped working. 4. A troubleshooter could check each component in a system one by one, substituting ….. good components for each potentially suspect one. 5. Efficient methodical troubleshooting starts on with a clear understanding of the expected behavior of the system and the symptoms ….. . 6. One of the core principles of troubleshooting is that reproducible problems can be reliably ….. and resolved. 7. I ….. the up arrow on my keyboard to scroll back to the previous command. 8. The student ….. to create models that are in the *Troubleshooting* section.

Keys: known, have pressed, failed, is trained, caused, being observed, is applied, isolated.

II. Translate the following sentences into English using the words and word combinations of the topical vocabulary:

1. С помощью утилиты он исправил проблемы с сетью, выполнил проверку на наличие вредоносных программ, а также проверку жёсткого диска и оперативной памяти. 2. Если сервер баз данных не может продолжать обычную обработку и должен отключиться, то происходит ошибка подтверждения. 3. Мы уже выполнили все действия, описанные в сообщении об ошибке подтверждения. 4. Устранение неисправностей оборудования выполняется только техническими специалистами. 5. Процессы устранения неполадок оборудования в первую очередь направлены на решение проблем с компьютерным оборудованием. 6. Устранение неполадок оборудования обычно выполняется на аппаратном оборудовании, установленном на компьютере или связанном с ним устройстве. 7. Прежде всего, основным принципом поиска и устранения неполадок является начало с самых простых и вероятных возможных проблем. 8. Эффективное методическое устранение неполадок мы начинаем с чёткого понимания ожидаемого поведения системы и наблюдаемых симптомов. 9. Некоторые из наиболее сложных проблем, связанных с устранением неполадок, связаны с симптомами, которые происходят с перерывами.

III. Ask all types of questions to the following sentence:

The troubleshooter may resort to the more systematic and logical process of verifying the expected function of parts of a system.

IV. a) Study the grammar table and learn.

Gerunds are words ending in "-*ing*" that are made from verbs but act as nouns. A gerund can be the subject or the object of a verb or it may be governed by a preposition.

b) Find in the above text and copy out sentences having the gerund, point out the gerunds in them and give the function of each. Say whether it is the subject of a verb, object of a verb or governed by a preposition.

V. This sentence includes examples of both *ing* - forms, the gerund and the present participle. Say which words in italics are gerunds and which are present participles.

Many IT professionals are now *helping* in the *executing* different tasks like, computer *networking* and information *processing*, data management, data base and software design, *engineering* of computer hardware as well as the administration and management of the entire systems at affordable cost.

COMMUNICATIVE SITUATIONS

I. Discuss the arguments for the following problem. Explain why it is so.

Computer technology is the discipline that studies the foundations of modern computer systems in terms of hardware, software, networks and communications and the relationships between each other. University degrees in computer technology usually cover both computer science and information technology.

II. Prove the following statement. Share opinions:

Theory is good for you because studying it expands your mind. Computer technology changes quickly. Specific technical knowledge, though useful today, becomes outdated in just a few years. (Michael Sipser)

ALGORITHM DESIGN

I. Note the pronunciation of the following:

arbitrary ['ɑːbɪtrəri]
assertion [ə'sɜːʃ(ə)n]
automatic [,ɔːtə'mætɪk]
conquer ['kɒŋkə]
convex ['kɒn'vɛks]
exhibit [ɪg'zɪbɪt]
geometry [ʤɪ'ɒmɪtri]
intellectual [,ɪntɪ'lɛktjʊəl]
recursively [,riː'kɜːsɪvli]
repertoire ['rɛpətwɑː]
visual ['vɪzjʊəl]

II. Read Text Ten and get ready to discuss it in the classroom:

Text 10
ALGORITHM DESIGN

Algorithm design is a challenging intellectual activity that provides a rich source of observation and a test domain for a theory of problem-solving behavior.

Algorithm design is the process of coming up with a sketch, in a very high level language, of a computationally feasible technique for achieving a specified behavior. The design process combines cleverness in problem solving, knowledge of specific algorithm design principles, and knowledge of the subject matter of the algorithm (e.g. geometry, graph theory, physics). When people design algorithms, their design repertoire includes discovery and visual reasoning in addition to the (ideally) disciplined application of problem-solving techniques. Human design is a rich source of ideas for a model of algorithm design. Observing that design process and attempting capture the basic ideas in an automated system both helps us understand how people structure and use their knowledge about design and also validates our observations. The goal of the project is to create an automatic design system that can apply existing design principles as well as exhibit some creativity. The observations of human design are to be incorporated, but the automatic system should take the strengths and weaknesses of both computers and people into account. We are not trying to model human problem solving behavior as an end in itself.

Since the design of complex algorithms is currently best accomplished by human beings, observing their performance would appear to be a profitable starting point for automating the design process. However, since the talents of computers are not those of people, it is reasonable to search for a different method if the goal is total automation of design or a novel mixture of human and machine design.

Our designers were independently given the task of creating algorithms to find convex hulls, closest pairs and intersecting line segments. Several protocols have been analyzed in great detail while the others have been gone over more lightly and used primarily as confirming evidence.

Assuming that a problem specification has been understood, design begins with a kernel idea or solution plan, quickly selected from those known to the designer. Depending on the designer's background, the idea may vary in sophistication from generate and test to input process output to more complex strategies such as divide and conquer or dynamic programming. The designer lays out the basic steps of the chosen idea and follows through with it unless the approach proves completely inapplicable |D1.1|

D1 had the initial idea that the algorithm should be one that generated all points in the input in some arbitrary order and tested each to determine whether it was on the hull. This had the potential of running in linear tim»- (proportional to the number of input points').

|D2 1| decided to try a divide and conquer algorithm (th*- special torn) of divide and conquer in which the input', are divided into subsets, the algorithm is recursively applied to each, and the results are back together.

After formulating a plan, the designer refines the basic steps of the kernel idea. By and large, this elaboration proceeds by stepwise refinement. The designer may lay down the major components, effectively decomposing the problem into subparts, or may add new inputs or assertions about details of the structure. The refinement steps (1) may be suggested by knowledge appropriate to the problem and task domain or (2) may be a natural result of attempting to execute an algorithm.

(*Elaine Kanf*)

III. Learn reading the following mathematical symbols and expressions:

* – pointer; asterisk
( ) – parentheses
| | – single vertical bar (line)
' – prime; derivative
» – inverted commas
tim = a mode

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

найти выпуклые оболочки; в некотором произвольном порядке; делятся на подмножества; цель проекта; испытательная область для теории; выполнять алгоритм; специальный разрыв; основные этапы сущности идеи; алгоритм деления и покорения; теория проблемного поведения; установить главные компоненты; самые близкие пары и пересекающиеся линейные сегменты; тема алгоритма; в зависимости от образования проектировщика; в общем и целом; пошаговой обработкой; подтверждение доказательств; возможная в вычислительном отношении методика; открытие и визуальное мышление.

II. Answer the following questions using the word combinations and phrases of the topical vocabulary:

1. What does an algorithm design provide? 2. What is called an algorithm design? 3. Why is human design a rich source of ideas for a model of algorithm design? 4. Should the automatic system take the strengths and weaknesses of both computers and people into account? 5. What task were the designers independently given? 6. What does the design begin with? 7. How may the idea vary? 8. When does the designer refine the basic steps of the kernel idea? 9. What does this elaboration proceed by? 10. What may the designer lay down? 11. What do you know about the refinement steps?

III. Explain in English the meaning of:

a feasible technique, creativity, an arbitrary order, stepwise.

IV. Retell the above text using as many of the word combinations from Exercise I as you can.

WORKING ON WORDS

I. Make up your own sentences or situations with the following word-combinations:

knowledge of the subject matter of the algorithm; problem-solving techniques; to validate one's observations; as confirming evidence; to search for a different method; the task of creating algorithms; depending on the designer's background.

II. Complete the sentences with the words from the box:

fundamental	algorithms	difficult	engineer	variety	steps	based

1. Designing the right algorithm for a given application is a …. job. 2. Ancient mathematical literature contains descriptions of algorithms for a ….. of tasks, such as finding prime numbers and greatest common divisors. 3. The concepts *algorithm* and *information* are ….. in computer science. 4. Our description language is ….. on algorithms. 5. The number of ….. that an algorithm uses on a particular input may depend on several parameters. 6. We will try to identify broad themes and design principles in the development of ….. . 7. For the computer ….. , design relates to software and hardware components of modern computing systems and computer-controlled equipment.

III. a). Study the table and learn phrasal verbs with "*lay*".

Lay down means to establish rules or procedures. **Lay into** means to criticize angrily. **Lay off** means to make an employee redundant. **Lay out** means to spend money; to plan or arrange *smth.*

b). Choose the correct preposition or adverb to complete each of the following sentences:

down *into* *off* *out*

1. Our designer laid ….. us when we arrived ten minutes late. 2. They laid ….. a lot of money on their design process. 3. The rules of the design process elaboration were laid ….. on Thursday. 4. The manager laid ….. two engineers because they couldn't exhibit any creativity. 5. The Engineering Council regrets to inform you that it will have to lay ….. some computer engineers without the creative ability to design next week. 6. My colleague will really lay ….. me if I tarnish the image of our computer engineering department. 7. Information technology specialists must lay ….. programs that focus on one specific aspect of computer engineering and cover it in great depth. 8. We usually lay ….. the management of information resources to meet the needs of users within an organizational and societal context through the creation, application, integration, and administration of computing technologies.

c). Find in the above text and copy out the sentences containing the phrasal verb "*lay*".

IV. Find in the above text and copy out phrases containing adverbs with the suffix *–ly*. Say what adjectives are these derivative adverbs formed from, translate them.

V. Study the grammar table and learn.

Word-building: Suffix *-ness* is appended to adjectives to form nouns meaning "the state of being (the adjective)", "the quality of being (the adjective)", or "the measure of being (the adjective)".

VI. a) Find in the above text nouns with the suffix *–ness*, copy them out and translate.

b) Add the suffix *–ness* to the following stems, make any necessary spelling changes, and translate the words:

fond, aware, kind, dark, calm, one, happy, heavy, sad, rude, testy, useful.

WRITTEN PRACTICE

I. Choose the proper verb form and write down the translation of each sentence:

1. Even bad algorithms ….. quickly when applied to small test cases on extremely fast processors. 2. It is important …. that an algorithm can be polynomial time even if its running time is not written as *n* raised to some integer power. 3. An algorithm is a procedure that ….. any of the possible input instances and transforms it to the desired output. 4. Divide and conquer typically ….. the problem in half, solves each half, then stitches the halves back together to form a full solution. 5. Graphs are important because they ….. to represent essentially any relationship. 6. Describing

algorithms requires a notation for expressing a sequence of steps ….. . 7. An algorithm's implementation complexity is often a function of how it ….. .

Keys: splits, has been described, can run, can be used, to realize, takes, to be performed.

II. Ask questions to which the following statements may serve as the answers.

1. To apply dynamic programming, we need to construct a recurrence computing the length of the longest sequence. 2. Many algorithms process items according to a particular order. 3. In designing algorithms for an optimization problem, we must prove that our algorithm always gives the best possible solution. 4. We will seek algorithms that are correct and efficient, while being easy to implement. 5. In order to represent an algebraic expression in a computer program, most systems seek to store the minimum information. 6. The development of new algorithms is one of the most active areas of investigation in computer algebra. 7. Computer – algebra systems have been improved significantly in the past few years.

III. a) Form the degrees of comparison of the following adjectives:

rich, high, feasible, specific, visual, basic, natural, profitable, novel, great, different, appropriate, total, reasonable, dynamic, inapplicable, large, new, vulnerable, major.

b) Find in the above text adjectives in the comparative and superlative degrees, write out phrases with them.

COMMUNICATIVE SITUATIONS

I. Express your opinion on the following point of view.

An important key to algorithm design is to use sorting as a basic building block, because once a set of items is sorted, many other problems become easy.

II. Do you know the possible ways of improvement of an algorithm design?

III. Comment on the following quotation:

“If you do not think about the future, you cannot have one.” (John Galsworthy)

THE INTERNET OF THINGS

I. Note the pronunciation of the following:

analysis [ə'næləsɪs]
architecture ['ɑːkɪtɛkʧə]
arena [ə'riːnə]
constituent [kən'stɪtjʊənt]
cyber-physical ['saɪbə-'fɪzɪkəl]
galaxy ['gæləksi]
interrelation [ˌɪntə(ː)rɪ'leɪʃən]
society [sə'saɪəti]
technology [tɛk'nɒləʤi]
thermostat ['θɜːməstæt]
ubiquitous [ju(ː)'bɪkwɪtəs]
virtual ['vɜːtjʊəl]

II. Read Text Eleven and get ready to discuss it in the classroom:

Text 11
THE INTERNET OF THINGS

The intriguing Internet of Things is the centre of a conglomeration of bustling activities, from education, research and standardization to economic planning. While there is no generally accepted definition of “Internet of Things”, it can be viewed as the ability for things and people to remotely interact through the Internet anywhere, anytime, thanks to the timely convergence of many technologies.

Machines, everyday objects and virtual elements (such as digital pictures) now have the possibility to be identified in the same way as individuals on the Internet of people. As a result, things can be integrated into a vast web of interrelations where they can communicate with each other or with people. Essentially, in the world of the Internet of Things, things are now on par with people. In most cases, thing-to-thing communications will be found in the business-to-business arena and thing-to-person communications in the business-to-consumer arena.

ITU defines the Internet of Things as a “global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things, based on existing and evolving interoperable information and communication technologies.” ITU’s foundational definition offers useful insight and a sound springboard for further analysis and research into the Internet of Things. ITU points out that the Internet of Things is a “vision”, not a single technology, and that it has “technological and societal implications.”

There are many more things than people on Earth – the tally of things that could be part of the Internet of Things varies enormously according to experts. No matter what the exact number is, it is big! For example, according to estimates made by Cisco’s Internet Business Solutions Group, some 50 billion devices will be connected to the Internet by 2020. These things include mobile devices, parking meters, thermostats, cardiac monitors, tyres, roads, cars, supermarket shelves and even cattle.

The Internet-of-Things galaxy encompasses ubiquitous computing, radio-frequency identification, cyber-physical systems, wireless sensor networks, and machine-to-machine communications. Other clusters, such as those centred on pervasive computing, autonomic computing, human-computer interaction, ambient intelligence, and, more generally, on smart objects, systems and technologies are also intrinsically connected to the Internet of Things.

The concepts of cyber-physical systems and the Internet of Things are undeniably intertwined. Cyber-physical systems are physical, biological, and engineered systems whose operations are integrated, monitored, and/or controlled by a computational core. Components are networked at every scale. Computing is deeply embedded into every physical component, possibly even into materials. The computational core is an embedded system, usually demands real-time response, and is most often distributed.

Wireless sensor networks are a fundamental constituent of the Internet of Things. This domain has strong scientific, technological and industry backing, and the link with the Internet of Things is immediate. The research of smart dust (a collection of countless tiny micro-electromechanical systems) and of the Internet of nano-things provides a window into the future shape of the Internet of Things.

Machine-to-machine communications are the earliest manifestation of the Internet of Things.

Pioneering data transmission technologies, such as basic telemetry and industrial control systems can legitimately be seen as machine-to-machine precursors. Over the years, machine-to-machine communication has evolved towards advanced remote monitoring and control. Machine-to-machine communication has begun to offer enabling platforms, integrating mobile and/or fixed, wired and/or wireless networking architectures (such as wireless personal area networks), and cellular and satellite (including global positioning system) services.

(From *ITU News magazine*)

Commentary

ITU: The International Telecommunication Union, originally the International Telegraph Union (French: Union Internationale des Télécommunications), is a specialized agency of the United Nations (UN) that is responsible for issues that concern information and communication technologies.

Cisco: Cisco Systems, Inc. is an American multinational corporation headquartered in San Jose, California, that designs, manufactures, and sells networking equipment.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

наравне с; скопление суетливой деятельности; требует ответ в реальном времени; предложить разрешающие платформы; предшественники от машины к машине; неоспоримо переплетены; дистанционно взаимодействовать; совместимая информация; возможность быть идентифицированными; подсчёт вещей; фундаментальный компонент; согласно оценкам; обширная паутина взаимосвязей; промышленная поддержка; полезное понимание; архитектура беспроводной сети; социальные последствия; своевременное сближение; трамплин для дальнейшего анализа и исследований; определение радиочастоты.

II. Look through the text again and find the answers to the following questions:

1. What is the centre of a conglomeration of bustling activities, from education, research and standardization to economic planning? 2. How can the definition of the Internet of Things be viewed? 3. What possibility do machines, everyday objects and virtual elements have? 4. Can things be integrated into a vast web of interrelations? 5. Are things on par with people now? 6. How does ITU define the Internet of Things? 7. What does ITU's foundational definition offer into the Internet of Things? 8. How many devices will be connected to Internet by 2020? 9. What do these things include? 10. What does the Internet of Things galaxy encompass? 11. What concepts are undeniably intertwined? 12. What are cyber-physical systems? 13. Is computing embedded into every physical component? 14. What are wireless sensor networks? 15. What is the earliest manifestation of the Internet of Things? 16. What can be seen as machine-to-machine precursors? 17. Has machine-to-machine communication evolved over the years? 18. What has it begun to offer?

III. Explain in English the meaning of:

cyber-physical systems, information society, real-time response.

IV. Retell the above text using the word combinations from Exercise I.

WORKING ON WORDS

I. Study the following word combinations and make up your own sentences or situations with them:

to be deeply embedded into, an accepted definition, the Internet of Things, a global positioning system, the earliest manifestation, to remotely interact, a vast web of interrelations, to communicate with each other, existing and evolving, centred on pervasive computing, to be on par, at every scale, advanced remote monitoring.

II. Find in the above text and copy out phrases in which the preposition *into* is used. Translate them.

III. a). Study the table and learn phrasal verbs with "*point*".

Point out means to make someone aware of something. **Point up** means to emphasize something, *esp*. by identifying. **Point off** means to mark off from the right-hand side (a number of decimal places) in a whole number to create a mixed decimal. (Mathematics) (From *Collins English Dictionary*)

b). Choose the correct preposition or adverb to complete each of the following sentences:

out up off

1. James agreed to check up whether his assistant had pointed …..the correct number of decimal places in this calculation. 2. Their research points ….. the problems of finding a solution to advanced remote monitoring. 3. My colleague pointed ….. that I only had a week to get finished the whole experiment on human-computer interaction. 4. The conference pointed ….. the discrepancy in the application and integration of computing technologies. 5. You forgot to point ….. three decimal places in this equation. 6. The user pointed ….. that there were certain flaws in the future shape of the Internet of Things. 7. We pointed ….. the difficulties he would encounter integrating wired or wireless networking architectures. 8. He pointed me ….. a vast web of interrelations.

c). Find in the above text and copy out the sentence containing the phrasal verb"*point*".

IV. Complete the sentences with words from the box.

notification prerequisite generally identifiable unauthorized applied existing generated

1. Each thing is uniquely ….. through its embedded computing system. 2. These devices collect useful data with the help of various ….. technologies and then autonomously flow the data between other devices. 3. Radio-frequency identification was seen by Kevin Ashton as a …. for the Internet of things. 4. A significant transformation is to extend "things" from the data ….. from devices to objects in the physical space. 5. Smart home technology …. in this way can provide users with more freedom and a higher quality of life. 6. The Internet of Things devices can be used to enable remote health monitoring and emergency ….. systems. 7. The risk with this is that the Internet of Things device could be easier to attack allowing ….. access to the device or the data. 8. We don't have any ….. accepted definition of "Internet of Things".

V. **Find in the above text and copy out sentences in which linking expressions *such as* and *as a result* are used. Translate the sentences with them. Say which of these linking expressions:**

a) expresses a reason?
b) introduces clarification?

WRITTEN PRACTICE

I. Study the grammar table and learn.

Relative clauses – whose and where
We use *whose* in relative clauses instead of his/her/their:
we saw some people – their car had broken down
→ We saw some people **whose car had broken down**.
We use **whose** mostly for people.
We can use *where* in a relative clause to talk about places:
the hotel – we stayed there – wasn't very clean
→ The hotel **where we stayed** wasn't very clean.

II a). Translate the following complex sentences paying attention to the word order in the subordinate clauses with *whose* and *where*.

1. I want to create and maintain a unique, sophisticated website where professional management is needed. 2. Yesterday I spoke with the scientist whose new research revealed that security was viewed as a major challenge to the IoT's growth. 3. It is still the place where you get to work with your visitors directly to decide how the interaction will flow. 4. Internet of Things describes a world where just about anything can be connected and communicated in an intelligent fashion. 5. At the conference I met the developer of this concept whose team conducted an additional research and described the implementation. 6. They like to play the game of geography, where two players alternately think of names of countries. 7. Each player must think of a country whose name begins with the same letter that the previously named country ends with. 8. This equation is often used to estimate the probability where several events can be joined.

b). Find in the above text and copy out complex sentences having relative clauses with *whose* and *where*.

III. Translate the following sentences into English using the words and word combinations of the topical vocabulary:

1. «Интернет вещей» (IoT) может изменить и уже меняет работу складских логистических комплексов. 2. Интернет вещей представляет собой очень важное направление развития человечества и технологического прогресса в целом. 3. Для внедрения IoT используются различные технические модели обеспечения связи, каждая из которых имеет свои собственные характеристики. 4. Интернет вещей позволит разработать такие динамические сети, которые будут состоять из миллиардов различных устройств и смогут обмениваться информацией друг с другом. 5. Все цифровые аналоги будут в

состоянии воспринимать информацию, поступающую из окружающего мира, и вступать во взаимодействие с различными предметами, а также обмениваться информацией. 6. Под термином «Интернет вещей» скрывается концепция информационной коммуникационной сети между большим количеством различных физических объектов (вещей), которые будут оснащены необходимым оборудованием для связи с внешней средой или друг с другом. 7. В настоящее время Интернет вещей рассматривается как интеллектуальная окружающая среда и всепроникающие компьютерные системы. 8. В результате может возникнуть совершенно новая среда, в которой интеллект, реализованный через программные приложения, сможет оценивать вещи, происходящие в физическом мире.

IV. Choose the proper verb form and write down the translation of each sentence:

1. We assume without loss of generality that q has no variables in common with p except x, and ….. the value of x. 2. This is incorrect because you ….. how to produce x deterministically when it exists. 3. Each machine requires only O(nk) states ….. the counting. 4. You must ….. a total recursive function that grows asymptotically faster than any provably total recursive function. 5. We have shown that the guessing ….. either universally or existentially so as not to increase the number of alternations along any computation path. 6. This exercise was not …... as an endurance test. 7. Because these strings are of polynomial length in n and C is sparse, the string y_n ….. of polynomial length. 8. This subformula says that the machine ….. at time 0 in its start state.

Keys: starts, to do, can be done, meant, does not change, build, have not shown, is.

V. Choose the verb form in the brackets that best completes the sentence.

1. The IoT is significant because an object that can represent itself digitally (becomes, become, to become) something greater than the object by itself. 2. With the internet of things, the physical world is (becoming, become, became) one big information system. 3. The quality and scope of the data across the Internet of Things (generates, generating, to generate) an opportunity for much more contextualized and responsive interactions with devices to create a potential for change. 4. As devices (become, becomes, to become) more connected thanks to the IoT, security and privacy have become the primary concern among consumers and businesses. 5. The smart lighting system (allows, allow, allowing) a city to intelligently provide the right level of lighting needed by time of day, season, and weather conditions. 6. Sensors installed inside equipment will (monitor, be monitored, monitored) if any parts have exceeded their designed thresholds, and will automatically (send, sent, to send) reports to owners and manufacturers. 7. These devices will (bridge, bridging, bridged) the gap between physical and digital world to improve the quality and productivity of life, society and industries.

TOPICS FOR DISCUSSION

I. Do you think things are now on par with people in the world of the Internet of Things? What are the advantages and disadvantages of the Internet of Things?

II. Prove the following fact:

With the ubiquity of computers and computer-based systems in the world today, computer engineers must be versatile in the knowledge drawn from standard topics in computer science and electrical engineering as well as the foundations in mathematics and sciences.

III. What do you think of the following statement? What could you add?

Necessity is the mother of invention. Inventions are solutions to different problems.

VERY-LARGE-SCALE INTEGRATION

I. Note the pronunciation of the following:

automated ['ɔːtəmeɪtɪd]
hierarchical [,haɪər'ɑːkɪkəl]
microchip ['maɪkrəʊ,ʧɪp]
minimizing ['mɪnɪmaɪzɪŋ]
modular ['mɒdjʊlə]
Moore's Law [mʊəz lɔː]
partitioning [pɑː'tɪʃənɪŋ]
rectangular [rɛk'tæŋgjʊlə]
schematics [skɪ'mætɪks]
synthesis ['sɪnθɪsɪs]
wafer ['weɪfə]

II. Read Text Twelve and get ready to discuss it in the classroom:

Text 12
VERY-LARGE-SCALE INTEGRATION

Very-large-scale integration (VLSI) is the process of creating an integrated circuit (IC) by combining hundreds of thousands of transistors or devices into a single chip. VLSI began in the 1970s when complex semiconductor and technologies were being developed. The microprocessor is a VLSI device. Before the introduction of VLSI technology most ICs had a limited set of functions they could perform. An electronic circuit might consist of a CPU, ROM, RAM and other glue logic. VLSI lets IC designers add all of these into one chip.

