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по изучению дисциплины

для студентов I–III курсов
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Unit 1.

Ex.1 Read and learn the following words and word combinations:

1. Deep learning - Глубокое обучение.
2. Artificial intelligence - искусственный интеллект.
3. vast amounts - огромное количество.
4. to generate - создавать.
5. data - данные.
6. pros and cons - плюсы и минусы, за и против.
7. digital - цифровой.
8. simulation - моделирование.
9. to perform -выполнять.
10. decision-making and problem-solving tasks - задачи по принятию решений и разрешению проблем.
11. to synergize - объединять усилия.
12. neural network - нейронная сеть.
13. application - приложение.
14. to delve - вникать.
15. subset - подмножество.
16. realm - область.
17. machine learning - машинное обучение.
18. human intelligence - человеческий интеллект.
19. robotics - робототехника
20. AI-oriental advanced technology - ориентированные на искусственный интеллект передовые технологии
21. to be capable of - быть способным к.
22. a rigorous need - строгая потребность.
23. assessment - оценка.
24. scope - масштаб.
25. outliner - планировщик.
26. to enhance - улучшать.
27. scatter plot - точечный график

Ex.2. Read and translate the text.

What Is Artificial Intelligence and How Does It Work?

Artificial intelligence (AI) can process vast amounts of data, learning from previous experiences to predict outcomes, optimize processes, and even generate new ideas. As AI becomes increasingly integrated into our digital infrastructure, its technical intricacies should be understood—so in this detailed article, we'll delve into what AI is, how it's used, pros and cons of its use, how it works, and future trends.

Artificial intelligence (AI) is the simulation of human intelligence in machines to perform complex decision-making and problem-solving tasks. These machines replicate human behavior by applying logic, learning from mistakes, and adapting to new information.

As an interdisciplinary field, AI synergizes knowledge from mathematics, computer science, psychology, neuroscience, cognitive science, linguistics, operations research, and economics. It employs a diverse toolkit of methods and technologies—such as search algorithms, logic programming, decision trees, and neural networks—to develop transformative and diverse applications. These include natural language processing (NLP,) robotics, and customer service.

Within the expansive realm of AI lie specialized subsets, such as machine learning (ML). ML is a subset of AI that uses algorithms to analyze data, learn from it, and make decisions. Another subset is deep learning (DL), which delves into complex neural networks —interconnected layers of algorithms—to analyze data in more nuanced ways. As AI keeps advancing, these subsets play key roles in transforming industries, solving complicated issues, and opening new possibilities.

Understanding AI starts with knowing three fundamental terms used in this field.

- **Artificial intelligence:** The field of AI simulates human intelligence in machines. It involves algorithms for searching data, decision-making trees, expert systems that mimic human expertise, and robotics.
- **Machine learning:** A branch of AI focusing on statistical models learning from data. It focuses on making predictions or decisions without explicit programming.

- **Deep learning:** A subset of ML employing complex neural networks. This is more advanced and can process a higher quantity of data.

AI has become indispensable in various industries, providing innovative solutions to complex problems. Traditional methods and practices have been transformed by AI-oriented advanced technologies that are tailored to specific needs.

Artificial intelligence's integration across industries leads to both advantages and disadvantages that shape the way we work and live.

To understand how artificial intelligence works, let's break the process down into distinct steps using the example of developing a predictive maintenance system in the industrial sector.

Step 1: Understanding the Problem.

Since AI exists to solve problems, the first step is to identify which problem you're trying to solve. This often starts with a rigorous needs assessment that defines the scope and limitations of what the artificial intelligence model is expected to achieve. This might include defining specific hypotheses, understanding the nature of the data you will work with, and identifying what success looks like in measurable terms, such as reducing manual task time or improving the accuracy of a diagnostic tool. Stakeholder interviews and domain-specific literature reviews are often conducted at this stage to understand the problem fully.

For predictive maintenance, the aim is to detect early signs of machine failure, thereby reducing downtime and false-positive rates. Clear objectives, constraints, assumptions, and potential risks must be outlined at this stage.

Step 2: Preparing the Data.

This stage involves a focus on meticulous data preparation. Imbalanced data sets are corrected, gaps in the data are addressed, and anomalies known as outliers are removed to enhance the model's reliability, and the right model type is chosen.

For predictive maintenance, data such as sensor readings, logs, and historical records, are collected. Sensor malfunctions and other irregularities must be rectified, and imbalanced data should be managed through techniques like resampling.

Step 3: Converting the Data.

Converting raw data into a usable form involves cleaning it, which means removing any errors or missing values. Then, you transform it into a standard format. Normalizing comes next, where you adjust the data so that everything is on a similar scale. Finally, you pull out the most relevant parts of the data, known as features, to focus on. This whole process is called feature engineering.

Step 4: Processing the Data.

In the data processing stage, the data is first loaded into a system. Then, easy-to-understand visuals like graphs and summary tables are created to help spot trends or unusual points in the data. Tools like Python libraries and methods such as statistical analysis are employed to identify patterns, anomalies, and underlying structures within the data.

In the predictive maintenance context, this might involve using scatter plots and heat maps to analyze trends in sensor readings leading to failure.

Step 5: Training the Machine.

Training a machine means setting it up to make decisions based on data. This involves three main learning styles: supervised learning uses data that's like a quiz with the answers provided; unsupervised learning gives the machine raw data and lets it find patterns; reinforcement learning is like a game, rewarding the machine for good decisions.

