Министерство науки и высшего образования Российской Федерации
Федеральное государственное бюджетное
образовательное учреждение высшего образования
«Уфимский государственный авиационный технический университет»

Н. В. ЕФИМЕНКО

АВТОМАТИЗИРОВАННЫЕ СИСТЕМЫ СПЕЦИАЛЬНОГО НАЗНАЧЕНИЯ: ИНОСТРАННЫЙ ЯЗЫК В ПРОФЕССИОНАЛЬНОЙ ДЕЯТЕЛЬНОСТИ

Уфа 2022

Министерство науки и высшего образования Российской Федерации
Федеральное государственное бюджетное
образовательное учреждение высшего образования
«Уфимский государственный авиационный технический университет»

Н. В. ЕФИМЕНКО

АВТОМАТИЗИРОВАННЫЕ СИСТЕМЫ СПЕЦИАЛЬНОГО НАЗНАЧЕНИЯ: ИНОСТРАННЫЙ ЯЗЫК В ПРОФЕССИОНАЛЬНОЙ ДЕЯТЕЛЬНОСТИ

*Допущено Редакционно-издательским советом УГАТУ
в качестве учебного пособия для студентов очной и заочной форм обучения,
обучающихся по специальности 09.05.01 Применение и эксплуатация
автоматизированных систем специального назначения и направлениям
подготовки магистров 09.04.01 Информатика и вычислительная техника
и аспирантов 09.06.01 Информатика и вычислительная техника*

Учебное электронное издание сетевого доступа

ISBN 978-5-4221-1608-9

Уфа 2022

Рецензенты:
доцент кафедры лингводидактики и переводоведения БашГУ
канд. филол. наук А. Р. Рюкова;
доцент кафедры русской литературы ИФОиМК БГПУ им. Акмуллы
канд. пед. наук З. А. Зарипова

Ефименко Н. В.
Автоматизированные системы специального назначения: иностранный язык в профессиональной деятельности : учебное пособие [Электронный ресурс] / Уфимск. гос. авиац. техн. ун-т. – Уфа : УГАТУ, 2022. – URL: https://www.ugatu.su/media/uploads/MainSite/Ob%20universitete/Izdateli/El_izd/2022-154.pdf

Целью учебного пособия является совершенствование навыков чтения, аннотирования и реферирования оригинальной англоязычной литературы. Особое внимание уделено подготовке студентов к составлению собственного речевого высказывания и ведению беседы по научной тематике. Включает 10 уроков, которые снабжены аутентичными текстами на материале специализированных журналов и упражнениями. Тексты могут быть использованы для повторения сложных грамматических конструкций и тренировки лексического минимума по данной специальности.

Предназначено для студентов, магистрантов и аспирантов факультета информатики и робототехники.

При подготовке электронного издания использовались следующие программные средства:

- Adobe Acrobat – текстовый редактор;
- Microsoft Word – текстовый редактор.

Автор *Ефименко Наталья Вячеславовна*

Редактирование и верстка: *Р. М. Мухамадиева*
Программирование и компьютерный дизайн: *О. М. Толкачёва*

Подписано к использованию: 09.08.2022
Объем: 2,13 Мб.

ФГБОУ ВО «Уфимский государственный авиационный технический университет»
450008, Уфа, ул. К. Маркса, 12.
Тел.: +7-908-35-05-007
e-mail: rik@ugatu.su

ВВЕДЕНИЕ

Учебное пособие «Автоматизированные системы специального назначения: иностранный язык в профессиональной деятельности» состоит из введения, 10 уроков, предназначенных для работы в аудитории и самостоятельной работы обучающихся, терминологического словаря к каждому уроку, лексико-грамматических упражнений, приложения и списка используемой литературы. Текстовый материал отобран из англо-американской научно-технической литературы, в которой раскрываются современные тенденции системного сочетания научно-технических направлений, таких как информатика и вычислительная техника, информационные технологии, автоматизация технологических процессов.

Тексты информативны (сопровождаются рисунками, таблицами и схемами), доступны для понимания и могут способствовать обучению различным видам чтения и ведению беседы в пределах данной тематики, что формирует и развивает профессиональные компетенции студентов.

Система предлагаемых упражнений обеспечивает закрепление лексического материала и сложных грамматических конструкций. Предтекстовые упражнения снимают терминологические трудности и способствуют накоплению словарного запаса, необходимого для работы с научно-техническим текстом по данной тематике. Послетекстовые упражнения помогают осуществлять контроль понимания материала и самостоятельно вести поиск нужной информации, обобщить полученную информацию, тем самым углублять профессиональные знания.

В данном образовательном продукте сделана попытка сформировать и развить умения рационального подхода к работе с тестовым и лексико-грамматическим материалом.

Обучение с помощью данного учебного пособия организуется как процесс постоянного решения речемыслительных задач, что обеспечивает эффективное усвоение языковых средств и их перенос в условиях новых контекстов и речевых ситуаций.

UNIT I
COMPUTER TECHNOLOGIES

<u>Before you read</u>

1. Discuss the question: How much do you know about computers? Work in pairs and answer the questions:

– What is a computer?
– What does a computer do?
– What are the main components of a computer?
– Have you got a computer at home? What type is it?
– What do you generally use your computer for?

2. Match the terms below with their definitions.

1 RAM (Random Access Memory)	**a)** a combinational digital circuit that performs arithmetic and bitwise operations on integer binary numbers
2 ROM (Read Only Memory)	**b)** the physical and electronic parts of a computer, rather than the instructions it follows
3 ALU (Arithmetic Logic Unit)	**c)** a type of storage medium that permanently stores data on personal computers (PCs) and other electronic devices
4 Hardware	**d)** the instructions which control what a computer does; computer programs
5 Software	**e)** a computer's short-term memory, where data that the processor is currently using is stored temporarily

3. Vocabulary to Text «Computer and its components»

Read and remember the following words and word combinations.

to process data – обрабатывать данные; обеспечивать прохождение данных

to execute – исполнять; выполнять; осуществлять; реализовать

elaboration – тщательная разработка; выработка; уточнение; обработка; разработка; проработка; доработка

hardware – 1) аппаратура (аппаратное) оборудование; аппаратные средства; «железо», 2) технические средства; техническое обеспечение

software – компьютерные программы, программное обеспечение, софт

instruction – команда (ЭВМ); оператор (языка программирования); инструкция

to perform – исполнять; делать; представлять; выполнить; совершить; осуществить

in order to – для того чтобы; чтобы; с целью

to distinguish – провести различие; отличать; различать; обособлять; характеризовать

volatile memory – память с разрушением информации; запоминающее устройство с разрушением информации при выключении (электропитания); энергозависимое запоминающее устройство

non-volatile memory – постоянная память; долговременная память; энергонезависимое запоминающее устройство

permanent – неизменный; долговременный; постоянный; непременный; непроходящий

Reading tasks

4. Read the text about computer and complete the table.

Computer and its components

A computer is an electronic device that performs high-speed mathematical or logical operations and executes instructions in a program. Its main functions are to accept and process data to produce results, store information and programs and show results.

The main characteristics of these powerful machines are:

– speed, as they can execute billions of operations per second;

– high reliability in the elaboration and delivery of data;

– storage of huge amounts of information.

A computer consists of hardware and software. The word hardware refers to all the components you can physically see such as the CPU (Central Processing Unit), the internal memory system, the mass storage system, the peripherals (input and output devices) and the connecting system. Software, instead, comprises all the computer programs and related data that provide the instructions for a computer to work properly.

The CPU is the brains of your computer and consists of ALU (Arithmetic Logic Unit), which carries out the instructions of a program to perform arithmetical and logical operations, and CU (Control Unit), which controls the system and coordinates all the operations. In order to memorise input and output data, there is an internal memory that can be distinguished into volatile and non-volatile. Volatile memory is memory that loses its contents when the computer or hardware device is off. Computer RAM (Random Access Memory) is a good example of volatile memory. It is the main memory of the computer where all data can be stored as long as the machine is on. On the contrary, a non-volatile memory contains information, data and programs that cannot be modified, or can be modified only very slowly and with difficulty. Computer ROM (Read Only Memory), for example, contains essential and permanent information and software which allow the computer to work properly. Memory storage devices are available in different options, sizes and capacities. These devices are extremely useful; they can be rewritten and offer incredible storage capacity, up to 256 GB. They can be magnetic (hard disks), optical (COs and OVOs) or solid (flash memory cards).

Component (acronym)	**Full name / Description**	**Functions and properties**
hardware		
software		
CPU		
ALU		
CU		
RAM		
ROM		

5. Mark these statements true (T) or false (F) according to the text. Find the parts of the text that gives the correct information.

– Control unit coordinates all the operations.

– Hardware refers to all the computer programs and related data that provide the instructions for a computer to work properly.

– Volatile memory is memory that retains its contents when the computer or hardware device is off.

– The main memory of the computer where all data can be stored is random access memory.

– An internal memory can be distinguished into volatile and non-volatile.

6. Complete and translate the sentences. Use information from the Text.

– Volatile memory is _________ that loses its contents when the computer or hardware device is off.

– The main functions of a computer are to accept and _________ data to produce results, store information and programs and show results.

– The central processing unit is the _________ of your computer and consists of arithmetic logic unit and control unit.

– Software comprises all the computer programs and related _________ that provide the instructions for a computer to work properly.

– In order to memorise _________ and _________ data, there is an internal memory that can be distinguished into volatile and non-volatile.

– Memory storage devices are extremely useful; they can be rewritten and offer incredible storage _________.

– Read Only Memory contains essential and permanent information and software which _________ the computer to work properly.

7. Choose the right variant. Explain your choice:

1) A computer is an electronic device _________ high-speed mathematical or logical operation.
   a) to be performing
   b) performing

2) Software, instead, comprises all the computer programs and _________ data that provide the instructions for a computer to work properly.
   a) related
   b) relating

3) In order to memorise input and output data, there is an internal memory that can _________ into volatile and non-volatile.
   a) distinguish
   b) be distinguished

4) Volatile memory is memory _________ its contents when the computer or hardware device is off.
   a) losing
   b) to be losing

5) A non-volatile memory contains information, data and programs that cannot _________, or can _________ only very slowly and with difficulty.
   a) modify
   b) be modified

8. Pick out 5–6 sentences which convey the basic information in the Text. Discuss this information with your groupmates.

UNIT II
COMPUTER NETWORKS

1. Discuss the questions. Take turns asking and answering the following questions.

– What does a network consist of?
– What is a router?
– What is Ethernet used for?
– What are the advantages of using a network?
– What are the disadvantages of using a network?

2. Match the terms below with their definitions.

1 LAN (Local Area Network)	**a)** a telecommunication network that is used to simply extend a local area network over a large geographical distance
2 WAN (Wide Area Network)	**b)** a set of rules governing the exchange or transmission of data between devices
3 Ethernet	**c)** the traditional technology for connecting devices in a wired local or wide area networks that enables devices to communicate with each other via a protocol, which is a set of rules or common network language
4 Router	**d)** a computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building
5 Protocol	**e)** a networking device that forwards data packets between computer networks and performs the traffic directing functions on the Internet

3. Vocabulary to Text «Computer Networks».
Read and remember the following words and word combinations.

network – сеть; распределенная операционная интерактивная сеть коллективного доступа

to share – делить; распределять; разделять; участвовать; делиться; распределить; владеть совместно; предоставлять друг другу

access ['ækses] – доступ (к ЭВМ); обращение (к базе данных); ввод и вывод данных; порядок обращения; выборка (из памяти или запоминающего устройства)

to run programs – запускать программу; выполнять программу

node – узел; ключ (ветки реестра)

medium – среда; обстановка; среда передачи данных; среднее значение; способ; средство

to cover – охватывать; охватить; закрыть; закрывать; перекрывать; покрывать; скрывать; скрыть; обеспечивать; простираться; расстилаться; распространяться; распространиться

to facilitate – способствовать; содействовать; оказать содействие; продвигать; обеспечить; помогать достижению (чего-либо); задействовать; облегчать (операции); упростить

insecure – небезопасный; ненадежный; непрочный; незащищенный

to interfere – вмешиваться; вторгаться

Reading tasks

4. Read the text about Computer Networks using the words and word combinations given above.

Computer Networks

A network is a group of computers linked together. It consists of at least two computers joined by cables on the same desk or same office, but it can also mean thousands of computers across the world. The users of a network can share hardware (scanner, printer, fax machine, etc.), access data in other people's computers and run other programs stored in the network although not installed on their own computer.

A network consists of:

– nodes, that is to say different computers and devices;

– a connecting medium, such as cables or a wireless connection;

– routers, which are special computers enabled to send messages;

– switches, that is to say devices which help to select a specific path to follow.

Networks can be connected in different ways according to the area they cover. A LAN (Local Area Network) is generally located in a limited space, such as a building or a campus. On the contrary, a WAN (Wide Area Network) operates in a larger area and it can reach most of the world, so it could be described as a collection of LANs all over the world.

The exchange of information in a network is controlled by communications protocols, which define the formats and rules that computers must follow when talking to one another. Well-known communications protocols are Ethernet, which is a family of protocols used in LANs, and the Internet Protocol Suite, which is used in any computer network.

Computer networks offer many advantages. For example, they facilitate communication, allowing people to send emails and texts, make phone/Video calls and videoconference. Furthermore, networks allow people to share files, data, and other types of information as users may access data and information stored on other computers in the network.

On the other hand, networks may be difficult to set up and may be insecure as computer hackers can send viruses or computer worms to the net computer. They may also interfere with other technologies, as power line communication strongly disturbs certain forms of radio communication and access technology such as ADSL (Asymmetric Digital Subscriber Line).

5. Mark these statements true (T) or false (F) according to the Text. Find the parts of the text that gives the correct information.

– The users of a network cannot share hardware (scanner, printer, fax machine, etc.).

– The users of a network can access data in other people's computers and run other programs stored in the network although not installed on their own computer.

– Networks can be connected only in different ways without according to the area they cover.

– Networks may be easy to set up.

– Networks may be insecure as computer hackers can send viruses or computer worms to the net computer.

6. Complete and translate the sentences. Use information from the Text.

– The exchange of information in a network is controlled by _________.

– Well-known communications protocols are _________, which is a family of protocols used in LANs, and _________, which is used in any computer network.

– A _________ is generally located in a limited space, such as a building or a campus.