Scientists who had worked on radar returned to solid-state device development. With the invention of transistors at Bell Labs in 1947, the field of electronics shifted from vacuum tubes to solid-state devices.

With the small transistor at their hands, electrical engineers of the 1950s saw the possibilities of constructing far more advanced circuits. However, as the complexity of circuits grew, problems arose. One problem was the size of the circuit. A complex circuit like a computer was dependent on speed. If the components were large, the wires interconnecting them must be long.

The electric signals took time to go through the circuit, thus slowing the computer.

The invention of the integrated circuit by Jack Kilby and Robert Noyce solved this problem by making all the components and the chip out of the same block (monolith) of semiconductor material. The circuits could be made smaller, and the manufacturing process could be automated. This led to the idea of integrating all components on a single silicon wafer, which led to small-scale integration (SSI) in the early 1960s, medium-scale integration (MSI) in the late 1960s, and then large - scale integration (LSI) as well as VLSI in the 1970s and 1980s, with tens of thousands of transistors on a single chip (later hundreds of thousands, then millions, and now billions).

Structured VLSI design is a modular methodology originated by Carver Mead and Lynn Conway for saving microchip area by minimizing the interconnect fabrics area. This is obtained by repetitive arrangement of rectangular macro blocks which can be interconnected using wiring by abutment. An example is partitioning the layout of an adder into a row of equal bit slices cells. In complex designs this structuring may be achieved by hierarchical nesting. Structured VLSI design had been popular in the early 1980s, but lost its popularity later because of the advent of placement and routing tools wasting a lot of area by routing, which is tolerated because of the progress of Moore's Law.

A primary task for VLSI designer is to translate circuit schematics into silicon form (this process is called physical design). Current designs, unlike the earliest devices, use extensive design automation and automated logic synthesis to lay out the transistors, enabling higher levels of complexity in the resulting logic functionality. Certain high-performance logic blocks like the SRAM (static random-access memory) cell, are still designed by hand to ensure the highest efficiency.

(From *Wikipedia, the free encyclopedia*)

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

намного более продвинутые схемы; интеграция малого уровня; в отличие от самых ранних устройств; равные ячейки срезов бит; ограниченный набор; высокопроизводительные логические блоки; модульная методология; разрабатывались технологии; твердотельное устройство; иерархическим вложением; проводка границей; пройти через схему; для обеспечения максимальной эффективности; область соединительных тканей.

II. Answer the following questions using the word combinations from Exercise I:

1. What kind of process is very-large-scale integration? 2. When did VLSI begin? 3. What might an electronic circuit consist of? 4. When and why did the field of electronics shift from vacuum tubes to solid-state devices? 5. Why did problems arise as the complexity of circuits grew? 6. How did the invention of the integrated circuit solve the problem of slowing the computer? 7. What did the idea of integrating all components on a single silicon wafer lead to? 8. Who is a modular methodology originated by? 9. Why did the structured VLSI design lose its popularity? 10. What is a primary task for a VLSI designer? 11. What logic blocks are still designed by hand?

III. Retell the above text using as many of the word combinations from Exercise I as you can.

WORKING ON WORDS

I. Re-write the following transcribed words into English spelling:

[ə'reɪndʒmənt] [ˌɪntɪ'greɪʃən] [ˈsɒlɪd-steɪt] [rɛk'tæŋgjʊlə] [ɪnˈvɛnʃən] [ˈmɒnəʊlɪθ] [ˈrændəm-'ækˌsɛs]

II. Make up your own sentences or situations with the following phrases:

to create an integrated circuit, a limited set of functions, far more advanced circuits, to lay out the transistors, to solve the problem, to interconnect using wiring by abutment, to ensure the highest efficiency.

III. Use the following phrasal verbs in the sentences of your own:

to work on, to be dependent on, to translate into, to combine into, to lay out, to concern with.

IV. Complete the sentences with the words from the box:

design	semiconductor	gates	mind	designers	devices	advances

1. The first ….. chips held two transistors e ach. 2. Designers must keep ever more of these rules in ….. while laying out custom circuits. 3. As microprocessors become more complex due to technology scaling, microprocessor ….. have encountered several challenges. 4. Subsequent…..added more transistors, and as a consequence, more individual functions or systems were integrated over time. 5. Today's microprocessors have many millions of ….. and billions of individual transistors. 6. Such improvements in technique led to …… with hundreds of logic gates, known as medium-scale integration (MSI). 7. Several ….. philosophies have been developed to aid this new design flow.

WRITTEN PRACTICE

I. Choose the necessary verb form from the box and translate the sentences:

was	desired	held	were intended	led	to fabricate	was trying

1. The first integrated circuits ….. only a few devices, perhaps as many as ten diodes, transistors, resistors and capacitors. 2. It has made possible ….. one or more logic gates on a single device. 3. In the mid-1920s several inventors attempted devices that ….. to control current in solid-state diodes and convert them into triodes. 4. The VLSI designer ….. to translate circuit schematics into silicon form. 5. There ….. an effort to name and calibrate various levels of large-scale integration above VLSI. 6. The use of silicon and germanium crystals ….. to improvements in fabrication and theory. 7. He proved by mathematical methods that the system had

certain ….. properties, and that certain undesired effects (such as deadlock) could not occur.

II. Write down all possible questions to the following sentence:

Complex semiconductor and technologies were being developed at that time.

III. Find in the above text and copy out sentences containing modal verbs with the Infinitive Passive.

IV. Supply possessive pronouns in agreement with their nouns in the following sentences:

1. Fabricators generally provide libraries of components for ….. production processes, with simulation models that fit standard simulation tools. 2. You can not imagine a day without an electronic gadget because electronics have become a part of ….. daily lives. 3. Creating an adequate model of a module requires an in-depth understanding of ….. internal operation. 4. He developed ….. integration technology to help increase the number of components on a single chip. 5. Our engineer also predicted that semiconductor technology would increase ….. effectiveness every year. 6. This technology helped immensely to reduce the size of devices and significantly on ….. speed. 7. Carver Mead and Lynn Conway designed ….. modular methodology for saving microchip area by minimizing the interconnect fabrics area. 8. Structured VLSI design lost ….. popularity later because of the progress of Moore's Law. 9. Preparation for professional practice requires graduates to have an understanding of ….. responsibilities associated with engineering practice. 10. In a few more years, we developed back-ends to perform ….. logic synthesis.

V. Translate the sentences and define the italicized verb forms:

1. Terms suggesting greater than VLSI levels of integration *have been* no longer in widespread use. 2. Our chip designers *couldn't analyze* entire semiconductor chips yesterday. 3. When a key *is pressed*, released or held down, the keyboard *sends* a packet of information known as a scan code to the computer. 4. The study of computer programming itself *investigates* various aspects of the use of the programming language and complex systems. 5. Often the chips were easier to lay out and more likely to function correctly, since their designs *could be simulated* more thoroughly prior to construction. 6. Although the languages and tools *have evolved*, this general approach of specifying the desired behavior in a textual programming language *remains* the basis of digital IC design today.

VI. Translate the following sentences paying special attention to the infinitives as parts of compound nominal predicates.

The infinitive after the linking verb **BE** is part of the compound nominal predicate.

1. The task of our designers is now to simulate across multiple fabrication processes before a chip is certified ready for production. 2. The aim of

their attack is to reconstruct the original word from the signal. 3. The problem was to make the size of the circuit smaller. 4. The basic concept was to use reliable, low-cost, relatively low-technology IC processes, and pack a large number of projects per wafer. 5. The approach is to acquire the raw signal directly from the antenna and to process the entire captured electromagnetic spectrum. 6. Their aim is to lead to large-scale integration (LSI), i.e. systems with at least a thousand logic gates. 7. The objective of diagnosis is to determine the location of the fault. 8. Its function is to ensure functional equivalence at the logical level. 8. A primary task for VLSI designer is to translate circuit schematics into silicon form.

VII. Translate the following sentences using the words and word combinations of the topical vocabulary.

1. Каждая большая интегральная схема представляет собой кристалл размером в несколько квадратных миллиметров, в котором сосредоточены десятки тысяч полупроводниковых элементов. 2. Преимуществами диодных матриц являются простота и небольшая занимаемая на кристалле площадь, а недостатком – значительные токи, потребляемые по входам матрицы. 3. Интегральная микросхема представляет собой микроэлектронное устройство, схему определённой сложности, которая изготавливается на полупроводнивом кристалле или плёнке. 4. Плёночная технология делится на два направления, связанных соответственно с использованием тонких или толстых плёнок. 5. Интегральные схемы разрабатываются и выпускаются сериями. 6. Цифровые интегральные микросхемы применяют в устройствах обработки дискретной информации, а так же в системах автоматики. 7. Большую интегральную схему создают методами планарной технологии путём формирования их элементов с одной стороны полупроводниковой пластины (подложки).

TOPIC FOR DISCUSSION

I. Express your opinion on the following point of view:

Computer scientists concern themselves primarily with the theoretical and algorithmic aspects of computing with a focus on the theoretical underpinnings of computing.

DATABASE

I. Note the pronunciation of the following:

accessed ['æksɛst]
altering ['ɔːltərɪŋ]
concurrency [kən'kʌrənsɪ]
database ['deɪtəˌbeɪs]
dominant ['dɒmɪnənt]
insertion [ɪn'sɜːʃən]
necessitate [nɪ'sɛsɪteɪt]
relational [rɪ'leɪʃənl]
resilience [rɪ'zɪlɪəns]
retrieval [rɪ'triːvəl]

II. Read Text Thirteen and get ready to discuss it in the classroom:

Text 13
DATABASE

A database is an organized collection of data, generally stored and accessed electronically from a computer system. Where databases are more complex they are often developed using formal design and modeling techniques.

The database management system (DBMS) is the software that interacts with end users, applications, the database itself to capture and analyze the data and provides facilities to administer the database. The sum total of the database, the DBMS and the associated applications can be referred to as a "database system". Often the term "database" is also used to loosely refer to any of the DBMS, the database system or an application associated with the database.

Computer scientists may classify database-management systems according to the database models that they support. Relational databases became dominant in the 1980s. These model data as rows and columns in a series of tables, and the vast majority use SQL for writing and querying data. In the 2000s, non-relational databases became popular, referred to as NoSQL because they use different query languages.

Formally, a "database" refers to a set of related data and the way it is organized. Access to this data is usually provided by a "database management system" (DBMS) consisting of an integrated set of computer software that allows users to interact with one or more databases and provides access to all of the data contained in the database (although restrictions may exist that limit access to particular data). The DBMS provides various functions that allow entry, storage and retrieval of large quantities of information and provides ways to manage how that information is organized.

Outside the world of professional information technology, the term database is often used to refer to any collection of related data (such as a spreadsheet or a card index) as however size and usage requirements typically necessitate use of a database management system. Existing DBMSs provide various functions that allow management of a database and its data which can be classified into four main functional groups:

Data definition – Creation, modification and removal of definitions that define the organization of the data.

Update – Insertion, modification, and deletion of the actual data.

Retrieval – Providing information in a form directly usable or for further processing by other applications. The retrieved data may be made available in a form basically the same as it is stored in the database or in a new form obtained by altering or combining existing data from the database.

Administration – Registering and monitoring users, enforcing data security, monitoring performance, maintaining data integrity, dealing with concurrency control, and recovering information that has been corrupted by some event such as an unexpected system failure.

Both a database and its DBMS conform to the principles of a particular database model. "Database system" refers collectively to the database model, database management system, and database.

Databases and DBMSs can be categorized according to the database model(s) that they support (such as relational or XML), the type(s) of computer they run on (from a server cluster to a mobile phone), the query language(s) used to access the database (such as SQL or XQuery), and their internal engineering, which affects performance, scalability, resilience, and security.

(From *Wikipedia, the free encyclopedia*)

Commentary

SQL (pronounced ɛs-kjuː-ɛl) stands for Structured Query Language. SQL is used to communicate with a database. According to ANSI (American National Standards Institute), it is the standard language for relational database management systems.

XQuery (XML Query) is a query and functional programming language that queries and transforms collections of structured and unstructured data, usually in the form of XML, text and with vendor-specific extensions for other data formats (JSON, binary, etc.).

XML stands for eXtensible Markup Language. XML is a markup language much like HTML. XML was designed to store and transport data as well as to be self-descriptive.

DBMS (database management system) is system software for creating and managing databases. The DBMS provides users and programmers with a systematic way to create, retrieve, update and manage data.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

работа с контролем параллелизма; организованный сбор данных; как строки и столбцы; собирать и анализировать данные; набор связанных данных; путём изменения или объединения существующих данных; реляционные базы данных; интегрированный набор компьютерного программного обеспечения; поиск большого количества информации; устойчивость и безопасность.

II. Memorize the following word combinations and make up your own sentences or situations with them:

to be corrupted by some event; to capture and analyze the data; retrieved data; as rows and columns; to maintain data integrity; to update and manage data.

III. Answer the following questions using the word combinations from Exercises I and II:

1. What is a database? 2. What does the database management system interact with? 3. May computer scientists classify database-management systems according to the database models that they support? 4. When did relational databases become dominant? 5. What uses SQL for writing and querying data? 6. What does a database management system consist of? 7. How many functional groups can the functions be classified into? 8. What does data definition mean? 9. When can information be corrupted? 10. How can databases and DBMSs be categorized?

IV. Retell the above text using as many of the words and word combinations from Exercises I and II as you can.

WORKING ON WORDS

I. a). Study the table and learn phrasal verbs with "*deal*".

Deal with somebody means to take an appropriate action in a particular situation or according to who you are talking to, managing, etc.

She is used to dealing with all kinds of people in her job.

Deal with somebody/something means to do business with a person, a company or an organization.

We have dealt with their company for many years.

Deal with something means to solve a problem, perform a task.

Have you dealt with these letters yet?

Deal something out means to share something out among a group of people.

The profits were dealt out among the investors.

Deal in something means to buy and sell a particular product.

Our company deals in computer software.

From *the Oxford Advanced Learner's Dictionary*

b). Choose the correct preposition to complete each of the following sentences: *with* *out*

1. He dealt … recovering information that was corrupted by such an unexpected system failure. 2. These application requirements must be dealt … among market research firms. 3. Database security deals … all various aspects of protecting the database content, its owners, and its users. 4. This database management system deals … modeling, storage, and retrieval of multi-dimensional arrays such as satellite images and climate simulation output. 5. Tasks such as loading data, building indexes and evaluating queries will be dealt … among our special authorized personnel. 6. Database access control deals … controlling who (a person or a certain computer program) is allowed to access information in the database. 7. The authorization rights to view payroll data are dealt … only among the financial group of users and view medical data among the others. 8. The government must now deal … the problem of high unemployment.

II. Fill in the blanks with corresponding adjectives from the list below.

1. Database servers are dedicated computers that hold the … databases. 2. RAID disk arrays are used for … storage. 3. In recent years, there has been a … demand for massively distributed databases with … partition tolerance. 4. Main memory databases are … than disk databases, and so are often used. 5. A mobile database can be carried on or synchronized from a … computing device. 6. Existing DBMSs provide … functions that allow management of a database. 7. Hardware database accelerators, … to one or more servers via a high-speed channel, are also used in large volume transaction processing environments. 8. End-user databases consist of data … by individual end-users. 9. A database management system (DBMS) consists of an … set of computer software that allows users to interact with one or more databases.

Integrated, faster, mobile, actual, high, developed, stable, various, connected, strong

WRITTEN PRACTICE

I. Choose the necessary verb form from the box and translate the sentences:

Providing	to provide	is designed	used	to represent	updating	based
respond	detailed					

1. A graph database uses graph structures with nodes, edges, and properties ….. and store information. 2. XML databases are a type of structured document-oriented database that allows querying …… on XML document attributes. 3. An active database includes an event-driven architecture which can ….. to conditions both inside and outside the database. 4. Operational databases store ….. data about the operations of an organization. 5. He usually uses a special kind of database for knowledge management, ….. the means for the computerized collection, organization, and retrieval of knowledge. 6. We aim ….. the same scalable performance of SQL systems for online transaction processing. 7. This term is often

….. casually to refer to both a database and the DBMS. 8. Data security prevents unauthorized users from viewing or ….. the database. 9. A document-oriented database ….. for storing, retrieving, and managing document-oriented information.

II. State functions of the past participles in the following sentence:

An embedded database system is a DBMS which is tightly integrated with application software that requires access to stored data in such a way that the DBMS is hidden from the application's end-users.

III. Write down all possible questions to the following sentences:

1. The main way to classify databases involves the type of their contents.
2. Computer scientists may classify database-management systems according to the database models that they support.
3. My information has been corrupted by an unexpected system failure.

IV. Translate the following sentences using the words and word combinations of the topical vocabulary.

1. База данных – это организованная структура, предназначенная для хранения, изменения и обработки взаимосвязанной информации, преимущественно больших объёмов. 2. Система управления базами данных представляет собой комплекс программных средств, необходимых для создания структуры новой базы, её наполнения, редактирования и отображения информации. 3. Использование реляционных баз данных было предложено доктором Коддом в 1970 году. 4. При помощи SQL можно выполнять запросы, которые возвращают наборы данных, получаемых из одной или нескольких таблиц. 5. Данный алгоритм хорошо работает лишь потому, что оба исходных массива были заранее отсортированы. 6. Исходный массив делится на подмассивы, состоящие из одного элемента. 7. База данных хранится и обрабатывается в вычислительной системе.

V. Make up sentences, using expressions furnished below. Pay attention to the diversity of the functions of the gerund and complexes with the gerund in the sentence.

Prevented from an unexpected system damaging; for writing and querying data; dealing with concurrency control; objected to having changed; stopped providing information; without warning us; by altering or combining existing data; without revealing any information corruption; protecting specific chunks of data; went on arguing; will insist on enforcing data security.

VI. Collect all the material about data bases and write down a short abstract.

TALKING TOPICS:

I. Prepare your arguments for the following statement or against it.

XML databases are mostly used in applications where the data is conveniently viewed as a collection of documents, with a structure that can vary from the very flexible to the highly rigid: examples include scientific articles, patents, tax filings, and personnel records.

II. Comment on the following:

Data security in general deals with protecting specific chunks of data, both physically (i.e., from corruption, or destruction, or removal), or the interpretation of them, or parts of them to meaningful information (e.g., by looking at the strings of bits that they comprise, concluding specific valid credit-card numbers).

ENERGY CONSERVATION

I. Note the pronunciation of the following:

audit ['ɔːdɪt]
eco-sufficiency ['iːkəʊ-sə'fɪʃənsi]
environmental [ɪnˌvaɪərən'mɛntl]
hierarchy ['haɪərɑːki]
hydroelectric [ˌhaɪdrəʊɪ'lɛktrɪk]
kinetic [kaɪ'nɛtɪk]
nuclear ['njuːklɪə]
wastage ['weɪstɪʤ]

II. Read Text Fourteen and get ready to discuss it in the classroom:

Text 14
ENERGY CONSERVATION

Energy conservation is the effort made to reduce the consumption of energy by using less of an energy service. This can be achieved either by using energy more efficiently (using less energy for a constant service) or by reducing the amount of service used (for example, by driving less). Energy conservation is a part of the concept of eco-sufficiency. Energy conservation reduces the need for energy services and can result in increased environmental quality, national security, personal financial security and higher savings. It is at the top of the sustainable energy hierarchy. It also lowers energy costs by preventing future resource depletion.

Energy can be conserved by reducing wastage and losses, improving efficiency through technological upgrades and improved operation and maintenance. On a global level energy use can also be reduced by the stabilization of population growth.

Energy can only be transformed from one form to other, such as heat energy to motive power in cars, or kinetic energy of water flow to electricity in hydroelectric power plants. However machines are required to transform energy from one form to other. It is possible to minimize losses by adopting green engineering practices to improve life cycle of the components.

Some countries employ energy or carbon taxes to motivate energy users to reduce their consumption. Carbon taxes can force consumption to shift to nuclear power and other energy sources that carry different sets of environmental side effects and limitations. On the other hand, taxes on all energy consumption can reduce energy use across the board while reducing a broader array of environmental consequences arising from energy production. For example, the state of California employs a tiered energy tax whereby every consumer receives a baseline energy allowance that carries a low tax. As usage increases above that baseline, the tax increases drastically. Such programs aim to protect poorer households while creating a larger tax burden for high energy consumers.

One of the primary ways to improve energy conservation in buildings is to perform an energy audit. An energy audit is an inspection and analysis of energy use and flows for energy conservation in a building, process or system with an eye toward reducing energy input without negatively affecting output. This is normally accomplished by trained professionals and can be part of some of the national programs. Recent development of smartphone apps enables homeowners to complete relatively sophisticated energy audits themselves.

Building technologies and smart meters can allow energy users, both commercial and residential; to visualize the impact their energy use can have in their workplace or homes. Advanced real-time energy metering can help people save energy by their actions.

(From *Wikipedia, the free encyclopedia*)

Commentary

Smartphone apps: The word "app" is an abbreviation for "application." It's a piece of software that can run through a web browser or offline on your computer, and on a smart phone, tablet or other electronic devices, including smart TVs and smart watches. Apps may or may not have a connection to the internet.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

Убытки и потери; применяя «зелёные» инженерные методы; большая налоговая нагрузка для потребителей высокой энергии; энергетический аудит; энергосбережение; с прицелом на снижение энергозатрат; уменьшить их потребление; устойчивая энергетическая иерархия; многоуровневый налог на энергию; экономить энергию; концепция экологичности; учёт энергии в реальном времени; будущее истощение ресурсов; экологические побочные эффекты и ограничения.

II. Memorize the following word combinations and make up your own sentences or situations with them:

To be accomplished by trained professionals, environmental side effects, to reduce the consumption of energy, energy conservation, with an eye toward, advanced real-time energy metering.

III. Look through the text again and find the answers to the following questions:

1. What is energy conservation? 2. What can energy conservation lower energy costs by? 3. Why can technological upgrades and improved operation and maintenance conserve energy? 4. Can energy be transformed from one form to another? 5. Why do some countries employ energy or carbon taxes? 6. Why is it important to perform an energy audit? 7. What is an energy audit? 8. How is an energy audit normally accomplished? 9. What do you know about smart meters?

IV. Find in Text 14 synonyms of the following words:
Stable, exhaustion, educated, radically, progressive.

V. Retell the above text using as many of the word combinations from Exercises I and II as you can.

WORKING ON WORDS

I. Re-write the following transcribed words into English spelling:
[ˌhaɪdrəʊɪ'lɛktrɪk] ['ɔːdɪt] ['meɪntənəns] [ˌkɒnsə(ː)'veɪʃən] [ˌhaɪdrəʊɪ'lɛktrɪk] ['miːtərɪŋ]

II. Explain in English the meaning of:
energy or carbon taxes; technological upgrades; hydroelectric power plants; eco-sufficiency.

III. Complete the sentences with the words from the box:

Consumers conservation demand efficiently reduce support different countless

1. In cold climates, heating air and water is a major ….. on household energy use. 2. Significant energy reductions are possible by using ….. technologies. 3. Zoning reforms that allow greater urban density as well as designs for walking and bicycling can greatly ….. energy consumed for transportation. 4. Energy ….. is the effort made to reduce the consumption of energy by using less of an energy service. 5. There are ….. reasons why people or organizations choose to conserve energy – from cutting costs to promoting economic, political and environmental sustainability. 6. Our ….. are often poorly informed of the savings of energy efficient products. 7. We must ….. the concept of Eco-sufficiency. 8. Through new technologies, consumers will be able to not only….. manage their consumption but get actively engaged in the energy market.

IV. Complete the passage below using the linkers in the box.

in fact however but such as and namely

We are living in air-conditioned comfortable houses, going to school or office using city transport network ….. trains and subway cars which run every few minutes, and sending and receiving data to and from any place in over the world through the Internet instantaneously. We are, ….. , scarcely acknowledging the fact that today's conveniently working society is supported by the enormous consumption of electric energy, and if supply of electricity is stopped, this society will be thrown into a terrible chaos. Electricity, like air and water, is so wide spread that nobody may recognize its existence. ….. , the electric power system has come to face three adversely affecting issues, ….. , steady electricity supply (energy security), decrease of electricity price and economic growth (economic growth), and harmonization with environment (environmental protection). Load leveling, electric energy storage technology, ….. renewable or new energy power generation systems such as wind-power generation are being developed as the effective measures to solve these types of trilemma syndrome, ….. it is true that we have not found the fundamental solution yet.

WRITTEN PRACTICE

I. a) Translate the following sentences paying attention to the infinitive in the function of a part of the compound predicate.

1. Their goal is to facilitate a flow of information and ideas for new and existing green engineering courses, case studies, and process design methodologies. 2. The primary purpose of zoning is to segregate uses that are thought to be incompatible. 3. The main task of energy conservation is to prevent climate change by reducing emissions. 4. The important function of zoning is to specify a variety of outright and conditional uses of land. 5. Our duty is to minimize losses by adopting green engineering practices to improve life cycle of the components. 6. The goal of trained professionals is to accomplish an inspection and analysis of energy use nowadays. 7. His next plan was to introduce measures that reduce the demand of energy. 8. Our primary task is to invest money, time and effort in energy conservation. 9. A more efficient alternative is to promote the development of rational uses of energy. 10. The important thing is to complete relatively sophisticated energy audits. 11. The goal is to facilitate a flow of information and ideas for new and existing green engineering courses, and process design methodologies.

b) Find in the above text the sentence containing the infinitive in the function of a compound nominal predicate and write it out.

