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Information in the modern digital world

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The article analyzes the concept of “information” in its different representations: in the form of documents, drawings, pictures, texts, audio or light signals, electrical or nerve impulses etc., considers the most significant properties of the information (objectivity and subjectivity; completeness; reliability; adequacy; availability; relevance; accuracy; value) which have lately gained a worldwide currency). It analyzes the topics of journal and online publications, IT expert reviews as to the researches on the Information Theory. It is noted that the Source, Signal Channel, Converter, Coding, Recipient are used for transferring information. It has been found that the data transfer can be analog or digital (binary signal stream) as well as modulated with analog modulation, or with digital coding. It has been determined that when transmitting signals two main methods are used in the modern world: direct transmission of signals with a preset original form (impulses bearing the value of binary codes) and transmission with signal carriers (in the mobile or satellite communication). The concept “Information Object” is highlighted: material objects and phenomena, abstractions, virtual entities; Storage Media: states of matter, parameters of physical fields, “thin-material” phenomena; Information Subject: people and other living organisms, program objects which actively interact with its information environment. It is noted that in the modern “digital” life the need for storing and accessing data at any time becomes very important for the user. The main physical media for storing information are listed. The Databases (Data Bank, Database System, Data Warehouse, Data Mart) for the personal data storage and secure access have been analyzed. The importance of the information security has been proved: protection against random factors, wrongful acts of the user, equipment failure and protection from criminal acts which consist in the disclosure of sensitive information, unauthorized access to the information as well as coding and cryptography.

Key words: *information; information properties; two main types of messages; information coding; code; types of codes; message coding; transmission of messages; information object; storage media; information subject; information storage; CDs and DVDs; hard disc drives; USB flash drive; Databases.*

Introduction

In our life we constantly transfer information. For example, when we talk on the cell phone, order goods from e-shops, download our favorite music or watch video online. In all these cases our messages travel through cable and air channels as well as are temporarily stored in the memory of servers and local computers and gadgets. The multiple

technical solutions, which ensure necessary efficiency of transmission, are used on each step of such travel.

However, it is important for us to understand the principles on which they are created as well as familiarize ourselves with their most popular typical implementations.

The storage and accumulation are one more important action, which we perform with information, and the main method of ensuring its availability during some period of time. Currently, the concept of the database, data warehouse

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(store) is the defining trend of implementation of this operation [1].

Analysis of the recent publications showed that the researches of such scientists as V. K. Konopelko, V.V.Losyeva, V. A. Lipnitskyi, V. A. Ihnatov, V. P. Tsybmal, Y.P.Zhurakovskiy, V. P. Poltorak, A. V. Ushakova etc. are devoted to the problems of information, its coding, signal transmission and information storage

The objective of this study is the analysis of the processes applied to information, namely: coding, transfer, and storage in the modern "information" life.

Result and discussion

The information is a set of statements (data), which are taken from the environment (incoming information), provided to the environment (outcoming information) or stored in certain system [3].

The information exists in the form of documents, drawings, pictures, texts, audio or light signals, electric and nerve impulses etc. The word "information" derives from the Latin word 'information', which means the statement, explanation of the fact, event.

Therefore, the information is the product of interaction between data and methods, which is considered within the context of this interaction.

The most important properties of information are [3]:

- objectivity and subjectivity;
- completeness;
- reliability;
- adequacy;
- availability;
- relevance;
- accuracy;
- value.

The information is transferred from the Source to the Recipient in the form of messages, which can have any original form. There are two main types of messages – discrete (for example, text) and continuous (for example, sound or image). The key question is that any continuous message can be converted to a discrete form, "digitalized", with a necessary precision [2].

The messages are transmitted through the Channel that certainly includes a physical environment. In particular, when transmitting in the space, it can be a cable or air, and when transmitting in the time (storage) – random access memory or external storage media. The Channel may also include technical means of transmission. The properties of the Channel always limit the transmission parameters. In particular, physically it is impossible to transfer any volume of information instantaneously and absolutely accurately.

The Converters adapt the original form to the conditions of transmission in the Channel and then renew it. In general, the conversion can include two main stages: coding and forming the signals for transmission in the physical environment [2].

The measure of information value is the novelty, which can be determined through the likelihood of appearance of elements of the messages – signs. In particular, if the likelihood of appearance of the certain type of the sign is

low, then it will be less expected, and its appearance is more unexpected, and therefore more informative [2].