For predictive maintenance, sets of rules called algorithms may be utilized to learn from past data (identified per step two) on equipment failures. This way, it can give a warning before a similar breakdown happens again.

Step 6: Evaluation.

To evaluate how well our machine's early warning system is doing, we use simple checks called metrics. Think of it as a report card that tells us how often the machine is right or wrong.

In predictive maintenance, we fine-tune these checks to make sure the machine doesn't give too many false alarms or miss real issues.

Step 7: Inference/Deployment.

Deploying the model into real-world scenarios requires linking the AI software with the machinery or software you already use, continuously monitoring its results, and feeding it new data, as it's collected, to make sure it's making accurate decisions. Deployment is also called inference; you can learn more about it in our dedicated article.

In predictive maintenance, the model would be embedded into the industrial control system using code, and then software would continually monitor the model's predictions and performance for inconsistencies, alerting human teams to make adjustments as needed.

Step 8: Retirement or replacement.

Finally, it's important to recognize when a model is outdated or underperforming and establish procedures for its phase out. This involves regularly checking its performance against set standards, such as accuracy rates or response times. This helps organizations keep their artificial intelligence outputs relevant.

When machine designs are updated in predictive maintenance, a more recent algorithm may be introduced. The older models are archived with detailed documentation to preserve their insights, which can help in refining future algorithms or solving similar problems.

Technical challenges in AI integration and scalability require a tailored approach for each use case. For example, in self-driving cars, advanced neural networks must instantly interpret external data, like pedestrians and rain, and synchronize it with the vehicle's real-time operating systems to ensure safe and efficient operation.

Artificial intelligence continues to advance, transforming various aspects of human existence.

Ex.3. Answer the following questions.

1. What is artificial intelligence?
2. What are the specialized subjects of AI?
3. Where does the field of AI simulate human intelligence?
4. What is machine learning?

5. What is deep learning?
6. How does AI work?
7. What does data processing mean?
8. Does artificial intelligence continue to advance, transforming various aspects of human existence?

Ex.4. Make up all possible types of questions to the following sentences.

1. Artificial intelligence is the simulation of human intelligence in machines to perform complex decision - making and problem - solving tasks.
2. ML is a subject of AI that uses the algorithms to analyze data, learn from it, and make decisions.
3. DL delves into complex neural network - interconnection layers of algorithms - to analyze data in more nuanced ways.

Ex. 5. Read the text, put the verbs in brackets in the appropriate tense form. Translate the text and put 5 questions on the Text.

Artificial intelligence (AI) ***(to refer)*** to the capability of computational systems to perform tasks typically associated with human intelligence, such as learning, reasoning, problem-solving, perception, and decision-making. It ***(to be)*** a field of research in computer science that ***(to develop)*** and ***(to study)*** methods and software that enable machines ***(to perceive)*** their environment and ***(to use)*** learning and intelligence ***(to take)*** actions that maximize their chances of achieving defined goals. Such machines may ***(be called)*** AIs.

High-profile applications of AI ***(to include)*** advanced web search engines (e.g., Google Search); recommendation systems (used by YouTube, Amazon, and Netflix); virtual assistants (e.g., Google Assistant, Siri, and Alexa); autonomous vehicles (e.g., Waymo); generative and creative tools (e.g., ChatGPT and AI art); and superhuman ***(to play)*** and ***(to analysis)*** in strategy games (e.g., chess and Go). However, many AI applications ***(to be not)*** perceived as AI: "A lot of cutting-edge AI ***(to filter)*** into general applications, often without being called AI because once something ***(to become)*** useful enough and common enough ***(to be not labeled)*** AI anymore."

Various subfields of AI research ***(to be)*** centered around particular goals and the use of particular tools. The traditional goals of AI research ***(to include)*** learning, reasoning, knowledge representation, planning, natural language processing, perception, and support for robotics. General intelligence is the ability to complete any task ***(to perform)*** by a human on an at least equal level—is among the field's long-term goals. ***(to reach)*** these goals, AI researchers ***(to adapt)*** and ***(to integrate)*** a wide range of techniques, including search and mathematical optimization, formal logic, artificial neural

networks, and methods based on statistics, operations research, and economics. AI also ***(to draw)*** upon psychology, linguistics, philosophy, neuroscience, and other fields.

Artificial intelligence ***(to be found)*** as an academic discipline in 1956 and the field ***(to go)*** through multiple cycles of optimism throughout its history, followed by periods of disappointment and loss of funding, known as AI winters. Funding and interest vastly increased after 2012 when deep learning outperformed previous AI techniques. This growth ***(to accelerate)*** further after 2017 with the transformer architecture and by the early 2020s many billions of dollars ***(to be invested)*** in AI and the field ***(to experience)*** rapid ongoing progress in what ***(to become)*** known as the AI boom. The emergence of advanced generative AI in the midst of the AI boom and its ability ***(to create)*** and ***(to modify)*** content ***(to expose)*** several unintended consequences and harms in the present and ***(to raise)*** concerns about the risks ,of AI and its long-term effects in the future, ***(to prompt)*** discussions about regulatory policies to ensure the safety and benefits of the technology.

Ex.6. Decide whether the following statements are true or false.

