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МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ АВТОНОМНОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ПРОФЕССИОНАЛЬНОГО ОБРАЗОВАНИЯ «СЕВЕРО-КАВКАЗСКИЙ ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ»

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INFORMATICS

COURSE OF LECTURES IN ENGLISH

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ИНФОРМАТИКА

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The manual is made according to requirements of the Federal state educational standard of the higher vocational training of the Russian Federation. In the given manual bases of computer science and information technologies, structures and functioning of information networks, computer safeties are considered. The big attention is given to Internet-technology. The basic data on tendencies of computer technics, information technologies development contain.

The manual is directed on formation of a set common cultural and professional knowledge the future bachelor in technical and humanitarian directions of preparation. It is recommended for students of humanitarian and engineering specialties of NCSU, and also for students, post-graduate students, the teachers studying informatics and information technologies.

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1. COMPUTER SCIECE AND INFORMATION PROPERTIES

INTRODUCTION

Lecture Outline
1.1. Computer science and main definitions.
1.2. Information measurement.
1.3. Analog information versus digital information.
1.4. Information processes in nature: codes.
1.5. Information properties.

The word *information* has been used to signify knowledge and aspects of cognition such as meaning, instruction, communication, representation, signs, symbols, etc. The Oxford English Dictionary defines information as "the action of informing; formation or molding of the mind or character, training, instruction, teaching; communication of instructive knowledge".

The most outstanding achievements of the twentieth century were the invention of *computers* and a new *understanding of the concept of information* itself. Furthermore, modern science is unraveling the nature of information in numerous areas such as communication theory, biology, neuroscience, cognitive science, education and others.

1.1. Computer Science and main Definitions

The computer science is the area of human activity connected with processes of information transformation by means of computers and their interaction with the field of application.

The information is data on objects and phenomena, their parameters, properties and conditions which reduce the degree of uncertainty, incompleteness of our knowledge about them. Concepts connected with the concept of information are: the signal, the message and the data.

The signal represents any process bearing the information.

The message is the information presented in the certain form and intended for transfer.

Data is the information presented in the formalized kind and intended for processing by its means, for example, computation.

Information became a prominent word and notion in the article published in 1948 by Claude Shannon. However, the word *information* did not figure in the title, which was "The mathematical theory of communication", even though it became known as the Shannon *Information Theory*. The crux of this information theory, originally developed to deal with the efficiency of information transmission in electronic channels, is the definition of an information quantity that can be measured. Such analysis of information is concerned with the discovery of the elementary particles or units of information. The price to pay for the ability to objectively measure such a quantity is that it does not deal at all with the subjective aspects of information, namely semantics and pragmatics. Indeed, information is defined as a quantity that depends on symbol manipulation alone.

Since information content depends on the language used, Shannon needed to compute information content on the most economical symbol system available, which he proved to be the binary system. Since the binary system of encoding messages using only two symbols, typically "0" and "1", is the most economical, to measure information content, Shannon's theory demands encoding every message using the binary system, and then counting alternative choices in this system. The most elementary choice one can make is between two items: "0' and "1", "heads" or "tails", "true" or "false", etc. Shannon defined the bit as such an elementary choice, or unit of information content, on which all selection operations are built. Bit is short for binary digit and is equivalent to the choice between two equally likely choices.

1.2. Information Measurement

Bit is the information quantity necessary for unequivocal definition of one of the two equiprobable events.

If bit is a minimum unit of information, byte is its basic unit. The group of 8 bits of the information is called *byte*.

1 Kb = 1024 bytes = 2^{10} bytes.

1 Mb = 1024 Kb = 2^{20} bytes.

1 Gbytes = 1024 Mb = 2^{30} bytes.

1 Tbytes = 1024 Gbytes = 2^{40} bytes. And so on.

The information quantity is the numerical characteristic of a signal reflecting those degrees of uncertainty (incompleteness of knowledge), which disappear after the message reception in the form of the given signal. This measurement of information uncertainty is called *entropy***,** and the method of information quantity measurement is called *statistical***.** If as a result of the message reception, full clearness in any question is reached, one can say that the full or exhaustive information has been received and there is no need for the reception of additional information. And, on the contrary, if after the message reception the uncertainty remains unchanged, it means the information has not been received (zero information).

The discursion shows, that the concepts of *the information, uncertainty and choice possibility* are closely connected. So, any uncertainty assumes choice possibility, and any information, reducing uncertainty, also reduces choice possibility. In case of the full information, there is no choice. The partial information reduces the number of choice variants, thereby reducing uncertainty.

Equiprobable events. Any system is characterized by the conditions, which appear as a result of certain events. We will consider equiprobable events or conditions, for example heads or tails losing when flipping a coin.

Hartley's Formula defines the information quantity *I* (in bits) for a number of possible equiprobable events *N* as follows:

$$I = \log_2 N. \qquad (1)$$

To determine possible events number if the information quantity is known, apply the inverse formula:

$$N = 2^I. \qquad (2)$$

Events that are not equiprobable. If as a result of the event, there are different probabilities, the events are *not equiprobable***.** For example, if one of the coin sides is heavier, it will fall with this side down more often.