The accidental impediments (noises), which can distort the signal values and therefore cause the information loss, influence the signals when transmitting through the channel. Such losses can be compensated for the increase of transmission time, and therefore – at the expense of the decrease of carrying capacity of the channel (in the same way that the pipeline contamination decreases the amount of fluid which it can carry for the set time) [2].

The information coding is a specially designed system of methods (rules) for recording the information. The main attributes of coding are the sign, code, language, by which the information is recorded and transferred in space and time.

The code is a set of signs which are structured according to the certain rules of any given language, for transferring the information. The sign is a mark, subject and identification of something [4].

When a sign merges with its meaning, it becomes a symbol. The code should be unambiguously perceived, reproduced and transmitted, i.e. be permanent, uniform and distinctive. It must be clear to the sender and recipient.

There are the following types of codes [4]:

- alphabetic – letter system;
- numeric – numeric system;
- alphanumeric – mixed system of alphabetic and numeric codes;
- raised dots – system of embossed dots (Braille system);
- matrix – system of recesses and holes etc.

The message coding is a statement of its content in a certain language. Thus, when communicating we directly use our speech, its content can be represented as a text for correspondence, and when typing a text on the keyboard its signs are automatically translated into a "binary" format. At each such stage, a new "translation" of the message is done [2]:

- source binary coding which ensures a comfortable and standardized placement of messages in the computer memory;
- code compression with and without the information loss, which ensures the compactness of messages;
- protection of the code transmission from the information noise impact in the channel, in particular, detection and correction of possible transmission errors.

The data transmission (data exchange, digital transmission, digital communication) is the physical transfer of data of the digital (bit) stream in the form of signals from point to point or from point to set of points by electronic means of communication through a communication channel; usually, for further processing by computer technologies. The examples of such channels may be copper wires, optical fiber, wireless communication channels or storage devices [5].

The data transfer can be analog or digital (binary signal stream) as well as modulated with the analog modulation or by digital coding [5].

The signal transmission is the transfer of information in the physical environment. Actually, the signals (for example, current and light impulses or radio waves) are the active carriers that interact with the passive physical environment (in particular, with copper and optical conductors in cables

or with "ether"). Meanwhile, the signals inevitably lose energy and attenuate (such attenuation usually increases for higher transmission speeds). Accordingly, the noise immunity of signals - the ability to resist the effects of "information noise" in the channel - is reduced. Therefore, the main task of signal transmission analysis is to assess their noise immunity at given transmission speeds, physical environment parameters and signal waveforms [2].

When transmitting signals, two main methods are currently used [2]:

- direct transmission of signals with a given original form. In particular, in today's digital environment, these are usually the impulses that carry the values of binary codes. This method is used when transmitting over the distance by cables and when storing the values of codes on physical storage media;

- transmission by using the carrier signals. This method is essential in the over-the-air transmission (for example, mobile or satellite). In this case, the radio waves are used as the carriers.

The real information signals have a certain frequency content (spectrum).

Meanwhile, at higher frequencies, the signal attenuations are higher due to the more energy consumption to interact with the physical environment. The specific corresponding dependences form the "frequency profile" of the transmission channel. The combination of the signal spectrum and the frequency profile of the channel determines the degree of the signal attenuation and its noise immunity. Thus, when analyzing the efficiency of signal transmission, it is important to use the frequency (spectral) form of their representation [2].

The information objects can be material objects and phenomena (in particular - everything we observe around); abstractions (for example, concepts and formulas); virtual entities (fictional characters and circumstances). As we can see, in principle there is not only "information about the matter", but also "information about the information".

The storage media can be: states of matter (for example, memory elements); parameters of physical fields (for example, electromagnetic field); "thin-material" phenomena (the nature of the latter has not yet been studied by the science, but they manifest themselves, in particular, in human feelings).

It is important that the information capacity of storage media is determined by the density of their structure (for example, it increases after the density of memory cells or frequency of radio waves increases). The information is always related to the media, but it can be copied, and in this sense, it is relatively independent of the media. The possibility of unlimited copying means that the laws of storage do not apply to it. It can be stated that the information is not material [2].

It is appropriate to define the Information Subject as an "actor". The examples can be: humans and other living organisms that exist in the course of active interaction with the environment; cybernetic devices that implement control (including the works); software objects that actively interact with their information environment. However, a regular computer or gadget is only a converter of information, as it cannot work independently. It is also of crucial importance that the concept of the subject also extends to the teams. For

example, for the danger signal, the entire flock of birds becomes the subject of the relevant information. A certain community of people (for example, scientists or engineers in some field) and even the entire mankind can be considered as a subject [2].