1.Artificial intelligence cannot process vast amounts of data, learning from previous experiences to predict outcomes, optimize processes, and even generate new ideas.
2. Artificial intelligence is the simulation of human intelligence in machines to perform complex decision - making and problem-solving tasks.
3. Within the expansive realm of AI lie specialized subsets, such as machine learning.
4. ML is a subset of AI that doesn't use algorithms to analyze data, learn from it, and make decisions.
5. Understanding AI doesn't start with knowing three fundamental terms used in this field.
6. Artificial intelligence refers to the capacity of computational systems to perform tasks typically associated with human intelligence
7. The traditional goals of AI research don't include learning reasoning, knowledge representation, planning, natural language processing.

Ex.7.Retell the texts from this unit.

Unit 2.

Ex.1. Read and learn the following words and word combinations.

1. Intelligent system - Интеллектуальная система.
2. to respond to - отвечать на.
3. Surrounding environment - окружающая среда.
4. current data - текущие данные.
5. remote monitoring - удаленный мониторинг.
6. collaboration - сотрудничество.
7. robotics - робототехника.
8. to emerge - появляться.
9. accelerated technological growth - ускоренный технологический рост.
10. common goal - общая цель.
11. to seek - искать.
12. ability - способность.
13. Big Data - Большие данные.
14. experience - опыт.
15. subfield - подполе.
16. perception - восприятие.
17. Action Control - Управление действием.
18. deliberate and social reasoning - осознанное и социальное мышление.
identification - идентификация.
19. remote management - удаленное управление.
20. property - собственность.
21. actuator - привод.
22. intelligence core - интеллектуальное ядро.
23. external - внешний

Ex.2 Read and translate the text.

Intelligent Systems: What are they, how do they work and why are they so important?

An intelligent system is an advanced computer system that can gather, analyze and respond to the data it collects from its surrounding environment. It can work and communicate with other agents, such as users of other computer systems. It can also learn from experience and adapt according to current data. An intelligent system might also support remote monitoring and management. Intelligent systems solve complex problems automatically and more efficiently within specific environments. They are formed by the collaboration of people and technologies such as Big Data, the IoT ("Internet of things"), mobile networks (3G, 4G, 5G) AI or artificial intelligence, robotics, video analytics, computer vision, and augmented reality, among others.

Intelligent systems are a technology that has emerged and become more important in the last decade.

Intelligent systems are the answer to the accelerated technological growth of recent years and the needs of people and organizations in an increasingly interconnected world.

In this context, intelligent systems involve various physical, digital and human parts to achieve a common goal. The rearrangement, interaction and learning between all these components is part of the transformation of Industry 4.0.

Industry 4.0 seeks to modify current companies' working models so they can adapt and grow in this new collaborative environment between machines and humans. At Algotive, we call it the machine-colleague experience.

The interconnectivity and relationship between each of the components of intelligent systems is what makes it "intelligent".

A strict definition of an intelligent system is given by Martin Molina in his paper, "What is an intelligent system?" published by the Technical University of Madrid:

“An intelligent system operates in an environment with other agents, possesses cognitive capabilities such as perception, action control, deliberative reasoning or language, follows principles of behavior based on rationality and social norms, and has the ability to adapt by learning.".

How do intelligent systems work?

Generally, intelligent systems use IP (Internet Protocol) technology and sensors to collect information from a specific environment and share it among its different elements to achieve a common goal.

This interconnection between the digital and physical worlds is called the Internet of Things. On the other hand, Big Data is another element that makes this type of system

possible to collect information and knowledge within a system. And this same technology learns from its experiences with artificial intelligence technologies and its main subfield, machine learning.
The main characteristics of an intelligent system are:

Perception: An intelligent system creates a representation of the world to interact with a specific environment and perform tasks.

Action Control: An intelligent system can carry out actions or interrupt actions to achieve a goal.

Interaction or connectivity: An intelligent system can put its elements into communication through a common language.

Deliberate and social reasoning: The machine makes decisions on its own to achieve a specific result, considering the human context.

Self-Learning: Intelligent systems can reduce errors and optimize their performance by learning from their own experiences.

Identification: Intelligent systems can recognize specific information automatically and transmit it through various channels.

Protection: An intelligent system's networks and communications must be secure to function properly.

Remote Management: An intelligent system allows people to interact with it from any location.

User Experience (UX): To interact with users, intelligent systems must have accessible and adjustable interfaces.

Data Analytics: An essential component of an intelligent system is its ability to process immense amounts of data.

Properties of intelligent systems

Intelligent systems have fundamental similarities, but depending on the industry, they can vary greatly.

Here are 6 elementary properties of intelligent systems:

1. Sensors
The technology collects data from the environment and transmits it to the intelligent core for identification and analysis.

2. Actuators
They perform the actions that the intelligence core determines once it analyzes the environment in real-time.

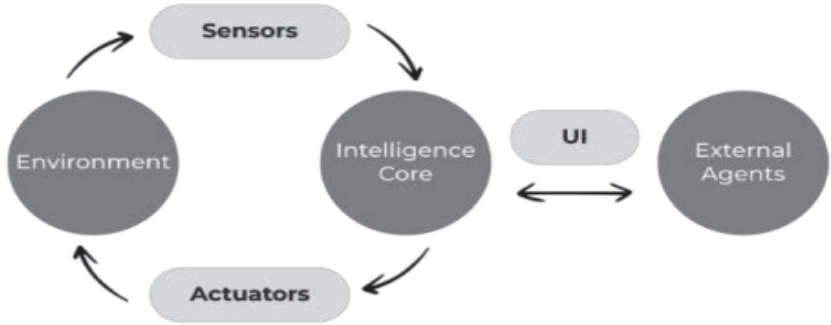
3. Specific environment
It is the context that the intelligent system analyzes and modifies. They can be static, discrete, episodic, deterministic, or known.