II. Write down questions to which the following statements may serve as the answers.

1. The British thermal unit (Btu or BTU) is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. 2. In passive solar building design, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. 3. Energy conservation can be achieved either by using energy more efficiently or by reducing the amount of service used. 4. In warm climates where air conditioning is used, any household device that gives off heat will result in a larger load on the cooling system. 5. New appliances are regularly tested on efficiency, and the most efficient ones are made the standard. 6. A prominent example of this is the energy savings that can be made by replacing an incandescent light bulb with a more modern alternative. 7. Standard electric boilers can be made to run only at hours of the day when they are needed by means of a time switch.

III. Supply the correct reflexive pronouns (myself/itself/ourselves, etc.) in the following sentences.

1. Smart metering system in ….. does not necessarily lead to energy savings, however correct use of the infrastructure, does. 2. Recent development of smart phone apps enables homeowners to complete relatively sophisticated energy audits ….. . 3. Last month the center for energy conservation was created as a project financed by the International Environment Facility and gradually established ….. as an independent technical national center. 4. George prides ….. on testing new appliances on efficiency. 5. In addition, total smart metering investment ….. appears to be influenced by local conditions (including local labour costs, geographical configurations, etc.). 6. She blamed ….. for not reducing wastage and losses of energy. 7. We focus ….. on the long term conservation of energy and prefer to make use of renewable energy technologies. 8. You must avail ….. of measures to reduce pollution, promote sustainability, and minimize risk to human health and the environment. 9. He taught ….. how to pass his test in energy savings. 10. I don't need any help. I can familiarize ….. with designing the systems that have a positive impact on the environment. 11. You didn't know about the electricity consumption data ….. till yesterday.

IV. In the following sentences, cross out the adjective which does not collocate with the noun.

1. The passive solar design or *climatic / sunny* design does not involve the use of mechanical and electrical devices. 2. When purchasing light bulbs, many consumers opt for *technical / cheap* incandescent bulbs, failing to take into account their higher energy costs and lower lifespan. 3. The burning of *valuable / fossil* fuels by humans is the largest source of emissions of carbon dioxide. 4. This is the most *prevalent / good* model adopted for smart metering. 5. One of the *satisfactory/main* factors in achieving energy savings is feedback provision on the electricity consumption data to the consumers enabled by smart metering infrastructure. 6. We didn't minimize depletion of *natural / historical* resources last month. 7. They have to ensure that all material and energy inputs and outputs are as inherently *safe / scientific* and benign as possible.

TALKING TOPICS:

I. Express your opinion on the following problem. Prove your point of view.

Despite the vital role energy efficiency is expected to play in cost-effectively cutting energy demand, only a small part of its economic potential is exploited in our country.

II. Read the following point of view. What could you add to prove it?

Green engineering is the design, commercialization, and use of processes and products that minimize pollution, promote sustainability, and protect human health without sacrificing economic viability and efficiency.

AUTOMATIC CONTROL THEORY

I. Note the pronunciation of the following:

actuator ['æktjʊeɪtə]
aeronautical [ˌeərə'nɔːtɪkəl]
anthropomorphic ['ænθrəpəʊ'mɔːfɪk]
automation [ˌɔːtə'meɪʃ(ə)n]
invariant [ɪn'veərɪənt]
linear ['lɪnɪə]
mechanization [ˌmɛkənaɪ'zeɪʃən]
robotics [rəʊ'bɒtɪks]

II. Read Text Fifteen and get ready to discuss it in the classroom:

Text 15
AUTOMATIC CONTROL THEORY

Control engineering is concerned with the analysis and design of goal-oriented systems. Therefore the mechanization of goal-oriented policies has grown into a hierarchy of goal-oriented control systems. Modern control theory is concerned with systems that have self-organizing, adaptive, robust, learning, and optimum qualities. This interest has aroused even greater excitement among control engineers. The control of an industrial process (manufacturing, production, and so on) by automatic rather than manual means is often called automation. Automation is prevalent in the chemical, electric power, paper, automobile, and steel industries, among others. The concept of automation is central to our industrial society. Industry seeks to provide products that are increasingly precise, reliable, accurate, and robust.

Control engineering is based on the foundations of feedback theory and linear system analysis, and it integrates the concepts of network theory and communication theory. Therefore control engineering is not limited to any engineering discipline but is equally applicable to aeronautical, chemical, mechanical, environmental, civil, and electrical engineering. For example, a control system often includes electrical, mechanical, and chemical components.

The first step of the automatic control system analysis is the development of a system dynamic model. Dynamic model here is assumed as model, describing dynamics of the system. This Automatic system theory course deals with linear time invariant systems, whose models are described by linear differential equations. Development of dynamic model allows simulation of a system, i.e. obtain solutions of system differential equations.

A control system is an interconnection of components forming a system configuration that will provide a desired system response. The basis for analysis of a system is the foundation provided by the linear system theory, which assumes a cause–effect relationship for the components of a system.

The input–output relationship represents the cause-and-effect relationship of the process, which in turn represents a processing of the input signal to provide an output signal variable, often with power amplification. An open-loop control system utilizes a controller or control actuator to obtain the desired response. An open-loop system is a system without feedback. An open-loop control system utilizes an actuating device to control the process directly without using feedback.

In contrast to an open-loop control system, a closed-loop control system utilizes an additional measure of the actual output to compare the actual output with the desired output response. The measure of the output is called the feedback signal. A feedback control system is a control system that tends to maintain a prescribed relationship of one system variable to another by comparing functions of these variables and using the difference as a means of control. A feedback control system often uses a function of a prescribed relationship between the output and reference input to control the process. Often the difference between the output of the process under control and the reference input is amplified and used to control the process so that the difference is continually reduced. The feedback concept has been the foundation for control system analysis and design.

Feedback control systems are used extensively in industrial applications. Thousands of industrial and laboratory robots are currently in use. Manipulators can pick up objects weighing hundreds of pounds and position them with an accuracy of one tenth of an inch or better. Automatic handling equipment for home, school, and industry is particularly useful for hazardous, repetitious, dull, or simple tasks. Machines that automatically load and unload, cut, weld, or cast are used by industry to obtain accuracy, safety, economy, and productivity. The use of computers integrated with machines that perform tasks like a human worker has been foreseen by several authors. As stated earlier, robots are programmable computers integrated with machines, and they often substitute for human labor in specific repeated tasks. Some devices even have anthropomorphic mechanisms, including what we might recognize as mechanical arms, wrists, and hands.

In its modern usage, automation can be defined as a technology that uses programmed commands to operate a given process, combined with feedback of information to determine that the commands have been properly executed. Automation is often used for processes that were previously operated by humans. When automated, the process can operate without human assistance or interference. In fact, most automated systems are capable of performing their functions with greater accuracy and precision, and in less time, than humans are able to do. A semiautomated process is one that incorporates both humans and robots. For instance, many automobile assembly line operations require cooperation between a human operator and an intelligent robot. A robot is a computer-controlled machine and involves technology closely associated with automation. Industrial robotics can be defined as a particular field of automation in which the automated machine (that is, the robot) is designed to substitute for human labor. Thus robots possess certain humanlike characteristics. We recognize that the automatic machine is well suited to some tasks and that other tasks are best carried out by humans.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

анализ системы автоматического управления; целевая политика; управлять данным процессом; система обратной связи; вызвало еще большее волнение; ранее управляемые людьми; без помощи или вмешательства человека; имеет дело с линейными инвариантными по времени системами; взаимосвязь компонентов; заменить человеческий труд; опорный вход; причинно-следственная связь; могут подбирать предметы; промышленная робототехника, автоматическое погрузочно-разгрузочное оборудование, техника управления.

II. Answer the following questions using the words and word combinations from Exercise I:

1. What is control engineering concerned with? 2. What is called automation? 3. What is control engineering based on? 4. Why is the first step of the automatic control system analysis the development of a system dynamic model? 5. Does the development of dynamic model allow simulation of a system? 6. What is the basis for analysis of a system? 7. What represents the cause-and-effect relationship of the process? 8. Which system is a system without feedback? 9. What can you say about a feedback control system? 10. Where are feedback control systems used? 11. What substitutes for human labor in specific repeated tasks? 12. What can be defined as a technology that uses programmed commands to operate a given process, combined with feedback of information to determine that the commands have been properly executed? 13. When can the process operate without human assistance or interference? 14. What process is called a semiautomated one? 15. What is a robot?

III. Find in Text 15 synonyms of the following words:

to use instead of, machine-driven systems, hoped for, aid of an individual, to define, correctly.

IV. Retell the above text using as many of the word combinations from Exercise I as you can.

WORKING ON WORDS

I. Memorize the following verbs followed by prepositions and use them in the sentences of your own:

be based on; associate with; be concerned with; limit to; deal with; be well suited to.

II. Complete the sentences with the words from the box:

improving	complementary	systems	toward	hour	investigation
designers	challenge	improved			

1. Advanced robotic ….. are striving for task adaptability through enhanced sensory feedback. 2. We are referring to labor productivity, which is real output per ….. of work. 3. The present ….. to control engineers is the modeling and control of modern, complex, interrelated systems such as traffic control systems and robotic systems. 4. Modern control engineering practice includes the use of control design strategies for ….. manufacturing processes, and the efficiency of energy use. 5. The gap exists between the complex physical system under ….. and the model used in the control system synthesis. 6. Precise, reliable control of automobile performance has ….. markedly over the past decades. 7. The twin goals of understanding and controlling are ….. because effective systems control requires that the systems be understood and modeled. 8. Many research activities are aimed ….. reducing implementation cost and expanding the realm of application. 9. In the past, disk drive ….. have concentrated on increasing data density and data access times.

II. Choose the correct preposition to complete each of the following sentences:

on (2) over for (2) in of toward

1. Information systems specialists encompass the acquisition, deployment, and management of information resources ….. use in organizational processes. 2. The most characteristic quality ….. control engineering is the opportunity to control machines and industrial and economic processes for the benefit of society. 3. The control system is very adaptable, but it relies ….. human supervision. 4. Control systems are moving ….. autonomous operation as an enhancement to human control. 5. Control system toolbox is collection of MATLAB programs ….. analysis and synthesis of automatic control systems. 6. Transfer function does not depend ….. output and input signals, therefore it is a very convenient tool to describe any control system. 7. Identifying deficiencies or weaknesses ….. existing products is another motivation for engineering design. 8. The research in human-computers interaction has been very successful and has influenced the computing system all ….. the world.

III. Study the grammar table and learn.

Between means 'in or into the space which separates at least two places, people or objects.'

E.g. The post office is between the bank and the shop.

Among means in 'the middle of or surrounded by other things.' It is used for groups or a mass of at least three. We see the people or things as part of a group. ***Amongst*** has the same meaning, but is more formal.

E.g. I searched among my things for my report.

IV. Do the exercise on prepositions *among* and *between*. Choose the correct one.

1. The trend toward increased connectivity ….. the networks of an organization and its external stakeholders is expected to continue. 2. She wants to distribute the tasks ….. our engineers. 3. The computer's operating system may rapidly switch back and forth ….. different tasks. 4. This secret should strictly remain ….. two of us. 5. The chief engineer was standing ….. his subordinates. 6. The connections ….. nodes are established using either cable media or wireless media. 7. The first ….. the electronic computers was The ENIAC, designed by John Mauchly and J. Presper Eckert. 8. He was placed ….. two designers of goal-oriented systems. 9. You can only choose ….. an open-loop control system and a closed-loop control system. 10. During the conference, I had to sit ….. a large group of reporters and journalists. 11. The fortunate engineer will celebrate his success ….. his friends. 12. She is German, but she has been living ….. Americans for many years. 13. ….. you and me, I don't like the idea to cease developing a computer-controlled machine.

V. Find in the above text and copy out sentences in which the prepositions *among* and *between* are used. Translate them.

WRITTEN PRACTICE

I. Put the verb in brackets into the present simple passive:

1. Productivity (define) as the ratio of physical output to physical input. 2. A control system consisting of interconnected components (design) to achieve a desired purpose. 3. Automatic machines (use) to increase the production of a plant per worker in order to offset rising wages and inflationary costs. 4. Control system engineers (concern) with understanding and controlling segments of their environment, often called systems, to provide useful economic products for society. 5. Control system toolbox widely (use) for linear systems. 6. Examples of control systems (examine) to understand the purpose of a control system. 7. Industries (concern) with the productivity per worker of their plants. 8. Engineering (concern) with understanding and controlling the materials and forces of nature for the benefit of humankind. 9. A system that maintains a prescribed relationship between the output and some reference input by comparing them and using the difference (i.e. error) as a means of control (call) a feedback control system. 10. A central processing unit is the part of a computer in which operations (control) and (execute).

II. These sentences include examples of both *ing* - forms, the gerund and the present participle. Say which words are gerunds and which are present participles.

1. An open-loop control system utilizes an actuating device to control the process directly without using feedback. 2. Designers are now considering employing disk drives to perform tasks historically delegated to central processing units, thereby leading to improvements in the computing environment. 3. Many IT professionals are now helping in the executing different tasks like, computer networking and information processing. 4. This program tends to focus on learning current operating systems, hardware/software training and computer repair.

III. Find in the above text and copy out sentences in which linking expressions *therefore*, *in fact* and *in contrast to* are used. Translate the sentences with them. Say which of these linking expressions:

a) introduces a contrast?

b) expresses reality?

c) introduces results and conclusions?

IV. Read the above text again, find and copy out the sentences with Present Perfect Active and Present Perfect Passive tense forms. Translate them into your language.

TOPICS FOR DISCUSSION:

I. Explain and expand on the following.

Automatic control is the application of control theory for regulation of processes without direct human intervention.

II. What is your dream job?

- Does it require a lot of training or experience?
- Is it well-paid?
- Does it involve working with other people?
- What advice would you give to someone who wanted to do your job?

ROBOTICS

I. Note the pronunciation of the following:

acceptance [ək'sɛptəns]
artificial [ˌɑːtɪ'fɪʃ(ə)l]
autonomously [ɔː'tɒnəməsli]
bio-inspired ['baɪəʊ-ɪn'spaɪəd]
electricity [ɪlɛk'trɪsɪti]
mechatronics [mɪ'kæ'trɒnɪks]
nanorobot ['nænəʊ'rəʊbɒt]
preexisting [ˌpriːɪg'zɪstɪŋ]
robotics [rəʊ'bɒtɪks]
technician [tɛk'nɪʃən]

II. Read Text Sixteen and get ready to discuss it in the classroom:

Text 16
ROBOTICS

Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electronic engineering, information engineering, computer science, and others. This field overlaps with electronics, computer science, artificial intelligence, mechatronics, nanotechnology and bioengineering. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing. The word robotics was derived from the word robot, which was introduced to the public by Czech writer Karel Čapek in 1920.

These technologies are used to develop machines that can substitute for humans and replicate human actions. Robots can be used in many situations and for lots of purposes, but today many are used in dangerous environments (including bomb detection and deactivation), manufacturing processes, or where humans cannot survive (e.g. in space, under water, in high heat, and clean up and containment of hazardous materials and radiation). Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, or any other human activity. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

The concept of creating machines that can operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century. Throughout history, it has been frequently assumed by various scholars, inventors, engineers, and technicians that robots will one day be able to mimic human behavior and manage tasks in a human-like fashion. Today, robotics is a rapidly growing field, as technological advances continue;

researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. Many robots are built to do jobs that are hazardous to people, such as defusing bombs, finding survivors in unstable ruins, and exploring mines and shipwrecks. Robotics is also used in STEM (science, technology, engineering, and mathematics) as a teaching aid. The advent of nanorobots, microscopic robots that can be injected into the human body, could revolutionize medicine and human health.

There are many types of robots; they are used in many different environments and for many different uses, although being very diverse in application and form they all share three basic similarities when it comes to their construction.

Robots all have some kind of mechanical construction, a frame, form or shape designed to achieve a particular task. For example, a robot designed to travel across heavy dirt or mud, might use caterpillar tracks. The mechanical aspect is mostly the creator's solution to completing the assigned task and dealing with the physics of the environment around it. Form follows function.

Robots have electrical components which power and control the machinery. For example, the robot with caterpillar tracks would need some kind of power to move the tracker treads. That power comes in the form of electricity, which will have to travel through a wire and originate from a battery, a basic electrical circuit. Even petrol powered machines that get their power mainly from petrol still require an electric current to start the combustion process which is why most petrol powered machines like cars, have batteries. The electrical aspect of robots is used for movement (through motors), sensing (where electrical signals are used to measure things like heat, sound, position, and energy status) and operation (robots need some level of electrical energy supplied to their motors and sensors in order to activate and perform basic operations)

All robots contain some level of computer programming code. A program is how a robot decides when or how to do something. In the caterpillar track example, a robot that needs to move across a muddy road may have the correct mechanical construction and receive the correct amount of power from its battery, but would not go anywhere without a program telling it to move. Programs are the core essence of a robot, it could have excellent mechanical and electrical construction, but if its program is poorly constructed its performance will be very poor (or it may not perform at all). There are three different types of robotic programs: remote control, artificial intelligence and hybrid. A robot with remote control programming has a preexisting set of commands that it will only perform if and when it receives a signal from a control source, typically a human being with a remote control. It is perhaps more appropriate to view devices controlled primarily by human commands as falling in the discipline of automation rather than robotics. Robots that use artificial intelligence interact with their environment on their own without a control source, and can determine reactions to objects and problems they encounter using their preexisting programming. Hybrid is a form of programming that incorporates both AI and RC functions.

(From *Wikipedia, the free encyclopedia*)

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

био-вдохновленная робототехника; содержат некоторый уровень; основные сходства; искусственный интеллект; самостоятельно; робот с гусеничным ходом; в качестве учебного пособия; основная сущность робота; имитировать поведение человека; с дистанционным программированием; сенсорная обратная связь; контролируемые в первую очередь человеческими командами; копировать действия человека; двигать гусеницы трекера.

II. Find in Text 16 the antonyms of the following words.

Genuine, abstract, similar, be permanent; stable; dependently.

III. Ask your problem questions to the text.

IV. Outline the main ideas of the text and write a summary.

WORKING ON WORDS

I. Explain in English the meaning of:

an interdisciplinary branch of engineering and science; robotics; a remote control; dangerous environments.

II. Complete the sentences with the words from the box:

used	formulated	to represent	involves	controlled	performed	adaptable

1. Cognitive models try ….. the robot, the world, and how they interact. 2. Many robots are designed for assembly work, which may not be readily ….. for other applications. 3. The mechanical structure of a robot must be ….. to perform tasks. 4. Many different types of batteries can be ….. as a power source for robots. 5. The ability of tiny computing devices to control complex operations has transformed the way many tasks are ….. . 6. The control of a robot ….. three distinct phases – perception, processing, and action (robotic paradigms). 7. In 1948, Norbert Wiener ….. the principles of cybernetics, the basis of practical robotics.

III. Complete each sentence using the correct preposition.

1. Robotics is a branch ….. engineering that involves the conception, design, manufacture, and operation of robots. 2. The first digitally operated and programmable robot, the Unimate, was installed ….. 1961 to lift hot pieces of metal ….. a die casting machine and stack them. 3. Artificial intelligence technologies try to work the human brain works, ….. making intelligent guesses, learning by example, and using deductive reasoning. 4. Techniques from control theory convert the task ….. commands that drive the actuators. 5. A programmable machine is one that can

be taught, ….. minor alterations, to perform a new assembly task or that can perform several tasks in sequence. 6. Robots that use artificial intelligence interact with their environment on their own ….. a control source. 7. Robotics projects and applications can be found ….. a large number of industries from automotive production to military drone operations to landing ….. and exploring Mars. 8. ….. the 1990s the idea of a network has become a meta-paradigm, i.e. a paradigm which is applicable in all different realms of industry, of science, of society etc.

Keys: by, on, with, of, into, since, without, in, across, from.

WRITTEN PRACTICE

I. These sentences include examples of both *ing* - forms, the gerund and the present participle. Say which words are gerunds and which are present participles.

1. Designing a battery-powered robot needs to take into account factors such as safety, cycle lifetime and weight. 2. Inserting a program into a robot gives it the ability to know when and how to carry out a task. 3. Balancing robots generally use a gyroscope to detect how much a robot is falling and then drive the wheels proportionally in the same direction. 4. Walking robots can be used for uneven terrains, which would provide better mobility and energy efficiency than other locomotion methods. 5. They will utilize an approach of passive dynamics where the momentum of swinging limbs can be used for greater efficiency. 6. He wants to develop a skating robot with a walking and skating multi-mode. 7. The concept of creating machines dates back to classical times, but research into the potential uses of robots did not grow substantially until the 20th century. 8. Of course, machines are capable of displaying intelligent behavior, both in a language connected and in a mechanical way.

II. Choose the proper verb form and translate the sentences.

1. Commercial and industrial robots are ….. today and used to perform jobs more cheaply, more accurately and more reliably, than humans. 2. Some robots are specifically designed for heavy load manipulation, and are ….. as "heavy-duty robots". 3. Robotics is one of the most advanced and ….. technologies in the field of medicine. 4. This robot was known as Shakey because its ….. camera shook as the robot moved. 5. The mechanical aspect of a robot helps it ….. tasks in the environment for which it’s designed. 6. Without a set of code telling it what ….. , a robot would just be another piece of simple machinery. 7. Computer vision systems rely on image sensors which ….. electromagnetic radiation which is typically in the form of either visible light or infra-red light. 8. Robots can also be ….. with multiple vision sensors to be better able to compute the sense of depth in the environment. 9. Our robotics engineers ….. robots, maintain them, develop new applications for them, and conduct research ….. the potential of robotics.

Keys: detect, emerging, equipped, widespread, to expand, mounted, design, labeled, to do, complete.

III. Translate the following sentences into English using the words and word combinations of the topical vocabulary:

1. Робототехника опирается на такие дисциплины, как электроника, механика, кибернетика, телемеханика, информатика, а также радиотехника и электротехника. 2. Уже создано множество механизмов, перемещающихся на более чем двух конечностях. 3. В настоящее время самой важной задачей является проблема оснащения робота искусственным интеллектом. 4. Благодаря весьма продвинутой системе искусственного интеллекта, построенной на основе нейросетей, робот научился ходить. 5. В 50-х годах XX века появились механические манипуляторы для работы с радиоактивными материалами. 6. Существует несколько подходов к классификации роботов, например, по сфере применения, по назначению или по способу передвижения.

IV. Make the following sentences interrogative paying special attention to the construction *there is/are*.

1. Since the 1960s, there have been significant developments in robotics in Japan, especially in humanoid robotics. 2. There are many groups engaged in robotics in the academic and industrial circles. 3. There are three different types of robotic programs: remote control, artificial intelligence and hybrid. 4. There are several explanations for the popularity of the robot Astro Boy and other robots in Japan. 5. There is a significant number of authors who have taken up the man-machine hypothesis in its literal meaning. 6. There are many types of robots used in many different environments and for many different uses. 7. There were efforts to reproduce human abilities in many countries all over the world.

TALKING TOPICS:

I. Express your opinion on the following problems:

1. Is it true that robots will become or have already become one of the main features in the development of our society?

2. How can robots help us in the future?

II. Study the following information. What is your opinion on the topic?

The word robotics was derived from the word robot, which was introduced to the public by Czech writer Karel Čapek in his play R.U.R. (Rossum's Universal Robots), which was published in 1920. The word robot comes from the Slavic word *robota*, which means labour/work. The play begins in a factory that makes artificial people called robots, creatures who can be mistaken for humans – very similar to the modern ideas of androids. Karel Čapek himself did not coin the word. He wrote a short letter in reference to an etymology in the Oxford English Dictionary in which he named his brother Josef Čapek as its actual originator. According to the Oxford English Dictionary, the word robotics was first used in print by Isaac Asimov, in his science fictionshort story "Liar!", published in May 1941 in Astounding Science Fiction. Asimov was unaware that he was coining the term; since the science and technology of electrical devices is electronics, he assumed robotics already referred to the science and technology of robots. In some of Asimov's other works, he states that the first use of the word robotics was in his short story Runaround (Astounding Science Fiction, March 1942), where he introduced his concept of The Three Laws of Robotics. However, the original publication of "Liar!" predates that of "Runaround" by ten months, so the former is generally cited as the word's origin.

(From *Wikipedia, the free encyclopedia*)

PROCESS & SYSTEM IDENTIFICATION

I. Note the pronunciation of the following:

criteria [kraɪ'tɪərɪə]
derivative [dɪ'rɪvətɪv]
disturbance [dɪs'tɜːbəns]
Eigensystem ['aɪgən ˌsɪstɪm]
hierarchal ['haɪərɑːk(ə)l]
mechanism ['mɛkənɪzm]
prioritizing [praɪ'ɒrɪˌtaɪzɪŋ]
robustness [rəʊ'bʌstnəs]
variables ['veərɪəblz]
varying ['veəriɪŋ]

II. Read Text Seventeen and get ready to discuss it in the classroom:

Text 17
PROCESS & SYSTEM IDENTIFICATION

Process identification is a set of activities aiming to systematically define the set of business processes of a company and establish clear criteria for prioritizing them. The output of process identification is a process architecture, which represents the business processes and their interrelations. Process architecture serves as a framework for defining the priorities and the scope of process modeling and redesign projects.