– A _________ operates in a larger area and it can reach most of the world, so it could be described as a collection of LANs all over the world.

– A network consists of _________, that is to say different computers and devices; a _________, such as cables or a wireless connection; _________, that is to say devices which help to select a specific path to follow; _________, which are special computers enabled to send messages.

7. Answer the questions without using information from the Text.

– What does a network consist of?
– What is a router?
– What is a LAN?
– What is a WAN?
– What is the function of communications protocols?
– What is Ethernet used for?
– What are the advantages of using a network?
– What are the disadvantages of using a network?

8. Refer back to the text and write a summary of the components, pros and cons of networks and describe a situation in which a network can be very useful (8–10 sentences).

UNIT III

NETWORK TOPOLOGIES

Before you read

1. Discuss the question: How much do you know about network topologies? Work in pairs and answer the questions.

– What is network topology?
– Why is network topology important?
– What are the types of network topology?
– What is the most common type of network topology?

2. Match the terms below with their definitions.

1 Bus network	**a)** the layout of the interconnections of the nodes of a computer network
2 Star network	**b)** a topology where computers in a specific area are connected to hubs creating a star, and then each hub is connected together along the network backbone
3 Star bus topology	**c)** a topology where computers are connected to each other in a circular format
4 Ring network	**d)** a topology where every node in the network is connected to one central switch
5 Network topology	**e)** a network type where every device is connected to a single cable that runs from one end of the network to the other

3. Vocabulary to Text «Network Topologies».
Read and remember the following words and word combinations.

network topology – топология сети; топологическая схема сети (общая физическая или логическая конфигурация телекоммуникационной системы: физическая топология – схема соединений компонентов кабелями и проводами, а логическая топология описывает, как по сети проходят сообщения)

node – узел; ключ (ветки реестра)

bus – шина; информационный канал; канал (передачи информации); магистральная шина

bus network – сеть с топологией типа «общая шина»; сеть с шинной топологией; шинная сеть; сеть с логической топологией шина

backbone – магистраль сети; опорная сеть; базовая сеть; сеть первичных межсоединений в иерархической распределенной системе

destination – цель; назначение; место назначения; адресат; пункт назначения (при передаче данных); адресат информации

star network – сеть с топологией типа «звезда»; сеть звездообразной топологии; звездообразная вычислительная сеть

hub – хаб; ядро (сети); Web-центр; концентратор (в сети); центральный узел коммуникаций

to go down – выходить из строя; понизиться; утрачивать работоспособность

ring network – сеть с топологией типа «кольцо»; сеть кольцевой топологии; сеть с кольцевой топологией (вычислительная); кольцевая сеть

token – устройство идентификации; знак (опознавательный); токен (генератор одноразовых паролей в системах аутентификации); маркер (в многопроцессорных системах); право доступа; обозначение; ярлык; лексема (синтаксическая единица в языках программирования); аппаратный ключ

nonetheless – тем не менее; все же; при этом; все-таки

star bus topology – топология типа «звезда-кольцо»; звездно-шинная топология

to expand – развертываться; увеличиться; увеличивать; расширять(-ся); наращивать; разворачивать; распаковывать

Reading tasks

4. Read and translate the text about Network Topologies using the words and word combinations given above.

Network Topologies

A network topology is the layout of the interconnections of the nodes of a computer network. It depends on the distance involved, the type of hardware used and the stability needed.

Bus network

In a bus network all nodes are connected to a common medium, called backbone, as it happens with Christmas lights. Information sent along the backbone travels until the destination is reached. This kind of topology is generally used only for small networks, as it isn't able to connect a large number of computers. The main advantage offered by this topology is that if a computer or device doesn't work, it doesn't affect the others (fig. 1).

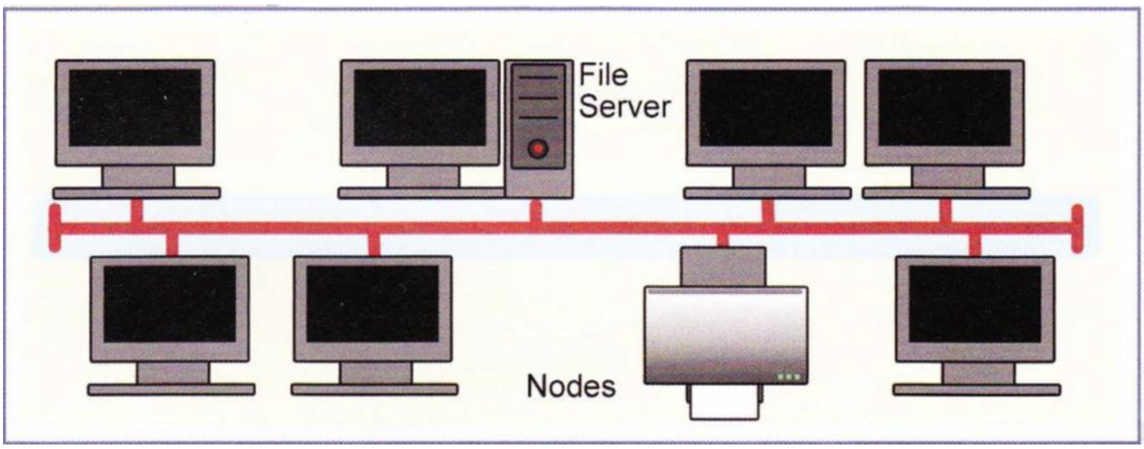

Fig. 1. Bus network

Star network

In a star network all nodes are connected to a special central node called the hub. Once it has received a signal, the hub passes it to all the other nodes until it reaches the destination computer. This means that all the computers and devices are joined together. This topology is commonly used in businesses because it can grant rapidity and safety in exchanging data. Thanks to this topology, data is always up-to-date and if a computer doesn't work, it doesn't affect the others. The only disadvantage to it is that if the hub goes down, the whole network doesn't work (fig. 2).

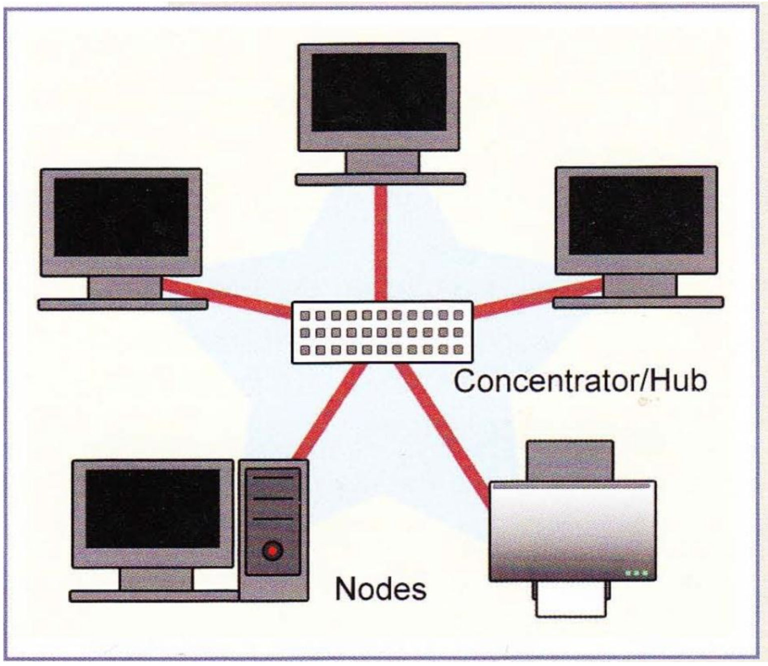

Fig. 2. Star network

Ring network

In a ring network each node is connected to its left in a circle. There is no central hub that holds all the data, and communication is sent in one direction around the ring through the use of a token. As it requires fewer cables, this topology is less expensive. Nonetheless, because it provides only one pathway among the nodes, a single node failure may isolate all the devices attached to the ring (fig. 3).

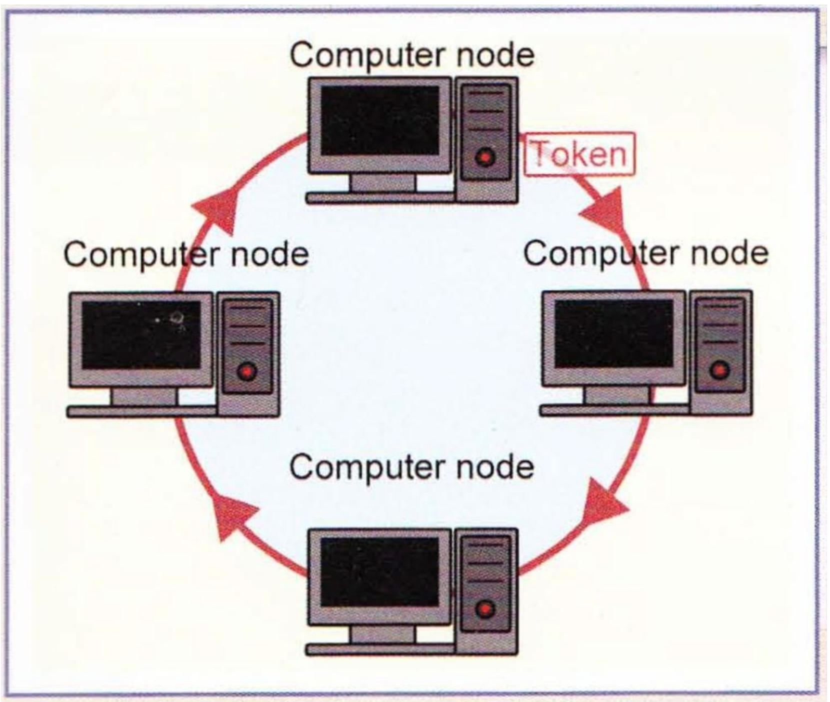

Fig. 3. Ring network

Star bus topology

Star bus topology is the most common network topology used today. It combines elements of star and bus topologies to create a more effective network. Computers in a specific area are connected to hubs creating a star, and then each hub is connected together along the network backbone. The main advantage of this type of topology is that it can be more easily expanded over time than a bus or a star. On the other hand, this topology is more difficult to configure than the others and if the backbone line breaks, the whole network goes down (fig. 4).

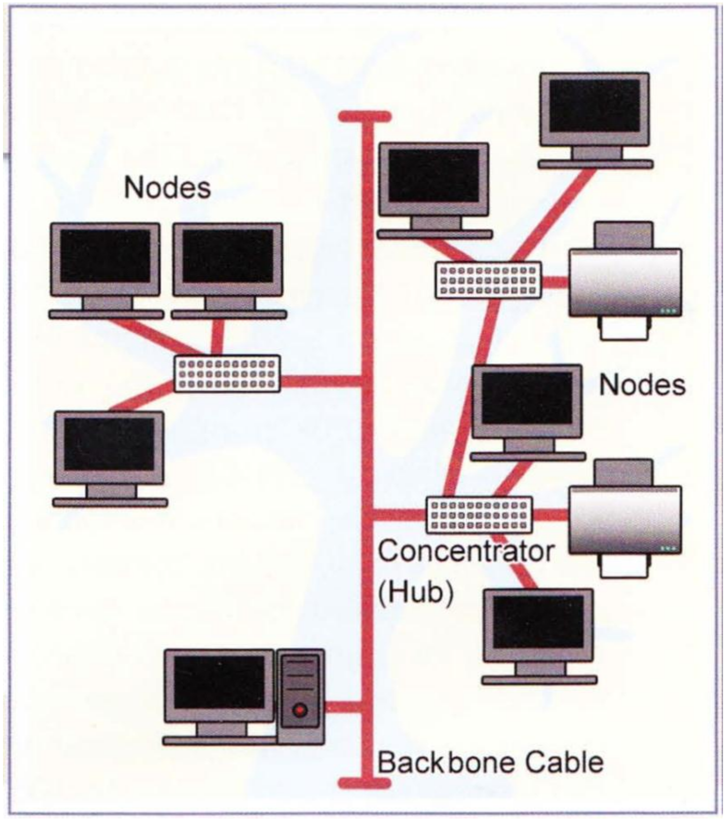

Fig. 4. Star bus topology

5. Complete the table with the missing information. Use information from the Text.

Topology	Connection	Use	Advantages	Disadvantages
		small networks		
	each node is connected to the central hub			
ring				

6. Mark these statements true (T) or false (F) according to the Text. Find the parts of the text that gives the correct information.

– The topology chosen depends only on the location of computers.
– All topologies use many cables and are very expensive.
– In a bus topology all the buses are connected one after the other.
– In a bus topology a server controls the flow of data.
– In a star network data is always updated.
– The hub doesn't connect printers and other devices in a star topology.
– In the ring topology each node is connected to the hub.
– In the ring topology if the hub doesn't work, the network goes down.
– Star bus topology combines elements of bus and ring topologies.
– In a star bus topology a backbone line failure affects the whole network.

7. Complete and translate the sentences. Use information from the Text.

– Bus topology is generally used only for ________ ________, as it isn't able to connect a large number of computers.
– In a star network all ________ are connected to a special central node called the hub.
– This topology is commonly used in businesses because it can grant ________ and ________ in exchanging data.
– In a ring network each node is connected to ________ in a circle.
– Computers in a specific area are connected to ________ creating a star, and then each ________ is connected together along the network backbone.

8. Pick out 7–8 sentences which convey the basic information in the Text. Discuss this information with your groupmates.

UNIT IV
AUTOMATION AND AUTOMATED SYSTEMS

Before you read

1. Discuss these questions.

- Which of the following does any automated system combine?

– A group of personnel, necessary automation complexes and regulations;
– software and hardware.

- Do automated systems differ from automation devices? Give your reasons.
- What is the role of automation in the industry?