4. Intelligence Core
Artificial intelligence and machine learning are the pillars of this section. It is what makes it possible to generate situational awareness and learn from the situation. l User interface (UI).

5. User Interface (UI)
It is the way an external agent communicates and alters the relationship between the system and the environment.

6. External Agents
The people who oversee the process of the intelligent system or even other artificial intelligence.

INTELLIGENT SYSTEMS FUNCTIONALITY



Applications of intelligent systems

As mentioned before, intelligent systems have the ability to decide for themselves what actions to perform by means of perceptions, knowledge, and experiences, which are previously established by people.

But it is essential to know how intelligent systems provide benefits to organizations from their operation in tangible solutions.

These are 5 applications of intelligent systems used by companies to enhance their operations, products, and/or services:

Autonomous Robots

This is one of the most complex intelligent systems but at the same time, one of the fastest-growing and most far-reaching in recent years.

Computer Vision

Computer vision gives computers the ability to understand the visual information they receive. For this application to acquire information from an image or video, algorithms based on neural networks must be implemented.

Natural Language Processing (NLP)

This field is dedicated to researching the way machines communicate with people through the use of human languages, such as Spanish and English. Any language can be processed by computers being a more advanced tool in text analysis because it is easier to analyze this information in electronic format.

Ex.3 Answer the following questions.

1. What is an intelligent system?
2. When did IS emerge?
3. Are intelligent systems the answer to the accelerated technological growth?
4. What makes IS intelligent?
5. What does IS do?
6. How do intelligent systems work?
7. What are the main characteristics of an intelligent system?
8. How many elementary properties do intelligent systems have?

Ex. 4. Make up all possible types of questions to the following sentences.

1. An intelligent system is an advanced computer system that can gather, analyze and respond to the data it collects from its surrounding environment.
2. An intelligent system operates in an environment with other agents, possessing cognitive capabilities.
3. ISs use IP technology and sensors to collect information from a specific environment and share it among its different elements to achieve a common goal.

Ex.5. Read and translate the text. Put a title to each paragraph. Make up 5 types of questions on this text.

One of the great powers of intelligent systems is the ability to process vast amounts of data and learn from them. Such abilities can be used for detecting patterns, developing predictions and anticipating risks and have a positive impact on different domains in aviation.

Intelligent systems may assist the crew by advising on routine tasks to enhance the operational efficiency of the flight. They can predict issues like turbulence and icing conditions and help pilots in decision making when faced with a conflict.

With digitalisation, the amount of data handled by production and maintenance organisations is growing and with this, the need to rely upon IS to handle this data is also increasing. IS-based predictive maintenance can assist in optimising maintenance schedules, predicting remaining useful life of parts and therefore preventing failures.

Among others the optimisation of flight trajectories is one example of how IS can help reducing carbon emissions during flight operations. Assessing the environmental impacts of aviation, such as noise around airports or in-flight engine emissions, IS can make it possible for specialists to improve their capability to deal with such data.

By analysing data on weather patterns, sectors configurations, air traffic congestions and other factors, ISs can support the optimisation of flight routes, reduce flight time, fuel consumption and costs. Such an optimisation would then lead to a more efficient air traffic management system, reducing delays and increasing the capacity of air travel.

It can also help Air Traffic Controllers to make more informed decisions and faster, when faced with a conflict.

On the air operations side, ISs can support in detection of foreign object on the runway and unlawful unmanned aircraft in the surrounding airports, as well as support in the prevention of bird strikes. Inside the airport terminal ISs can assist in security screening detection of dangerous goods and surveillance. IS can support in creating more effective and robust systems to prevent cyber-attacks. They can be used for automatic detection and patching of systems vulnerabilities (prevention), as well as for the identification of threats on a behavioural basis (detection).

ISs will empower the safety intelligence by, for instance, improving the capability to identify vulnerabilities. They can support in detecting emerging risks, risk classification of occurrences, design of Safety Risk Portfolio and prioritization of safety issues.

Ex.6.Decide whether the following statements are true or false.

1. Intelligent system is an advanced computer system that cannot gather, analyze and respond to the data it collects from its environment.
2. Intelligent systems might not support remote monitoring and management.
3. Intelligent systems are a technology that has emerged and become more important in the last decade.
4. The inter connectivity and relationship between each of the components of intelligent systems is not what makes it intelligent.
5. Intelligent systems don’t use IP technology.
6. Intelligent systems can’t recognize specific information automatically.
7. To interact with users, intelligent systems must not have accessible and adjustable interfaces.
8. It is not essential to know how intelligent systems provide benefits to organizations from their operation in tangible solutions.

Ex.7. Retell the texts from this unit.

Unit 3.

Ex.1 Read and learn the following words and word combinations.

1. Intelligent flight control system - Интеллектуальная система управления полетом.
2. generation - поколение.
3. to optimize the aircraft performance - улучшать эксплуатационные характеристики самолета.
4. to provide increased safety - обеспечивать повышенную безопасность.
5. benefit - выгода.
6. failure conditions - условия отказа.
7. civilian aircraft - гражданские самолеты.
8. to accomplish - выполнить.
9. stable - стабильный.
10. control surface - поверхность управления.
11. to detect a fault - обнаруживать неисправность.
12. to drive the error - устранить ошибку.
13. to conduct - проводить.
14. measure - мера.
15. to discard - отбросить

Ex.2 Read and translate the text.

