INFORMATION AS HETEROGENEITY

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Abstract: In the work argues that if we want to create "Science of Information" we must use single, unified, unique definition of the "information" concept. Information is heterogeneity, stable for some definite time. Heterogeneity (elementary particles, atoms, molecules, …) possess certain information characteristics, properties (information properties of the first order), in particular they contains certain volume of the information. Interaction of heterogeneities leads to a change their information characteristics. Availability of Observer (can give for the information (heterogeneity) new properties (information property of the second order) – perception, content, sense, value, intelligence, … Information properties of the first level impose fundamental restrictions on information characteristics of the second level. The rationale of a single definition of information can be based on the laws of the Universe.

Keywords: definition, information, science of information, homogeneity, heterogeneity, objective reality, observer, information properties, fundamental restrictions, Universe.

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1. Science of Information

D. Doucette (2010) has defined "Science of Information": "In establishing the new evolved information discipline, there should be some initial awareness that information is a part of all elements, systems, conditions and is therefore also an integral part of the other individual disciplines and sciences. In studying information phenomena, it is essential to look beyond the limitations of how human use and perceive information, or even how living organisms' uses information. It is proposed that information is a continuous evolving process that exists in some simple to complex form in every stage of development across all science and academia domains as well as being a significant part of everything that

exists. Information is a trigger mechanism, emphasis and nutrient for not only information activities but also all physical biological elements, systems and activities".

2. Definition of the "information" concept

If we want to create "Science of Information" we must use single, unified, unique definition of the "information" concept.

I suggested this definition (1989). "Information is heterogeneity, stable for some definite time". Regardless of the nature of heterogeneity, would be it letters, words, phrases or - elementary particles, atoms, molecules, or - people, groups, societies, etc.

Let us give definitions of homogeneity and heterogeneity (Gurevich, 2009, 2010). Consider a set of elements. If the elements are the same, identical (not different each from other), then the set is homogeneous. If the elements are not the same, no identical (different each from other), then the set is no homogeneous.

The measure of the degree of heterogeneity or information is Shannon's information entropy and other information characteristics (information divergence, joint entropy, communication information).

The proposed definition and the Shannon information entropy (1948) and other information characteristics can describe information (heterogeneity) of any nature.

This table describes the possible information types and their corresponding types of heterogeneity.

Type of information	**Time of existence of the heterogeneity**	**Type of heterogeneity**
Classical information	Time of existence of the heterogeneity of the heterogeneity is infinite $t_n=\infty$.	This is absolutely stable heterogeneity.
Macroinformation (*Chernavsky, 2004*)	Time of existence of the heterogeneity is not less than the time of existence of the system $t_n \geq t_s$	This is essentially stable heterogeneity.
Information	Time of existence of the heterogeneity is not less than the time of existence of the system, but more then the time course of processes in the system $t_{n1} \leq t_n \leq t_s$	This is stable heterogeneity
Microinformation (*Chernavsky, 2004*)	Time of existence of the heterogeneity is essentially less than the time of existence of the system $t_n < t_{n1}$	This is unstable heterogeneity.

t_s - the time of existence of the system,

t_n - the time of existence of the heterogeneity,

t_{n1} - the time course of processes in the system.

Note 1.

Heterogeneities can be used for storage of information (preferably the fermions) and transmission (preferably the bosons) (Gurevich , 2007, 2009).

Note 2.

Fluctuations - random deviations from the mean values of physical quantities characterizing the system from a large number of particles caused by thermal motion of particles or quantum-mechanical effects, are not stable some time, and therefore in fixed systems do not carry information. In non-stationary systems (eg, in the universe), the fluctuations can generate information.

Note 3.

Should be noted that the author suggested that not only the more general definition of information, but also the most simple definition of information. He uses only one of the most general mathematical concepts - the notion of set.

3. Information properties of the first order

The information (heterogeneity) is an objective reality.

The existence of information (heterogeneity) does not depend on availability of Observer.

Heterogeneity (elementary particles, atoms, molecules, …) possess certain information characteristics, properties (information properties of the first order), in particular they contains certain volume of the information.

Interaction of heterogeneities leads to a change their information characteristics.

4. Information properties of the second order

Availability of Observer (José María Díaz Nafría, Mario Pérez-Montoro, 2010) can give for the information (heterogeneity) new properties (information property of the second order) – perception, content, sense, value, intelligence…

The Observer:

Perceives, locates, remembers the information (heterogeneity).

Generates system of the standards (concepts) describing the information (heterogeneity).

Perceives the information (heterogeneity) within the limits of the generated system of standards (concepts).

Generates language of the description of the information (heterogeneities).

Describes the information (heterogeneity). Classifies the information (heterogeneity).

Generates base of the information (heterogeneity) (knowledge base).

Generates the new information (heterogeneity).

Make the information actual (within the limits of the possibilities).

At work with the information (heterogeneities) Observer are forming mind, intelligence.

The level of mind, intellect of the Observer is defined by volume processed (stored) information and productivity (speed) of work with the information.

Observer may not notice or ignore availability of the information (heterogeneity).

In the article (Florio Antonio) described a possible scheme of building information properties of the second order on the basis of information properties of the first order.

5. Information properties of the first order impose fundamental restrictions on information characteristics of the second level

Information properties of the first level impose fundamental restrictions on information characteristics of the second level: restrictions on a memory size and productivity of information systems, perception of the natural (physical, chemical and biological) systems of the Observer.