Process architecture refers to the hierarchal design of processes and systems that are applied when transforming inputs into outputs. The term can be applied to computing, the processes businesses undertake, and project management to name but a few. In fact, it applies to fields such as computers (software, hardware, networks, etc.), business processes (enterprise architecture, policy and procedures, logistics, project management, etc.), and any other process system of varying degrees of complexity.

Processes are defined as having inputs, outputs and the energy required to transform inputs to outputs. Use of energy during transformation also implies a passage of time: a process takes real time to perform its associated action. A process also requires space for input/output objects and transforming objects to exist: a process uses real space.

PID (proportional integral derivative) controller is undeniably the most popular method used in controlling various industrial processes. The feature to tune the three elements in PID has allowed the controller to deal with specific needs of the industrial processes. A PID controller is used to regulate temperature, flow, pressure, speed and other process variables. PID controllers use a control loop feedback mechanism to control process variables and are the most accurate and stable controller.

There are three elements of control actions and improving robustness of controllers through combination of these control actions in various forms. A plant model is simulated using the Process Control Simulator in order to evaluate the controller performance. At first, the open loop response of the plant is studied by applying a step input to the plant and collecting the output data from the plant. Then, FOPDT of physical model is formed by using both Matlab-Simulink and PRC method. Then, calculation of controller's setting is performed to find the values of Kc and τi that will give satisfactory control in closed loop system. Then, the performance analysis of closed loop system is obtained by setpoint tracking analysis and disturbance rejection performance. To optimize the overall physical system performance, a refined tuning of PID or detuning is further conducted to ensure a consistent resultant output of closed loop system reaction to the setpoint changes and disturbances to the physical model. As a result, the PB = 100 (%) and τi= 2.0 (s) is preferably chosen for setpoint tracking while PB = 100 (%) and τi = 2.5 (s) is selected for rejecting the imposed disturbance to the model. In a nutshell, selecting correlation tuning values is likewise depended on the required control's objective for the stability performance of overall physical model.

The field of system identification uses statistical methods to build mathematical models of dynamical systems from measured data. System identification also includes the optimal design of experiments for efficiently generating informative data for fitting such models as well as model reduction. A common approach is to start from measurements of the behavior of the system and the external influences (inputs to the system) and try to determine a mathematical relation between them without going into many details of what is actually happening inside the system; this approach is called system identification.

One of the many possible applications of system identification is in control systems. For example, it is the basis for modern data-driven control systems, in which concepts of system identification are integrated into the controller design, and lay the foundations for formal controller optimality proofs.

System identification techniques can utilize both input and output data (e.g. Eigensystem realization algorithm) or can include only the output data (e.g. frequency domain decomposition). Typically an input-output technique would be more accurate, but the input data is not always available.

The quality of system identification depends on the quality of the inputs, which are under the control of the systems engineer. Therefore, systems engineers have long used the principles of the design of experiments. In recent decades, engineers have increasingly used the theory of optimal experimental design to specify inputs that yield maximally precise estimators.

(From *Wikipedia, the free encyclopedia*)

Commentary

The **Eigensystem** realization algorithm (ERA) is a system identification technique popular in civil engineering, in particular in structural health monitoring.

ERA can be used as a modal analysis technique and generates a system realization using the time domain response (multi-)input and (multi-)output data.

Eigenvector ['aɪɡən'vɛktər] is a vector that when operated on by a given operator gives a scalar multiple of itself.

FOPDT – A first-order plus deadtime (FOPDT) model is a simple approximation of the dynamic response (the transient or time-response) of a process variable to an influence. It's also called first-order lag plus deadtime (FOLPDT), or “deadtime” may be replaced with “delay,” changing the acronym to FOLPD.

Kc stands for the proportional gain which implies the ratio of changes of PV (process variable) to the changes of SP (set point).

PB stands for the proportional band. It expresses the gain of the controller as a percentage of the span of the instrument.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

навязанное возмущение модели; для отслеживания заданного значения; при преобразовании входных данных в выходные; техника ввода-вывода; повышение надёжности контроллеров; математическое отношение; служит основой; течение времени; в последние десятилетия; отклик разомкнутого контура; объём процессов моделирования; механизм обратной связи с контуром управления; выполнить связанное с ним действие; в двух словах; расчёт настройки контроллера; заложить основы.

II. Explain in English the meaning of:

a mathematical relation, the open loop response, to lay the foundations, a refined tuning, to define the priorities.

III. Answer the following questions using the words and word combinations from Exercise I:

1. What is process identification? 2. What does process architecture serve as? 3. What design does process architecture refer to? 4. Why is a PID controller the most popular method used in controlling various industrial processes? 5. How many elements of control actions and improving robustness of controllers are there? 6. What is calculation of controller's setting performed for? 7. What is obtained by setpoint tracking analysis and disturbance rejection performance? 8. Why is a refined tuning of PID or detuning further conducted? 9. What is selecting correlation tuning values depended on? 10. What methods does the field of system identification use to build mathematical models of dynamical systems from measured data? 11. What lays the foundations for formal controller optimality proofs? 12. Can system identification techniques utilize both input and output data? 13. What does the quality of system identification depend on?

IV. Outline the main ideas of the text and write a summary.

WORKING ON WORDS

I. Make up situations round the following expressions.

To utilize both input and output data; to evaluate the controller performance; to establish clear criteria; to tune the elements; by setpoint tracking analysis.

II. Complete the sentences with the words from the box:

easier	every	system	easiest	design	common	feedback	super

1. A process system is a specialized ….. of processes. 2. Proportional action *P* is the most ….. form of control action. 3. A …… control loop that compares the process variable, PV of plant to its set point, SP. 4. If the process system is studied hierarchically, it is ….. to understand and manage. 5. Requirements for a process system are derived at ….. hierarchical level. 6. Process architecture is the structural ….. of general process systems. 7. The suprastructure considers the ….. system of which the process system is a part. 8. MATLAB is the ….. and most productive software environment for engineers and scientists.

III. Complete each sentence using the correct preposition.

1. The tuning constants are shown below as "*K*" and must be derived for each control application, as they depend ….. the response characteristics of the complete loop external to the controller. 2. A Simulink block is a model element that defines a mathematical relationship ….. its input and output. 3. MATLAB is a multi-paradigm numerical computing environment and proprietary programming language developed ….. MathWorks. 4. The control systems consist ….. a single instrument or a group of instruments which are designed, developed, installed and operated to control a process. 5. A control loop must have a controller block ….. an actuator that control parameters of the process. 6. The lower value of PB means a greater *Kc* setting ….. the controller. 7. In mathematical form, PB is reciprocal to *Kc* as described ….. the equation. 8. Refined-PID tuning optimizes all features of control actions ….. deteriorating other features.

Keys: for, by, on, with, of, without, between, in.

WRITTEN PRACTICE

I. Choose the proper verb form and translate the sentences.

1. Simulink is a simulation and model-based design environment for dynamic and embedded systems, ….. with MATLAB. 2. *Kc* is unable ….. steady state error. 3. Combination of two or more than two control actions in parallel ….. more comprehensive controller such as proportional-plus-integral controller (PI) and pro – portional-integral-derivative controller (PID). 4. For a proper controlled system, the utput response should ….. magnificent, and should not oscillate in any new condition of set point or applied disturbance. 5. The structure of a process system, or its architecture, can be ….. as a dualistic relationship of its infrastructure and

suprastructure. 6. Mathematical consideration of process architectures may be ….. in CCS and the π-calculus. 7. The infrastructure ….. a process system's component parts and their interactions. 8. Suprastructure should not be ….. with superstructure, which is actually part of the infrastructure built for the external support.

Keys: viewed, produces, confused, integrated, describes, to eliminate, be, found.

II. Write the singular of the following irregular plural nouns. Use a dictionary if necessary.

There are certain words we use on a regular basis, especially in mathematical and scientific contexts, that are borrowed from Latin or Greek. Many of these words retain their Latin or Greek plurals in math and science settings.

Matrices, maxima, calculi, data, criteria, analyses, phenomena, formulae, axes, media, ellipses, indices, stimuli, bases.

III. Supply the Present Simple Passive of the verbs in brackets.

1. The corresponding eigenvalue is the factor by which the eigenvector (scale). 2. This performance typically (achieve) by designing the control law relying on a model of the system, which needs to be identified starting from experimental data. 3. Grey box modeling also (know) as semi-physical modeling. 4. When the error (eliminate), the integral term will cease to grow. 5. Parameter estimation is relatively easy if the model form (know) but this is rarely the case. 6. This more recent approach (call) the identification for control, or I4C in short. 7. This idea better (understand) by considering the true transfer function. 8. A new value (determine) by a weighted sum of the control terms. 9. These processes (simulate) in real time and space and studied hierarchically.

IV. Translate the following sentences paying special attention to the infinitives as parts of compound nominal predicate.

1. In control systems applications, the objective of engineers is to obtain a good performance of the closed-loop system. 2. A common approach is to start from measurements of the behavior of the system and the external influences. 3. Today, the aim of this concept is to be used universally in applications requiring accurate and optimized automatic control. 4. Their purpose is to define eigenvalues and eigenvectors using either the language of matrices or the language of linear transformations. 5. Our task is to describe the response of the controller in terms of its responsiveness to an error. 6. My goal is to identify algorithms of this type. 7. This approach is to be used with grey box models where the algorithms are primed with the known terms. 8. Your main task is to obtain a model satisfying enough for the closed-loop performance. 9. A control performance objective is to achieve the high performance on the true system.

V. Choose the correct alternative in each of the following sentences.

1. Then they *sorting/sorted* the eigenvectors according to the eigenvalues and divided them into three subsets. 2. The distinguishing feature of the PID controller is the ability *to use/ to be used* the three control terms of proportional, integral and derivative influence on the controller output to apply accurate and optimal control. 3. The use of the PID algorithm does not *guarantees/guarantee* optimal control of the system or its stability. 4. The controller's PID algorithm restores the measured speed to the *desired/ desiring* speed with minimal delay. 5. In linear algebra, an eigenvector or characteristic vector of a linear transformation *is/has been* a nonzero vector. 6. The tuning constants must be *derived/derive* for each control application, as they depend on the response characteristics of the complete loop external to the controller. 7. We can *build/building* different mathematical models of dynamical systems from measured data.

TOPICS FOR DISCUSSION:

I. Discuss the following problem.

Which processes are most susceptible to successful process management?

II. Discuss what place labour takes in your life, what it gives every citizen personally and why you should consider your tastes when choosing your future work.

COMPUTER NETWORKING

I. Note the pronunciation of the following:

bandwidth ['bændwɪdθ]
domain [dəʊ'meɪn]
elapse [ɪ'læps]
expedited ['ɛkspɪdaɪtɪd]
forwarding ['fɔːwədɪŋ]
intuitively [ɪn'tju(ː)ɪtɪvli]
preferential [ˌprɛfə'rɛnʃəl]
priority [praɪ'ɒrɪtɪ]
queue [kjuː]
router ['ruːtə]

II. Read Text Eighteen and get ready to discuss it in the classroom:

Text 18
EXPEDITED FORWARDING

The goal of the EF PHB is to provide low queuing delay to the marked packets; the canonical example is VoIP traffic, even though the latter now has its own PHB. EF is generally considered to be the best DS service, though this depends on how much EF traffic is accepted by the DS domain. Each router in a DS domain supporting EF is configured with a committed rate, R, for EF traffic. Different routers can have different committed rates. At any one router, RFC 3246 spells out the rule this way (note that this rule does indeed express a per-hop behavior): intuitively, the definition of EF is simple: the rate at which EF traffic is served at a given output interface should be at least the configured rate R, over a suitably defined interval, independent of the offered load of non-EF traffic to that interface. To the EF traffic, in other words, each output interface should appear to offer bandwidth R, with no competing non-EF traffic. In general this means that the network should appear to be lightly loaded, though that appearance depends very much on the strict control of entering EF traffic. Normally R will be well below the physical bandwidths of the router's interfaces. RFC 3246 goes on to specify how this apparent service should work. Roughly, if EF packets have length L then they should be sent at intervals L/R. If an EF packet arrives when no other EF traffic is waiting, it can be held in a queue, but it should be sent soon enough so that, when physical transmission has ended, no more than L/R time has elapsed in total. That is, if R and L are such that L/R is 10µs, but the physical bandwidth delay in sending is only 2µs, then the packet can be held up to 8µs for other traffic. Note that this does not mean that EF traffic is given strict priority over all other traffic (though implementation of EF- traffic processing via priority queuing is a reasonable strategy); however, the sending interface must provide service to the EF queue at intervals of no more than L/R; the EF rate R must be in effect at per-packet time scales. Queuing ten EF packets and then sending the lot of them after time 10L/R is not allowed. Fair queuing can be used instead of priority queuing, but if quantum fair queuing is used then the quantum must be small. An EF router's committed rate R means simply that the router has promised to reserve bandwidth R for EF traffic; if EF traffic arrives at a router faster than rate R, then a queue of EF packets may build up (though the router may be in a position to use some of its additional bandwidth to avoid this, at least to a degree). Queuing delays for EF traffic may mean that someone's application somewhere fails rather badly, but the router cannot be held to account. As long as the total EF traffic arriving at a given router is limited to that routers' EF rate R, then at least that router will be able to offer good service. If the arriving EF traffic meets a token-bucket specification TB(R,B), then the maximum number of EF packets in the queue will be B and the maximum time an EF packet should be held will be B/R. So far we have been looking at individual routers. A DS domain controls EF traffic only at its border. One very conservative approach is to limit the total EF traffic entering the DS domain to the common committed rate R. This will likely mean that individual routers will not see EF traffic loads anywhere close to R.

Suppose in addition the domain knows from experience that exiting EF traffic generally divides equally between R1–R4, and also that these border routers are the bottlenecks. Then it might allow an EF-traffic entry rate of R at each router R1– R4, meaning a total entering EF traffic volume of 4ˆR. Of course, if on some occasion all the EF traffic entering through R1, R2 and R3 happened to be addressed so as to exit via R4, then R4 would see an EF rate of 3ˆR, but hopefully this would not happen often. If an individual ISP wanted to provide end-user DiffServ-based VoIP service, it might mark VoIP packets for EF service as they entered (or might let the customer mark them, subject to the ISP's policing). The rate of marked packets would be subject to some ceiling, which might be negotiated with the customer as a certain number of voice lines. These marked VoIP packets would receive EF service as they were routed within the ISP. For calls also terminating within that ISP – or switching over to the traditional telephone network at an interface within that ISP – this would be all that was necessary, but some calls will likely be to customers of other ISPs. To address this, the original ISP might negotiate with its ISP neighbors for continued preferential service; such service might be at some other DS service class (e.g. AF). Packets would likely need to be remarked as they left the original ISP and entered another. The original ISP may have one larger ISP in particular with which it has a customer-provider relationship. The larger ISP might feel that with its high-volume internal network it has no need to support preferential service, but might still agree to carry along the original ISP's EF marking for use by a third ISP down the road.

(*by Peter L Dordal*)

Commentary

EF (Expedited Forwarding) – The expedited forwarding per-hop behavior assures that any traffic class with EF's related DSCP is given highest priority and is not queued. EF provides low loss, latency, and jitter. ... Use the EF DSCP when assigning priority to customers or applications with a premium SLA.

PHB (per-hop behavior) – In computer networking, per-hop behaviour (PHB) is a term used in differentiated services (DiffServ) or multiprotocol label switching (MPLS). It defines the policy and priority applied to a packet when traversing a hop (such as a router) in a DiffServ network.

DS stands for differentiated services or DiffServ; it is a computer networking architecture that specifies a simple and scalable mechanism for classifying and managing network traffic and providing quality of service (QoS) on modern IP networks.

RFC 3246 (Proposed Standard, March 2002) – This document defines a PHB (per-hop behavior) called Expedited Forwarding (EF). The PHB is a basic building block in the Differentiated Services architecture. EF is intended to provide a building block for low delay, low jitter and low loss services by ensuring that the EF aggregate is served at a certain configured rate.

µs is a symbol for the microsecond, an SI unit of time equal to 10−6 seconds.

ISP stands for Internet Service Provider.

VoIP is an acronym for Voice over Internet Protocol, or in more common terms phone service over the Internet.

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following words and word combinations and write them out:

поведение для каждого перехода; независимо от предлагаемой нагрузки; продолжает уточнять; скорость помеченных пакетов; низкая задержка в очереди; настроен с фиксированной скоростью; должен действовать в масштабе времени для каждого пакета; квантовая организация честных очередей; роутер не может быть привязан к аккаунту; пограничные маршрутизаторы; задержка физической полосы пропускания; трафик имеет строгий приоритет; поддерживать льготный сервис; время истекло в общей сложности; скорее всего, нужно отметить; в течение определённого интервала.

II. Memorize the following word combinations and make up your own sentences or situations with them:

to reserve bandwidth, to provide low queuing delay, on some occasion, be subject to some ceiling, to express a per-hop behavior.

III. Reproduce the text in your own words using the topical vocabulary.

WORKING ON WORDS

I. Complete the sentences with the words from the box:

sophisticated	placing	including	marking	defined	belonging	forwarding

1. Modern data networks carry many different types of services, ….. voice, video, streaming music, web pages and email. 2. DiffServ relies on a mechanism to classify and mark packets as ….. to a specific class. 3. DiffServ operates on the principle of traffic classification, ….. each data packet into one of a limited number of traffic classes. 4. A group of routers that implement common, administratively ….. DiffServ policies are referred to as a DiffServ domain. 5. Assured ….. allows the operator to provide assurance of delivery as long as the traffic does not exceed some subscribed rate. 6. To prevent issues associated with tail drop, more ….. drop selection algorithms such as random early detection are often used. 7. By ….. the packets, the sender indicates that it wants the packets to be treated as a specific service, but it can only hope that this happens.

II. Fill in prepositions or adverbs:

through on to among towards by under over with down

1. Computers may be connected ….. each other by wired media or wireless media. 2. When a user requests a page using some web browser located on some Web Server anywhere in the world, the Web Server responds ….. the proper HTML page. 3. Fast Ethernet on fiber is defined ….. 100BASE-FX standard which provides speed up to 100mbps on fiber. 4. When one host tries to communicate or send message to a host which is not adjacent to it, the data travels ….. all intermediate hosts. 5. Full Mesh topology provides the most reliable network structure ….. all network topologies. 6. Switching is a mechanism by which data/information sent from source ….. destination which are not directly connected. 7. Wireless signals are spread ….. in the air and are received and interpret by appropriate antennas. 8. The entire message is broken ….. into smaller chunks called packets. 9. The packet switching technique enables the user to differentiate data streams based ….. priorities. 10. A router never forwards broadcast traffic ….. default.

III. Choose the right word:

1. From an administrator's point of *view/eyesight*, a network can be a private network which belongs to a single autonomous system and cannot be accessed outside its physical or logical domain. 2. In the ring topology, each host machine *connects/joins* to exactly two other machines, creating a circular network structure. 3. Serial transmission requires only one *communication/tie* channel as oppose parallel transmission where communication lines depends upon bit word length. 4. Data link *level / layer* is responsible for converting data stream to signals bit by bit and to send that over the underlying hardware. 5. A gateway is a router equipped with all the information which leads to route *parcels/ packets* to the destination host. 6. To correct the *error/mistake* in data frame, the receiver must know which bit (location of the bit in the frame) is corrupted. 7. When the server accepts client request, the client is then *ratified / authorized* to access web pages.

IV. Translate the following sentences paying attention to the words and word combinations in italics:

1. Components of a network can be connected to each other differently i*n some fashion.* 2. In general this means that the network should appear *to be lightly loaded*. 3. Hosts which needs to communicate *outside their subnet,* needs to know destination network address, where the packet/data is to be sent. 4. A router creates a data packet and then sends it to each host *one by one*. 5. Real-time traffic can be said *to be delay-intolerant*. 6. *A lost video packet* might result in replay of the previous video frame. 7. To address this, the original ISP might negotiate with its ISP neighbors for *continued preferential* service. 8. Networks have interconnecting devices, which receives data from directly connected sources, stores data, analyze it and then forwards to the next interconnecting device *closest to* the destination. 9. Handling traffic that is *both loss- and delay-intolerant* is very difficult.

WRITTEN PRACTICE

I. Translate the following sentences containing comparisons and analyze forms of adjectives and adverbs used to show varying degrees of comparison: the positive, the comparative, and the superlative.

1. Real-time traffic is traffic with some sort of hard or soft delay bound, presumably larger than the one-way no-load propagation delay. 2. Real-time traffic should not be allowed to arrive at any router, for example, faster than it can depart. 3. A network can be as small as distance between your mobile phone and its Bluetooth headphone and as large as the Internet itself, covering the whole geographical world, i.e. the Earth. 4. Number of systems may vary from as least as two to as much as 16 million LAN provides a useful way of sharing resources between end users. 5. Internetwork or simply Internet is the largest network in existence on this planet. 6. Bus topology may have problem while more than one hosts sending data at the same time. 7. The data is sent in only one direction and as soon as it reaches the extreme end, the terminator removes the data from the line. 8. A network structure whose design contains more than one topology is said to be Hybrid Topology. 9. One of the most convenient ways to transfer data from one computer to another was to save it on some storage media and transfer physical from one station to another. 10. Multicast traffic uses special treatment as it is most a video stream or audio with the highest priority. 11. The most common mode (delete mode) is to delete the emails from remote server after they are downloaded to local machines. 12. The higher the line, the more playback delay, but also the more that playback can accommodate late packets.

II. Find in the above text and copy out sentences containing adjectives or adverbs in the positive, comparative and superlative degree and translate them.

III. Write down all possible questions to the following sentence.

So far we have been looking at individual routers.

IV. Translate the following sentences containing modal verbs with infinitive passive.

1. When data-frame is transmitted there are probabilities that data-frame may be lost in the transit or it is received corrupted. 2. Network address must always be configured on a network interface card. 3. This task can be done by a server which provides Layer-3 address of a remote host mapped with its domain name. 4. The received stream should be delivered to the receiving application (for playback, if it is a voice or video stream) slightly behind the time when it was sent. 5. Setting the playback buffer capacity to 25 ms means that the third packet is not received in time to be played back, and so it must be discarded. 6. While the lower rates have lower voice quality, they can be used as a fallback in the event that congestion prevents successful use of the 64 kbps rate. 7. If EF packets have length L then they should be sent at intervals L/R. 8. The maximum time an EF packet should be held in the queue will be B/R. 9. New connections must not be accepted unless resources are available. 10. We think that in this case the delay cannot be avoided completely.

SPEAKING:

I. Comment on the changing fashion in modern digital gadgets. Say: Do you try to keep up with the fashion?

SYSTEM ANALYSIS of COMPLEX CONTROL SYSTEMS

I. Note the pronunciation of the following:

designed [dɪ'zaɪnd]
environment [ɪn'vaɪərənmənt]
forecasting ['fɔːkɑːstɪŋ]
module ['mɒdjuːl] –
nonlinear [nɒn'lɪnɪə]
paradigm ['pærədaɪm]
parameter [pə'ræmɪtə]
preparatory [prɪ'pærətəri]
procedure [prə'siːʤə]
timeliness ['taɪmlɪnɪs]
scenarios[sɪ'nɑːrɪəʊz]

II. Read Text Nineteen and get ready to discuss it in the classroom:

Text 19
COMPUTER-BASED ANALYSIS OF COMPLEX SYSTEMS

It should be noted at this point that while many software systems for computer-aided analysis and design are available by now, they are oriented mostly towards linear systems and towards regulatory control with explicit control algorithms. There still are only very few software packages designed for simulation and analysis of complex control systems involving the use of nonlinear process models, forecasting procedures and optimization algorithms for on-line decision making.

During design of a complex control system one can distinguish two main stages:

• Preparatory stage.
• Interactive design stage.

At the preparatory stage the description (model) and the properties of the process to be controlled are obtained and investigated in broad terms. The objectives are specified and expressed in the form required. Then, the layout of the control structure is proposed, together with algorithms to be used during on-line operation for: identification (filtering), forecasting and decision making. It is obvious that the complexity of those algorithms is growing as we consider more complex problems and structures and as more powerful computing facilities are available for the on-line usage. This last factor is in fact extremely important as it somehow changes the basic paradigm of control design.

For many years the control and system engineers were used to the idea that the control rule had to be simple and computationally low demanding. Many sophisticated techniques were proposed to design such control algorithms and – due to rather simple, mostly linear, form – it was possible to investigate the properties of those algorithms by the theoretical analysis.

The control algorithms can be made and are made quite complex and computationally demanding. In particular the model-based predictive control for nonlinear systems involving the repetitive, on-line, usage of non-linear models, real-time forecasting tools and optimization techniques, is considered for many applications.