Intelligent flight control system

The Intelligent Flight Control System (IFCS) is a next-generation flight control system designed to provide increased safety for the crew and passengers of aircraft as well as to optimize the aircraft performance under normal conditions. The main benefit of this system is that it will allow a pilot to control an aircraft even under failure conditions that would normally cause it to crash. The IFCS is being developed under the direction of NASA's Dryden Flight Research Center with the collaboration of the NASA Ames Research Center, Boeing Phantom Works, the Institute for Scientific Research at West Virginia University, and the Georgia Institute of Technology.

The main purpose of IFCS project is to create a system for use in civilian and military aircraft that is both adaptive and fault tolerant. This is accomplished through the use of upgrades to the flight control software that incorporate self-learning neural network technology. The goals of the IFCS neural network project are.

1. To develop a flight control system that can identify aircraft characteristics through the use of neural network technology in order to optimize aircraft performance.
2. To develop a neural network that can train itself to analyze the flight properties of the aircraft.
3. To be able to demonstrate the aforementioned properties on a modified F-15 ACTIVE aircraft when the aircraft is in a stable flight condition, and will discard any characteristics that would cause the aircraft to go into a failure condition. If the aircraft's condition changes from stable to failure, for example, if one of the control surfaces becomes damaged and unresponsive, the IFCS can detect this fault and switch the flight characteristic model for the aircraft. The neural network then works to drive the error between the reference model and the actual aircraft state to zero.

Generation 1 IFCS flight tests were conducted in 2003 to test the outputs of the neural network. In this phase, the neural network was pre-trained using flight characteristics obtained for the McDonnell Douglas F-15 STOL/MTD in a wind tunnel test and did not actually provide any control adjustments in flight. Generation 2 IFCS tests were conducted in 2005 and used a fully integrated neural network as described in the theory of operation. It is a direct adaptive system that continuously provides error corrections and then measures the effects of these corrections in order to learn new flight models or adjust existing ones. To measure the aircraft state, the neural network takes 31 inputs from the roll, pitch, and yaw axes and the control surfaces. If there is a difference between the aircraft state and model, the neural network adjusts the outputs of the primary flight computer through a dynamic inversion controller to bring the difference to zero before they are sent to the actuator control electronics which move the control surfaces.

Ex.3 Answer the following questions.

1. What is the intelligent flight control! system?
2. What is the main benefit of this system?
3. What are the goals of the IFCS neural network project?
4. When were generation 1 IFCS flight tests conducted?
5. What was their aim?
6. When were generation 2 IFCS tests conducted?
7. Did they use a fully integrated neural network?
8. Is it a direct adaptive system?

Ex.4. Make up all possible types of questions to the following sentences.

1. The intelligent Flight Control System was designed to provide increased safety for the crew and passengers of aircraft.
2. Generation 1 IFCS flight tests were conducted in 2003 to rest the outputs of the neural network.
3. To measure the aircraft state, the neural network takes 31 inputs from the roll, pitch, and yaw axes and the control surfaces.

Ex.5. Read this text, translate it. Put all the sentences of this text into negative and interrogative form. Do it in written form.

Intelligent autopilot system

A different research and development project with the goal of designing an intelligent flight control system is being carried out at University College London. Their prototype is known as the Intelligent Autopilot System which has Artificial Neural Networks capable of learning from human teachers by imitation. The system is capable of handling severe weather conditions and flight emergencies such as engine failure or fire, emergency landing, and performing Rejected Take Off (RTO) in a flight simulator.

Ex.6. Decide whether the following statements are true or false.

1. The IFCS is not being developed under the direction of NASA's Dryden flight research center
2. The main purpose of the networks project is to create a system for use in civilian and military aircraft
3. Generation 1 IFCS flight tests were conducted in 2000 to test the outputs of the neural network
4. The neural network wasn't pre-trained using flight characteristics obtained for the McDonnell Douglas F-15 STOL/MTD
5. Generation 2 IFCS tests were conducted in 2005 and did not use a fully integrated neural network as described in the theory of operation
6. A different research and development project with the goal of designing an intelligent flight control system is being carried out by the University College of Berlin
7. The main benefit of this system is that it will allow a pilot to control an aircraft even under failure conditions that would normally cause it to crash.

Ex.7. Make the summary of the texts from this unit and retell it.

Unit 4.

Ex.1 Read and learn the following words and word combinations:

1. Data processing - обработка данных
2. Data manipulation – манипуляции, преобразование данных
3. to Verify – проверять, верифицировать
4. to Convert – преобразовывать, конвертировать
5. Reliance - зависимость
6. Data analysis – анализ данных
7. Concept – концепт
8. Raw data – необработанные данные
9. to Benefit – приносить пользу, быть кстати
10. to Extract – извлекать
11. to Consume – потреблять
12. Extraneous information - посторонняя, лишняя, ненужная информация
13. to Carry out – выполнять
14. Phase – этап
15. Manually - вручную
16. Batch Processing - пакетная обработка данных
17. Return someone's call – перезвонить
18. On-demand – по требованию
19. (CPU) Central Processing Unit – (ЦП) Центральный процессор

Ex.2. Read and translate the text.