2. Match the terms below with their definitions.

1 Software	**a)** any information or data entered into a computer for processing
2 Hardware	**b)** the process of introducing a machine to do something that used to be done by hand or with animals
3 Input	**c)** the process of using machines and computers that can operate without human control
4 Automation	**d)** the collection of physical elements of a computer system that has shape and size and can be physically tangible
5 Mechanization	**e)** a set of instructions or programs instructing a computer to do specific tasks

3. Vocabulary to Text «Automation and automated systems».
Read and remember the following words and word combinations.

competitiveness – конкурентоспособность

integrated manufacturing – интегрированное производство (с централизованным управлением от ЭВМ)

technique [tek'ni:k] – методика (техника); метод; способ; технический прием

decision making – принятие решений; процедура принятия решений

to facilitate – способствовать; содействовать; продвигать; обеспечивать

adjustment – корректировка; регулировка; настройка; выверка; корректировка; упорядочение; совмещение; приведение в соответствие; наладка

computer-aided design – система автоматизированного проектирования (САПР)

computer-aided manufacturing – автоматизированное программирование; система автоматизированного программирования; компьютерная поддержка производства

computer-aided engineering – компьютерное моделирование; система автоматизированного конструирования; компьютерная поддержка расчетов и инженерного анализа

automated research system – автоматизированная система научных исследований

automated control systems – автоматизированная система управления (АСУ)

Reading tasks

4. Read and translate the Text using the words and word combinations given above.

Automation and automated systems

Current highly increasing competitiveness over the industry demands high quality and most consistent products with a competitive price. To address this challenge number of industries considering various new product designs and integrated manufacturing techniques in parallel with the use of automated devices.

Automation takes a step further mechanization that uses a particular machinery mechanism aided human operators for performing a task. Mechanization is the manual operation of a task using powered machinery that depends on human decision making. On the other hand, automation replaces the human involvement with the use of logical programming commands and powerful machineries.

«Automation puts the people out of work» is a common misconception of automation. But the reason for putting the process operation to be automated is to increase the productivity and product quality, reduce manual/periodic checking, improve safety, and reduce the production cost and to be operator friendly.

Automation is the technology by which a process or procedure is accomplished without human assistance. It is implemented using a program of instructions combined with a control system that executes the instructions.

One of the remarkable and influential moves for getting the solutions of above mentioned challenge is the industrial automation. Industrial automation facilitates to increase the product quality, reliability and production rate while reducing production and design cost by adopting new, innovative and integrated technologies and services.

Industrial automation can be defined as the use of set technologies and automatic control devices that results the automatic operation and control of industrial processes without significant human intervention and achieving superior performance than manual control. These automation devices include programmable logic controllers (PLCs), personal computers (PCs), programmable automation controllers (PACs), etc. and technologies include various automated system and industrial communication systems.

An **automated system** is a combination of both software and hardware designed and programmed to work automatically without the need of any human operator to provide inputs and instructions for each operation. Automated systems allow monitoring processes in real time and identify problems as they arrive, enabling quick adjustments along the way. The automated system implements the technology, namely the information technology, which establishes a number of certain functions.

The automated system has several types: computer-aided design (CAD), computer-aided manufacturing (CAM), computer-aided engineering (CAE), automated research systems and automated control systems, etc.

Nowadays, the automated system is being introduced and developed in almost every organization and every enterprise of any region and any country.

5. Mark these statements true (T) or false (F) according to the text. Find the parts of the text that gives the correct information.

– «Automation puts the people out of work» is a common conception of automation.

– Automation replaces the human involvement with the use of logical programming commands and powerful machineries.

– Automation is the technology by which a process or procedure is accomplished with human assistance.

– The use of set technologies and automatic control devices results the automatic operation and control of industrial processes.

– Automated systems allow monitoring processes in real time and identify problems as they arrive, disabling quick adjustments.

6. Complete the sentences. Use the information from the Text.

– To address this challenge number of industries ________ various new product designs and integrated manufacturing techniques in parallel with the use of automated devices.

– Mechanization is the manual operation of a task ________ powered machinery that depends on human decision-making.

– Automation replaces the human involvement ________ of logical programming commands and powerful machineries.

– It is implemented using a program of instructions ________ with a control system that executes the instructions.

– An automated system is a combination of both software and hardware ________ and ________ to work automatically without the need of any human operator to provide inputs and instructions for each operation.

7. Choose the right variant. Explain your choice

1) But the reason for putting the process operation ________ is to increase the productivity and product quality, reduce manual/periodic checking, improve safety, and reduce the production cost and to be operator friendly.
   a) to have been automated
   b) to be automated
   c) to automate

2) Industrial automation facilitates _________ the product quality, reliability and production rate while reducing production and design cost by adopting new, innovative and integrated technologies and services.
   a) to be increasing
   b) increase
   c) to increase

3) An automated system is a combination of both software and hardware _________ and programmed to work automatically without the need of any human operator to provide inputs and instructions for each operation.
   a) has designed
   b) designed
   c) was designed

4) Automated systems allow _________ processes in real time and identify problems as they arrive, enabling quick adjustments along the way.
   a) monitoring
   b) to monitor
   c) monitor

5) Industrial automation can _________ as the use of set technologies and automatic control devices that results the automatic operation and control of industrial processes without significant human intervention and achieving superior performance than manual control.
   a) define
   b) be defined
   c) to be defined

8. Pick out 5–6 sentences which convey the basic information in the Text. Discuss this information with your groupmates

UNIT V
COMPUTER INTEGRATED MANUFACTURING (CIM)

<u>Before you read</u>

1. Discuss these questions.

– What do you understand by the term *Computer Integrated Manufacturing*? Can you give some examples?

– What is the role of computer in the manufacturing process?

– Do you know the difference between concurrent engineering, workflow automation and flexible manufacturing?

2. Match the terms below with their definitions.

1 To integrate	**a)** a particular way of thinking about or dealing with something
2 Data	**b)** a method used in the development of a new product in which the different departments that are involved in the design, manufacturing, and selling of the product work together from the beginning of the project
3 Approach	**c)** tools, machines, or other things that you need for a particular job or activity
4 Concurrent engineering	**d)** to combine two or more things in order to become more effective
5 Equipment	**e)** information, especially facts or numbers, collected to be examined and considered and used to help decision-making, or information in an electronic form that can be stored and processed by a computer

3. Vocabulary to Text «Information System».
Read and remember the following words and word combinations.

Computer Integrated Manufacturing – компьютерно-интегрированное производство;комплексное автоматизированное производство

to encompass [ɪn'kʌmpəs] – охватывать; осуществлять; заключать; сосредоточить в себе; объединять в себе; заключать; содержать

dedicated software – специализированное программное обеспечение

in a seamless manner – гладко; четко; грамотно; безукоризненно; безупречно; бесперебойно

feasible – выполнимый; возможный; обоснованный; целесообразный; исполнимый; подходящий; эффективный в практическом плане

error-prone – ненадежный; подверженный погрешностям; склонный к ошибкам; способствующий ошибкам

stand for – значить; поддерживать; символизировать; означать; представлять (что-л.); выражать; представлять; быть на чьей-либо стороне

holistic approach – комплексный подход; целостный подход

scheduled ['ʃedju:ld] ['skedju:ld] **delivery date** – запланированная дата доставки

total quality management – комплексное управление качеством

business process reengineering – перепроектирование бизнес-процессов; реорганизация бизнес-процессов; реинжиниринг бизнес-процессов; перестройка бизнес-процессов concurrent engineering

workflow automation – автоматизация документооборота; автоматизации процессов

enterprise resource planning – планирование ресурсов предприятия.

flexible manufacturing – гибкое автоматизированное производство; быстро переналаживаемое производство

flexible manufacturing cell – гибкий производственный модуль; гибкий автоматизированный участок

objective [əb'ʤektɪv] – цель; основная цель; техническое требование

incompatible – несовместимый; противоречащий; несочетающийся

to accomplish – завершать; совершать; совершить; выполнить; достигать; исполнять

to exploit – пользоваться (lawput); использовать; эксплуатировать; вводить в действие; извлекать выгоду из чего-л.

to evolve – развивать; развиваться; видоизмениться; претерпевать изменения; превращаться; эволюционировать; выделять.

Reading tasks

4. Read and translate the Text, using the words and word combinations given above.

Computer Integrated Manufacturing (CIM)

Computer Integrated Manufacturing (CIM) encompasses the entire range of product development and manufacturing activities with all the functions being carried out with the help of dedicated software packages. The data required for various functions are passed from one application software to another in a seamless manner. For example, the product data is created during design. This data has to be transferred from the modeling software to manufacturing software without any loss of data. CIM uses a common database wherever feasible and communication technologies to integrate design, manufacturing and associated business functions that combine the automated segments of a factory or a manufacturing facility. CIM reduces the human component of manufacturing and thereby relieves the process of its slow, expensive and error-prone component. CIM stands for a holistic and methodological approach to the activities of the manufacturing enterprise in order to achieve vast improvement in its performance.

This methodological approach is applied to all activities from the design of the product to customer support in an integrated way, using various methods, means and techniques in order to achieve production improvement, cost reduction, fulfillment of scheduled delivery dates, quality improvement and total flexibility in the manufacturing system. CIM requires all those associated with a company to involve totally in the process of product development and manufacture. In such a holistic approach, economic, social and human aspects have the same importance as technical aspects.

CIM also encompasses the whole lot of enabling technologies including total quality management, business process reengineering, concurrent engineering, workflow automation, enterprise resource planning and flexible manufacturing.

The advances in automation have enabled industries to develop islands of automation. Examples are flexible manufacturing cells, robotized work cells, flexible inspection cells etc. One of the objectives of CIM is to achieve the consolidation and integration of these islands of automation. This requires sharing of information among different applications or sections of a factory, accessing incompatible and heterogeneous data and devices. The ultimate objective is to meet the competition by improved customer satisfaction through reduction in cost, improvement in quality and reduction in product development time.

CIM makes full use of the capabilities of the digital computer to improve manufacturing. Two of them are:

– Variable and Programmable automation;

– Real time optimization.

The computer has the capability to accomplish the above for hardware components of manufacturing (the manufacturing machinery and equipment) and software component of manufacturing (the application software, the information flow, database and so on).

The capabilities of the computer are thus exploited not only for the various bits and pieces of manufacturing activity but also for the entire system of manufacturing. Computers have the tremendous potential needed to integrate the entire manufacturing system and thereby evolve the computer integrated manufacturing system.

5. Mark these statements true (T) or false (F) according to the text. Find the parts of the text that gives the correct information.

– The data required for various functions are passed from one application software to another without a hitch.

– CIM increases the human component of manufacturing and thereby relieves the process of its slow, expensive and error-prone component.

– CIM requires all those associated with a company to involve totally in the process of product development and manufacture.

– It is not necessary to share of information among different applications or sections of a factory, access incompatible and heterogeneous data and devices.

– Computers have the tremendous potential needed to integrate the entire manufacturing system.

6. Complete the sentences. Use information from the Text.

– This data _________ to be transferred from the modeling software to manufacturing software without any loss of data.

– CIM _________ for a holistic and methodological approach to the activities of the manufacturing enterprise in order to achieve vast improvement in its performance.

– CIM _________ all those associated with a company to involve totally in the process of product development and manufacture.

– CIM _________ full use of the capabilities of the digital computer to improve manufacturing.

– Computers _________ the tremendous potential needed to integrate the entire manufacturing system.

7. Choose the right variant. Explain your choice.

1) Computer Integrated Manufacturing (CIM) encompasses the entire range of product development and manufacturing activities with all the functions _________ with the help of dedicated software packages.
   a) being carried out
   b) to be carried out
   c) having been carried out

2) This data has _________ from the modeling software to manufacturing software without any loss of data.
   a) transferred
   b) to be transferred
   c) been transferred

3) One of the objectives of CIM is _________ the consolidation and integration of these islands of automation.
   a) to be achieved
   b) to have been achieved
   c) to achieve

4) The ultimate objective is _________ the competition by improved customer satisfaction through reduction in cost, improvement in quality and reduction in product development time.
   a) to meet
   b) to have met
   c) to be meeting

5) CIM also encompasses the whole lot of _________ technologies including total quality management, business process reengineering, concurrent engineering, workflow automation, enterprise resource planning and flexible manufacturing.
   a) enabling
   b) enabled
   c) being enabled

8. Pick out 5–6 sentences which convey the basic information in the Text. Discuss this information with your groupmates.

UNIT VI
COMPUTER-AIDED DESIGN (CAD). COMPUTER-AIDED MANUFACTURING (CAM)

Before you read

1. Discuss the question: How much do you know about Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM)? Work in pairs and answer the questions.

– What are the essential features of CAD software?
– What is the main advantage of CAD?
– What are the essential features of CAM?
– What is the main advantage of Computer-Aided Manufacturing?

2. Match the terms below with their definitions.

1 Computer-aided manufacturing (CAM)	**a)** software that can be used to create two-dimensional (2-D) drawings or three-dimensional (3-D) models.
2 Drafting	**b)** an integrated circuit containing the arithmetic, logic, and control circuitry required to interpret and execute instructions from a computer program
3 Simulation	**c)** the making of drawings of objects, structures, or systems that have been visualized by engineers, scientists, and others.
4 Microprocessor	**d)** the development and use of computer models for the study of actual or postulated dynamic systems
5 Computer-aided design (CAD)	**e)** an application technology that uses computer software and machinery to facilitate and automate manufacturing processes

3. Vocabulary to Text «The origins of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM)».
Read and remember the following words and word combinations.

Computer-aided design (CAD) – система автоматизированного проектирования (САПР); компьютеризированное проектирование (CAD); машинное проектирование (CAD); компьютерное конструирование

Computer-aided manufacturing (CAM) – автоматизированная система управления производством (АСУП); система автоматизированного программирования; автоматизированная система управления технологическими процессами

to enable – давать возможность или право (что-либо сделать); обеспечить возможность (для кого-то делать что-то); поддерживать; приспосабливать; позволять; делать доступным; наделять; облегчать; делать годным; обеспечить; обеспечить условия; создать условия

to simulate – моделировать (имитировать процессы, явления, особ. с помощью ЭВМ)

geometrical design – геометрическое проектирование

computer numerical control (CNC) – числовое программное управление (ЧПУ)

direct numerical control (DNC) – прямое цифровое управление (ПЦУ); прямое числовое программное управление

to encode – шифровать; зашифровывать по коду; кодировать; преобразовывать из аналоговой формы в цифровую

drafting process – процесса подготовки проекта; процесс разработки; процесс проектирования

to manipulate – управлять; манипулировать; воздействовать (на кого-либо, что-либо); производить действия; обрабатывать; комбинировать

to facilitate – способствовать; содействовать; оказать содействие; продвигать; помогать достижению (чего-либо); обеспечивать; выполнять; устранять трудности; улучшать; упростить (проверку)

shortcoming – недостаток; несовершенство; изъян; дефект; падение недочет; недоработка; слабая место

parts-shaping – обработка детали на поперечно-строгальном станке

stamping – штамповка; штемпелевание; маркирование

drilling – бурение; сверление; тренировка

milling – вальцевание; вальцовка; дробление; прокатка; фрезерование

grinding – шлифование; размельчение; точение

part-holding clamps – фиксаторы (захваты) для закрепления деталей

Reading tasks

4. Read and translate the text about the origins of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) using the words and word combinations given above.