During the preparatory stage good understanding of underlying theory is needed as well as the knowledge about the process to be controlled. Computer simulation may be required to get better understanding of the process properties.

The interactive design stage begins when the structural decisions regarding the control structure and algorithms are made. These algorithms have then to be made operational, tuned, checked for reliability and timeliness and validated in terms of meeting the design objectives. Eventually they can be modified or even replaced with others.

At this stage the computer-based analysis and simulation (CAS) is necessary if we want to have the control system tested and verified prior to the actual real implementation. The objectives of CAS are:

• to test the functioning of all the algorithms involved: their correctness, accuracy, timeliness and reliability,

• to investigate the system performance under various possible scenarios of the uncontrolled inputs or disturbances, and under variations of the process parameters (parameters of the process model),

• to seek a trade-off, where necessary, between the use of more complicated decision techniques, involving larger decision delays, and the use of less complicated algorithms allowing for prompt control actions but offering less in terms of control objectives.

In order to perform CAS efficiently and in a proper manner it is required to have:

• Software environment (shell) allowing for convenient organization of the simulation experiments with: friendly user interface, facilities for timing and communication between participating tasks and data base for storing historical data, input scenarios and the results of simulation.

• Algorithms for identification, forecasting and decision making (e.g. optimization routines) used as the elements of a control structure; these are chosen within the preparatory stage but have to be available as subprograms or procedures with well-defined interfaces.

• Process simulator consisting, if required, of several modules related to the process components.

• Simulator of the process environment; in particular the module or modules, allowing for generation of the uncontrolled inputs to the process and other data required by the control algorithms.

• Data related to the process and the process environment; parameters, historical data, probability distributions etc.

Both process and process environment simulators are necessary to create “a reality”. CAS will provide useful, meaningful results only in the case when we can put trust into this reality. One cannot also overestimate the importance of having sufficient and reliable data related to the process and its environment. The computer-based analysis cannot be done without such data.

Various algorithms forming the control mechanisms should be available prior to a simulation experiment. It may happen, however, that some of these algorithms will be very complicated and it will be useful to replace them, for the purpose of simulation, with much simpler ones. In particular, assume that the real-time control system involves the use of complicated forecasting procedures. As far as the results of computer simulation are concerned the use of forecast dummies could be possible. The forecast dummy would be obtained by using a much simpler algorithm. It is only essential to make sure that on average the forecast dummies have the same probabilistic error characteristics as the real forecasts operationally generated on-line.

(*by K. Malinowski, E. Niewiadomska-Szynkiewicz*)

WORKING ON THE TEXT

I. Find in the above text English equivalents for the following word combinations and write them out:

принятие решений; характеристики вероятностной ошибки; вычислительно требовательные; следует отметить; с точки зрения достижения целей проекта; неконтролируемые входы или помехи; в среднем; использование манекенов для прогнозирования; средства для синхронизации; явные алгоритмы управления; до моделирования эксперимента; исследовать производительность системы; на подготовительном этапе; обеспечить полезные, значимые результаты; основная теория.

II. Find the synonyms of the following words.

To suppose, comfortable, prophesying, ultimately, obvious, surroundings, basic.

III. Write some problem questions to Text 19 for class discussion.

IV. Retell the above text using as many of the word combinations from Exercise I as you can.

WORKING ON WORDS

I. Give your own definition of the following terms.

The computer-based analysis, the real-time control system; nonlinear process models; forecast dummies.

II. Complete the sentences with the words from the box:

algorithms environment simulation range tools algorithm class user

1. Computer ….. may be required to get better understanding of the process properties. 2. This ….. of systems allows to set up the simulation experiments and to analyze different types of processes. 3. These computer ….. provide framework organization for different classes of applications. 4. He is oriented mostly towards the regulator control with explicit control ….. . 5. The implemented ….. is based on the open-loop- feedback control approach. 6. The ….. may set or change the area of admissible storage and release. 7. General purpose systems (class B) for computer-based simulation and analysis will have much wider ….. of applications. 8. It is difficult for the user to modify a software ….. when new features need to be introduced.

III. Translate the sentences containing the preposition *prior to*.

1. He made sure all revisions were approved by the chief engineer prior to the organization of simulation experiments. 2. It dates, doubtless, from a time prior to the investigation of the system performance. 3. Probabilistic errors had not been seen in the operation prior to the generation on-line. 4. Prior to this some companies had, to a certain extent, used these forecasting procedures, but few, were completely equipped in these respects. 5. Even prior to the discovery of control mechanisms in the theoretical analysis, a number of engineers had made determinations of the importance of having sufficient and reliable data related to the process and its environment. 6. By some it has been argued that we possessed no kind of control systems involving the use of nonlinear process models prior to the introduction of explicit control algorithms. 7. But it tends to minimize the importance of the distinction of that which is prior to individual experience and that which results there from.

IV. Find in the above text and copy out sentences having the preposition *prior to*.

WRITTEN PRACTICE

I. Complete the following sentences using a word or phrase from the box.

since both… and as well as in contrast to in order to due to until such as

1. The advantage of a specialized system (class A) is that one can have in the software environment both typical algorithms for identification and control ….. the process simulators. 2. On the other hand, ….. make such systems easy to use they should consist of a wide range of facilities for convenient implementation of the user's applications. 3. The model permits one to analyze many fundamental display-related issues ….. the following in a quantitative manner. 4. This process is repeated ….. all remaining rows of the array are completed. 5. ….. frequency domain techniques are limited to linear systems, time domain is widely used to analyze real-world nonlinear systems. 6. ….. an open-loop control system, a closed-loop control

system utilizes an additional measure of the actual output to compare the actual output with the desired output response. 7. ….. the increasing complexity of the system under control and the interest in achieving optimum performance, the importance of control system engineering has grown in the past decade. 8. Typically, these packages include ….. classical ….. state-space oriented methodologies.

II. Look at the first sentence in each pair and highlight the passive verb forms. Then complete the second sentence, which is active.

1. a) The program is prepared for multi-input and multi-output dynamic discrete-time systems that in general may be non linear and non stationary.

b) The system designer ….. the program for multi-input and multi-output dynamic discrete-time systems that in general may be non linear and non stationary.

2. a) The forecast dummy will be obtained by using a much simpler algorithm.

b) Our team ….. the forecast dummy by using a much simpler algorithm.

3. a) Computers and similar devices are called nodes when connected to a network.

b) We ……. computers and similar devices nodes when they are connected to a network.

4. a) These algorithms have already been checked for reliability and timeliness.

b) You …. these algorithms for reliability and timeliness.

5. a) The communication of information between the nodes on a network is controlled by the file server.

b) The file server ….. the communication of information between the nodes on a network.

6. a) The results of computer simulation were validated in terms of meeting the design objectives.

b) The computer engineer …. the results of computer simulation in terms of meeting the design objectives.

7. a) The system performance is now being investigated under variations of the process parameters.

b) They ….. the system performance under variations of the process parameters.

8. a) The mechanism to integrate all the components of the network is provided by the network operating system.

b) The network operating system ….. the mechanism to integrate all the components of the network.

9. a) New products are being developed at the intersection of traditional disciplines of engineering, computer science, and the natural sciences.

b) This computer engineer …. new products that are at the intersection of traditional disciplines of engineering, computer science, and the natural sciences.

III. Choose the proper verb form and write down the translation.

1. The criterion ….. an analytical means for testing the stability of a linear system of any order. 2. This software environment has already proved ….. very useful when performing the analysis of the impact on various possible decision

delays in flood control systems. 3. A control system is an interconnection of components forming a system configuration that ….. a desired system response. 4. This algorithm involves optimization of control trajectory for a ….. prediction of external uncontrolled inputs. 5. The interactive design stage ….. when the structural decisions regarding the control structure and algorithms are made. 6. The underlying numerical algorithms ….. on the latest research in numerical analysis. 7. We have ….. a general purpose system allowing for setting up simulation experiments and analysis for different types of processes.

Keys: will provide, are based, given, provides, to create, to be, begins.

IV. Read and translate the following sentences paying attention to the infinitive passive in the function of an attribute.

The infinitive in the function of an attribute immediately follows its head-word.

1. The large number of factors to be considered illustrates the complexity of the design specification activity in assigning these factors their relative importance in a particular design. 2. Our image of the problem to be solved is not what appears in the written description and ultimately in the specifications. 3. The physical systems to be analyzed must provide insight and indicate directions for improvement. 4. Successful engineers learn to simplify complex systems to be designed for the parameter analysis. 5. Parameter analysis to be carried out is based on identification of the key parameters, generation of the system configuration, and evaluation of how well the configuration meets the needs. 6. The performance specifications to be completed will describe how the closed-loop system should perform. 7. In layered communication system, one layer of a host deals with the task to be done by its peer layer at the same level on the remote host. 8. The computer-based analysis to be performed relies on sufficient and reliable data related to the process and its environment.

V. Find in Text 19 the sentences with the infinitive passive in the function of an attribute and translate them.

TOPICS FOR DISCUSSION

I. Prove the following.

The computer-based analysis and simulation of complex systems have become the only viable option to a system engineer. In order to perform the computer-based analysis and simulation (CAS) efficiently and in a proper manner it is required to have good software environment.

II. Think of a situation in which you did not take advice and the technique for designing control algorithms went wrong as a result. Say what you should or should not have done.

III. Have you ever considered working abroad? Give your reasons.

SUPPLEMENT
TEXTS FOR HOME-READING AND ABSTRACTING

Text 1

Learn the material about a computer network.

Computer network

A computer network is a set of connected computers. Computers on a network are called nodes. The connection between computers can be done via cabling, most commonly the Ethernet cable, or wirelessly through radio waves. Connected computers can share resources, like access to the Internet, printers, file servers, and others. A network is a multipurpose connection, which allows a single computer to do more.

A computer network, or data network, is a digital telecommunications network which allows nodes to share resources. In computer networks, computing devices exchange data with each other using connections (data links) between nodes. These data links are established over cable media such as wires or optic cables, or wireless media such as Wi-Fi.

Network computer devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as personal computers, phones, servers as well as networking hardware. Two such devices can be said to be networked together when one device is able to exchange information with the other device, whether or not they have a direct connection to each other. In most cases, application-specific communications protocols are layered (i.e. carried as payload) over other more general communications protocols. This formidable collection of information technology requires skilled network management to keep it all running reliably.

Computer networks support an enormous number of applications and services such as access to the World Wide Web, digital video, digital audio, shared use of application and storage servers, printers, and fax machines, and use of email and instant messaging applications as well as many others. Computer networks differ in the transmission medium used to carry their signals, communications protocols to organize network traffic, the network's size, topology, traffic control mechanism and organizational intent. The best-known computer network is the Internet.

Advantages of Computer Networking

1. It enhances communication and availability of information.

Networking, especially with full access to the web, allows ways of communication that would simply be impossible before it was developed. Instant messaging can now allow users to talk in real time and send files to other people wherever they are in the world, which is a huge boon for businesses. Also, it allows access to a vast amount of useful information, including traditional reference materials and timely facts, such as news and current events.

2. It allows for more convenient resource sharing.

This benefit is very important, particularly for larger companies that really need to produce huge numbers of resources to be shared to all the people. Since the technology involves computer-based work, it is assured that the resources they wanted to get across would be completely shared by connecting to a computer network which their audience is also using.

3. It makes file sharing easier.

Computer networking allows easier accessibility for people to share their files, which greatly helps them with saving more time and effort, since they could do file sharing more accordingly and effectively.

4. It is highly flexible.

This technology is known to be very flexible, as it gives users the opportunity to explore everything about essential things, such as software without affecting their functionality. Plus, people will have the accessibility to all information they need to get and share.

5. It is an inexpensive system.

Installing networking software on your device would not cost too much, as you are assured that it lasts and can effectively share information to your peers. Also, there is no need to change the software regularly, as mostly it is not required to do so.

6. It increases cost efficiency.

With computer networking, you can use a lot of software products available on the market which can just be stored or installed in your system or server, and can then be used by various workstations.

7. It boosts storage capacity.

Since you are going to share information, files and resources to other people, you have to ensure all data and content are properly stored in the system. With this networking technology, you can do all of this without any hassle, while having all the space you need for storage.

Disadvantages of Computer Networking

1. It lacks independence.

Computer networking involves a process that is operated using computers, so people will be relying more of computer work, instead of exerting an effort for their tasks at hand. Aside from this, they will be dependent on the main file server, which means that, if it breaks down, the system would become useless, making users idle.

2. It poses security difficulties.

Because there would be a huge number of people who would be using a computer network to get and share some of their files and resources, a certain user's security would be always at risk. There might even be illegal activities that would occur, which you need to be careful about and aware of.

3. It lacks robustness.

As previously stated, if a computer network's main server breaks down, the entire system would become useless. Also, if it has a bridging device or a central linking server that fails, the entire network would also come to a standstill. To deal with these problems, huge networks should have a powerful computer to serve as file server to make setting up and maintaining the network easier.

4. It allows for more presence of computer viruses and malware.

There would be instances that stored files are corrupt due to computer viruses. Thus, network administrators should conduct regular check-ups on the system, and the stored files at the same time.

5. Its light policing usage promotes negative acts.

It has been observed that providing users with internet connectivity has fostered undesirable behavior among them. Considering that the web is a minefield of distractions – online games, humor sites and even porn sites – workers could be – tempted during their work hours. The huge network of machines could also encourage them to engage in illicit practices, such as instant messaging and file sharing, instead of working on work-related matters. While many organizations draw up certain policies on this, they have proven difficult to enforce and even engendered resentment from employees.

6. It requires an efficient handler.

For a computer network to work efficiently and optimally, it requires high technical skills and know-how of its operations and administration. A person just having basic skills cannot do this job. Take note that the responsibility to handle such a system is high, as allotting permissions and passwords can be daunting. Similarly, network configuration and connection is very tedious and cannot be done by an average technician who does not have advanced knowledge.

7. It requires an expensive set-up.

Though computer networks are said to be an inexpensive system when it is already running, its initial set up cost can still be high depending on the number of computers to be connected. Expensive devices, such as routers, switches, hubs, etc., can add up to the cost. Aside from these, it would also need network interface cards (NICs) for workstations in case they are not built in.

(*by Ashish Kr. Jha*)

Text 2

Study the following text.

Repeaters & Bridges

Since a signal loses strength as it passes along a cable, it is often necessary to boost the signal with a device called a repeater. A repeater operates at the physical layer. Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network. An important point to be noted about repeaters is that they do not amplify the signal. When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength. It is a 2 port device.

The repeater electrically amplifies the signal it receives and rebroadcasts it. Repeaters can be separate devices or they can be incorporated into a concentrator. They are used when the total length of your network cable exceeds the standards set for the type of cable being used.

A good example of the use of repeaters would be in a local area network using a star topology with unshielded twisted-pair cabling. The length limit for unshielded twisted pair cable is 100 meters. The most common configuration is for each workstation to be connected by twisted-pair cable to a multi-port active concentrator. The concentrator amplifies all the signals that pass through it allowing for the total length of cable on the network to exceed the 100 meter limit.

A collision domain is the set of nodes competing to access the same transmissive medium → the simultaneous transmission causes collision. Interconnecting two network segments creates a single collision domain: repeater is not able to recognize collisions which are propagated to all ports → this is a limit to the size of the physical domain.

A bridge is a device that allows you to segment a large network into two smaller, more efficient networks. A bridge operates at data link layer. If you are adding to an older wiring scheme and want the new network to be up-to-date, a bridge can connect the two. A bridge monitors the information traffic on both sides of the network so that it can pass packets of information to the correct location. Most bridges can "listen" to the network and automatically figure out the address of each computer on both sides of the bridge. The bridge can inspect each message and, if necessary, broadcast it on the other side of the network.

The bridge manages the traffic to maintain optimum performance on both sides of the network. You might say that the bridge is like a traffic cop at a busy intersection during rush hour. It keeps information flowing on both sides of the network, but it does not allow unnecessary traffic through. Bridges can be used to connect different types of cabling, or physical topologies. They must, however, be used between networks with the same protocol.

Types of Bridges

Transparent Bridges: - These are the bridge in which the stations are completely unaware of the bridge’s existence i.e. whether or not a bridge is added or deleted from the network, reconfiguration of the stations is unnecessary. These bridges make use of two processes i.e. bridge forwarding and bridge learning.

Source Routing Bridges: - In these bridges, routing operation is performed by source station and the frame specifies which route to follow. The hot can discover frame by sending a special frame called discovery frame, which spreads through the entire network using all possible paths to destination.

Bridge decouples broadcast domain from collision domain:

it 'splits' the collision domain: it implements the CSMA/CD protocol to detect collisions, avoiding propagating them to the other ports;

it extends the broadcast domain: frames sent in broadcast are propagated to all ports.

(From *Wikipedia, the free encyclopedia*)

Text 3

Outline the main ideas of the text and write a summary.

Definition of a Computer Network

A computer network may be defined as the coordination or interconnection of a number of individual computers. A computer network is basically established by the network layer in the Open Systems Infrastructure model, popularly known as the OSI model.

Computer networks exist on various scales, from links between machines in the same room up through wiring connecting the machines in a building or campus to regional, national and global networks. Various media are used to carry the communications signals: copper wire, fibre-optic cables and wireless or radio transmissions etc.

Networking is the concept of sharing resources and services. A network of computers is a group of interconnected systems sharing resources and interacting using a shared communications link. A network, therefore, is a set of interconnected systems with something to share. The shared resource can be data, a printer, a fax modem, or a service such as a database or an email system. The individual systems must be connected through a pathway (called the transmission medium) that is used to transmit the resource or service between the computers. All systems on the pathway must follow a set of common communication rules for data to arrive at its intended destination and for the sending and receiving systems to understand each other. The rules governing computer communication are called protocols. In summary, all networks must have the following:

1. A resource to share (resource)
2. A pathway to transfer data (transmission medium)
3. A set of rules governing how to communicate (protocols)

Having a transmission pathway does not always guarantee communication. When two entities communicate, they do not merely exchange information; rather, they must understand the information they receive from each other. The goal of computer networking, therefore, is not simply to exchange data but to understand and use data received from other entities on the network. An analogy is people speaking, just because two people can speak, it does not mean they automatically can understand each other.

These two people might speak different languages or interpret words differently. One person might use sign language, while the other uses spoken language. As in human communication, even though you have two entities who "speak," there is no guarantee they will be able to understand each other. Just because two computers are sharing resources, it does not necessarily mean they can communicate. Because computers can be used in different ways and can be located at different distances from each other, enabling computers to communicate often can be a daunting task that draws on a wide variety of technologies.

BENEFITS OF COMPUTER NETWORK

Assuming you have six people in your family. Each has their own computer and wants to be able to print and have internet access. You don't want to pay for six modems (for internet connections) and six printers. Why not have one internet connection and one printer connected to one computer. This computer has all other computers attached to it.

They all share its internet and printer. They can also each have some shared folders that everyone on the network can access (upon providing a password). Properly planned, an efficient network brings a wide range of benefits to a company such as:

File Sharing: Networks offer quick and easy way to share files directly. Instead of using a disk or USB key to carry files from one computer or office to another, you can share files directly using a network.

Security: Specific directories can be password protected to limit access to authorized users. Also, files and programs on a network can be designated as "copy inhibit" so you don't have to worry about the illegal copying of programs.

Resource Sharing: All computers in the network can share resources such as printers, fax machines, modems, and scanners.

Communication: Even outside of the internet, those on the network can communicate with each other via electronic mail over the network system. When connected to the internet, network users can communicate with people around the world via the network.

Flexible Access: Networks allow their users to access files from computers throughout the network. This means that a user can begin work on a project on one computer and finish up on another. Multiple users can also collaborate on the same project through the network.

Workgroup Computing: Workgroup software like Microsoft BackOffice enables many users to contribute to a document concurrently. This allows for interactive teamwork.

Error reduction and improving consistency: One can reduce errors and improve consistency by having all staff work from a single source of information, so that standard versions of manuals and directories can be made available, and data can be backed up from a single point on a scheduled basis, ensuring consistency.

(From *Wikipedia, the free encyclopedia*)

Text 4

Sum up your ideas of the text.

Broadcast routing

A broadcast message is destined to all network devices. Broadcast routing can be done in two ways (algorithm): A router creates a data packet and then sends it to each host one by one. In this case, the router creates multiple copies of single data packet with different destination addresses.

In computer networking, telecommunication and information theory, broadcasting is a method of transferring a message to all recipients simultaneously. Broadcasting can be performed as a high-level operation in a program, for example, broadcasting in Message Passing Interface, or it may be a low-level networking operation, for example broadcasting on Ethernet.

All-to-all communication is a computer communication method in which each sender transmits messages to all receivers within a group. In networking this can be accomplished using broadcast or multicast. This is in contrast with the point-to-point method in which each sender communicates with one receiver.

In computer networking, broadcasting refers to transmitting a packet that will be received by every device on the network. In practice, the scope of the broadcast is limited to a broadcast domain. Broadcasting a message is in contrast to unicast addressing in which a host sends datagrams to another single host identified by a unique address.

Unicast is communication between a single sender and a single receiver over a network. The term exists in contradistinction to multicast, communication between a single sender and multiple receivers, and anycast, communication between any sender and the nearest of a group of receivers in a network.

In computer networking, unicast refers to a one-to-one transmission from one point in the network to another point; that is, one sender and one receiver, each identified by a network address.

Broadcasting is the most general communication method, and is also the most intensive in the sense that many messages may be required and many network devices are involved.

Broadcasting may be performed as all scatter in which each sender performs its own scatter in which the messages are distinct for each receiver, or all broadcast in which they are the same. The MPI message passing method which is the de facto standard on large computer clusters includes the MPI_Alltoall method.

Not all network technologies support broadcast addressing; for example, neither X.25 nor frame relay have broadcast capability, nor is there any form of Internet-wide broadcast. Broadcasting is largely confined to local area network (LAN) technologies, most notably Ethernet and token ring, where the performance impact of broadcasting is not as large as it would be in a wide area network.

The successor to Internet Protocol Version 4 (IPv4), IPv6 also does not implement the broadcast method, so as to prevent disturbing all nodes in a network when only a few may be interested in a particular service. Instead it relies on multicast addressing - a conceptually similar one-to-many routing methodology. However, multicasting limits the pool of receivers to those that join a specific multicast receiver group.

Both Ethernet and IPv4 use an all-ones broadcast address to indicate a broadcast packet. Token Ring uses a special value in the IEEE 802.2 control field.

Broadcasting may be abused to perform a type of DoS-attack known as a Smurf attack. The attacker sends fake ping requests with the source IP-address of the victim computer. The victim computer is flooded by the replies from all computers in the domain.

When applying link-state algorithms, a graphical map of the network is the fundamental data used for each node. To produce its map, each node floods the entire network with information about the other nodes it can connect to. Each node then independently assembles this information into a map. Using this map, each router independently determines the least-cost path from itself to every other node using a standard shortest paths algorithm such as Dijkstra's algorithm. The result is a tree graph rooted at the current node, such that the path through the tree from the root to any other node is the least-cost path to that node. This tree then serves to construct the routing table, which specifies the best next hop to get from the current node to any other node.

(From *Wikipedia, the free encyclopedia*)

Text 5

Read the following text and be ready to discuss it.

Ethernet Packet Format & Ethernet Multicast

Here is the format of a typical Ethernet packet (DIX specification); it is still used for newer, faster Ethernets: dest addr src addr type data CRC. The destination and source addresses are 48-bit quantities; the type is 16 bits, the data length is variable up to a maximum of 1500 bytes, and the final CRC checksum is 32 bits. The checksum is added by the Ethernet hardware, never by the host software. There is also a preamble, not shown: a block of 1 bit followed by a 0, in the front of the packet, for synchronization. The type field identifies the next higher protocol layer; a few common type values are 0x0800 = IP, 0x8137 = IPX, 0x0806 = ARP. The IEEE 802.3 specification replaced the type field by the length field, though this change never caught on. The two formats can be distinguished as long as the type values used are larger than the maximum Ethernet length of 1500 (or 0x05dc); the type values all meet this condition. The Ethernet maximum packet length of 1500 bytes worked well in the past, but can seem inconveniently small at 10 Gbit speeds. But 1500 bytes has become the de facto maximum packet size throughout the Internet, not just on Ethernet LANs; increasing it would be difficult. TCP TSO (12.5 TCP Offloading) is one alternative. Each Ethernet card has a (hopefully unique) physical address in ROM; by default any packet sent to this address will be received by the board and passed up to the host system. Packets addressed to other physical addresses will be seen by the card, but ignored (by default). All Ethernet devices also agree on a broadcast address of all 1's: a packet sent to the broadcast address will be delivered to all attached hosts. It is sometimes possible to change the physical address of a given card in software. It is almost universally possible to put a given card into promiscuous mode, meaning that all packets on the network, no matter what the destination address, are delivered to the attached host. This mode was originally intended for diagnostic purposes but became best known for the security breach it opens: it was once not unusual to find a host with network board in promiscuous mode and with a process collecting the first 100 bytes (presumably including user id and password) of every telnet connection.