Data processing

Data processing can sometimes be easily confused with data manipulation or data analysis, but it's an important concept that shouldn't be overlooked. Data processing means collecting and translating data into operable, helpful, and valuable information, which can be used to make business decisions.

Data processing can also include cleaning, verifying, enhancing, analyzing, and converting different types of data. All businesses will take raw data and convert it into usable information that can be used to make important business decisions. Some

companies even add in extra steps like encrypting data or formatting it on certain devices to give their customers ease of use.

When data needs to be processed, it has to be made ready for analysis or presented in a way that is meaningful to people. Generally, processing data involves cleaning it up and formatting it so that people can consume it.

An enormous amount of data exists today: According to reports we create over 2.5 quintillion bytes of new information each day and most of it remains untouched by human eyes. In fact, as reported, 73% of all stored data is never analyzed. As our reliance on digital information grows, we're going to need ways to process all the raw digital content quickly, accurately, and intelligently; otherwise, our systems will become bogged down with too much extraneous information.

Data processing is a series of programmed steps that are carried out on data, whether it be structured or unstructured. Unstructured data like text messages and emails can't just be run through a database system to extract important information, they need to be processed first to make sense of what they mean.

Six phases of data processing

1. Data collection.

The first stage in data processing, data collection is all about getting a hold of raw information. It should be collected from accurate and reliable sources.

2. Data preparation.

Before doing anything with the data, it first needs to be prepared or cleaned. Data preparation is about removing noise and formatting your data in a way that makes sense for downstream analysis. In other words, sorting out the collected raw data.

3. Data Input.

This step involves getting the raw data into a digitally readable format. Getting data into the system is usually a top priority. This could be done in any number of ways – manually or other types of input devices that collect structured or unstructured data.

The biggest consideration at this stage is accuracy and quality – are you sure that what's coming in is clean and can be trusted to perform analysis on?

4. Data Processing.

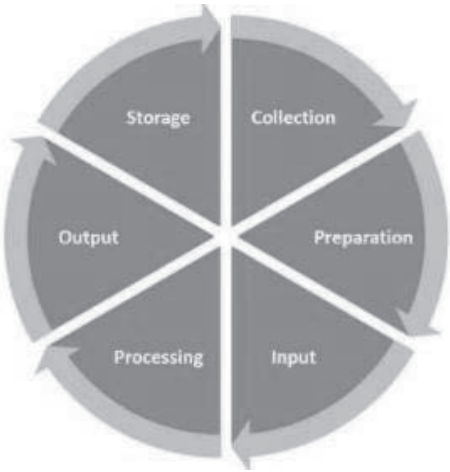
In this stage, data is processed for interpretation. Raw data is processed using machine learning and artificial intelligence algorithms.

5. Data Output.

Ultimately, the data is transferred and presented in a readable format to the user such as documents, graphs, files, etc.

6. Data Storage.

The last phase of data processing is a storage of the processed data. After data is transmitted and displayed, the data is stored for future use and references.



The types of data processing

There are multiple types of data processing processes available to select from based on your unique situation, but understanding the basics of each one will make it easier to determine which one or ones are most appropriate for your particular needs.

Batch Processing.

Batch Processing means processing data in batches. It involves processing large amounts of data as a single unit, like once per day or once per month.

Batch processing is great for reports and dashboards because it's simple to set up and allows to pull historical trends out of large amounts of raw data in real-time. For instance, generating electricity bills at the end of the month.

Real-time processing.

Real-time processing is used for analyzing data as it's coming in, and it typically involves an immediate response to a trigger event. It processes and transfers data as soon as it's obtained. It helps rapid decision-making.

For example, when the company receives a query from a customer about an order, you want to be able to answer that query immediately by pulling up relevant details about their order (such as payment method) from existing records. In other words, you don't want to wait until tomorrow or next week to return their call. Real-time processing does just that—it updates information in your database almost instantaneously as new data comes in.

Online Processing.

This is a data processing where businesses can upload their raw data and receive processed results online. Online processing is fast and simple.

The main idea behind online processing is that data can be entered through an interface, such as a Web browser, phone, etc., at any time when it's convenient for users.

For example, When you buy a pen in a supermarket, the barcode is scanned for payment and the invoice, and the item is marked as sold in the supermarket's inventory

system. It also gets updated in costs and sales reports. Once the payment is made, you can receive your results in real-time.
In general, most online processors will process your data on-demand.

Multiprocessing.

Multiprocessing refers to one computer system having more than one processor. It has two or more microprocessors. The purpose of a multiprocessor system is to distribute data processing among several processors so that they can execute different parts of a single program concurrently (instead of sequentially).

This approach permits data-intensive applications to run faster. Examples include tasks in financial services, scientific and engineering computations, video editing, and audio editing systems.

Time-sharing.

One of the time-sharing's main characteristics is that it allows many users to have access to a computer system simultaneously. While in batch processing only one user can make changes and then another batch job runs; with time-sharing several users can execute jobs concurrently with the central processing unit (CPU)

Ex.3 Answer the following questions.

1. What is the core purpose of data processing, and how is it fundamentally different from just data manipulation or data analysis?
2. Why is data processing considered crucial for businesses?
3. What consequence is mentioned if we fail to process data effectively?
4. What is the first phase of data processing called, and what is its primary focus?
5. What is the final phase called, and what happens there?
6. What happens during the "Data Preparation" phase? Why is this step necessary before further processing?
7. What is the main consideration emphasized during the "Data Input" phase, and why is it critical?
8. Describe the example given in the text that illustrates the use and benefit of real-time processing.
9. Define online processing according to the text. What is its key characteristic regarding user interaction and timing?
10. What is the primary goal of multiprocessing in data processing?