The origins of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM)

Computer-aided design (CAD) involves creating computer models defined by geometrical parameters. These models typically appear on a computer monitor as a three-dimensional representation of a part or a system of parts, which can be readily altered by changing relevant parameters. CAD systems enable designers to view objects under a wide variety of representations and to test these objects by simulating real-world conditions.

Computer-aided manufacturing (CAM) uses geometrical design data to control automated machinery. CAM systems are associated with computer numerical control (CNC) or direct numerical control (DNC) systems. These systems differ from older forms of numerical control (NC) in that geometrical data are encoded mechanically. Since both CAD and CAM use computer-based methods for encoding geometrical data, it is possible for the processes of design and manufacture to be highly integrated. Computer-aided design and manufacturing systems are commonly referred to as CAD/CAM.

The origins of CAD/CAM

CAD had its origins in three separate sources, which also serve to highlight the basic operations that CAD systems provide. The first source of CAD resulted from attempts to automate the drafting process. These developments were pioneered by the General Motors Research Laboratories in the early 1960s. One of the important time-saving advantages of computer modeling over traditional drafting methods is that the former can be quickly corrected or manipulated by changing a model's parameters. The second source of CAD was in the testing of designs by simulation. The use of computer modeling to test products was pioneered by high-tech industries like aerospace and semiconductors. The third source of CAD development resulted from efforts to facilitate the flow from the design process to the manufacturing process using numerical control (NC) technologies, which enjoyed widespread use in many applications by the mid-1960s. It was this source that resulted in the linkage between CAD and CAM. One of the most important trends in CAD/CAM technologies is the ever-tighter integration between the design and manufacturing stages of CAD/CAM-based production processes.

The development of CAD and CAM and particularly the linkage between the two overcame traditional NC shortcomings in expense, ease of use, and speed by enabling the design and manufacture of a part to be undertaken using the same system of encoding geometrical data. This innovation greatly shortened the period between design and manufacture and greatly expanded the scope of production processes for which automated machinery could be economically used. Just as important, CAD/CAM gave the designer much more direct control over the production process, creating the possibility of completely integrated design and manufacturing processes.

The rapid growth in the use of CAD/CAM technologies after the early 1970s was made possible by the development of mass-produced silicon chips and the microprocessor, resulting in more readily affordable computers. As the price of computers continued to decline and their processing power improved, the use of CAD/CAM broadened from large firms using large-scale mass production techniques to firms of all sizes. The scope of operations to which CAD/CAM was applied broadened as well. In addition to parts-shaping by traditional machine tool processes such as stamping, drilling, milling, and grinding, CAD/CAM has come to be used by firms involved in producing consumer electronics, electronic components, molded plastics, and a host of other products. Computers are also used to control a number of manufacturing processes (such as chemical processing) that are not strictly defined as CAM because the control data are not based on geometrical parameters.

Using CAD, it is possible to simulate in three dimensions the movement of a part through a production process. This process can simulate feed rates, angles and speeds of machine tools, the position of part-holding clamps, as well as range and other constraints limiting the operations of a machine. The continuing development of the simulation of various manufacturing processes is one of the key means by which CAD and CAM systems are becoming increasingly integrated. CAD/CAM systems also facilitate communication among those involved in design, manufacturing, and other processes. This is of particular importance when one firm contracts another to either design or produce a component.

5. Mark these statements true (T) or false (F) according to the Text. Find the parts of the text that gives the correct information.

– Computer-aided design (CAD) involves creating computer models defined by geometrical parameters.

– CAD systems enable designers to test objects by simulating real-world conditions.

– The use of computer modeling to test products was pioneered by textile industry.

– A linkage between CAD and CAM overcame traditional NC shortcomings In ease of use and speed but not in expense.

– The use of CAD/CAM broadened from large firms using large-scale mass production techniques to firms of all sizes.

6. Complete and translate the sentences. Use information from the Text.

– Computer-aided manufacturing (CAM) uses geometrical design data to ________ automated machinery.

– CAD had its origins in three separate sources, which also serve to ________ the basic operations that CAD systems provide.

– One of the important ________ advantages of computer modeling over traditional drafting methods is that the former can be quickly corrected or manipulated by changing a model's parameters.

– One of the most important trends in CAD/CAM technologies is the ________ integration between the design and manufacturing stages of CAD/CAM-based production processes.

– The rapid growth in the use of CAD/CAM technologies was made possible by the development of mass-produced ________ chips and the microprocessor.

7. Choose the right variant. Explain your choice

1) Models typically appear on a computer monitor as a three-dimensional representation of a part or a system of parts, which can be readily altered by ________ relevant parameters.
   a) changed
   b) changing

2) CAM systems are ________ with computer numerical control (CNC) or direct numerical control (DNC) systems.
   a) associated
   b) associating

3) The development of CAD and CAM and particularly the linkage between the two overcame traditional NC shortcomings in expense, ease of use, and speed by enabling the design and manufacture of a part to be undertaken using the same system of ________ geometrical data.
   a) encoding
   b) encoded

4) The rapid growth in the use of CAD/CAM technologies after the early 1970s was made possible by the development of mass-produced silicon chips and the microprocessor, ________ more readily affordable computers.
   a) resulting in
   b) resulted in

5) The ________ development of the simulation of various manufacturing processes is one of the key means by which CAD and CAM systems are becoming increasingly integrated.
   a) continued
   b) continuing

8. Pick out 5–6 sentences which convey the basic information in the Text. Discuss this information with your groupmates.

UNIT VII
CAD/CAM SYSTEMS: ADVANTAGES AND DISADVANTAGES

<u>Before you read</u>

1. Discuss these questions.

– What are the advantages of modeling with Computer-Aided Design (CAD)?

– Are there any disadvantages of CAD/CAM systems?

2. Match the terms below with their definitions.

1 Zoom	**a)** the activity of using mathematical models (= simple descriptions of a system or process) to do calculations or predict what might happen
2 Dimention	**b)** the effect of a camera moving toward or away from a subject by using a camera lens
3 Computer-aided software engineering	**c)** the simulation of human mental processes by machines, especially computer systems
4 Modeling	**d)** the domain of software tools used to design and implement applications
5 Artificial intelligence	**e)** a mathematical space (or object) is informally defined as the minimum number of coordinates needed to specify any point within it

3. Vocabulary to Text «CAD/CAM systems: advantages and disadvantages».
Read and remember the following words and word combinations.

drafting – черчение; составление документа; составление проекта; проектно-конструкторские работы; подготовка проектов

compass – компас; окружность; круг; предел; граница; обхват; диапазон; пределы

to alter – переделывать; видоизменять; меняться; переменить; внести изменения; преобразовывать; перешить

«zoom» feature – способность к масштабированию; способность (дисплея) к изменению масштаба изображения

camera lens – объектив кинокамеры; объектив фотоаппарата

to gain – получать; приобретать; зарабатывать; добывать; выиграть; добиться (чьего-либо расположения); достигать

cutaway – изображенный в разрезе; срезанная часть; изображенный в сечении

to reveal – выявлять; отображать; открывать; раскрывать; вскрывать; обнаружить; разоблачать; разоблачить; показывать; показать

spatial – пространственный; существующий в пространстве; занимающий какое-либо пространство; территориальный; трехмерный

to have no means – не иметь возможностей, не иметь средств

to comprehend – осмыслить; осмысливать; постичь; охватить; включить; уразуметь; вмещать (Langfreak); осмысливаться; осмыслиться; охватываться; постигаться; объять (понять, представить); глубоко понимать

to penetrate – проникать; проникать внутрь; проходить; вторгаться; постигать; понимать; пропитывать

to mimic – пародировать; подделывать; подражать; походить на; копировать; притворяться; копироваться; имитировать; моделировать; повторять

gravity – притяжение; сила притяжения; гравитация; серьезность; важность

friction – трение; сила трения; истирание; конфликт; разногласия; сцепление; замедление работы

grid – координатная сетка; наносить координатную сетку; план каркаса здания (чертеж); сетка скважин; строить координатную сетку; электроэнергетическая система; зернистость; электрическая сеть; решетка; управляющий провод; система распределенных вычислений

mesh – ячейка (сети); отверстие (решета, грохота); очко; петля сети; ячейка сети; объединение; слияние; замкнутая сеть; сетка

circuit ['sɜ:kɪt] – канал двусторонней связи; проход; итерация; двусторонний канал связи; электросхема; микросхема; прибор; цепь

viable – жизнеспособный; конкурентный; жизнерадостный; целесообразный; осуществимый

vehicle ['vi:ɪk(ə)l] – носитель; автомобиль; экипаж; автотранспортное средство; перевозочное средство

to bedevil [bɪ'dev(ə)l] **–** путать; мучить; околдовывать; запутывать; вносить неразбериху; сбивать с толку; сбить с толку; запутать; выводить из себя

realm – поименованная область (в базах данных); область действия; область (именованная совокупность записей базы данных); область; сфера

computer-aided software engineering – автоматизированное проектирование и создание программ; автоматизированная разработка ПО

computer-assisted – автоматизированный; выполняемый с помощью вычислительной машины; выполняемый с применением компьютера; компьютерный; компьютеризированный; электронный

ubiquitous [ju:'bɪkwɪtəs] **–** повсеместный; вездесущий; встречающийся повсюду; широко распространенный, единый

Computer-Aided Selling – автоматизация продаж

Computer-Aided Marketing – автоматизированный (компьютерный) маркетинг

work flows – поток деятельности; автоматизация деловых процедур; автоматизация документооборота; последовательность операций; рабочие процессы; документооборот; технологический процесс; поток обрабатываемых деталей; поток заготовок; технологический маршрут; ход работ; производственный процесс

Reading tasks

4. Read and translate the text about CAD/CAM systems using the words and word combinations given above.

CAD/CAM systems: advantages and disadvantages

Modeling with CAD systems offers a number of advantages over traditional drafting methods that use rulers, squares, and compasses. For example, designs can be altered without erasing and redrawing. CAD systems also offer «zoom» features analogous to a camera lens, whereby a designer can magnify certain elements of a model to facilitate inspection. Computer models are typically three dimensional and can be rotated on any axis, much as one could rotate an actual three dimensional model in one's hand, enabling the designer to gain a fuller sense of the object. CAD systems also lend themselves to modeling cutaway drawings, in which the internal shape of a part is revealed, and to illustrating the spatial relationships among a system of parts.

To understand CAD it is also useful to understand what CAD cannot do. CAD systems have no means of comprehending real-world concepts, such as the nature of the object being designed or the function that object will serve. CAD systems function by their capacity to codify geometrical concepts. Thus the design process using CAD involves transferring a designer's idea into a formal geometrical model. Efforts to develop computer-based «artificial intelligence» (AI) have not yet succeeded in penetrating beyond the mechanical – represented by geometrical (rule-based) modeling.

Other limitations to CAD are being addressed by research and development in the field of expert systems. This field is derived from research done in AI. One example of an expert system involves incorporating information about the nature of materials – their weight, tensile strength, flexibility, and so on – into CAD software. By including this and other information, the CAD system could then «know» what an expert engineer knows when that engineer creates a design. The system could then mimic the engineer's thought pattern and actually «create» more of the design. Expert systems might involve the implementation of more abstract principles, such as the nature of gravity and friction, or the function and relation of commonly used parts, such as levers or nuts and bolts. Expert systems might also come to change the way data are stored and retrieved in CAD/CAM systems, supplanting the hierarchical system with one that offers greater flexibility. Such futuristic concepts, however, are all highly dependent on our abilities to analyze human decision processes and to translate these into mechanical equivalents if possible.

One of the key areas of development in CAD technologies is the simulation of performance. Among the most common types of simulation are testing for response to stress and modeling the process by which a part might be manufactured or the dynamic relationships among a system of parts. In stress tests, model surfaces are shown by a grid or mesh, that distort as the part comes under simulated physical or thermal stress. Dynamics tests function as a complement or substitute for building working prototypes. The ease with which a part's specifications can be changed facilitates the development of optimal dynamic efficiencies, both as regards the functioning of a system of parts and the manufacture of any given part. Simulation is also used in electronic design automation, in which simulated flow of current through a circuit enables the rapid testing of various component configurations.

The processes of design and manufacture are, in some sense, conceptually separable. Yet the design process must be undertaken with an understanding of the nature of the production process. It is necessary, for example, for a designer to know the properties of the materials with which the part might be built, the various techniques by which the part might be shaped, and the scale of production that is economically viable. The conceptual overlap between design and manufacture is suggestive of the potential benefits of CAD and CAM and the reason they are generally considered together as a system.

Recent technical developments have fundamentally impacted the utility of CAD/CAM systems. For example, the ever-increasing processing power of personal computers has given them viability as a vehicle for CAD/CAM application. Another important trend is toward the establishment of a single CAD-CAM standard, so that different data packages can be exchanged without manufacturing and delivery delays, unnecessary design revisions, and other problems that continue to bedevil some CAD-CAM initiatives. Finally, CAD-CAM software continues to evolve in such realms as visual representation and integration of modeling and testing applications.

The CASE for CAS and CAS/CAM

A conceptually and functionally parallel development to CAD/CAM is CAS or CASE, computer-aided software engineering. «CASE» is the use of a computer-assisted method to organize and control the development of software, especially on large, complex projects involving many software components and people.» CASE dates back to the 1970s when computer companies began to apply concepts from the CAD/CAM experience to introduce more discipline into the software development process.

Another abbreviation inspired by the ubiquitous presence of CAD/CAM in the manufacturing sector is CAS/CAM. This phrase stands for Computer-Aided Selling/Computer-Aided Marketing software. In the case of CASE as well as CAS/CAM, the core of such technologies is integration of work flows and application of proven rules to a repeating process.

5. Mark these statements true (T) or false (F) according to the Text. Find the parts of the text that gives the correct information.

– CAD systems also offer «zoom» features analogous to a conferencing app.

– Computer models are typically three dimensional and can be rotated on any axis.

– CAD systems can comprehend real-world concepts, such as the nature of the object being designed or the function that object will serve.