Estimates the volume of information in the atoms, amino acids, nitrogenous bases, differential information capacity of usual matter, are determine the fundamental limits on information capacity storage devices. Differential capacity information of storage devices, constructed based on combinations of atoms, does not exceed $\approx 10^{-25}$ bits/kg, and the information capacity of the storage mass 1kg $\leq 10^{25}$ bits and it can be enhanced with respect to the current level of no more than $\approx 10^{11}$ times.

Differential information capacity of storage devices, built on the basis of atoms does not exceed $\approx 10^{-28}$ bits/kg, and the information capacity of the storage mass 1kg $\leq 10^{28}$ bits, and it can be increased by no more than 10^{14} times.

The difference between the energies of the basis states of the hydrogen atom, considered as a q-bit, impose fundamental limitations on the speed of computing devices. The number of operations you is satisfied by a hydrogen atom, a q-bit, limited $k_{op/s} = 2\Delta E / \hbar \approx 1{,}5 \cdot 10^{12}$ operations per second. Restrictions 10^{28} bit/kg, $\leq 1{,}5 \cdot 10^{12}$ op / sec You can add a number of fundamental natural limits, including the speed of light, the elementary charge, Planck's time, ... (Gurevich, 2010).

Observational limits and perception (José María Díaz Nafría, Mario Pérez-Montoro, 2010). The following fundamental conclusions can be forward extracted, which concern what can be known about the object causing an observed wave phenomenon: The number of details to be found in the environment due to the presence of the object is finite. Such number depends on the surface bounding the object and not on its volume. The volumetric distribution of an object can not be known only based on its manifestations on the environment. The description of the object that can be achieved corresponds to a projection of the inner inhomogeneities over a bounding surface. These four conclusions establish fundamental limits

to the observation problem, not attached to the specificity of our organs of animal or human sensibility, but to the differences that can merely be found in the environment and the maximal knowledge that could be derived concerning the object causing these differences.

6. Set of systematic definitions of information

«Because the concept of information is so complicated, we may have to have a set of systematic definitions of information: ontological information, epistemological information and so on in good order; instead of seeking only one single definition of information» (Y. X. Zhong, e-mail, January 12, 2011).

I can not agree with this view. If we use different definitions of information we will receive assessments, results that can not be compared, which is impossible to generalize.

7. The laws of the Universe and information

The rationale of a single definition of information can be based on the laws of the Universe (Universe, 2011).

According to modern concepts, the observed universe today originated 13,7 ± 0,13 billion years ago from some initial singular state with enormous temperature and density and has since continuously expanded and cooled. The formation of the solar system began about 4.6 billion years ago with the gravitational collapse of a small part of a giant interstellar molecular clouds. Much of the substance turns out to be, in the gravitational center of the collapse with the subsequent formation of stars - the Sun.

The formation of the Earth began about 4.5 billion years old, with the following (very approximate) date: 3.8 billion years ago life originated: appeared the first not nuclear organisms (prokaryotes), 2 billion years ago appeared the first cells with the nucleus (eukaryotes), 1 billion years ago appeared the first multicellular organisms, 360 million years ago appeared the first amphibians, 200 million years ago appeared the first mammals, 2.5 million years ago came the genus Homo, 200 thousand years ago people acquired a modern look. Several thousand years ago formed a science.

Thus, about 8 billion years in the Universe was no life. There was information only in the form of physical heterogeneity. Its existence does not depend on availability of Observer. Heterogeneity (elementary particles, atoms, molecules, …) possess certain information (and physical) characteristics, properties (information properties of the first order), in particular they contains certain volume of the information. Interaction of heterogeneities leads to a change their information characteristics.

Observer appeared (very approximate) some billion years ago and give for the information (heterogeneity) new properties (information properties of the second order) – perception (3.8 billion years ago), content, sense (200 million years ago), value, intelligence (some million years ago), …

8. Some classes of homogeneities and heterogeneities

Natural
Inorganic, including physical
biological
environmental
other
Artificial
material
abstract (ideal)
abstract material
Mixed
socio-technological
organizational and technical
socio-economic
other

9. Some examples.

Physical homogeneities

Space
Time
Vacuum

The hierarchy of physical heterogeneities

Gauge fields
Fundamental particles
Elementary Particles
Atoms
Molecule
Plasma
Gases
Liquid
Solids (crystals)
Stars
Galaxy
Universe

The hierarchy of geological heterogeneities

Land
Kernel

Mantle
Crust
Platforms
Oceans and seas
Continents
Mountains
Plain
Depression
Rocks
Minerals

linguistic homogeneities

The text of the gaps, the same symbols

Hierarchy linguistic heterogeneities

Letters
Words
Offers
Lyrics
Books
Library

Technical homogeneities as a background scene

Elements of the same type

Hierarchy of technical heterogeneities
Element
Communications
Subsystem
System

Module
Block
Device
Product
Complex
Network

Module
Block
Subroutine
Program

Complex
Network

Biological homogeneities

Chromosomes in the cells of one organism

Hierarchy of biological heterogeneities

Amino acid
Protein

Nucleotides
DNA
RNA

Cell
Cytozoon
Virus
Bacterium
Multicellular organism

Population

Socio-economic homogeneity

Money

The hierarchy of socio-economic heterogeneity

Individual
Family
Group
Nation
Production unit
Industry sector
National economy
Country
Civilization

Each level of the hierarchy of heterogeneity of any type contains various elements. At each level of the hierarchy of heterogeneities can determine the probability of realization of each element (in the discrete case) and the distribution function of the density distribution of elements (in the continuous case).

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