11. Why does the text specifically mention that unstructured data (like emails) needs processing before it can be meaningfully analyzed? What implication does this have for the processing phases?

Ex.4 Match the type of data processing (Column A) to its correct description and example (Column B). One description in **Column B will NOT be used.**

1. Batch Processing	**A.** Breaks data into frames for simultaneous processing by multiple CPUs in one system (e.g., weather forecasting).
2. Real-time Processing	**B.** Collects and processes data in groups at scheduled intervals for large datasets (e.g., payroll systems).
3. Online Processing	**C.** Processes data instantly upon input for urgent tasks (e.g., ATM withdrawals).
4. Multiprocessing	**D.** Allocates computing resources in time slots to multiple users simultaneously.
5. Time-sharing	**E.** Automatically feeds data into the CPU as it becomes available for continuous tasks (e.g., barcode scanning).
	F. Stores processed data in cloud databases for remote access (e.g., SaaS platforms).

Ex.5 Fill in the blanks with the correct word or phrase from the list.

• Data processing, • Data manipulation, • to Verify, • to Convert, • Reliance, • Data analysis, • Raw data, • to Benefit, • to Extract, • to Consume, • Extraneous information, • to Carry out, • Phase, • Manually, • Batch Processing

1. _____ transforms _____ into useful information for decision-making.

2. _____ is often confused with _____ or _____, but it's a distinct concept.

3. Businesses _____ data encryption _____ their customers.

4. Data must be cleaned so humans can easily _____ it.
5. Our growing _____ on digital data requires efficient processing to avoid overload.
6. Systems slow down when flooded with _____.
7. Unstructured data must be processed to _____ meaningful insights.
8. The first _____ of data processing is collecting _____ from reliable sources.
9. In the Input _____, data may be entered _____ or via devices.
10. _____ involves processing large datasets at scheduled intervals (e.g., monthly reports).
11. A key step is _____ data quality during input.

Ex.6. Decide whether the following statements are true or false.

1. Data processing is easily confused with data manipulation or data analysis but is a distinct concept.
2. The primary goal of data processing is to collect raw data without translating it into useful information.
3. Cleaning, verifying, and converting data are steps that can be part of data processing.
4. Businesses never encrypt data during processing to protect customer information.
5. Processed data must be formatted so humans can easily consume it.
6. 73% of all stored data is analyzed regularly.
7. Unstructured data (e.g., emails) can be directly analyzed without preprocessing.
8. The first phase of data processing is data collection from reliable sources.
9. Data input can be done manually or via automated devices.
10. Batch processing handles data in real-time for urgent tasks like ATM withdrawals.
11. The final phase of data processing is data storage for future use.
12. Reliance on digital information requires efficient processing to avoid system overload.

Ex.7. Retell the texts from this unit.

Unit 5.

Ex.1 Read and learn the following words and word combinations:

1. Data Storage - Хранение данных
2. Data Movement - Перемещение данных
3. Control - Управление
4. Main Memory - Основная память (ОЗУ)
5. I/O (Input/Output) - Ввод-вывод
6. System Interconnection - Системная взаимосвязь (системная шина)
7. Control Unit - Устройство управления
8. Arithmetic & Logic Unit (ALU) - Арифметико-логическое устройство (АЛУ)
9. Registers - Регистры
10. CPU Interconnections - Взаимосвязи ЦП
11. Input Device - Устройство ввода
12. Output Device - Устройство вывода
13. Component - Компонент
14. Function - Функция
15. Structure - Структура
16. Assemble - Собирать(ся) (о компонентах)
17. Interrelated - Взаимосвязанные
18. Hierarchical structure - Иерархическая структура
19. Intermediate result - Промежуточный результат
20. Short-Term Data Storage - Кратковременное хранение данных
21. Long-Term Data Storage - Долговременное хранение данных
22. Data Communication - Передача данных (между удалёнными устройствами)
23. Synchronize - Синхронизировать

Ex.2 Read and translate the text.

Structure and Function of Computer

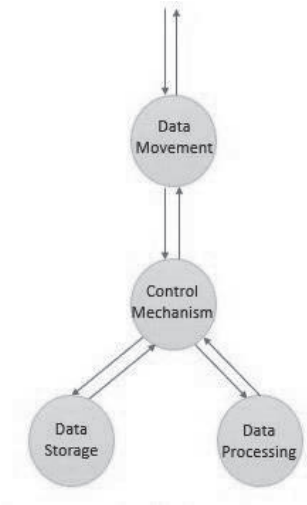
The structure and function of the computer depict how the components of the computer are assembled, how they are interrelated to each other and what operations these components perform.

Being a complex system, the computer contains millions of electronic components. To understand the structure and function better we organize these electronic elements in a hierarchical structure.

Function of Computer

If we generalize the functions of the computer, we can divide them into four categories. The four basic functions are as below:

1. Data Processing
2. Data Storage
3. Data Movement
4. Control



The figure shows the four basic functions of the computer. Let us understand each of these functioning units.

Data Processing

If we talk of the computer, basically we consider it for performing computation. So, there must be a unit in the computer that would perform computation. For performing computation this unit must be capable of processing data.