– The key area of development in CAD technologies is the simulation of performance.

– It is not necessary for a designer to know the properties of the materials with which the part might be built.

6. Complete the sentences. Use the information from the Text.

– CAD systems also offer «zoom» features analogous to a camera lens, whereby a designer can magnify certain elements of a model to ________ inspection.

– CAD systems function by their capacity to ________ geometrical concepts.

– The design process using CAD involves ________ a designer's idea into a formal geometrical model.

– Among the most common types of ________ are testing for response to stress and modeling the process by which a part might be manufactured or the dynamic relationships among a system of parts.

– Dynamics tests function as a complement or substitute for ________ working prototypes.

– The design process must be undertaken with an ________ of the nature of the production process.

– Recent technical developments have fundamentally impacted the ________ of CAD/CAM systems.

– CAD-CAM software continues to evolve in such ________ as visual representation and integration of modeling and testing applications.

7. Choose the right variant. Explain your choice.

1) CAD systems also lend themselves to ………. cutaway drawings, in which the internal shape of a part is revealed
   a) modeling
   b) model

2) CAD systems have no means of comprehending real-world concepts, such as the nature of the object being designed or the function that object will serve.
   a) designed
   b) being designed

3) One example of an expert system involves incorporating information about the nature of materials – their weight, tensile strength, flexibility, and so on – into CAD software.
   a) incorporating
   b) incorporated

4) In stress tests, model surfaces are shown by a grid or mesh, that distort as the part comes under simulated physical or thermal stress.
   a) simulated
   b) simulating

5) Another abbreviation inspired by the ubiquitous presence of CAD/CAM in the manufacturing sector is CAS/CAM.
   a) inspired
   b) inspiring

8. Refer back to the text and write a summary of the components, pros and cons of networks and describe a situation in which a network can be very useful (8–10 sentences).

UNIT VIII
TWO-DIMENSIONAL CAD

1. Discuss the question: How much do you know 2-D CAD?
Work in pairs and answer the questions

– What is «Smart Paper»?
– What are the advantages of the «smart paper» approach?
– What is Computer Aided Engineering?

2. Match the terms below with their definitions

1 2-D CAD	**a)** the simple mathematical model that supports the geometric entities (lines, arcs, etc.)
2 Smart paper	**b)** relies on basic geometric shapes like lines, rectangles, circles, etc. to produce flat drawings
3 Scaling	**c)** the minimum number of coordinates needed to specify any point within mathematical space
4 Computer Aided Engineering (CAE)	**d)** a linear transformation that enlarges or diminishes objects
5 Dimension	**e)** the use of computer software to improve product design and resolve engineering problems for a wide range of industries

3. Vocabulary to Text «Smart Paper» concept in 2-D CAD».
Read and remember the following words and word combinations.

geometric entities – геометрические объекты, геометрические элементы

intelligence – ум; интеллект; рассудок; разум; умственная одаренность; понимание; знания; встроенные вычислительные средства; развитая логика; развитые логические возможности; развитые логические функции; оперативная информация; информация

to support – оказывать содействие; поддерживать; обеспечить; согласовывать; оказывать помощь; вставать на чью-либо сторону (someone)

side edge – боковое ребро; боковая грань; боковая кромка; боковое лезвие

accuracy ['ækjərəsı] – достоверность (информации); точность; тщательность; пунктуальность; исправность; верность; корректность (e.g. корректность данных); правильность

to exploit – использовать; использоваться; пользоваться; разрабатывать; эксплуатировать; эксплуатироваться; извлекать выгоду; зарабатывать (на ком-либо/на чем-либо); развивать (to exploit success – развивать успех)

decimal place – разряд десятичной дроби; знак после запятой; десятичный знак; десятичный разряд

formulae ['fɔ:mjuli:] (plural) **–** формулы (formula (singular) – формула)

projections – прогнозные показатели; проектные показатели

advent – появление; открытие; внедрение; введение (новой техники или системы учета); создание чего-либо; возникновение; вступление; применение; развитие; разработка

to figure out – выражаться (в цифрах at); вычислять; вычислить; понять; постичь; понимать; постигать; додумать; выяснить; решить задачу

to be affected by – испытывать влияние (ч-либо); подчиняться; подвергаться влиянию; подвергаться воздействию; подвергаться действию; зависеть от

Computer Aided Engineering (CAE) – Автоматизированное конструирование (планирование, проектирование, разработка и создание с использованием компьютеров (конструирование в широком смысле; компьютерное моделирование; компьютеризованное моделирование; автоматизированные инженерные работы; компьютеризованная инженерия

Finite Element Analysis (FEA) – исследование (анализ, расчет) методом конечных элементов

Computational Fluid Dynamics (CFD) – гидродинамическое моделирование; вычислительная гидродинамика; вычислительная динамика жидкости и газа

component [kəm'pəunənt] – составной элемент; компонента; ингредиент; входящий в состав; составная часть; часть целого; деталь; часть

Initial Graphics Exchange Specification (IGES) – исходная спецификация обмена графической информацией; Международный стандарт обмена графической информацией

detrimental effect – негативное воздействие; неблагоприятный эффект; отрицательное воздействие; негативное влияние; ущерб; вред

misnomer [mɪs'nəumə] – неправильное название; неправильное наименование

mathematical centroid – центроид; центр формы (объекта на изображении); центр тяжести; средняя точка; центр тяжести фигуры; центр инерции

Reading tasks

4. Read and translate the Text using the words and word combinations given above.

«Smart Paper» concept in 2-D CAD

Probably the best way to think of doing 2-D CAD design and drawings is to think of the system as «smart paper». Although the geometric entities (lines, arcs, etc.) being created on the screen could also be manually drawn on a piece of paper, the CAD system has the ability to provide important information and intelligence about that geometry. The key to this intelligence is the simple mathematical model that supports the entities.

If one works with a drawing as a piece of paper, and one wants to draw a circle at a specific location on the paper with a specific radius to size the circle, then there is no choice but to approximate the circle. The CAD system, however, has the ability to idealize that circle and essentially make it perfect. The CAD system can be «told» to make a circle that has a 10 mm radius and lies at a point 100 mm from the bottom and side edge of the paper. Although the CAD system will eventually make a hardcopy that is (like the manual drawing) only an estimation of the circle, internally the CAD system can remember the exact dimensions that the CAD user had in mind. It can store the 10 mm and 100 mm values as actual numbers. Although the CAD system also has a finite accuracy of perhaps 8 significant digits, and the 10 mm ideal value may actually be stored as 9.999999 mm, this is well within the accuracy of virtually all manufacturing processes.

There are a number of advantages that can be exploited from the «smart paper» analogy or the idea that the CAD system stores a mathematical model of the design. Table 1 lists a number of these advantages. It is important to note, however, that these functions will not work properly if the CAD system is not used accurately. For instance, whenever possible the actual numerical values for the geometry (i.e., «object lines») should be entered to the CAD system (as opposed to just guessing based on the appearance). If a circle is supposed to be 15/16 of an inch in diameter, then the value of 0.9375 should be typed into the CAD system somehow. Even if the eventual dimension shown on the drawing might be 0.93 (to reflect the tolerances associated with decimal places), it makes the most sense to have the CAD system automatically round the number instead of just making the circle only 0.93″ in diameter (which will degrade the mathematical model).

Table 1

Advantages of the «Smart Paper» Concept in 2-D CAD

«Smart Paper» Advantage	Description
Dynamic measurement	Although one can calculate distances, areas, angles, etc. by manually writing out formulae and solving them, basically all these values can be quickly and easily calculated and displayed by the CAD system. It can continue to provide these measurements throughout the design process.
Projections	If the CAD system tracks views, their scale, and their viewing angle (Front, Top, Right, etc.), then it should be able to create projections. This option allows the user to create geometry in one view and have some of it automatically created in other views with the correct orientation. With the advent of 3-D models however, this is a much less used capability.

Scaling	Geometry that is created properly can be scaled to larger and smaller sizes and create accurate new geometries based on existing ones. Some systems may also allow the scaling to not be uniform in the X- and Y-directions. For instance, a part could be stretched to be longer in the X-direction, but not changed in the Y-direction.
Accurate moves and rotations	Geometry that is created properly can be reoriented in a number of ways, for example, shifting or moving what has been drawn by a specific amount (say move all holes to the right by 10.523 mm). It can be much more accurate than following methods that only look right.
Automatic dimensions	Geometry that is created properly can have the CAD system determine the values of dimensions easily and automatically (even if a variety of drawing view scales are used in the drawing). In this case, after the design is drawn, the user can just pick the lines, edges, points, etc., and the system will figure out the proper distance between them and create a dimension that shows the appropriate value.

Two-dimensional CAE benefits

Most, if not all, analytical functions performed by engineers have been affected by the use of computer software. These types of computer programs are usually classified as CAE or Computer Aided Engineering. Probably the most common of these programs is called FEA or Finite Element Analysis. These programs attempt to predict the behavior of solid materials (such as metals) under various loads or forces. Another common type of program is called CFD or Computational Fluid Dynamics. These programs attempt to predict the behavior of fluids.

In each of these cases, the CAE software needs to use a fairly large amount of geometric information about the components being analyzed. Assuming that a 2-D CAD system has been used properly (i.e. following the «smart paper» approach), the CAD drawing can be useful for engineering analysis. If the geometric entities are scaled and drawn accurately, then the data about these geometric entities probably can be transferred to the CAE program directly. Usually this involves the use of a neutral file format such as the Initial Graphics Exchange Specification (IGES). The desired result is to have lines or line segments from the CAD program to be recognized as lines or line segments in the CAE program. And, when 2 line segments meet at a corner, for instance, the line segments must both really end at the intersection. Although a small gap between these lines would still look correct and would have no detrimental effect on the designer's drawing, such a gap could cause difficulties in the CAE program. Many of these geometric difficulties stem from the generation of something in the CAE program called a mesh. A mesh is a grid or framework of points within the confines of the part's geometry that controls where calculations can be performed. The creation of meshes often involves the application of automated geometric calculations, and issues like lines in a corner not touching will often cause errors.

Another aspect of engineering analysis with 2-D CAD data will involve the 2-D geometric properties. One obvious calculation would be area. If a part of a drawing has geometric entities that form a closed section, then the CAD system should be able to calculate the area of that section. Another common requirement for calculation in a CAD system is section properties such as inertia or moment of inertia. The inertia gives an indication of a cross section's ability to resist being deformed based on a specified axis; it weights the distribution of the area with respect to an axis. This calculation is also useful for finding a CG or Center of Gravity (generally these are misnomers for a mathematical centroid or center of area, but the relation to a real center of gravity is too strong and so the term CG is used anyway). The CG would be a point at the geometric center of any arbitrary shape. Both the inertia and the CG are very often applied in formulae for analyzing mechanical parts and assemblies.

5. Mark these statements true (T) or false (F) according to the Text. Find the parts of the text that gives the correct information.

– There are a number of advantages that can be exploited from the «smart paper» analogy or the idea that the CAD system stores a mathematical model of the design.

– CAD system can't create projections.

– Geometry that is created properly can't create accurate new geometries based on existing ones.

– Geometry that is created properly can have the CAD system determine the values of dimensions easily and automatically.

– The CAE software doesn't need to use a fairly large amount of geometric information about the components being analyzed.

6. Complete and translate the sentences. Use information from the Text.

– Although the ________ (lines, arcs, etc.) being created on the screen could also be manually drawn on a piece of paper, the CAD system has the ability to provide important information and intelligence about that geometry.

– The CAD system, however, has the ability to ________ that circle and essentially make it perfect.

– There are a number of advantages that can be exploited from the «smart paper» analogy or the idea that the CAD system stores a ________ of the design.

– Some systems may also allow the ________ to not be uniform in the X- and Y-directions.

– Although a small gap between these lines would still look correct and would have no ________ on the designer's drawing, such a gap could cause difficulties in the CAE program.

7. Choose the right variant. Explain your choice.

1) Although the geometric entities (lines, arcs, etc.) ________ on the screen could also be manually drawn on a piece of paper, the CAD system has the ability to provide important information and intelligence about that geometry.
   a) created
   b) to be created
   c) being created

2) There are a number of advantages that can ________ from the «smart paper» analogy or the idea that the CAD system stores a mathematical model of the design.
   a) be exploited
   b) to be exploited
   c) exploit

3) If a circle is supposed to be 15/16 of an inch in diameter, then the value of 0.9375 should _________ be typed into the CAD system somehow.
   a) type
   b) be typed
   c) to be typed

4) This option allows the user _________ to create geometry in one view and have some of it automatically created in other views with the correct orientation.
   a) to create
   b) creating
   c) create

5) In each of these cases, the CAE software needs to use a fairly large amount of geometric information about the components _________.
   a) analyzed
   b) being analyzed
   c) analyzing

8. Refer back to the text and write an abstract (8–10 sentences in Russian) in accordance with the requirements for writing a scientific abstract. Use the information from the Appendix.

UNIT IX
TREE-DIMENSIONAL CAD

Before you read

1. Discuss the question: How much do you know 3-D CAD?
Work in pairs and answer the questions.

– When did 3-D modeling start?
– What is the difference between 2D and 3D CAD?
– What are the advantages of the 3-D CAD system?