Another category of Ethernet addresses is multicast, used to transmit to a set of stations; streaming video to multiple simultaneous viewers might use Ethernet multicast. The lowest-order bit in the first byte of an address indicates whether the address is physical or multicast. To receive packets addressed to a given multicast address, the host must inform its network interface that it wishes to do so; once this is done, any arriving packets addressed to that multicast address are forwarded to the host. The set of subscribers to a given multicast address may be called a multicast group. While higher-level protocols might prefer that the subscribing host also notifies some other host, eg the sender, this is not required, although that might be the easiest way to learn the multicast address involved. If several hosts subscribe to the same multicast address, then each will receive a copy of each multicast packet transmitted. We are now able to list all cases in which a network interface forwards a received packet up to its attached host:

• if the destination address of the received packet matches the physical address of the interface;

• if the destination address of the received packet is the broadcast address;

• if the interface is in promiscuous mode;

• if the destination address of the received packet is a multicast address and the host has told the network interface to accept packets sent to that multicast address.

If switches (below) are involved, they must normally forward multicast packets on all outbound links, exactly as they do for broadcast packets; switches have no obvious way of telling where multicast subscribers might be. To avoid this, some switches do try to engage in some form of multicast filtering, sometimes by snooping on higher-layer multicast protocols. Multicast Ethernet is seldom used by IPv4, but plays a larger role in IPv6 configuration.

(*by Peter L Dordal*)

Text 6

Study the text. Be ready to speak about its main ideas.

Ethernet Address Internal Structure

The second-to-lowest-order bit of a physical Ethernet address indicates whether that address is believed to be globally unique or if it is only locally unique; this is known as the Universal/Local bit. For real Ethernet physical addresses, the multicast and universal/local bits of the first byte should both be 0. When (global) Ethernet IDs are assigned to physical Ethernet cards by the manufacturer, the first three bytes serve to indicate the manufacturer. They are allocated by the IEEE, and are officially known as organizationally unique identifiers. These can be looked up at any of several sites on the Internet to identify the manufacturer associated with any given Ethernet address; the official IEEE site is standards.ieee.org/develop/regauth/oui/public.html (OUIs must be entered here without colons). As long as the manufacturer involved is diligent in assigning the second three bytes, every manufacturer provided Ethernet address should be globally unique. Lapses, however, are not unheard of. Ethernet addresses for virtual machines must be distinct from the Ethernet address of the host system, and may be (e.g. with so-called “bridged” configurations) as visible on the LAN as that host system’s address. The first three bytes of virtual Ethernet addresses are often taken from the OUI assigned to the manufacturer whose card is being emulated; the last three bytes are then either set randomly or via configuration. In principle, the universal/local bit should be 1, as the address is only locally unique, but this is often ignored. It is entirely possible for virtual Ethernet addresses to be assigned so as to have some local meaning, though this appears not to be common.

The Slot Time and Collisions

The diameter of an Ethernet is the maximum distance between any pair of stations. The actual total length of cable can be much greater than this, if, for example, the topology is a “star” configuration. The maximum allowed diameter, measured in bits, is limited to 232 (a sample “budget” for this is below). This makes the round-trip-time 464 bits. As each station involved in a collision discovers it, it transmits a special jam signal of up to 48 bits. These 48 jam bits bring the total above to 512 bits, or 64 bytes. The time to send these 512 bits is the slot time of an Ethernet; time intervals on Ethernet are often described in bit times but in conventional time units the slot time is 51.2 µsec. The value of the slot time determines several subsequent aspects of Ethernet. If a station has transmitted for one slot time, then no collision can occur (unless there is a hardware error) for the remainder of that packet. This is because one slot time is enough time for any other station to have realized that the first station has started transmitting, so after that time they will wait for the first station to finish. Thus, after one slot time a station is said to have acquired the network. The slot time is also used as the basic interval for retransmission scheduling, below. Conversely, a collision can be received, in principle, at any point up until the end of the slot time. As a result, Ethernet has a minimum packet size, equal to the slot time, i.e. 64 bytes (or 46 bytes in the data portion). A station transmitting a packet this size is assured that if a collision were to occur, the sender would detect it (and be able to apply the retransmission algorithm, below). Smaller packets might collide and yet the sender might not know it, ultimately leading to greatly reduced throughput. If we need to send less than 46 bytes of data (for example, a 40-byte TCP ACK packet), the Ethernet packet must be padded out to the minimum length. As a result, all protocols running on top of Ethernet need to provide some way to specify the actual data length, as it cannot be inferred from the received packet size. As a specific example of a collision occurring as late as possible, consider the diagram below. A and B are 5 units apart, and the bandwidth is 1 byte/unit. A begins sending "hello world" at T=0; B starts sending just as A's message arrives, at T=5. B has listened before transmitting, but A's signal was not yet evident. A doesn't discover the collision until 10 units have elapsed, which is twice the distance.

(*by Peter L Dordal*)

Text 7

Read the following text and be ready to discuss it.

Network LAN Technologies

Ethernet

Ethernet is a Local Area Network implementation technology which is widely deployed. This technology was invented by Bob Metcalfe and D.R. Boggs in early 70s. It was standardized in IEEE 802.3 in 1980. Ethernet is network technology which shares media. Network which uses shared media has high probability of data collision. Ethernet uses CSMA/CD technology to detect collisions. CSMA/CD stands for Carrier Sense Multi Access/Collision Detection. When a collision happens in Ethernet, all its host rolls back and waits for some random amount of time and then re-transmit data. Ethernet connector, i.e. Network Interface cards is equipped with 48-bits MAC address. This helps other Ethernet devices to identify and communicate with remote devices in Ethernet. Traditional Ethernet uses 10BASE-T specifications. 10 is for 10mpbs speed, BASE stands for using baseband and T stands for Thick net or Thick Ethernet. 10BASE-T Ethernet provides transmission speed up to 10mbps and uses Coaxial cable or Cat-5 Twisted Pair cable with RJ-5 connector. Ethernet follows Star Topology with segment length up to 100 meters. All devices are connected to a Hub/Switch in a Star Fashion.

Fast-Ethernet

To encompass need of fast emerging software and hardware technologies, Ethernet extends itself as Fast-Ethernet. It can run on UTP, Optical Fiber and can be wireless too. It can provide speed up to 100 mbps. This standard is named as 100BASE-T in IEEE 803.2 using Cat-5 Twisted pair cable. It uses CSMA/CD technique for wired media sharing among Ethernet hosts and CSMA/CA (Collision Avoidance) technique for wireless Ethernet LAN. Fast Ethernet on fiber is defined under 100BASE-FX standard which provides speed up to 100mbps on fiber. Ethernet over Fiber can be extended up to 100 meters in half-duplex mode and can reach maximum of 2000 meters in full-duplex over multimode fibers.

Giga-Ethernet

After being introduced in 1995, Fast-Ethernet could enjoy its high speed status only for 3 years till Giga-Ethernet introduced. Giga-Ethernet provides speed up to 1000 mbits/seconds. IEEE802.3ab standardizes Giga-Ethernet over UTP using Cat-5, Cat-5e and Cat-6 cables. IEEE802.3ah defines Giga-Ethernet over Fiber.

LAN uses Ethernet which in turn works on shared media. Shared media in Ethernet create one single broadcast domain and one single collision domain. Introduction of switches to Ethernet has removed single collision domain issue and each device connected to switch works in its separate collision domain. But even Switches cannot divide a network into separate Broadcast domain. Virtual LAN is a method to divide a single Broadcast domain into more than one Broadcast domains. Host in one VLAN cannot speak to a host in another. By default, all hosts are placed into same VLAN.

VLAN is Layer-2 technology which works closely on Ethernet. To route packets between two different VLANs a Layer-3 device (such as Router) is required.

VLANs work by applying tags to network frames and handling these tags in networking systems – creating the appearance and functionality of network traffic that is physically on a single network but acts as if it is split between separate networks. In this way, VLANs can keep network applications separate despite being connected to the same physical network, and without requiring multiple sets of cabling and networking devices to be deployed.

VLANs allow network administrators to group hosts together even if the hosts are not directly connected to the same network. Because VLAN membership can be configured through software, this can greatly simplify network design and deployment. Without VLANs, grouping hosts according to their resource needs the labor of relocating nodes or rewiring data links. VLANs allow networks and devices that must be kept separate to share the same physical cabling without interacting, improving simplicity, security, traffic management, or economy. For example, a VLAN could be used to separate traffic within a business due to users, and due to network administrators, or between types of traffic, so that users or low priority traffic cannot directly affect the rest of the network's functioning. Many Internet hosting services use VLANs to separate their customers' private zones from each other, allowing each customer's servers to be grouped together in a single network segment while being located anywhere in their data center. Some precautions are needed to prevent traffic "escaping" from a given VLAN, an exploit known as VLAN hopping.

(From *Wikipedia, the free encyclopedia*)

Text 8

Read the following text and be ready to discuss it.

100 Mbps (Fast) Ethernet

Classic Ethernet, at 10 Mbps, is quite slow by modern standards, and so by 1995 the IEEE had created standards for Ethernet that operated at 100 Mbps. Ethernet at this speed is commonly known as Fast Ethernet; this name is used even today as "Fast" Ethernet is being supplanted by Gigabit Ethernet. By far the most popular form of 100 Mbps Ethernet is officially known as 100BASE-TX; it operates over twisted-pair cable.

The bandwidth, minimum packet size and maximum network diameter were all interrelated, in order to ensure that collisions could always be detected by the sender. Increasing the speed means that at least one of the other constraints must be scaled as well. For example, if the network physical diameter were to remain the same when moving to 100 Mbps, then the Fast-Ethernet round-trip time would be the same in microseconds but would be 10-fold larger measured in bits; this might mean a minimum packet size of 640 bytes instead of 64 bytes. (Actually, the minimum packet size might be somewhat smaller, partly because the "jam signal" doesn't have to become longer, and partly because some of the numbers in the 10 Mbps delay budget above were larger than necessary, but it would still be large enough that a substantial amount of bandwidth would be consumed by padding.) The designers of Fast Ethernet felt that such a large minimum-packet size was impractical. However, Fast Ethernet was developed at a time (~1995) when reliable switches were widely available.

Large "virtual" Ethernet networks could be formed by connecting small physical Ethernets with switches, effectively eliminating the need to support large-diameter physical Ethernets. So instead of increasing the minimum packet size, the decision was made to ensure collision detectability by reducing the network diameter instead. The network diameter chosen was a little over 400 meters, with reductions to account for the presence of hubs. At 2.3 meters/bit, 400 meters is 174 bits, for a round-trip of 350 bits. The slot time (and minimum packet size) remains 512 bits – now 5.12 µsec – which is safely large enough to ensure collision detection. This 400-meter diameter, however, may be misleading: the specific 100BASE-TX standard, which uses so-called Category 5 twisted-pair cabling (or better), limits the length of any individual cable segment to 100 meters. The maximum 100BASE-TX network diameter – allowing for hubs – is just over 200 meters. The 400-meter distance does apply to optical-fiber-based 100BASE-FX in half-duplex mode, but this is not common. The 100BASE-TX network-diameter limit of 200 meters might seem small; it amounts in many cases to a single hub with multiple 100-meter cable segments radiating from it. Switches partition an Ethernet into separate "collision domains"; the network-diameter rules apply to each domain separately but not to the aggregated whole. In a fully switched (that is, no hubs) 100BASE-TX LAN, each collision domain is simply a single twisted-pair link, subject to the 100-meter maximum length. Fast Ethernet also introduced the concept of full-duplex Ethernet: two twisted pairs could be used, one for each direction. Full-duplex Ethernet is limited to paths not involving hubs, that is, to single station-to-station links, where a station is either a host or a switch. Because such a link has only two potential senders, and each sender has its own transmit line, full-duplex Ethernet is entirely collision-free. Fast Ethernet (at least the 100BASE-TX form) uses 4B/5B encoding, covered in 4.1.4 4B/5B. This means that the electronics have to handle 125 Mbps, versus the 200 Mbps if Manchester encoding were still used. Fast Ethernet 100BASE-TX does not particularly support links between buildings, due to the maximum cable-length limitation. However, fiber-optic point-to-point links are an effective alternative here, provided full-duplex is used to avoid collisions. We mentioned above that the coax-based 100BASE-FX standard allowed a maximum half-duplex run of 400 meters, but 100BASE-FX is much more likely to use full duplex, where the maximum cable length rises to 2,000 meters.

(*by Peter L Dordal*)

Text 9

Read the text and outline its main ideas.

Computer-Controlled Assembly

Continuing inflation, competition from other countries and record deficits in international trade have created a widespread awareness of the need to increase productivity in manufacturing, which means decreasing the man-hours, materials, energy or capital required to produce industrial goods of all kinds. An additional stimulus for increasing productivity arises from the desire to improve the quality of life, including the life of workers now engaged in stultifying, repetitive and sometimes hazardous tasks. Today there are pressures to use power, materials and capital more efficiently.

Although there are many ways of increasing manufacturing productivity – financial, fiscal and social – we shall focus here on advanced technology to an old field: assembly. Technology has brought about radical changes in many areas – power generation, transportation chemical manufacturing, communications and data processing – but it has had only a minor effect on the way the broad spectrum of consumer goods, from electric toasters to automobiles, are actually assembled.

At present manufacturing is based largely on experience; it is really an art form. Equipment designers and factory managers prefer to repeat what has worked in the past, which can be taken as evidence that they are struggling with a vastly complicated situation. Such changes as introduced tend to be small ones. Wholesale shifts in technique are expensive and risky.

At present assembly is performed by people and, when the production volume is high enough, by special-purpose machines. People are readily taught new tasks, and they adapt to changing conditions, to different models of the same product on the same assembly line and to major changes in product design.

Special-purpose machines are very efficient, give reproducible performance and are not subject to fatigue, but they consist almost totally of jigs and fixtures built to perform one task, or a closely related series of tasks, on one product. They cannot easily be altered to accommodate different models on the production line or changes in product design.

Most products are manufactured in batches with wide style variations, in quantities too small or a design life too short to justify investment in a special-purpose machine. In addition many items are not designed with sufficient attention to assembly problems, partly because assembly phenomena are not well enough understood to allow precise requirements to be placed before the product designers. Moreover, assembly-line workers do more than just put parts together. They often make spot repairs and perform many vital inspection tasks.

A programmable machine is one that can be taught, with minor alterations, to perform several tasks in sequence. This capability is essential if assembly machines are to be economic for low-volume manufacturing.

(by James L. Nevins and Daniel E. Whitney)

Text 10

Read and sum up your ideas of the text.

Beyond Software

After the idea of network became a meta-paradigm in all different disciplines, in philosophy and science as well as in technology it had been realized by the creation of the World Wide Web. The concept of network is not just a heuristic idea, but an idea which has empirical existence. From that point on, the scientific and the technological community started to understand the idea of a human-machine or a man-machine hybrid. It is not just the idea of computers being connected. Because computers are being connected literally do nothing, unless they are part of human-machine-systems, i.e. unless human beings are involved.

If one looks for instance at the screen of a PC then one sees changes of physical states. But in order to interpret these as different letters or different signs, in order to interpret signs at all, one needs a human observer that is also a human user. The machine user entity is the node, not the node of the technical network as such.

The hybrids of human beings and machines are connected to networks. And therefore, the hybrid networks (the human-machine-networks) replace the idea of individual artificial intelligent entities such like computers or robots. From the 1990s on we did not talk anymore about robots as individual intelligent entities or individual mechanical entities displaying intelligent behavior. Now we are talking about systems, networks of mechanical devices and human beings displaying intelligent behavior together in processes of interaction. Again the idea began to develop – like 50 years before – that there is a decisive difference between hardware and software, between the mechanical device (be it electrical, chemical or whatsoever) and the program running on that mechanical device.

Our wet-wear which we have in our skulls, our brains is of course also entities on which programs, i.e. software is running. There is an interesting development to be observed when we project this back into history. By doing this it becomes obvious that the definition of the humankind of human beings was always a mirror of the most advanced pieces of technology.

At the beginning of the Modern Age in the mechanical thinking human beings of course were considered to be complicated clocks. Just think of Leibnitz, for whom of course the whole world was a clock work and God was the clock maker, who had manufactured all these perfectly running clocks. The idea of pre-stabilized harmony is illustrated by Leibnitz with the image of a clockmaker, who created absolutely synchronized clocks (Bayle 1978). And then we can see it happen all over again, when in the 19th-century the human brain was perceived to be something like a very complicated telephone system (Searle1984). And since the 1950s and 1960s the neurosciences perceived the human brain as a computer (Anderson & Ross 1964). From the 1980s on the idea of self-organizing networks, neural networks replaced the idea of the human brain being a computer (Hopfield 1988; Churchland 1986). And almost the same is happening now again, if the step from the individual mechanical technical devices displaying intelligent behavior is made to the system of the coordination of individual mechanical devices displaying intelligent behavior (Beni 2004). It is in this context that the old question of the individual robots shows up again with respect to software:

• Could it be possible for us to design devices which would be capable of designing other devices, could we e.g. design a robot that could be capable of designing other robots? Can machines or computers produce software?

And the answer of course is highly disputed: Yes, it is no longer impossible, it is rather easily possible.

And now the decisive question comes up:

• Can machines or computers offer nominal values that include an aim towards the realization, of which the software judged to be suitable used? In other words: Can machines deal with values?

If that is the case then of course the main anthropological issue would be solved by the dissolution of the main anthropological issue. There would be no privileged situation for human beings anymore, if robots could do the same. So the answer to this question is: No. I should put it differently: the answer has to be: No. If we try to stick to the notion of a "human being" and if we try to stick to the notion of "human-machine-hybrid-systems" then there should be at least one decisive difference between human beings and machines displaying intelligent behavior. And this decisive difference is probably the capability of defining and setting values. Consequently the answer is "No" and has to be "No." If the answer would be "Yes," then we would have to start a new round of deliberations.

(*by Walther Ch. Zimmerli*)

NOTE

Leibnitz [lɪb'nɪts], Baron Gottfried Wilhelm von Leibniz. 1646 – 1716. German philosopher and mathematician.

Text 11

Discuss the problems mentioned in the text.

Assembly Line Robots & Swarm-Intelligence

Looking at the production system we see that the dominant idea, even if we are in actual fact already working within a network is still one of a sequence or a line: the assembly line. If we look at late modern production systems we see, however, that it is not organized according to the tradition of the assembly line anymore, but rather according to an integrated network of different assembly lines (and the same applies to the traditional idea of supply chains) (Zimmerli, Bagusat & Muller 2007). But the main idea is nevertheless still that of an assembly line of robots, the type of robots e.g. you usually see at the car production. They do not show "android" features, they do not look homo erectus-like, but you see e.g. one great arm. And this great arm performs almost the same movements all the time. That is what assembly line robots are all about. They seem to move on their own free will. One looks at them and they seem to display intelligent autonomous behavior. And one would not even be capable to tell whether they are actually internally programmed to do that or whether they are developing their program as they go along. It would not be possible to tell that because there is an asymmetry between the possibility to explain these movements after the fact and the possibility to predict them before, i.e. an asymmetry between explanation and prediction. These assembly line robots seem to move on their own free will. Under certain circumstances and under different conditions of carrying out various operations, they may seem (to some observers) like independent beings, who program their own set values.

What we have seen before applies here too: if the only action which these robots cannot do, the only limits to robots taking over work operations in the production process would be the setting of the values by themselves, then of course everything else, every operation that can be described by software production analysis methods can be carried out by every suitably implemented machine.

The only thing that cannot be carried out by suitably implemented machines is the setting of the set values itself. And if we apply the notion of "network," then it becomes obvious that the operation of networks of robots can easily be programmed, be it by human beings or by machines: Of course we can design machines, which are capable of designing networks of programs of machines.

Originally swarm intelligence used to be a notion taken from the biological sphere, especially with respect to the behavior of ants, birds and fish. But these days we speak about swarm-intelligence of robots, especially of nano-robots, which are very tiny little devices displaying intelligent behavior themselves (Winfield, Harper & Nembrini 2005). Or to put it more precisely: the behavior displayed by swarms of small robots ("nanobots") is not a behavior called "intelligent," because the individual nanobots display intelligent behavior, but only because the system of intelligent nanobots is displaying intelligent behavior. That is why the very notion of "robots programmed in an assembly line (or any other kind of collaborative pattern)" is presupposing the idea of a decentralized *meta-program* or rather a behavioral collaborative pattern of robots (or other "intelligent" machines) – and this idea is what we call "swarm-intelligence."

So the question is not whether the individual robot in an assembly line performs intelligent behavior (that is always the case, because that is what they are supposed to do) but the assembly line itself has to display intelligent behavior.

Example: given that a robot as the individual intelligent production machine always takes a piece or device and puts it over here and does all the time with it, what it is programmed to do, and given that there is no piece or device around then the whole system does not work. So the individual robot could perform the same operation as many times as it is programmed, but if the supply of the elements needed to perform an actual labor action by doing this would be lacking, i.e. if the system would not be so efficient by not having a sufficient supply of elements or devices, then the system itself would not be behaving in an intelligent way; it would run empty.

So, if the network itself is not programmed intelligently then there is no way of talking about intelligent behavior of robots. Therefore, we have to deal from now on with what I call meta-programs or meta-robots. The discourse on robots has in actual fact already been replaced by the discourse on meta-robots, if we talk about robots in this new system-oriented way. With regard to this meta-robot, however, an asymmetry-hypothesis (that seems to be valid) between observation of behavior and programming is applied.

Although we can observe intelligent behavior it is possible that we cannot program it. What we find here is the next level of the asymmetry between explanation and prediction in the philosophy of science and it is called the difference between programming and teaching. The very notion of "teaching" is used here in a system, which does not deal with the interaction between teachers and students at all, but with the interaction between human beings and machines. For instance, if one tries to program a laser welding device then one does not have to write programs anymore.

Consequently, what we do is teaching the machine by actually physically guiding it, by taking the laser welding arm and putting it into some place and then putting it over and bringing it back, and then putting it back over there. And after doing that a few times the machine has "learned" it, and from then on it does it by itself. Of course, it does not literally do it by itself; it is not autonomous in the very strict philosophical sense of "autonomy." But we have taught the machine to do that and the machine does it, unless we teach it to behave differently.

We can teach the machine by talking to it, in written language (program) or by showing it how to behave, by taking the laser welding arm again and putting it to a different place etc. By doing so a few times, you have taught the machine to behave like an intelligent being. And pretty much the same applies to swarm intelligence of a system which has to be "taught" and not just programmed.

(by Walther Ch. Zimmerli)

Text 12

Study the text. Be ready to speak about its main ideas.

Robotics as a Future Vision for Hypermodern Technologies

The robots of today are smart, but they are not smart enough. They have to act under pressure: Their employers always require higher and more complex performance.

There is especially one thing of what they have to be capable of: thinking. The almost unstoppable triumphal procession of the working machine ended up in stagnation during the past years. Even despite remarkable technical improvements, most of such systems are still comparatively dumb. For example, Car-O-bot can easily open a room door. But once the door is stocked, because the frame has got distorted, the machine becomes helpless. The same thing happens to a welding robot once the assembly line stops. Robots are not yet useful for practice. Robotics-research was focused far too long on the necessities of only a few industries. At that time people did not invest into the intelligence of robots, but into optimizing the environment. Now there are robots, built especially in order to be integrated into small and middle production processes. This new generation of robots is at least limitedly able to cooperate directly with human colleagues. But to enable such an improvement, the machines are required to perceive their environment, e.g. tools or instruments. One of the most important tasks is the precise proportioning of power. The dialogue between human being and a machine is hard working as well. But things that work in sterile and clean laboratories do not have to work on the outdoors. More and more objects and characteristics need to be included by the machine if its environment gets more and more complex. Increasing speed and stability are lowering precision and controllability. This is a cultural breakdown for the engineers, who usually try to control everything with precision.

The terms of “technique” and “technology” are used quite similar. Relating to my phenomenological-hermeneutical method, the following distinction is recommended: Technique refers to technical abilities and the produced artifacts as well as their use. Technology describes the technical knowledge and the teaching of technical knowledge (about technical courses of action and about operational sequences), and further the out coming machines and technological structures. Both kinds are interacting with each other and exist nowadays next to each other. I will call the sum of techniques and technologies the “technical world.” An adequate definition of the technique, which I, for further valuation, take as a basis even for the interaction of humans and machines, demonstrated in the description of the production cycle. It has got three aspects with two sides in each case: It includes (1) the construction and the production of instruments and works, as well as the use of instruments, (2) the use and the consumption of technical works and (3) the disposal and the recycling of technical works and of new products in terms of a closure of the circuitry. The two aspects are (1) producing and using in terms of human actions and (2) technical instruments in order to perceive works as describable physical, chemical and biological operations. The Production of something is a technical action in a proper sense, to use something refers to determined technical handling and to dispose of something refers to technical handling in a classical meaning. The subject of

Philosophy of Technology is technical and technical determined handling, since technical handling is performed to finally enable technical determined handling.

The subject of Philosophy of Technology is in the strict sense the mutual relation of technical handling and technical determined handling. Different technical potentials have to be seen as a result of the connection between technical handling on the one hand and technical determined handling on the other hand. The cycle of technical and technical determined handling, as different kinds of "know how," implies a dynamization of the concept of technical handling and a transformation of the different kinds of technical practice. The classical concept of *poiesis* and the *instrumental rationality* are no longer appropriate to the current technical reality.