In order for the information to be available at any time, it is important to have access to it. That is why the question of storage and protection against unauthorized access to personal data arises. The information storage consists in ensuring that the proper condition of information and its material storage media is maintained. A set of measures is aimed at ensuring preservation of the completeness and integrity of the generated data about certain information, the creation and maintenance of appropriate conditions for their use as well as the prevention of unauthorized access, dissemination and use [7].

The information storage is a set of actions aimed at protecting the accumulated information from loss, spoilage, destruction, damage.

The information is always accumulated on a certain medium, so the information storage requires, first of all, reliable media that are minimally exposed to physical wear. In the process of human development, the storage media have been constantly improved: the clay tables and papyrus scrolls have been replaced by the printed books, and nowadays the electronic media (optical and magnetic disks, which can reliably and compactly store huge amounts of information) come to the fore. The special archiving programs that allow compacting the records, reducing, for example, the amount of textual information by about three times [6] are applied for additional increase of the compactness of placement of the electronic information.

Each computer has one or more drives (called as the hard drives). The hard drives can store large amounts of information, including the photos, videos, music, documents, applications etc. The information is stored on your computer's hard drive even when the computer is turned off. There are also external hard drives. The easiest way to increase the amount of free space on your PC is to connect an external hard drive. It can supplement the volume of your computer's internal hard drive, especially if the internal drive functions slower due to the lack of space. You can back up important files to an external hard drive. Most of these hard drives are connected through USB [8].

Today, almost all computers are equipped with CD and DVD readers (drives), which are usually placed on the front panel of the system unit. With the help of lasers, the devices read (record) data from the disk [8].

A flash memory, or simply a flash drive, is a small portable device in the form of a key fob that plugs into a computer's USB port. Like a hard drive, the flash memory is used to store information, but it is usually much smaller than most hard drives. In digital cameras, phones, the information is stored on SD cards (flash memory). The information on SD cards can be erased and then SD cards can be used again. Laptops and some computers are equipped with built-in SD card readers [8].

The databases are one more place for storing information. The stored data do not depend on the users' programs, the common control method is applied for modification and alteration [1]:

The data bank is a system that provides certain services for storing and searching data to a certain group of users on a particular topic.

The database system is a set of management system, application software, database, operating system and hardware that provide information services to users.

A data warehouse is a database that stores the data aggregated in many dimensions.

An alternative to the data warehouse is the concept of data marts. The data marts are a set of thematic databases that contain the information related to certain information aspects of the subject area.

Another problem with storing information is that the data need to be protected. The protection of information (ensuring the inability to access the information of third parties; unintentional or unauthorized use, alteration or destruction of information). The information protection should be carried out in several areas: protection against accidental factors, wrongful acts of the user, equipment failure and protection against criminal acts, which consist in the disclosure of confidential information, unauthorized access to information [6].

These tasks are performed by the security services, which ensure the integrity and reliability of data, data classification, access control and protection against hardware failures. The ways and methods of concealing secret messages have been known for a long time, and, in addition, a stenography, the ancient field of human activity, was just revived to solve the issues of information security.

Along with it, other methods of protection are used: coding and cryptography. The purpose of cryptography is to block access to classified information by encrypting the contents of classified messages. The purpose of stenography is to hide the very existence of a secret message [6].

Conclusions

Therefore, the modern understanding of the information system provides for the use of computer as the main technical means of data processing. The computers fitted with specialized software applications are the technical base and the tool of information system.

Not only the life in any of its forms can exist without information, the manmade information systems and the entire physical world cannot function either. Any physical (mechanical) process occurs only because it is a process of exchange, interaction of material objects, in which each participant of the physical process receives information about another participant of the process through physical actions (forces, impulses, waves, etc.) and changes its parameters exactly in accordance with these forces and their configuration. This is the basic physical law - the law of causality of the physical world.

The communication, exchange of information is inherent to all living beings, and to special extent - human. Being accumulated and processed from certain positions, the information gives new information, leads to the acquisition of new knowledge. Obtaining information from the outside world, its analysis and generation are one of the main functions of the human, other living organisms, and automated information technology systems, which distinguishes them from the rest of the inanimate world.

The information cannot be considered just as a technical term, it is a fundamental philosophical category, which has such properties as memorization, protection, transmission (with transformation), reproduction, erasure.

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