2. Match the terms below with their definitions.

1 3-D modeling	**a)** the central data repository, or hub , in a corporation's data processing center, linked to users through less powerful devices such as workstations or terminals
2 Mainframe	**b)** a whole number that cannot be divided exactly by two
3 Interference	**c)** the representation of an object, situation, or set of information as a chart or other image
4 Visualization	**d)** the net effect of the combination of two or more wave trains moving on intersecting or coincident paths (in physics)
5 Odd	**e)** the process of creating a three-dimensional representation of an object using specialized software

3. Vocabulary to Text «3-D CAD system».
Read and remember the following words and word combinations.

planar – плоскостной; плоский; двухмерный; лежащий в одной плоскости

enormous – громадный; огромный; грандиозный

mainframe – базовый компьютер; универсальный компьютер; универсальная вычислительная машина; большая вычислительная система; компьютер с высокой общей производительностью (призванный решать типовые задачи, как-то: обслуживание больших баз данных или одновременное обслуживание запросов от множества пользователей); большая многопроцессорная вычислительная система; большой универсальный высокопроизводительный отказоустойчивый сервер

odd – нечетное число; нечетная кратность; странность; случайность

to tweak – незначительно изменить; корректировать; вносить поправки; настраивать; налаживать; отлаживать; внести небольшие изменения; щипать

robust – устойчивый; устойчивый к сбоям; устойчивый к ошибкам; надежный в эксплуатации; прочный

translucent – подсвечиваемый снизу; полупрозрачный; просвечивающий; матовый; пропускающий свет

line-to-line – линейное; схема «линия - линия»; линия в линию; междуфазный

feedback – ответная реакция; обратная связь; обратная информация; поток обратной информации

to evaporate – испарять; превращать в пар; испаряться; превращаться в пар; выпаривать; обезвоживать; исчезать; развеяться; лопнуть (о терпении); сойти на нет; улетучиться; рассеивать

intrinsic – подлинный; истинный; действительный; внутренний; присущий; свойственный; существенный; имманентный; объективный; встроенные средства; предопределенный; встроенный

Reading tasks

4. Read and translate the Text, using the words and word combinations given above.

3-D CAD system

In the 2-D case, work with the CAD system is based on planar mathematics. Users of these CAD systems see only the flat representation of data. The output of the system is just drawings (whether in electronic or paper form). Although these 2-D CAD systems have basically eliminated all drafting and the manual production of formal mechanical drawings, they still require that the designer (or other type of user) mentally visualize the physical object or design based on flat views.

Although this is not a significant problem for simpler parts, it can be an enormous problem when the object or assembly is complex. For instance, when the drawing is showing how to weld together 30 or 40 interconnected plates at a variety of angles, it can literally take hours of studying to fully understand the design.

Clearly, the process of designing and documenting something geometrically complex would benefit from a CAD system that could actually show and manipulate three-dimensional models. For many years, this was simply not practical for industrial users due to the relatively limited power available from computers (particularly mainframe computers that had to be shared with many other users). However, throughout the 1980s and 1990s, the power of non-mainframe computational systems expanded consistently and aggressively. Eventually (at least by the mid 1990s), the computational power that could be afforded to each designer was sufficient to create and manipulate 3-D models. Now, 3-D methods can be considered the norm for mechanical design.

Table 2 lists some of the advantages of the 3-D CAD system. It may seem odd that these need to be listed, but there has generally been great resistance to the adoption of the 3-D CAD system in most companies. It has simply been such a large break with previous systems that the transition was generally disruptive. It has been disruptive to work processes since decades-old paper-driven design methodologies have had to be changed. It has been disruptive to productivity since there is a significant learning curve as designers have to be retrained, but then they slowly gain back and then exceed the 2-D work output. And, it has been disruptive financially since the initial contracts for obtaining the systems can be quite significant (as opposed to existing 2-D CAD systems that are already paid for).

Finally and perhaps most importantly, it has been disruptive at a personal level since the 3-D CAD system is more demanding of the user. They must be comfortable with following the logic and organization of the software's methods. Unlike 2-D CAD, where virtually any particular method of construction could be followed as long as the final product (the drawing) looked right, 3-D CAD users must create a "real" mathematical model. These models are expected to be used, re-used, and tweaked over time. In the 3-D CAD system, more particular methods of construction must be followed. Some methods could be disastrous in the future, while other methods are robust and powerful. The trick, in a sense, is to think like the software, and to maximize its strengths and minimize its weaknesses. Many designers particularly those who have done 2-D work for a long time are not prepared for this level of involvement with the software.

There are some important issues for users to consider at the start. First, 3-D CAD is not really that difficult. Most people able to do design work can learn how to do 3-D CAD effectively, at least if they keep practicing. Second, there is a fair amount of jargon and assumed knowledge hidden in the 3-D CAD systems.

Table 2

Advantages of 3-D CAD

Visualization	The most basic advantage of 3-D CAD is that the designer can really see the design. There is no need to study the views on a drawing. And, 3-D CAD provides a means of navigating or dynamically viewing 3-D models. This means the designer can view it from any angle and rotate it any direction. Usually, the designer can also make it translucent, cut open the model, etc.

Automated drawings	Since drawings are often still needed to communicate designs with suppliers and customers, 3-D CAD is used to automatically create the geometric entities in drawings. Once a user indicates the viewing angles (Front, plane, datum, etc.), 3-D CAD can view object, remove or process hidden lines, and then create drawing views. 3-D CAD meets or beats times for drawing new geometry created in 2-D CAD.
Geometric properties	Once 3-D model is created, it can be analyzed in many ways that are not possible with 2-D CAD. For instance, the volume of a properly created 3-D model can be easily calculated. Assuming material of part is known, the weight can then be calculated. Even if the 3-D model is an assembly of many different materials, the 3-D CAD system can still account for this and give a very accurate weight. Distances in 3-D models can also be measured in sophisticated ways (3-D point-to-point, points-to-lines, points-to-edges, surfaces-to-points, lines-to-lines, etc.), so designs can be more refined and understood than in 2-D.
Interference checking	Once a 3-D model is created, it is possible to have the 3-D CAD system automatically determine if models or pieces of models interfere.
Improved quality	3-D CAD provides easier transition to the creation of analytical models (for predicting failure). Drawings that are automatically created from 3-D models have fewer chances for geometry errors. Isometric views can be produced easily; an isometric view on a drawing is helpful for the drawing reader to quickly assess what the drawing is attempting to show; reader can search for the proper level of detail and understand the drawing more productively and make fewer errors in interpreting.

"True" design reviews	Design reviews are "high level" meetings that discuss the state of a product design (including designers, engineers, managers, customers, marketing, manufacturing personnel). They are meant to make sure that the design is meeting requirements. Although they can be done with drawings, there is very limited feedback since attendees are forced to imagine the product design state (often non-engineering personnel are not adept at studying drawings). This problem practically evaporates when viewing a projected image of a 3-D model. Feedback is plentiful.
Intelligent models	3-D modeling software generally encourages designers to include design intent. This may take the form of creating parametric relationships, entering equations, family tables, constraints, etc. This can allow a generic part model to generate related parts automatically. It might also encode into a 3-D model which dimensions or parameters are most important in the design.
Standardization	Although 2-D CAD may have a means for storing and organizing standard geometry, once it is placed into a drawing, there is typically no tracking of reuse. 3-D CAD can keep a record of the times the standard 3-D part models are used in an assembly.
Associativity	3-D CAD can keep track of individual geometric entity's relationships to each other. Using this associativity feature, when the 3-D model is revised, the geometry and dimensions in the 2-D drawing can automatically change. Relationships can also drive changes in an assembly or analysis model based on a part change.

Integrated product development	With capabilities such as visualization, associativity, and intelligent models, it becomes much more realistic to create interdisciplinary teams for product development. Disciplines that might be represented on such a team would be manufacturing engineering, marketing, process planning, purchasing, system integration, etc. Although these groups can be used on a team with 2-D CAD, in 3-D CAD these groups can very easily integrate the state of the design with their disciplines (just by looking at and manipulating the 3-D models).

These systems have developed over a long period of intense research and development, and often academic terminology and techniques creep into the software. Users that have not been engrossed in the systems over this long time are often blind-sided. Hopefully, the remainder of this chapter will expose some of these pitfalls. Third, 3-D CAD can not be beaten. The intrinsic advantages of a complete geometric model of a product are simply too great to bother using 2-D any more for any serious mechanical design activity. Once a 3-D model exists, it can be interrogated, studied, analyzed, and sliced and diced in a way that not even a physical prototype can equal. So there is no reason to fight the 3-D approach.

5. Mark these statements true (T) or false (F) according to the text. Find the parts of the text that gives the correct information.

– In the 2-D case, work with the CAD system is based on non-planar mathematics.

– Throughout the 1980s and 1990s, the power of non-mainframe computational systems expanded consistently and aggressively.

– 3-D methods can be considered the norm for mechanical design.

– It has been disruptive at a personal level since the 3-D CAD system is less Demanding of the user.

– Most people able to do design work can learn how to do 3-D CAD effectively.

6. Complete and translate the sentences. Use information from the Text.

– Although this is not a significant problem for simpler parts, it can be an enormous problem when the object or assembly is ________.

– Clearly, the process of designing and documenting something geometrically complex would benefit from a CAD system that could actually show and manipulate ________.

– It has been disruptive to work processes since decades-old ________ design methodologies have had to be changed.

– 3-D CAD provides a means of ________ or dynamically viewing 3-D models.

– 3-D CAD can view ________, remove or process hidden lines, and then create drawing views.

– Even if the 3-D model is an assembly of many different materials, the 3-D CAD system can still ________ this and give a very accurate weight.

– 3-D CAD provides easier transition to the creation of ________ (for predicting failure).

– 3-D modeling ________ generally encourages designers to include design intent.

– 3-D CAD can keep a record of the times the standard 3-D part models are used in an ________.

– 3-D CAD can keep ________ of individual geometric entity's relationships to each other.

– With capabilities such as visualization, associativity, and ________, it becomes much more realistic to create interdisciplinary teams for product development.

7. Choose the right variant. Explain your choice.

1) When the drawing is showing how to weld together 30 or 40 ________ plates at a variety of angles, it can literally take hours of studying to fully understand the design.
   a) interconnecting
   b) interconnected

2) For many years, this was simply not practical for industrial users due to the relatively ________ power available from computers (particularly mainframe computers that had to be shared with many other users).
   a) limited
   b) limited

3) It has been disruptive to work processes since decades-old ________ design methodologies have had to be changed.
   a) paper-driven
   b) paper-driving

4) Finally and perhaps most importantly, it has been disruptive at a personal level since the 3-D CAD system is more ________ of the user.
   a) demanded
   b) demanding

5) These models are expected ____________________ over time.
   a) to be used, re-used, and tweaked
   b) to be using, re-using, and tweaking.

8. Refer back to the text and write an abstract (8–10 sentences in Russian) in accordance with the requirements for writing a scientific abstract. Use the information from the Appendix

UNIT X
SUPPLEMENTARY READING

1. Read the text. Please tell what information in the text was new to you. Make a summary of the text and reproduce it in class.

Computer Hardware Basics

In order to fully master a CAD system, it is important to understand how a computer functions. The intent here is not to become a expert in computer technology, but to build a foundation. With this foundation, a good CAD user or a CAD manager can hopefully evaluate systems and create appropriate design processes. Particularly with the wide proliferation of very capable 3-D CAD systems, it is essential to know how the CAD software is going to interact with the computer hardware; 3-D CAD is one of the most demanding applications available to run on computers. Understanding how the software is trying to utilize the computational resources can make the difference between a productive design process and one that provides little benefit at all.

A basic understanding of computer systems allows designers and engineers to make proper trade-off's in utilizing available computer resources. If a designer knows about graphics accelerators, he or she can tell if a low-end PC can handle a particular task. If the designer knows about how files are written and stored on a computer, he or she can tell what it will take to translate the model to other formats or to other types of computer systems. If the designer knows something about computer networks, he or she will be able to tell how long it will take to transfer a design's files to other computer systems. These situations are common in everyday design and engineering practice. CAD plays a vital role in many aspects of design and engineering. Furthermore, designers and engineers that use CAD are expected to understand how to maximize the benefits of CAD, and understanding the computer systems themselves is an important ingredient in this process.

Hardware refers to the physical components of a computer system. However, it must be understood that the computer hardware is of little value without software. Software is the computer programming that runs or "executes" on the hardware. The hardware is often closely tied to the software that is running on the computer, and in particular, on software called the operating system or OS. Sometimes the combination of the hardware and software is referred to as a platform. For example, two common platforms are the UNIX® platform (the Unix operating system combined with a workstation) and the Windows® platform (the Windows operating system combined with a personal computer (PC)).

2. Before reading the Text, look at the title and say what information you expect to find in it. Then read the Text and compare the given information with your prognosis.

CPU

The CPU can be easily referred to as the master of the system. It is an integrated circuit (IC or "chip") that really manages the data amongst the components. All the other components, therefore, are designed around the CPU, and the CPU usually has the most obvious effect on the performance of the computer. These devices have been developing and advancing for decades now, and many classes or types of CPUs have come and gone. Although mainframe computers were once built around the CPU (to be shared by hundreds of users via terminals) today each user normally has a CPU dedicated to their use within their personal system.

There are only a handful of vendors that produce CPUs that would typically be used for CAD software. Therefore, there are only a few basic computer systems that CAD users will generally come in contact with. Probably the most popular CPUs (for all applications) are made by Intel®. Intel CPUs have had names such as 8086, 80286, 80386, 80486. After this series of CPUs, a series of Pentium® chips were made (Pentium, Pentium II, Pentium III, etc.), and then the Itanium®. Another popular series of CPUs are made by Motorola®. Their chips have had names such as 68000, 68010, 68020, 68030, 88000, etc. These chips were the basis for the Apple® Macintosh® (Mac) computers. The remaining CPUs found in CAD systems would be from complete computer systems manufacturers such as IBM, Hewlett-Packard® or "HP®," Sun Microsystems™, etc. Their chips would generally be considered "proprietary" since other computer systems makers generally do not use them. This is in contrast to Intel and Motorola which do not provide complete computer systems. Another source of CPUs would be from "clones." These chips are made by companies other than Intel or Motorola, but they are functionally equivalent or compatible with the original chips.

In popular usage, a PC is basically a computer with an Intel or Intel-compatible chip in combination with a Microsoft® operating system. Apple computers (such as the Mac) use Motorola chips, and they would be considered a personal computer, but they would probably not be referred to as a PC. Also, in popular usage anyway, a workstation is generally a very high performance personal computer from a proprietary source, combined with a variant of the Unix operating system. However, with the overall performance of the PC reaching the performance of the workstation, PC companies are now also referring to their computers as workstations, even though they use the Intel-type CPU.

In terms of function, it is only really necessary to understand that the CPU runs or executes very specific, rudimentary logic instructions. These instructions can be referred to as machine code or machine language. Programs such as CAD are not “written” in this language, but computer programs that run on the system must eventually be “boiled down” to this language. CAD software vendors write programs in so-called “high level” languages such as FORTRAN, C, C++, Java™, etc., and programs called compilers convert the program into the machine code instructions.

Probably the most important concept to grasp with respect to the CPU is that it only communicates with the “outside world” (i.e. the CAD software or any data) via memory. The CPU does not really communicate with storage (such as disk drives) directly; instead, the system first brings the data from storage to memory (data going from disk drives to chips), and then the data goes from memory to the CPU. This is important since memory chips are perhaps 1000 times faster in sending or receiving data than disk drives. This, in turn, is important when dealing with computer performance with respect to CAD software.