The human handling of a technical artifact puts it into an anthropological context, into an anthropological potential. The human being is in possession of a handling knowledge, an implicit know how of the effect, which can be achieved by technical handling. This implicit knowledge occurs as individual knowledge within individuals, even in animals (e.g. the gull and the clam), but it does not occur as a systematic world knowledge. The world knowledge is the collected handling knowledge within the world including the own finiteness. The capability of human handling is related to the world, full of theories and sense.

(by Walther Ch. Zimmerli)

Text 13

Read the text and then comment.

The Different Cultural Robot-Traditions in Europe and Japan

The concept of the robot (as automat) belongs to the mechanical tradition of engineers, researchers (example: "Frankenstein") and of the working machine in Europe. The mechanism conceived as something unnatural, with the result that the mechanical automata had often developed a terrible independent existence.

Automata are working machines in Europe. They replace labour although it is high valued social good in Europe. Changes of our environment by autonomous intelligent technology (automation) could be larger than changes, which are triggered by the humanoid robot which is conceived as a human companion and partner. From a European point of view the more important issues are found in the automation and in the change of the paradigm of work. The robot in Japan, especially the humanoid robot, emerged from the tradition, from folk culture and from pre-scientific myths. As a matter of fact he has not such terrible independent existence like in Europe and is derived from a childlike scheme. Humanoid robots are therefore more popular and socially acceptable in Japan.

During the ancient times they were suggested to be freely deployable and controllable slaves called "androids." Hephaistos has forged Pandora through godly mission. Even Daidalos, artificial created human beings (in the sense of living statues) became traditional since the Greeks. The "Iron Maiden" of the tyrant Nabis of Sparta (200 B.C.) was even a real statue. Citizens who did not pay tribute got "hugged" and then speared by her stings if they would not pay on time. During medieval times there have been threatening and inflective statues. The mechanical clock and automatic mechanisms were discovered first at Byzantium and Arabia. The "Iron Man" by Albertus Magnus did appear to serve as his doorkeeper.

The 18th century has been the century of "androids," which occurred within various legends during the age of the mechanics (Volker 1994). The flutist was a system of bellows, driven by clock units. Pygmalion can be seen as a living statue (Volker 1994). Within the Greek mythology the forging goddess Hephaistos was responsible for creating artificial beings. Daidalos, the Attic master-builder, belongs to the fabulous mankind creators, as well. His inventions are already technically comprehensible. The term "android" relates to the Greek words "aner" ("man," "human being") and "eidos" ("look," "form," "shape") what stands for "The human copy." Admittedly, he was shaped first during the time of absolutism. During the 17th- and 18th-century the artistic clockmakers promoted the replication of the human being to new heights. But within the Industrial Revolution, the practical interests to create human like machines got lost for the engineers. Mary Shelley's literary character of "Frankenstein" is a counter movement to this. Shelley quotes a basic topic from the literary illustration of technology: the unpredictability of research and invention with cross natural borders (Drux 2001). These discussions are nowadays promoted, facing artificial life and expert systems. Especially the defeat of Kasparow in his match with the computer deep blue has caused a sensation. The computer's game appeared to be intuitively right, inventive and highly intelligent to Kasparow. What a human would have done for his feelings had been calculated through a machine. The world champion concludes that high quantity leads to quality at certain, at least in chess.

E.T.A. Hoffmann talks about "androids," what means humanlike beings. An artificial human being plays for example the main character in his work "Die Automate" from 1814. The "speaking Turk" is the protagonist, an automat, which is so artistically manufactured that it is impossible to find the source of its voices. The speaking Turk is adequately responding to questions by ingenious and appropriate answers in different languages. Automata are imitations of human beings, which are almost perfect if they are no longer to distinguish from the original. A certain kind of averseness towards the waxworks becomes apparent in the writings of E.T.A. Hoffmann, even if the instruments of the artists are very reasonable. The automaton and the mechanical orchestra of the professor are displaying the dead and numbness of the machines music. The mechanic is using his ability (art) for this adverse joy and not for the perfection of musical instruments even though the perfection of the musical instruments would lead to higher musical mechanisms. Natural noises and environmental music are put into one context. Hoffmann's conclusion is that the human being is not replaceable via technology. The automaton is not the right execution of technology. Hoffmann plays with the ancient and romantic motive: technology is limited. Technology should be used to build musical instruments, and therefore it is decreed as pure device. Technology has to be used and controlled by the human being. But the human being should not be replaced by technology. In E.T.A. Hoffmann's "Der Sandmann" is an "android" as well, same as in Ambroce Bierce's "Moxon's Master" and as in "Meister Zacharias" from "Le Docteur Ox" by Jule Vernes.

Robots, cyborgs and other "androids" are playing a special role in the science-fiction literature of the past decades. During the era of Reagan emerged a movement of massive anti-technological sentiment. It was caused by the Vietnam War, which just reverted into renewed optimism, while new technologies promised an economical strengthening (upturn). Models have been formulated in Star Wars where the scheme of a robot was transferred into a defence system. This led to a proceeding militarization of the universe. A cyborg contained subjectivity in the "theatre of mind." The movie "The Terminator" has been characteristic for that. Cyberspace is an artificial world within one computer or within a network of computers. It is the matter of an artificial intelligence without human corpus or body. The cyborg represents the abstraction and emotional distance, which is produced by technological media. Computers are also central in the movies "2001 – A Space Odyssey" and "War Games" from 1983. Machines can be obsessed, they can be constructed as servants and act like servants. But there is a counter-movement which assumes subjectivity for machines. In this way the cyborg can get rehabilitated. Such "android" commanders are for example displayed in the movie "Blade Runner," which is about "replicants."

(*by Bernhard Irrgang*)

Text 14

Read the text about a computer algebra system and outline its main ideas.

Computer algebra system

A computer algebra system (CAS) is any mathematical software with the ability to manipulate mathematical expressions in a way similar to the traditional manual computations of mathematicians and scientists. The development of the computer algebra systems in the second half of the 20th century is part of the discipline of "computer algebra" or "symbolic computation", which has spurred work in algorithms over mathematical objects such as polynomials.

Computer algebra systems may be divided into two classes: specialized and general-purpose. The specialized ones are devoted to a specific part of mathematics, such as number theory, group theory, or teaching of elementary mathematics.

General-purpose computer algebra systems aim to be useful to a user working in any scientific field that requires manipulation of mathematical expressions. To be useful, a general-purpose computer algebra system must include various features such as:

- a user interface allowing a user to enter and display mathematical formulas, typically from a keyboard, menu selections, mouse or stylus.

- a programming language and an interpreter (the result of a computation commonly has an unpredictable form and an unpredictable size; therefore user intervention is frequently needed),

- a simplifier, which is a rewrite system for simplifying mathematics formulas,

- a memory manager, including a garbage collector, needed by the huge size of the intermediate data, which may appear during a computation,

- an arbitrary-precision arithmetic, needed by the huge size of the integers that may occur,

- a large library of mathematical algorithms and special functions.

The library must not only provide for the needs of the users, but also the needs of the simplifier. For example, the computation of polynomial greatest common divisors is systematically used for the simplification of expressions involving fractions.

This large amount of required computer capabilities explains the small number of general-purpose computer algebra systems. The main ones are Axiom, Maxima, Magma, Maple, Mathematica and SageMath.

The development of computers has made possible the introduction of computer algebra systems for "doing mathematics". They are software systems able to perform mathematical operations formally.

These systems, such as Macsyma, Reduce, Derive, Maple, Mathematica, Matlab, Sage, can also be used on relatively small computers (PC), and with their help, we can transform complicated expressions, calculate derivatives and integrals, solve systems of equations, represent functions of one and of several variables graphically, etc. They can manipulate mathematical expressions, i.e., they can transform and simplify mathematical expressions according to mathematical rules if this is possible in closed form. They also provide a wide range of numerical solutions to required accuracy, and they can represent functional dependence between data sets graphically. Most computer algebra systems can import and export data. Besides a basic offer of definitions and procedures which are activated at every start of the system, most systems provide a large variety of libraries and program packages from special fields of mathematics, which can be loaded and activated on request. Computer algebra systems allow users to build up their own packages. However, the possibilities of computer algebra systems should not be overestimated.

For instance, Maxima is a system for the manipulation of symbolic and numerical expressions, including differentiation, integration, Taylor series, Laplace transforms, ordinary differential equations, systems of linear equations, polynomials, sets, lists, vectors, matrices and tensors. Maxima yields high precision numerical results by using exact fractions, arbitrary-precision integers and variable-precision floating-point numbers. Maxima can plot functions and data in two and three dimensions.

The Maxima source code can be compiled on many systems, including Windows, Linux, and MacOS X. The source code for all systems and precompiled binaries for Windows and Linux are available at the SourceForge file manager.

Computer algebra systems began to appear in the 1960s and evolved out of two quite different sources—the requirements of theoretical physicists and research into artificial intelligence. They have been extensively used in higher education. Many universities offer either specific courses on developing their use, or they implicitly expect students to use them for their course work. The companies that develop computer algebra systems have pushed to increase their prevalence among university and college programs.

(From *Wikipedia, the free encyclopedia*)

GRAMMAR REFERENCE

ENGLISH TENSES (ACTIVE VOICE)

	INDEFINITE	CONTINUOUS	PERFECT	PERFECT CONTINUOUS
	verb	**be + -ing**	**have + III form**	**have been + -ing**
PRESENT	**I/You/we/they ask** **He/she/it asks** *Repeated, customary action. *usually/generally* *always/never* *often/seldom* *sometimes* *Fact *Future action (to a timetable, schedule)	**am** **is asking** **are** *Action (process) going on at the present moment. *now, at present,* *at the moment* *Future action planned before	**have** **asked** **has** *Completed action connected with the present; result. *already/yet* *ever/never* *lately/recently* *this week/today* *by now*	**have** **been asking** **has** *Action (process) which began in the past and is still going on now. *for a month* *a long time* *since 5 o'clock* *how long* *since when*
PAST	**asked** **took** *Action (succession of actions) in the past. *yesterday* *last week* *3 days ago*	**was** **asking** **were** *Action (process) taking place at a given moment in the past. *at 5 yesterday* *from 5 to 6 yesterday* *for 3 days last week* *all day long* *the whole day* *when he came*	**had asked** * Action completed before a certain moment in the past *by 5 o'clock yesterday* *before he came* *by the end of last year* *At sequence of tenses.	**had been asking** *Action (process) which began before a definite moment in the past and was still going at the moment. *He had been working for 2 hours, when my brother came.*
FUTURE	**will ask** *Future action. *tomorrow* *next week* *in 3 days* *in 2037*	**will be asking** *Action (process) taking place at a given moment in the future. *at 5 tomorrow* *from 5 to 6 tomorrow* *for 3 days next week* *all day long tomorrow* *when he comes*	**will have asked** *Action completed before a definite moment in the future. *by 5 o'clock tomorrow* *when he comes* *by next summer*	**will have been asking** *Action (process) which will begin before a definite moment in the future and will be going on at that moment. *When you come, I'll have been working for 2 hours.*

ENGLISH TENSES (PASSIVE VOICE)

	INDEFINITE	CONTINUOUS	PERFECT
	to be + III form	**to be being + III form**	**to have been + III form**
PRESENT	*Customary action *He **is answered** the questions every day.*	*Action (process) taking place at a given moment in the past. *The cake **is being cooked** now.*	*Completed action connected with the present. *The work **has been done** today.*
PAST	*Action (succession of actions) in the past. *He **was answered** the questions yesterday. They **were taken** home yesterday.*	*Action (process) taking place at a given moment in the past. *The cake **was being cooked** the whole evening.*	* Action completed before a certain moment in the past *He said his car **had been bought** yesterday. The work **had been done** by 5 pm yesterday.*
FUTURE	*Future action *I **will be taken** there tomorrow.*		*Action completed before a definite moment in the future. *The work **will have been done** by 5 pm tomorrow.*
FUTURE-in-the PAST	*He said that I **would be taken** there the next day.*		*He said that the work **would have been done** by 5 pm the next day.*

THE INFINITIVE

The Infinitive is a non-finite form of the verb in English. It consists of the base form of the verb with the particle "to": to do; to go; to connect; to take; to break; to find.

The infinitive has some properties of the verb. The infinitive names an action (to drive a car) or state (to be sick), but cannot show person, number, or mood. The infinitive has active and passive forms (to take; to be taken) and can express voice and time, though in a rather limited way.

	Active	Passive
Present Infinitive	to ask*	to be asked*
Present Progressive Infinitive	to be asking	-
Perfect Infinitive	to have asked	to have been asked
Perfect Progressive Infinitive	to have been asking	-

The Use of the Infinitive

The Infinitive has the following functions in the sentence:

1. The subject

When the Infinitive is used as the Subject, it is usually placed after the predicate and the sentence is introduced by the introductory it.

It is very hard *to work* under such conditions.

However the Infinitive in this function can occur at the beginning of the sentence too.

To collect all this information for such a short period of time would be completely impossible!

To quit now would be a mistake.

2. A part of the Compound Predicate

a. Part of the Compound Nominal Predicate.

The plan was *to go* to the dean.

The important thing is *to repeat* all the rules.

Note: There is an interesting model where both the subject and the predicate are expressed by the Infinitive.

To love is *to believe*.

To know is *to understand*.

The Infinitive is generally preceded by the particle *to* in this function and in most cases expresses an action which follows that of the link-verb.

The link-verb in sentences with the infinitive as predicative is always *to be*.

E.g. Dr Johnson's idea was *to turn* his native town into a health resort.

Her task is *to get* the required information.

The infinitive in this function always has appositive meaning, i.e. it explains the meaning of the subject of the sentence. Hence, sentences of this kind have the following structural peculiarity – the subject of the sentence can be expressed only by a limited number of nouns. The most commonly occurring of these nouns are: *advice, aim, answer*, *approach, desire, difficulty, duty, function, idea, intention, job, method,* *need, objective, plan, problem, purpose, reason, task, thing, way*, *wish* and some others.

b. Part of the Compound Verbal Modal Predicate

You should *have told* me about it yesterday.

I must *do* it at once.

c. Part of the Compound Verbal Aspect Predicate

She began *to cry*.

3. An object

I hate *to ask* people such questions.

They promised *to come* in time.

Note: Sometimes the introductory object it is used.

He found it difficult *to spot* her in the crowd.

4. An attribute

The captain was the last *to leave* the ship.

Here is an article *to be translated* at once.

Notes:

a. The Infinitive is used attributively often acquires some modal meaning - the meaning of obligation or that of possibility.

This is a book *to read* before going to bed.

(Это книга, которую можно читать перед сном.)

She gave him some documents *to be signed* immediately.

(Она дала ему документы, которые надо было немедленно подписать.)

He is not a man *to make* a woman happy.

(Он не тот человек, который может сделать женщину счастливой.)

b. When the meaning is passive, the active form of the Infinitive is often used instead of the passive one here.

There is no time *to be lost* = There is no time *to lose*.

5. An adverbial modifier

a. Adverbial modifier of purpose, often with the conjunctions **in order** and **so as**, especially when the meaning is negative.

She put on her coat in order *not to catch* cold.

b. Adverbial modifier of result after the adverbs **too**, **enough** and **sufficiently**.

Molecules are too small *to see* with an eye.

c. Adverbial modifier of comparison with conjunctions **as if**, **as though**.

She began to talk loudly as if **to show** that she was not upset.

d. Adverbial modifier of attendant circumstances.

An astronaut leaves the Earth and returns fifty years later *to find* his twin-brother quite an old man while he is still in the prime of his life.

6. A parenthesis (in the word-combinations: to tell the truth, to begin with, to sum up, to be more exact, etc.)

To begin with we have not enough money to buy it.

To tell the truth, I was disappointed by that letter.

7. A part of the complex object, the complex subject with the infinitive.

a. the complex object

The complex object consists of a noun in the common case or a pronoun in the objective case and an infinitive.

The complex object is used after:

(1) the verbs of physical perception (to hear, to see, to feel, to watch, etc.)

I saw him *cross* the street.

After these verbs the infinitive is used without the particle **to**.

(2) the verbs of mental perception (to think, to consider, to remember, to know, to find, etc.)

THE PRESENT PARTICIPLE AND ITS FUNCTIONS

The form of a verb that ends in *–ing* is called the Present Participle. You can make the present participle of the verb by adding *–ing* to the infinitive.

Verbs that end in a silent *e,* drop this *e* when you add –ing *e.g*. write – writing; hope – hoping; take – taking.

Some verbs double the last letter, e.g. stop – stopping; get – getting; put – putting.

Verbs ending in *ie,* change this to *y*, *e.g*. lie – lying, tie – tying.

Present Participle has the following functions in the sentence:

1. Present Participle as an attribute (may also function as an adjective, especially in attributive use)

That was a terrifying experience.

Here is the telegram announcing his arrival.

2. The present participle is used with the verb *to be* to form the Continuous Tenses (Progressive Tenses).

The engineer is carrying out the experiment involving the use of nonlinear process models.

3. The present participle as an adverbial modifier

a. The present participle can be used as an adverbial modifier of time.

Doing his study she found a note under his desk.

As an adverbial modifier of time the present participle may be preceded by the conjunctions **when** and **while**. These conjunctions are used here when the actions are simultaneous.

When crossing a street be careful.

b. The present participle (Participle I) can be used as an adverbial modifier of cause.

Having rich parents she could afford to spend a summer holiday in Europe.

c. The present participle can be used as an adverbial modifier of comparison with the conjunctions **as if**, **as though** (как будто, как если бы).

She raised her hand as if trying to stop him.

d. The present participle can be used as an adverbial modifier of manner or attending circumstances.

She worked in the garden singing merely.

For a moment we stood silently looking at one another.

4. The present participle can be used as parenthesis (вводное слово).

Frankly speaking, I am not delighted with his choice.

5. The present participle can be used as a predicative (the nominal part of the compound nominal predicate).

The effect of his words was terrifying.

6. The present participle is used in the Objective Participial construction.

When used in the Objective Participial construction Present Participle performs the function of part of a complex object.

I saw him crossing the street.

7. The present participle is used in the Subjective Participial construction.

When used in the Subjective Participial construction Present Participle performs the function of part of the compound verbal modal predicate of special type.

He was heard pacing his room upstairs at night.

THE PAST PARTICIPLE AND ITS FUNCTIONS

Forming the Past Participle (Regular Verbs)

The past participle indicates past or completed action or time. It is often called the 'ed' form as it is formed by adding d or ed, to the base form of regular verbs, however it is also formed in various other ways for irregular verbs.

If it's a regular verb, the past participle is the same as the simple past tense. Add "ed" to most verbs:

call > called
invent > invented

If a verb of one syllable ends in consonant-vowel-consonant, double the final consonant and add "ed":

chat > chatted

stop > stopped

If last syllable of a longer verb is stressed and ends in consonant-vowel-consonant, double the last consonant and add "ed":

occur > occurred

prefer > preferred

If the verb ends "e," just add "d":

use > used

live > lived

If the verb ends in consonant + "y", change the "y" to an "i" and add "ed":

carry > carried

rely > relied

Forming the Past Participle (Irregular Verbs)

If it's an irregular verb, the past participle is formed in all sorts of different ways. Here are some examples:

arise > arisen

catch > caught

choose > chosen

know > known

take > taken

You just have to learn them.

Past Participle has the following functions in the sentence:

1. It can be used as *an attribute*.

Look at that *broken* chair.

2. It can be used to form a verb phrase as part of *the present perfect tense*.

I have learnt English. (Learnt is part of the verb phrase 'have learnt')

It can be used to form *the passive voice*.

The experiment was carried out yesterday.

3. It can be used as *an adverbial modifier*.

When asked she always helped me.

THE GERUND
Its Forms and Functions

Gerunds are words that are formed with verbs but act as nouns. They're very easy to spot, since every gerund is a verb with *-ing* tacked to its tail.

The gerund looks exactly the same as a present participle, but it is useful to understand the difference between the two. The gerund always has the same function as a noun (although it looks like a verb).

A gerund can be the subject or the object of a verb or it may be governed by a preposition.

If a gerund is formed from a transitive verb it can take an object.

Gerund	Active	Passive
Indefinite	reading	being read
She likes reading. She likes being read.		
Perfect	having read	having been read
Thank you for having helped me. I remember having been asked this question.		

Functions	Examples
Subject	Reading books is useful. Smoking is harmful. Reading love stories made her cry.
Predicative	His hobby is collecting stamps. The main thing is getting there in time. Seeing is believing.
Part of a Compound Verbal Predicate	She went on reading. She stopped smoking.
Direct Object	I couldn't avoid speaking to her. The film is worth seeing. I don't mind waiting.
Prepositional Object	I am fond of reading. He insisted on doing the work himself. I don't like his habit of making people wait.
Attribute	All liked the idea of going to the country. I have no intention of discussing this question. There are different ways of solving this problem. She liked the idea of studying software engineering.
Adverbial Modifier	On entering the room he came up to me. He left the room without saying a word. Excuse me for being so late.

THE GERUND AFTER PREPOSITIONS

The gerund must be used when a verb comes after a preposition. This is also true of certain expressions ending in a preposition, for example the expressions in spite of and there's no point in.

In spite of missing the train, we arrived on time.

THE GERUND AFTER PHRASAL VERBS

Phrasal verbs are composed of a verb + preposition or adverb.

When will you give up smoking?

THE GERUND IN COMPOUND NOUNS

In compound nouns using the gerund, it is clear that the meaning is that of a noun, not of a continuous verb. For example, with the word "swimming pool" it is a pool for swimming in, it is not a pool that is swimming.

I am giving Sally a driving lesson.

THE GERUND AFTER SOME EXPRESSIONS

The gerund is necessary after the expressions can't help, can't stand, to be worth, and it's no use.

It might be worth phoning the station to check the time of the train.

ENGLISH PRONOUNS

Personal Pronouns		Possessive Adjectives and Pronouns		Reflexive Pronouns
subject form	object form	possessive adjective	possessive pronoun	
I	me	my	mine	myself
you	you	your	yours	yourself
he	him	his	his	himself
she	her	her	hers	herself
it	it	its	its	itself
we	us	our	ours	ourselves
you	you	your	yours	yourselves
they	them	their	theirs	themselves

ADJECTIVES: DEGREES OF COMPARISON

Positive Degree: An adjective is said to be in the positive degree when there is no comparison. Adjectives change in form when they show comparison.

COMPARATIVE ADJECTIVES

Comparative adjectives are used to compare differences between the two objects they modify (larger, smaller, faster, higher). They are used in sentences where two nouns are compared, in this pattern:

Noun (subject) + verb + comparative adjective + than + noun (object).

The second item of comparison can be omitted if it is clear from the context (final example below).

EXAMPLES:

My house is larger than hers.

This box is smaller than the one I lost.

Jim and Jack are both my friends, but I like Jack better. ("than Jim" is understood)

SUPERLATIVE ADJECTIVES

Superlative adjectives are used to describe an object which is at the upper or lower limit of a quality (the tallest, the smallest, the fastest, the highest). They are used in sentences where a subject is compared to a group of objects. We use the article 'the' before the superlative degrees.

Noun (subject) + verb + the + superlative adjective + noun (object).

The group that is being compared with can be omitted if it is clear from the context (final example below).

EXAMPLES:

My house is the largest one in our neighborhood.

This is the smallest box I've ever seen.

We all threw our rocks at the same time. My rock flew the highest. ("of all the rocks" is understood)

Formation of Comparative & Superlative Degrees of Adjectives

Forming comparatives and superlatives is easy. The form depends on the number of syllables in the original adjective.

Adjectives usually form their comparative and superlative degrees:

1) by addition of '-er' and '-est' to the positive degree

POSITIVE	COMPARATIVE	SUPERLATIVE
bright	brighter	brightest
black	blacker	blackest
bold	bolder	boldest
clever	cleverer	cleverest
cold	colder	coldest
fast	faster	fastest
great	greater	greatest
high	higher	highest
kind	kinder	kindest
long	longer	longest
rich	richer	richest
small	smaller	smallest
strong	stronger	strongest
sweet	sweeter	sweetest

tall	taller	tallest
thick	thicker	thickest
young	younger	youngest

2) by addition of '-r' and '-st' to the positive degree ending in 'e'

POSITIVE	COMPARATIVE	SUPERLATIVE
brave	braver	bravest
fine	finer	finest
large	larger	largest
nice	nicer	nicest
noble	nobler	noblest
pale	paler	palest
simple	simpler	simplest
wise	wiser	wisest
white	whiter	whitest

3) When the positive ends in 'y' and has a consonant before it, we change 'y' into 'i' and then add 'er' and 'est'.
By deleting the final ‘y’ and adding ‘ier’ and ‘iest’

POSITIVE	COMPARATIVE	SUPERLATIVE
costly	costlier	costliest
dry	drier	driest
easy	easier	easiest
happy	happier	happiest
heavy	heavier	heaviest
lazy	lasier	lasiest
mercy	mercier	merciest
wealthy	wealthier	wealthiest

4) when the positive degree ends in a consonant with a vowel before it, we double the consonant and then add '-er' and '-est'

POSITIVE	COMPARATIVE	SUPERLATIVE
big	bigger	biggest
dim	dimmer	dimmest
fat	fatter	fattest
hot	hotter	hottest
thin	thinner	thinnest

5) by addition of '-er' and '-est' to the positive degree when it ends in '-y'

POSITIVE	COMPARATIVE	SUPERLATIVE
gay	gayer	gayest
grey	greyer	greyest

6) by placing 'more' and 'most' before the positive form. The adjectives that do this are usually rather long words. All adjectives of three or more syllables, e.g. ex-cit-ing, un-for-tu-nate, are compared like this.