It is the data processing unit that processes the data. It must also be able to process data in a wide variety of forms. Thus, the range of processing requirements is broader. Though there is a tremendous processing requirement, there are only a few methods or types for processing data.

Data Storage

Once the processing has been done there must be some means to store the final and intermediate results. Even though it seems that we enter the data into the computer, it processes that data and immediately produces the result. But still, the computer needs to store those pieces of data that are being worked on at the current moment.

The computer requires two kinds of data storage functions:

1. Short-Term Data Storage Function
2. Long-Term Data Storage Function

The short-term data storage function is generally used to store the intermediary result of any computation. The long-term data storage function is generally used to store the final result of any computation. It also involves the storage of files that can be subsequently retrieved and can be updated.

Data Movement

Every computer has an input and output device that makes the computer move data between itself and outside the world. The input devices are meant for entering the data into the computer. It is the data that we need to process. The output devices are where the computer displays the produced result or the output data.

The operating environment of any computer requires both input and output peripheral devices. The computers are also capable of moving data over a longer distance i.e., to or from a remote device. We refer to this moving of data between the remote devices as data communication.

Data Controlling

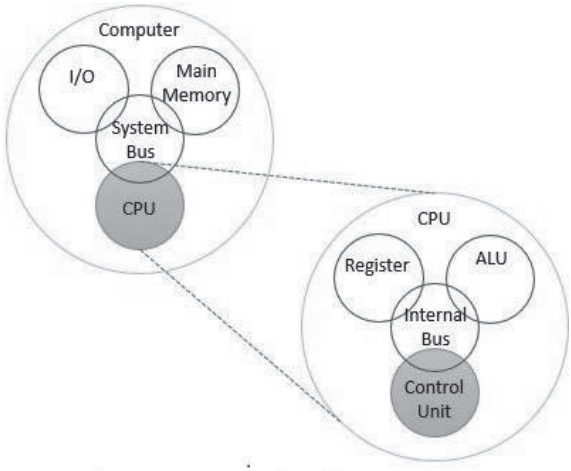
We have learned about three functioning units: data storage, movement and processing. As they are interrelated units, we require a unit that would control and synchronize the function of these units.

However, controlling of these three units is regulated by the individual who provides the instruction to the computer. In response to these instructions the control unit manages the resources of the computer and controls the performance of the functional units.

Knowing about the functional units lets us proceed with our discussion about the structure of the computer.

Structure of Computer

If we talk about the structure of a computer it is composed of several components. We can broadly classify these components into four types:



1. **Main Memory:** This structure of the computer is mainly used for storing the data.
2. **I/O:** These structural units of the computer are mainly used for moving data in or out of the computer.
3. **System Interconnection:** This structural component is held for moving the data and controlling the signal inside the computer. It provides communication between the functional units of the computer. This structure includes the system bus

4. **Central Processing Unit:** This structural component of the computer performs the controlling and processing function. Thus, it is also referred to as the processor.

A computer may have one or more of the above-discussed components. The traditional computers had a single processor but the modern or advanced computers have multiple processors. Even the processor can be classified into the components discussed below:

1. **Control Unit:** This unit controls all the operations of the processor.
2. **Arithmetic & Logic Unit (ALU):** This unit performs the computations while data processing.
3. **Registers:** It is the internal storage unit of the processor.
4. **CPU Interconnections:** This unit provides communication between the control unit, ALU and registers.

There are several ways to implement the control unit of the processor one of which is the microprogrammed approach that operates by executing the microinstructions.

In this way, the structure and function of the computer associatively decide how the components of the computer are assembled, how they are interrelated to each other and what operations these components perform.

Ex.3 Answer the following questions.

1. What are the four basic functions of a computer?
2. Why is the computer considered a complex system, and how are its components organized for better understanding?
3. What is the primary purpose of the data processing unit in a computer?
4. Are there many different methods for processing data in computers?
5. What are the two types of data storage functions in a computer? How do they differ?
6. Why does a computer need both short-term and long-term data storage?
7. How does a computer interact with the outside world in terms of data movement?
8. What is the role of the control unit in a computer?
9. How does the control unit interact with other functional units (data storage, movement, and processing)?
10. How does the system interconnection contribute to the functioning of a computer?
11. What are the key components of a CPU, and what role does each play?

Ex.4 Decide whether the following statements are true or false.

1. The four basic functions of a computer are data processing, data storage, data movement, and control.
2. The data processing unit in a computer is only capable of processing data in a single, fixed format.
3. Short-term data storage is used for storing final results, while long-term storage is for intermediate results.
4. Input and output devices are responsible for moving data between the computer and the outside world.
5. Data communication refers to the movement of data within the computer's internal components only.

Ex.5 Fill in the blanks with the correct word or phrase from the list.

• registers, • data communication, • system interconnection, • interrelated, • ALU, • control unit, • short-term data storage, • long-term data storage, • I/O, • structure.

1. The _____ performs mathematical and logical operations in a computer.
2. Temporary data used during processing is stored in _____ .
3. The _____ manages the operations of the CPU.
4. Data is transferred between the computer and external devices through _____ operations.
5. The _____ allows communication between different computer components.
6. Final results and files are kept in _____ .
7. The CPU uses _____ to hold small amounts of data during processing.
8. Computers use _____ to exchange information with remote devices.
9. All computer components are _____ and work together.
10. The _____ of a computer defines how its parts are organized.

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