It turns out that CAD software can be very “intense” for the CPU; CAD demands a great deal of computational power from the system as it makes many mathematical calculations. Therefore managing or optimizing the system’s performance is often an exercise in keeping the CPU working on the mathematics and using memory as much as possible (as opposed to just shuttling data back and forth in Storage devices). The CPU communicates with memory via memory “addresses” (a little more detail is presented on this topic in the Memory and Storage sections of this chapter).

The CPU is fed the instructions at a certain fast speed. This happens under the governance of a clock or timing circuitry based on the electronic resonance or vibration of a quartz crystal-based device. This governing speed is known as the clock speed. Clock speeds were once as low as 4.7 Megahertz (or a million “ticks” per second) at the beginning of the CAD for PC era, but now they exceed 1 Gigahertz (or a billion “ticks” per second). At each few “ticks” of the clock, the system can complete a machine code instruction as indicated by the program being executed. This instruction could be moving data around the system (say from memory to a “register” in the CPU); or it could be calculating or manipulating data within the system (say adding 2 numbers together). Although there are other chips or circuits that help the CPU perform these functions, the clock speed and the CPU’s basic architecture pretty much determine the computational performance of the computer.

In addition to the clock speed, the performance of the CPU is dependent on the number of “bits” in the system architecture. A bit (short for binary digit) is simply the 1s and 0s, or ONs and OFFs, that computers use and manipulate. Throughout the computer the “bus” transmits these bits between devices. The width or the number of “lanes” in the bus’s electronic highway obviously affects the performance of the system. If one system can put 8 bits on the highway at one time, while another can put 32 bits on the highway, then the 32-bit system is going to transmit data much more data in the same amount of time.

Originally, PCs were built upon an 8-bit architecture, with complementary 8-bit CPUs (generally the Intel 8086). When PCs were based on the Intel 80286, they were then using a 16-bit architecture with a 16-bit CPU. Once PCs were based on the Intel 80386, they were using a 32-bit processor (although sometimes with only a 16-bit bus). Once the Intel 80486 arrived, all PCs could be considered completely 32-bit based (although the operating system had 16-bit limitations for many years afterward).

As each of these new CPUs arrived, there was a significant increase in performance since the kind of work PCs generally performed could readily utilize the new architecture’s capability. However, once 32-bit architecture was widespread, the amount of data generated by the PC was generally being efficiently handled by the computer; thus, 64-bit and 128-bit architectures only provide relatively small increases in performance.

Another important distinction amongst the competing CPU types is RISC vs. CISC architecture. RISC is an acronym for a “Reduced Instruction Set” architecture. CISC represents a “Complete Instruction Set” approach. The RISC architecture was a hallmark of the workstation-class Unix-based type of computer for many years. The RISC architecture allows the CPU to have long machine code instructions moving more quickly to the CPU, and this allows the CPU to complete a function (such as multiplying 2 numbers) 2 or 3 times faster than the CISC type of CPU. So, the RISC computer can either perform as well as a CISC computer using only a half or a third of the clock speed, or the RISC computer can perform 2 or 3 times faster if both systems are at the same clock speed. But, if the clock speeds of the CISC computer are 2 or 3 times faster than the RISC system, then they may have about the same level of performance.

3. Read the text and write an abstract (8–10 sentences in Russian) in accordance with the requirements for writing a scientific abstract. Use the information from the Appendix.

Memory

Unfortunately, many computer users (CAD users included) use the terms memory and disk interchangeably. However, they are actually very different. There is a big difference between running out of disk space and running out of memory. It is important to keep the CAD system using memory as much as possible, since this can have a large impact on CAD system performance. Memory is made up of integrated circuits or “chips” (somewhat similar to the CPU). However, instead of being the “engine” of the system like the CPU, the memory chips are just a place to temporarily store data that is being worked on.

The memory chips can send, receive, and store at very fast speeds (such as nanoseconds or billionths of a second), while the disk drive can only typically do this on the order of milliseconds (or thousands of a second). Therefore, it is clear that when a CAD program is running, it is important to keep the CPU busy working with the data in the memory chips. However, the data in the memory chips is gone once the power to the system is turned off, so eventually, it is important to get the data stored on the disk drives (which do not lose data without the electrical power). Therefore, memory is considered volatile, since the data in the chips disappears when the power is turned off, and storage (such as disk drives) is considered nonvolatile, since the data on the drives does not disappear when the power is turned off.

Memory can be referred to in a number of ways. Occasionally memory is referred to as core memory, or just “core.” In the early 1980s, a VAX 11/780 “minicomputer” which handled 20 users may have had core memory of 16 Megabytes (or about 16 million bytes; each byte made up of 8 ones and zeroes). The VAX’s operating system would manage or control the use of that 16 Megabytes for the users on a continual basis. However, the most common term now for memory is RAM. RAM stands for Random Access Memory (meaning it can hold many different kinds of data dynamically). There are other memory chips called ROM chips, but they are generally not relevant to the CAD user.

Although the PCs of the early 1980s had no more than 512 kilobytes (about 512,000 bytes) of Memory, CAD platforms will easily have a gigabyte (about one billion bytes). And, unlike the VAX example, all this memory is basically used by just one user. Of course, the platforms can run more than one program at a time, so there is still some “competition” for the available data space in the memory chips, but this competition for resources should be minimized to keep the CAD program running as smoothly and as fast as possible.

4. Before reading the Text, look at the title and say what information you expect to find in it. Then read the Text and compare the given information with your prognosis.

Memory Addresses

An important concept to grasp is that of memory addresses. The memory chips are often described as having a huge number of mailboxes. Every mailbox has a predetermined identifier or address, and the mail (i.e. data) is supposed to be directed to that mailbox based on the address. So, in addition to having an address, each mailbox can have contents. In other words, at each given address (or mailbox) we expect to find something within it (the data). Addresses might also be referred to as pointers, since they point to where data is located.

These little mailboxes are really transistor-based devices etched into the structure of the chip's chemical layers, but the mailbox analogy is quite helpful. So in a CAD system, a geometric entity (such as a line segment) could be found in memory based on perhaps 4 addresses (symbolizing an X- and a Y-value for each end of the line segment), and the contents of each of these addresses would be the actual values of X and Y at the ends. The addresses could be called "variables" such as X1, Y1, X2, Y2, and the values of these variables could be numbers such as 1.5 mm, 2.5 mm, 12.5 mm, 15.0 mm, etc.

In addition to CAD data (such as the line segment data above), the memory system must hold other kinds of information. First of all, some amount of the operating system program must be kept in memory. This makes sense since the CPU must run the operating system as well as the CAD program, and yet the CPU can only communicate (as usual) via memory. Of course, the computer design and the operating system behavior will affect how much of the operating system must be kept in memory. The more that is kept there, the faster the computer may run, but this means there is less memory available for doing "real" work (like keeping the line segment data). Another kind of information that must be kept in memory is the actual CAD application programming instructions (i.e. the machine code for the CAD program). This is sometimes referred to as the "code segment" as opposed to "data segments." Just as with the operating system overhead, if most of the CAD program is always in memory, then it may run fast. But if too much of the program is in memory, there may be too little left for the CAD data (such as the line segment data) and then it runs slower anyway.

5. Read the text. Please tell what information in the text was new to you. Make a summary of the text and reproduce it in class.

Memory Configurations

In terms of the physical memory chips, they are often found in a wide variety of configurations. Usually, the main circuit board or motherboard contains the CPU as well as the memory chips. These chips are arranged in banks. These banks have a given capacity to hold a certain number of memory chip modules. These modules may be called SIMMs, although there are other types of configurations with different names. The number of these modules in combination with the capacity of a given memory chip will create the total "physical" memory or RAM for the given computer system.

A typical situation would be a SIMM module with 4 chips on it. The chips could have a capacity of 32 Megabytes each, so when they are combined into a single SIMM, there would be 128 Megabytes. Then 4 of these SIMMs could be combined on the motherboard to give a total of 512 megabytes of physical memory. Recall that this then becomes the maximum "address space" that the CPU could specifically utilize to run the system, and then depending on the operating system, this could be expanded to a certain higher number as "virtual" memory. For instance, this 512 megabyte physical memory could be configured to mimic 4 gigabytes of memory as virtual memory.

Table 3 summarizes the contrasts between the memory system and the disk system.

Table 3

A Comparison between the Memory System and the Storage System

	Memory System	Storage System
Memory System Storage System	Integrated circuits (chips)	Disk drives Floppy drives
Data behavior	Volatile (data is lost when the system is shutdown)	Nonvolatile (data is not lost when the system is shutdown)
Data speed	Fastest device for the computer (data rates measured in nanoseconds)	Slow devices for the computer (data rates in milliseconds)
Terminology	RAM Main memory System memory Core memory	Disk Drive Hard drive Floppy drive DASD (archaic mainframe reference)

6. Read the text and write an abstract (8–10 sentences in Russian) in accordance with the requirements for writing a scientific abstract. Use the information from the Appendix.

Storage

As already mentioned, the storage system is made up of a device or devices that can permanently store data (it is “nonvolatile”). This is in contrast to the memory system which is erased or empty when the computer is turned off or shut down. In addition, the capacity or “size” of the data that can be stored on a storage device is usually much larger.

In terms of actual devices, the storage system is generally made up of one or more disk drive. These drives are devices that have a spinning a disk within them. Thus, these devices are often also referred to as disks or hard disks. These devices may also be referred to as hard drives, disk drives, or C drives. These terms basically all refer to the same thing. The spinning disk has magnetic material on it that can be altered by recording or playback “heads” (similar to a magnetic tape). These heads are on a electronically controlled arm that can swing over the spinning disk. The whole mechanism is in contained in a vacuum-sealed enclosure that fits into the computer system enclosure. Another type of storage device would be a floppy drive or a diskette drive. These work on the same principle as the hard disk, but they are generally used for transporting smaller amounts of data between computers.

Although the memory system is the only way that the CPU really communicates with the outside world, the storage system is the way that a user really communicates with the computer. Users do not save what the CPU has done, unless it is written to the storage system. This is true for CAD programs, as well. The user does need to be aware of what data is currently stored or saved on the storage system, and the user must be aware of how the CAD program is going to read and/or write new forms of that data. The way that the user generally recognizes the data on the storage devices is through files.

7. Before reading the Text, look at the title and say what information you expect to find in it. Then read the Text and compare the given information with your prognosis

Formatting

Another issue with respect to the behavior of the disk drive device is formatting. When a disk drive is first made available to a computer system, the master file needs to be created on the device, and the master file needs to know where the available space exists. This is the process known as formatting. There are often different levels of formatting. A low level format would actually have the heads scan and/or check every region of the disk. A normal level format usually just creates a brand new master file. Of course, creating that new master file means the old master file is gone, and thus all the data that was on the disk drive is basically gone (it can't be located any longer).

The use of formatting is generally confined to setting up new computers, but it can be used to improve performance as well. If the master file has been used on a computer system for a long time, the file may become large. Then, even when all the files that are residing on the disk drive are removed, the master file may still be large. In this case, reformatting the disk drive may speed up the rate at which files can be looked up in the master file. Another performance improvement that may be realized from low level formatting has to do with marking physical regions of the disk as unreliable or unusable. In this case, the master file is able to know that certain parts of the disk should no longer be used.

In addition to the performance aspects of the master file, the master file concept can also be used to undelete files. When a file is removed or deleted from a disk drive, the only action that generally happens is that the data in the master file about the deleted file is removed from the master file. However, the physical region (or regions) of the spinning disk that actually stored the data is unchanged. Obviously, if the information in the master file is not completely removed during the delete process, but simply put aside for future use, it would be possible to restore the file that was deleted. Of course, if the physical region of the disk (which would then be considered available for other files) is re-used for new data by the master file, then the "undelete" process is not going to work very well. In general, PCs have had the undelete capability for many years; however, the workstations have never had this capability. One reason not to include this capability is the potential for slowing down the overall speed of data access. If the master file completely "forgets" the deleted file information, then the master file can remain more compact.

Another issue with respect to disk drive behavior is the importance of how the data in a computer file are actually located on the spinning disk. This is especially true for the very large files, and CAD files, particularly 3-D models, tend to be rather large (as mentioned earlier with respect to the memory system it could be 100s of megabytes). With these large files the data is going to far exceed the capacity for storage of one particular region of the disk (that is a particular cylinder or block). In this case, the data is going to be written to a large portion of these regions, and the master file is going to have to keep track of where all those regions are located.

Clearly it would be best if all that data is written to regions of the disk that are "next to each other" or contiguous. In this case, the master file will only have a small amount of information to store; i.e., where the large file starts on disk and how far to go to read all the data. On the other hand, if the large amount of data in a big CAD file is broken into many small pieces, and these small pieces are in regions of the disk that are not contiguous, then the heads above the spinning disk have to move many times (perhaps 100s or even 1000s of times) to reassemble the entire file into the memory system. Clearly this situation is going to be pretty devastating to the performance of the disk drive and thus the entire storage system. This situation is sometimes called "thrashing," although this term may be best considered to apply to the situation of the memory system having to unload data to the storage system, and the storage system has to rapidly attempt to shuttle data to and from memory (or swapping).

One important method to prevent this breakdown in performance of the disk drive is to not let the disk drive capacity become too near to its maximum. As the used regions of the disk grow, the available regions not only become smaller (since less and less free space is available), these regions become spread apart as the larger files create smaller gaps. As a rule of thumb, no disk drive should exceed 80 percent of its maximum capacity. On the other hand, if a disk drive is 90 or 95 percent used, one can be certain that performance is suffering as the heads attempt to find and assemble files.

It was mentioned earlier that reformatting a disk drive will improve performance, and indeed, this will help alleviate the situation of the heads not getting data efficiently due to the poor organization of the data on the disk. However, it was also mentioned that the reformatting will erase all the data in the disk drive. Obviously, this is not always acceptable. In this case, a technique called "defragmentation" can be used. In this case, a special computer program is used to "shuffle" the data around on the disk (without doing the more drastic reformatting). The program reads a file into the memory system, then it deletes enough of the file to create some contiguous space on the disk. Then it rewrites the file from the memory system back to this improved region. This process continues, file by file, until the all the files on the disk drive are in a more efficient arrangement. Of course, one must be certain that all the data on the disk drive has been backed up (as mentioned earlier) before anything like a "defrag" program is used. If the computer system should shut down for some reason during the running of the program, the result could be somewhat catastrophic.