POSITIVE	COMPARATIVE	SUPERLATIVE
active	more active	most active
attractive	more attractive	most attractive
beautiful	more beautiful	most beautiful
brilliant	more brilliant	most brilliant
careful	more careful	most careful
courageous	more courageous	most courageous
cunning	more cunning	most cunning
difficult	more difficult	most difficult
famous	more famous	most famous
faithful	more faithful	most faithful
important	more important	most important
proper	more proper	most proper
popular	more popular	most popular
splendid	more splendid	most splendid
suitable	more suitable	most suitable

Some adjectives do not follow any of the rules explained earlier. They are compared irregularly. Here are the different forms of such adjectives.

POSITIVE	COMPARATIVE	SUPERLATIVE
bad	worse	worst
evil	worse	worst
good	better	best
ill	worse	worst
far	farther	farthest
well	better	best
late	later	latest (time)
late	later	last (position)
little	less	least
much	more	most
many	more	most

near	nearer	nearest
old	older	oldest
old	elder	eldest

EXAMPLES:
Today is the worst day I've had in a long time.
You play tennis better than I do.
This is the least expensive sweater in the store.
This sweater is less expensive than that one.
I ran pretty far yesterday, but I ran even farther today.

APPENDIX I
IRREGULAR VERBS

Infinitive	Past Indefinite	Past Participle	Translation
arise	arose	arisen	возникать, появляться
awake	awoke / awaked	awoke / awaked	будить; просыпаться
be	was / were	been	быть
bear	bore	born(e)	носить, выносить
beat	beat	beaten	бить
become	became	become	становиться
begin	began	begun	начинать(ся)
bind	bound	bound	связывать, обязывать
bite	bit	bitten	кусать
blow	blew	blown	дуть
break	broke	broken	ломать
bring	brought	brought	приносить
broadcast	broadcast	broadcast	передавать по радио (телевидению)
build	built	built	строить
burn	burnt	burnt	гореть, жечь
buy	bought	bought	покупать
catch	caught	caught	ловить, схватывать
choose	chose	chosen	выбирать
come	came	come	приходить
cost	cost	cost	стоить
cut	cut	cut	резать
do	did	done	делать
draw	drew	drawn	тащить; рисовать; выводить (заключение)
drink	drank	drunk	пить
drive	drove	driven	гнать; везти; ехать
eat	ate	eaten	есть (принимать пищу)
fall	fell	fallen	падать
feed	fed	fed	питать, подавать
feel	felt	felt	чувствовать
flee	fled	fled	бежать, спасаться бегством
fight	fought	fought	бороться, сражаться
find	found	found	находить
fly	flew	flown	летать
forbid	forbade	forbidden	запрещать
forget	forgot	forgotten	забывать

forgive	forgave	forgiven	прощать
freeze	froze	frozen	замерзать, замораживать
get	got	got	получать; становиться
give	gave	given	давать
go	went	gone	идти, ехать
grow	grew	grown	расти, выращивать
hang	hung	hung	висеть, вешать
have	had	had	иметь
hear	heard	heard	слышать
hide	hid	hid / hidden	прятать
hit	hit	hit	ударять; поражать
hold	held	held	держать
hurt	hurt	hurt	повредить, ушибать
keep	kept	kept	держать, хранить
know	knew	known	знать
lay	laid	laid	класть
lead	led	led	вести
learn	learnt / learned	learnt / learned	учиться
leave	left	left	оставлять, уезжать
lie	lay	lain	лежать
light	lit / lighted	lit / lighted	зажигать, освещать
lose	lost	lost	терять
make	made	made	делать; заставлять
meet	met	met	встречать
pay	paid	paid	платить
put	put	put	класть
read	read	read	читать
ride	rode	ridden	ездить верхом
ring	rang	rung	звонить; звенеть
rise	rose	risen	подниматься
run	ran	run	бежать
say	said	said	говорить, сказать
see	saw	seen	видеть
seek	sought	sought	искать, разыскивать; стараться
sell	sold	sold	продавать
set	set	set	устанавливать, располагать
send	sent	sent	посылать
shine	shone	shone	сиять, светить
show	showed	shown	показывать
shut	shut	shut	закрывать
sit	sat	sat	сидеть
sleep	slept	slept	спать

speak	spoke	spoken	говорить
speed	sped	sped	спешить; ускорять
stand	stood	stood	стоять
string	strung	strung	привязывать
sweep	swept	swept	мести
swim	swam	swum	плавать
take	took	taken	брать
teach	taught	taught	обучать, учить
tell	told	told	рассказывать
think	thought	thought	думать
throw	threw	thrown	бросать
understand	understood	understood	понимать
wake	woke / waked	woken / waked	будить; просыпаться
wear	wore	worn	носить
win	won	won	выигрывать
write	wrote	written	писать

VOCABULARY

A

abstraction [æb'strækʃn] – абстракция
abutment [ə'bʌtmənt] – граница
accommodate *v.* [ə'kɒmədeɪt] – приспосабливать
accurate ['ækjʊrɪt] – точный
adaptive [ə'dæptɪv] – адаптивный, приспосабливающийся
adder ['ædə] – сумматор
adjacent [ə'ʤeɪsənt] – примыкающий, смежный
adjust *v.* [ə'ʤʌst] – регулировать
administer *v.* [əd'mɪnɪstə] – управлять
advantage [ədv'ɑːntɪʤ] – преимущество
aliasing ['eɪlɪæsɪŋ] – наложение спектров
allocate *v.* ['æləʊkeɪt] – распределять, размещать
alteration [ˌɔːltə'reɪʃ(ə)n] – изменение
ambient ['æmbɪənt] – окружающий
amplification [ˌæmplɪfɪ'keɪʃ(ə)n] – усиление
amplify *v.* ['æmplɪfaɪ] – усиливать
apparent [ə'pærənt] – очевидный
appliance [ə'plaɪəns] – прибор, устройство
approach [ə'prəʊʧ] – подход
approximate *v.* [ə'prɔksɪmɪt] – приближаться, приблизительно равняться
arrange *v.* [ə'reɪnʤ] – организовать, устраивать
array [ə'reɪ] – массив, матрица
artificial [ˌɑːtɪ'fɪʃ(ə)l] – искусственный
assemble *v.* [ə'sɛmbl] – собирать, составлять
assembly [ə'sɛmbli] – сборка
assertion [ə'sɜːʃ(ə)n] – утверждение
assign *v.* [ə'saɪn] – присвоить
asterisk ['æstərɪsk] – звёздочка (знак сноски)
attend *v.* [ə'tɛnd] – обслуживать, сопровождать
average ['ævərɪʤ] – средний
avoid *v.* [ə'vɔɪd] – избегать

B

background [ˈbækgraund] – фон; происхождение; предпосылки
bandwidth [ˈbændwɪdθ] – пропускная способность
binary [ˈbaɪnərɪ] – двоичный
boost *v.* [buːst] – повышать, способствовать увеличению
border [ˈbɔːdə] – граница
bottleneck [ˈbɒtlnɛk] – узкое место (горлышко бутылки)
bound *v.* [baʊnd] – связывать, ограничивать
building-block [ˈbɪldɪŋ-blɒk] – структурный элемент; стандартный блок

C

capitalize *v.* [kəˈpɪtəlaɪz] – печатать или писать прописными буквами
cardinal [ˈkɑːdɪnl] – количественный; кардинальный; количественное число
carry out *v.* [ˈkæri aʊt] – выполнять
cause–effect [kɔːz-ɪˈfɛkt] – причинно-следственный
cellular [ˈseljulə] – сотовая связь; сотовый
circuit [ˈsɜːkɪt] – цепь, контур; схема
circuitry [ˈsɜːkɪtri] – схема
circumference [səˈkʌmfərəns] – окружность; периметр
clock [ˈkl ɔk] – часы
clock speed [ˈkl ɔk spiːd]– тактовая частота
coarse [kɔːs] – грубый; необработанный
combustion [kəmˈbʌsʧən] – сгорание
complexity [kəmˈplɛksɪti] – сложность
complicated [ˈkɒmplɪkeɪtɪd] – сложный, запутанный
computational [kɒmpjʊˈteɪʃənl] – вычислительный
computing [kəmˈpjuːtɪŋ] – вычисление
concurrency [kənˈkʌrənsɪ] – совпадение, согласованность
confine *v.* [kənˈfaɪn] – ограничивать
conform *v.* [kənˈfɔːm] – соответствовать
congestion [kənˈʤɛsʧən] – перегруженность
connection [kəˈnɛkʃən] – соединение, связь
conservation [ˌkɒnsə(ː)ˈveɪʃən] – сохранение, сбережение
consistent [kənˈsɪstənt] – последовательный, совместимый, согласующийся
consumption [kənˈsʌm(p)ʃən] – потребление

containment [kənˈteɪnmənt] – сдерживание
conventional [kənˈvɛnʃənl] – обычный, традиционный; условный
convergence [kənˈvɜːʤəns] – сходимость, конвергенция, сближение
core [kɔː] – ядро
corrupt *v.* [kəˈrʌpt] – искажать
cost [kɒst] – показатель
count *v.* [kaʊnt] – подсчитывать
count *n.* [kaʊnt] – отсчёт
~ repeat count – повторный отсчёт
counter [ˈkaʊntə] – счётчик
counterpart [ˈkauntəpɑːt] – дубликат

D

deadlock [ˈdɛdlɒk] – безвыходное положение; тупик
decimal [ˈdesɪməl] – десятичный
decomposition [ˌdiːkɒmpəˈzɪʃən] – разложение, распад
delay [dɪ'leɪ] – задержка
depletion [dɪ'pliːʃən] – истощение
deposit *v.* [dɪ'pɔzɪt] – осаждать
derivative [dɪ'rɪvətɪv] – производное; производная функция
disable *v.* [dɪs'eɪbl] – отключить
discrete [dɪsˈkriːt] – дискретный; отдельный
dichotomy [daɪ'kɒtəmi] – последовательное деление на две части; дихотомия
digitize *v.* ['dɪʤɪtaɪz] – оцифровать, преобразовывать в цифровую форму
disadvantage [ˌdɪsəd'vɑːntɪʤ] – недостаток, вред
distinct [dɪs'tɪŋkt] – отчётливый определённый
distinguish *v.* [dɪs'tɪŋgwɪʃ] – различать
distribution [ˌdɪstrɪ'bjuːʃən] – распределение, распространение
disturbance [dɪs'tɜːbəns] – нарушение
domain [dəʊ'meɪn] – домен; область
dope *v.* [dəʊp] – легировать
dummy ['dʌmi] – фиктивный
duration [djʊə'reɪʃən] – продолжительность

E

eigenvector ['aɪgənˈvɛktər] – собственный вектор
elaborate [ɪ'læbərɪt] – продуманный; тщательно разработанный

elapse *v.* [ɪ'læps] – истекать, проходить
eliminate *v.* [ɪ'lɪmɪneɪt] – устранить
embed *v.* [ɪm'bɛd] – встраивать
embody *v.* [ɪm'bɒdi] – воплощать
entity ['ɛntɪti] – объект; сущность
environment [ɪn'vaɪərənmənt] – окружающая среда
equation [ɪ'kweɪʃən] – уравнение
estimate ['ɛstɪmɪt] – оценка; смета
estimator ['ɛstɪmeɪtə] – оценочная функция; оценщик
etch *v.* [etʃ] – вытравливать
evaluate *v.* [ɪ'væljʊeɪt] – оценивать
evolve *v.* [ɪ'vɔlv] – развивать(ся)
excessive [ɪk'sɛsɪv] – чрезмерный, излишний
execute *v.* ['eksɪkjuːt] – выполнять, исполнять, осуществлять, совершать
expedited ['ɛkspɪdaɪtɪd] – ускоренный
expire *v.* [ɪks'paɪə] – истекать, кончаться
explicit [ɪks'plɪsɪt] – точный, явный
exponential [ˌɛkspəʊ'nɛnʧəl] – экспоненциальный, показательный

F

facility [fə'sɪlɪtɪ] – установка, устройство; возможность, способность
factor ['fæktə] – фактор; коэффициент; множитель
failure ['feɪljə] – отказ, сбой
fatigue *v.* [fə'tiːg] – изнурять
feasible ['fiːzəbl] – выполнимый
feat [fiːt] – подвиг; проявление большого искусства
feedback ['fiːdbæk] – обратная связь
ferroelectric ['fɛrəʊ ɪ'lɛktrɪk] – сегнетоэлектрический
fetch *v.* [feʧ] – получить, извлекать
fidelity [fɪ'dɛlɪti] – точность
fit *v.* [fɪt] – соответствовать, приспосабливать
flash [flæʃ] – вспышка; короткий кадр
forecasting ['fɔːkaːstɪŋ] – прогнозирование
formidable ['fɔːmɪdəbl] – огромный
forwarding ['fɔːwədɪŋ] – пересылка
fraction [frækʃn] – дробь
frequency ['friːkwənsɪ] – частота

fulfill [fʊl'fɪl] *v.*– выполнять

full-scale ['fʊl'skeɪl] – в натуральную величину

G

general-purpose ['ʤɛnərəl-'pɜːpəs] – многоцелевой, универсальный; общего назначения

H

halt [hɔːlt] *v.* – останавливать

hard-wired [hɑːd-'waɪəd] – аппаратно-реализованный; жёстко-проводной

hazardous ['hæzədəs] – опасный, рискованный

humidity [hjuː'mɪdɪtɪ] – влажность

I

impair *v.* [ɪm'peə] – ухудшать, ослаблять

implantable [ɪm'plɑːntəbl] – вживляемый, имплантируемый

implementation [ˌɪmplɪmɛn'teɪʃən] – реализация; осуществление; выполнение

incompatibility [ˌɪnkəmˌpætə'bɪlɪti] – несовместимость

infeasible [ɪn'fiːzəbl] – невыполнимый; неосуществимый

insertion [ɪn'sɜːʃən] – вставка

instantaneous [ˌɪnstən'teɪniəs] – мгновенный

instantiations [ˌɪnst(ə)ntɪ'eɪʃənz] – конкретизации

integrated-circuit ['ɪntɪgreɪtɪd-'sɜːkɪt] – интегральная схема

integer ['ɪntɪʤə] – целое число

interconnection [ˌɪntə(ː)kə'nɛkʃən] – взаимосвязь, соединение

interoperable [ˌɪntə(ː)'ɒpərəbl] – совместимый

interrelation [ˌɪntə(ː)rɪ'leɪʃən] – взаимосвязь

interrupt [ˌɪntə'rʌpt] – *n.* прерывание; *v.* прерывать

intertwine *v.* [ˌɪntə(ː)'twaɪn] – сплетаться

intrinsically [ɪn'trɪnsɪk(ə)li] – внутренне; свойственно

invariant [ɪn'veərɪənt] – инвариантный, неизменный

invention [ɪn'vɛnʃən] – изобретение

investigate *v.* [ɪn'vɛstɪgeɪt] – исследовать

J

jig [ʤɪg] – зажимное приспособление

jitter ['ʤɪtə] – дрожание

join *v.* [ʤɔɪn] – соединять, присоединить

justifiable ['ʤʌstɪfaɪəbl] – допустимый
justify *v.* ['ʤʌstɪfaɪ] – обосновывать, подтверждать

L

label [leɪbl] – метка, ярлык
layout ['leɪaut] – расположение
length [lɛŋθ] – длина
level ['lɛvl] – уровень
load [ləʊd] – нагрузка
loop [luːp] – цикл
low pass filter [ləʊ pɑːs 'fɪltə] – фильтр нижних частот

M

map *v.* [mæp] – отображать
measurement ['mɛʒəmənt] – измерение
mechatronics [mɪ'kæ'trɒnɪks] – мехатроника
meter ['miːtə] – измерять
microcontroller ['maɪkrəʊkən'trəʊlə] – микроконтроллер
myriad ['mɪrɪəd] – несметный, бесчисленный; несметное число
memory ['memərɪ] – память
motive *v.* ['məʊtɪv] – побуждать
multiplicative [ˌmʌltɪ'plɪkətɪv] – мультипликативный
multiply *v.* ['mʌltɪplaɪ] – увеличиваться, умножать

N

necessitate *v.* [nɪ'sɛsɪteɪt] – вызывать необходимость; вынуждать
negligible ['nɛglɪʤəbl] – незначительный, не принимаемый в расчёт
node [nəʊd] – узел
notation [nəʊ'teɪʃn] – система счисления, представление; нотация

O

obsolete ['ɒbsəliːt] – устарелый
obtain *v.* [əb'teɪn] – получать
occupy *v.* ['ɒkjʊpaɪ] – занимать
one-shot mode [wʌn-ʃɒt məʊd] – однократный режим
open-loop ['əʊpən-luːp] – открытый цикл
originate *v.* [ə'rɪʤɪneɪt] – происходить; возникать

oscillator [ˈɒsɪleɪtə] – генератор, осциллятор

outline [ˈaʊtlaɪn] – план, схема

overcome *v.* [ˌəʊvəˈkʌm] – преодолеть

overestimate *v.* [ˌəʊvəˈrɛstɪmeɪt] – переоценивать
overlap *v.* ['əuvəlæp] – перекрывать; накладываться

P

package ['pækɪʤ] – пакет
partitioning [pɑː'tɪʃənɪŋ] – разделение

payload [ˈpeɪləʊd] – полезная нагрузка

perform *v.* [pəˈfɔːm] – выполнять

performance [pəˈfɔːməns] – производительность; выполнение; характеристика; эксплуатационные качества
pervasive [pəː 'veɪsɪv] – распространяющийся

photomask [ˌfəʊtəʊˈmɑːsk] – фотошаблон
planar ['pleɪnə] – плоскостной
polynomial [ˌpɒlɪ'nəʊmiəl] – многочлен
preparatory [prɪ'pærətəri] – подготовительный
precise [prɪ'saɪz] – точный

precursor [pri(ː)ˈkɜːsə] – предшествующий продукт; предшественник
printed board ['prɪntɪd bɔːd] – печатная плата

project *v.* [ˈprɒʤɛkt] – отражать, проецировать

property [ˈprɒpəti] – свойство

proximity [prɔkˈsɪmɪtɪ] – близость

Q

quantify *v.* ['kwɒntɪfaɪ] – определять количество
quantize *v.* [kwɒntaɪz] – квантовать

quantum information [ˈkwɒntəm ˌɪnfəˈmeɪʃən] – квантовая (количественная) информация
query ['kwɪəri] – запрос
queue [kjuː] – очередь

R

ramp [ræmp] – наклонная плоскость

rectangular [rɛkˈtæŋgjʊlə] – прямоугольный
redundant [rɪ'dʌndənt] – избыточный
refinement [rɪ'faɪnmənt] – улучшение, обработка

reject *v.* [rɪ'ʤɛkt] – отклонять, отвергать
relational [rɪ'leɪʃənl] – реляционный, относительный
reliability [rɪˌlaɪə'bɪlɪti] – надёжность
remark *v.* [rɪ'mɑːk] – отмечать
repetitious [ˌrɛpɪ'tɪʃəs] – без конца повторяющийся
replicate *v.* ['rɛplɪkeɪt] – копировать, повторять
replicative ['rɛplɪkeɪtɪv] – репликационный
representation [reprɪzen'teɪʃn] – представление
reproducible [ˌriːprə'djuːsəbl] – воспроизводимый
resemble *v.* [rɪ'zɛmbl] – быть похожим
resilience [rɪ'zɪlɪəns] – упругость; эластичность
resolution [ˌrɛzə'luːʃən] – разрешающая способность
resource [rɪ'sɔːs] – ресурс
response [rɪs'pɒns] – ответ, реакция; отклик
restriction [rɪs'trɪkʃən] – ограничение
resultant [rɪ'zʌltənt] – результирующий, получающийся в результате
retain *v.* [rɪ'teɪn] – сохранять, удерживать
retrieval [rɪ'triːvəl] – поиск
reveal *v.* [rɪ'viːl] – показывать, раскрывать
reverse [rɪ'vɜːs] – обратный
robotics [rəʊ'bɒtɪks] – робототехника
robust [rəʊ'bʌst] – крепкий, прочный
routine [ruːt'iːn] – подпрограмма
run *v.* [rʌn] (ran; run) – управлять, запускать

S

sample ['sɑːmpl] – *v.* отбирать образцы; *n.* выборка
sampling ['sɑːmplɪŋ] – дискретизация, отбор образцов
sawtooth ['sɔːtuːθ] – пилообразный (*напр.* волна)
scalability [skeɪlə'bɪlɪti] – масштабируемость
scale [skeɪl] – масштаб, шкала; уровень
search engine [sɜːʧ 'ɛnʤɪn] – поисковая система
self-contained [sɛlf-kən'teɪnd] – автономный
semiconductor [ˌsɛmɪkən'dʌktə] – полупроводник
separate ['sɛprɪt] – отдельный
sequence ['siːkwəns] – последовательность

set aside [ə'saɪd] *v.* – не принимать во внимание; не учитывать, пренебрегать
set forth [fɔːθ] *v.* – излагать, формулировать
setpoint ['sɛtpɔɪnt] – заданное значение
shell [ʃɛl] – оболочка, корпус
silicon ['sɪlɪkən] – кремний
simulation [ˌsɪmjʊ'leɪʃən] – моделирование
small-scale [smɔːl-skeɪl] – небольшой; маломасштабный
solder *v.* ['sɒldə] – паять
solenoid ['səʊlɪnɔɪd] – соленоид
solid ['sɒlɪd] – твёрдый
solve *v.* [sɔlv] – решить
sophisticated [sə'fɪstɪkeɪtɪd] – сложный
sophistication [səˌfɪstɪ'keɪʃən] – сложность, изощрённость
split-half [splɪt-hɑːf] – сплит-тайм; половина разделения
statement ['steɪtmənt] – оператор; формулировка
store *v.* [stɔː] – хранить, накапливать, запоминать
strength [strɛŋθ] – прочность
stultify *v.* ['stʌltɪfaɪ] – сводить на нет
substitute for *v.* ['sʌbstɪtjuːt fɔː] – заменить
sufficient [sə'fɪʃənt] – достаточный
supplement *v.* ['sʌplɪmənt] – добавлять, подкреплять
support [sə'pɔːt] – поддержка; поддерживать
surface ['sɜːfɪs] – поверхность
suspend *v.* [səs'pend] – приостанавливать
sustainable [səs'teɪnəbl] – устойчивый
swarm intelligence [swɔːm ɪn'tɛlɪʤəns] – разведка роя (алгоритм); интеллект роя

T

terminate *v.* ['tɜːmɪneɪt] – завершаться
timeliness ['taɪmlɪnɪs] – своевременность
timing ['taɪmɪŋ] – синхронизация
tiny ['taɪni] – крошечный; очень маленький
tool [tuːl] – инструмент, орудие
tracking ['trækɪŋ] – отслеживание
trade-off [treɪd-ɒf] – компромисс
tread [trɛd] – протектор
troubleshoot *v.* ['trʌbəlˌʃʊt] – разрешать проблемы; исправлять проблемы

troubleshooting ['trʌbəl,ʃʊtɪŋ] – исправление проблем

tune *v*. [ˈtjuːn] – настроить

tuning [ˈtjuːnɪŋ] – настройка, регулировка

U

ubiquitous [ju(ː)'bɪkwɪtəs] – повсеместный

unit [ˈjuːnɪt] – устройство; блок; модуль

V

valid [ˈvælɪd] – действительный, допустимый, обоснованный, справедливый

validate *v*. [ˈvælɪdeɪt] – проверять; утверждать

value [ˈvæljuː] – значение; ценность; величина

variable [ˈvɛərɪəbl] – переменная

verify [ˈverɪfaɪ] *v*. – проверять, контролировать; верифицировать

W

wastage ['weɪstɪʤ] – потери, изнашивание

weld [wɛld] *v*. – сваривать

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Навчальне видання

Веретенникова Валентина Петрівна

Computer Engineering
A Coursebook of Professional English

Навчальний посібник

Підручник «Комп'ютерна інженерія. Професійна англійська мова» містить оригінальні тексти, запозичені з англійських та американських науково-популярних публікацій, і супроводжується великою кількістю лексичних та граматичних вправ. Він спрямований на підготовку студентів до читання літератури та обговорення тем, пов'язаних з багатьма проблемами комп'ютерних технологій; в ньому використовуються різні методи та прийоми для набуття навичок усної та письмової мови.

Видається в авторській редакції

Підписано до друку 9.11.2020 р.
Формат 60х90/16. Тираж 100 прим.
Обсяг 9,5 д.а.

Надруковано у ФОП Бондаренко М. О.
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Свідоцтво про внесення суб'єкта видавничої справи
до державного реєстру видавців ДК № 4684 від 13.02.2014 р.