In the chapter on software, the concept of directories and subdirectories for files is presented. This technique of organizing larger numbers of files on a disk drive has some bearing on the performance, as well. It is the master files that need to keep track of the directories, and thus the same arguments of spreading data too thinly on the disk, or making the master file too large and cumbersome can apply to directories. For instance, if there are 10,000 files on a disk drive and they are in a single directory, then the master file for that directory will be relatively large. On the other hand, if these files are spread into 10 different subdirectories, and there is one master file for the top level directory, and then 10 smaller master files for each of the directories, then these master files will be much smaller, and therefore more efficient. Unfortunately, not all operating systems take complete advantage of this sort of efficiency, but it is still to be considered very beneficial for CAD programs, in particular, to keep files in a well-organized system of directories.

8. Read the text and write an abstract (8–10 sentences in Russian) in accordance with the requirements for writing a scientific abstract. Use the information from the Appendix

The operating system (OS)

The OS of a computer system is clearly the most important layer of software of which a user needs to have some knowledge (besides the CAD application itself). Anything a CAD user learns concerning the operating system is time well spent.

There are many important functions of the operating system, and as many as possible are presented here, but this is really a basic overview. The following are some generic functions generally expected to be performed by the operating system.

Memory management: Brings applications (such as the CAD software) from the storage system (i.e. disk drive) to the memory system (i.e. the RAM chips).

File management: Creates, modifies, copies, deletes the files in the storage system.

User management/security: Controls users and what users have access to which functions of the computer system.

Command interface: A set of commands and/or language that can be used to control and automate functions.

Network management: Controls access to network resources (at least at a high level).

Device management: Controls what peripherals are active and their configuration.

Queue management: Controlling functions (such as printing) that need to manage data streams to off-line operations.

Memory Management

The primary means by which the operating system controls the computer is via memory management. When a user wants to run a program (such as the CAD software), the user somehow indicates this to the operating system (such as clicking on an “icon” or typing a command). The operating system then “looks” at the appropriate location on the storage system (whether a local disk drive or on a network), finds the file for starting the CAD software, and then copies the executable data found in that disk file into the memory system. The operating system then signals to the CPU where in Memory to find the data and programming, and the CPU then performs the functions indicated by the new code in memory. Thus, although the CPU does the processing of data, the operating system tells the CPU what function is desired by the user.

Of course, there are many other functions that the computer performs just to keep itself operating. Although a user may be running CAD software, there is plenty going on behind the scenes, and the operating system is generally coordinating this unseen activity. Usually this sort of management is configured when the computer is first set up, and then the operating system simply sustains this management activity without intervention. However, each of these unseen activities requires resources (such as memory) when they run or execute.

Often the way the operating system manages memory (between the competing programs) tends to be a distinguishing characteristic of the operating system. In the past, operating systems such as PC-DOS only allowed one program to run at a time. Now most operating systems, such as Unix and Windows, do allow more than one program to be running at the same time. This behavior can be referred to as multiprocessing or multitasking (although this can be an oversimplification). Older derivatives of Windows allowed all programs to enter and leave the Memory system in a sort of cooperative manner, but Unix and its derivatives, as well as newer versions of Windows have one small master program that coordinates and controls the other programs vying for resources. This small master program is called an operating system kernel. The kernel based systems tend to be more stable since the master program is more likely to be able to get rid of rogue or badly-written programs, while systems without a kernel can crash more often.

9. Read the text. Please tell what information in the text was new to you. Make a summary of the text and reproduce it in class.

User Management

Beyond the behavior associated with multitasking, there is somewhat of a distinction between operating systems depending on whether they are multi-user or not. In this case, the operating system is not only able to coordinate the functions of different programs; it is able to manage different users. These are computers that have “logins” or “logons.” This kind of operating system is also going to have different classes of users. Some users are going to be able to modify the system itself, while other users are going to only be able to run the system, while yet other users may have even fewer privileges. In many cases, the ability to control users is blurred between a network and an individual computer. Unix and mainframe operating systems are able to manage individual, independent users accessing a single computer. This is how they were originally developed, since computer terminals were used by a group of people. Windows based computers tend to only exhibit multi-user behavior when the PC is connected to a network, and privileges are granted in consideration of the network resources. Controlling this function can be referred to as user management.

Depending on the operating system, there can be a fairly sophisticated set of privileges that can be granted and/or revoked to certain users. The most important function to control is the privilege of modifying the computer system or operating system itself. This is known as the administrative or "admin" privilege. For most operating systems, the name of user that has this privilege is derived from "admin" (SYSADM, NETADM, etc.). On Unix systems, the user with this privilege is called "root" (since Unix systems have an interesting "tree" organization scheme based on files or pseudofiles and access to the "root" of the tree would mean any part of the tree could be changed). Thus, on Unix systems, having "root access" would mean that the computer system or the operating system could be fundamentally altered.

Besides administrative access control, user management often involves segregating users so that there are only certain parts of the computer system that they can affect. In this case, different users may be able to access files in one "area" of the storage system that has been designated for their use, but they may not access files in other "areas" (which could be part of someone else's reserved space). This sort of control would be typical for a CAD user on a typical computer system. They have the privilege of working on the computer system, and they have some space in which to do their work, but there are areas of the computer that are off limits in some way. In some cases, this user may have whole systems hidden from his view, while in other cases, the user can "see" other resources, but can not actually use them. This space on the computer system where a general user can create and destroy data is generally called "home" or the "home directory" or a "C drive."

Another aspect of user management that can be configured in many operating systems is called groups. In this case, there are types of users that are grouped together. As a group, then, they would have access to certain privileges such as being able to read and write each other's files. This sort of arrangement could be used to control different design teams working on a CAD system. Only members of a given team would be able to alter the team's files. However, "higher end" CAD systems would probably offer this capability as part of the CAD system itself (instead of relying on the operating system).

10. Before reading the Text, look at the title and say what information you expect to find in it. Then read the Text and compare the given information with your prognosis.

Command Interface

Operating systems generally have a command "interpreter." This is a type of computer language that works "directly" with the operating system. A part or "module" of the operating system is "invoked" to interpret the commands of the user. These commands can be interactive, meaning the user is typing the command and then the computer acts on the request. The commands for the interpreter could also come from a file. This is an important function for automating tasks that the user does not want to keep typing manually.

In many cases, the use of this automation process is "hidden" from the standard CAD user. Instead, a CAD administrator or someone from the computer systems department would probably use the command interface to define functions, and then the standard CAD user would be given a means of requesting the function (such as through an icon or pull down menu). Of course, even standard CAD users can derive some benefit from being at least somewhat familiar with the command interpreter capability. This would facilitate understanding what the operating system is capable of doing, and it could facilitate assisting the administrators of the system.

There are a number of names and capabilities associated with the command interpreter and its language. For workstations, the most common reference is to the shell program or shell scripts or just scripts. The shell is seen as a program that is sort of a shell around the real program that is controlling the CPU, memory, and storage, and it provides a more direct interface between the user and the operating system. These shell programs come in a number of "flavors" based on a succession of versions of the Unix operating system. Some versions of Unix generally were coming from AT&T's Bell Labs and its descendants as System IV, System V ("System 5"), etc. Other versions were coming from the University of California at Berkeley as BSD (Berkeley Standard Distribution). One flavor generally had a shell program called "sh"; the other had a shell program called "csh". Later, versions of this operating system somewhat merged the shells into a "ksh". The programs that can be written to work with these shell programs can be quite powerful, and the “scripting” of unix is a renowned capability for the operating system.

There are also a number of terms applied to the dominant operating systems for PCs. Most early PCs worked with the program called PC-DOS (for Disk Operating System), and the PC-DOS program had a command interpreter. Mainframes and early microcomputers also had programs called DOS and/or OS, but this book will be assuming that DOS means the Microsoft PC operating system program. The PC-DOS command interpreter could be programmed through a type of file called a batch file; it ended with the .BAT file extension (batch programming was another mainframe term for many years, but again that will be ignored in this work). Thus, it is not unusual to have the use of the command interpreter capability be referred to as the “DOS prompt” (even though Windows has long since replaced DOS), or for files that drive many command interpretersto be referred to as “batch files.” Since Microsoft has controlled most, if not all, of the development of the PC command interpreter capability, there is far less confusion about their content (as would be the case with the sh/csh/ksh situation with Unix). However, since the PCs were not generally driven as much by scripting (for interactive commands as well as shell scripts), the PC would generally be considered less capable with respect to the command interpreter in comparison to Unix.

ЗАКЛЮЧЕНИЕ

Курс «Автоматизированные системы специального назначения: иностранный язык в профессиональной деятельности» относится к разряду тех дисциплин, знание которых обеспечивает успешность профессиональной коммуникации студента, магистранта, аспиранта. Данный факт объясняет прикладной характер предлагаемого учебного пособия, что обуславливает наличие большого количества аутентичного текстового материала и лексико-грамматических упражнений. Использование настоящего учебного пособия на практических занятиях по дисциплине «Иностранный язык в профессиональной деятельности» будет способствовать формированию всех компонентов иноязычной коммуникативной компетенции слушателей.

Структура пособия и его дидактические единицы формируют живое знание различными способами: словесно-символическим, визуальным, предметно-практическим. В обучении грамматике сочетаются коммуникативный и системный подходы, кроме того, происходит обеспечение постоянной актуализации выученной лексики. Изучение иностранного языка всегда требует самостоятельных усилий со стороны обучаемого, а предлагаемая система упражнений не только способствуют закреплению имеющихся знаний, формированию языковых умений и навыков, но и регистрирует степень их сформированности.

Учебное пособие отличается мотивационным построением текста, современным «многослойным» изложением, позволяющим последовательно и углубленно формировать тезаурус на иностранном языке в области информатики и вычислительной техники, автоматизации технологических процессов. Содержание характеризуется современностью теоретических и практических подходов и доступностью изложения сложных сюжетов динамично развивающейся науки.

Международные и межкультурные компетенции – это важный ключ к профессиональному успеху. Языковые компетенции помогают открывать новые горизонты и дают большие преимущества.

ПРИЛОЖЕНИЕ

НАУЧНАЯ АННОТАЦИЯ

План аннотации

1. Основная идея (главная мысль) текста/статьи.
Статья (текст) посвящен(а) проблеме/ вопросу ...

2. Структурированная информации по абзацам/разделам.
! Приводится авторская позиция по проблематике статьи/текста.
В начале статьи
– речь идет о ...;
– дается определение...;
– обосновывается значимость ...;
– привлекается внимание к ...
Далее
– описывается...;
– рассказывается...;
– рассматривается...;
– излагается ...
В частности,
– отмечается, например, ...;
– подробно излагается...;
– описывается схема...;
– указывается ...;
– доказывается мысль...
Наконец
– раскрывается...
В заключение
– приводятся примеры

3. Заключение.
Резюмируя вышесказанное, следует отметить...

Статья/текст может представлять интерес для ...
Статья/текст может оказаться полезной для …

Фразы, рекомендуемые для написания аннотации к научной статье/тексту

В данной статье рассматривается проблема...
Обосновывается идея о том, что...
Прослеживается...
В статье затрагивается тема...
Дается сравнение...
Статья посвящена комплексному исследованию...
Целью статьи является анализ изучения...
Статья посвящена феномену...
В статье раскрываются проблемы...
Особое внимание уделено...
В статье анализируется...
Автор приходит к выводу, что...
Основное внимание в работе автор акцентирует на...
Выделяются и описываются характерные особенности...
В статье выяснены особенности...
На основе изучения… установлено...
Статья посвящена пристальному анализу...
На основании анализа..., а также привлечения... устанавливается, что...
Статья посвящена актуальной на сегодняшний день проблеме...
Данная проблема мало изучена и требует дальнейших исследований.
В статье обобщен новый материал по исследуемой теме, вводятся в научный оборот...
Автором предложены...
Работа имеет междисциплинарный характер, написана на стыке...
Основное содержание исследования составляет анализ...
Такой взгляд будет интересен специалистам в области...
В статье речь идет о...
Статья посвящена детальному анализу...
Значительное внимание уделяется...
В заключение раскрывается...
Статья раскрывает содержание понятия...
Автор прослеживает становление...
Обобщается практический опыт...
В статье исследуются характерные признаки...
В статье рассматриваются ключевые этапы...

В качестве исследовательской задачи авторами была определена попытка оценить...
В статье раскрываются процессы...
Статья подводит некоторые итоги изучения...
Автор дает обобщенную характеристику...
Данное направление дополняется также рассмотрением...
Обосновывается мысль о том, что...
В статье проанализированы концепции...
В качестве ключевого доказательства... используется...
В статье приведен анализ взглядов исследователей...
Дискуссионным продолжает оставаться вопрос о...
В данной статье предпринята попытка раскрыть основные причины...
В статье излагаются взгляды на...
Автор стремится проследить процесс...
В статье дан анализ научных изысканий...

СПИСОК ЛИТЕРАТУРЫ

1. Ефименко Н. В. Business Informatics: учеб. пособие. Уфа: УГАТУ, 2012. 70 с.

2. Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM). URL: https://www.inc.com/encyclopedia/computer-aided-design-cad-and-computer-aided-cam.html (дата обращения 04.04.2022)

3. Computer-aided design (CAD) and computer-aided manufacturing (CAM). URL: https://www.referenceforbusiness.com/small/Co-Di/Computer-Aided-Design-CAD-and-Computer-Aided-Manufacturing-CAM.html (дата обращения 20.05.2022)

4. Hirz M., Dietrich W., Gfrerrer A., Lang J. Integrated Computer-Aided Design in Automotive Development. New York, London: Springer, 2013. 482 p.

5. Radhakrishnan P., Subramanian S., Raju V. CAD/CAM/CIM. USA: New age international (P) limited, 2008. 690 p.

6. Schoonmaker S.J. The CAD guidebook // A basic manual for understanding and improving Computer-Aided Design. USA, Pennsylvania: Grove Worldwide, Shady Grove, 2003. 335 p.

7. Sopranzi S. Flash on English for Mechanics, Electronics and Technical Assistance. USA: Tecnostampa, 2013. 50 p.