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DIGITAL ANTHROPOLOGY

Textbook on general educational discipline

"Philosophy and Methodology of Science"

For students, listeners mastering the content of the educational program

of higher education of the II stage

For all specialties full-time and part-time forms of education

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The textbook supplements the lecture material with topical issues of the philosophy of neural technologies. The material belongs to the section "Philosophy of natural science and technology" of the lecture course on the philosophy and methodology of science. The natural-science aspects of human consciousness and technological trends in the evolution of convergent structures of digital ecosystems are described. The evolution of system computer engineering is analyzed.

INTRODUCTION

In a smart society, the role of digital components of activity is growing. They are used in the educational process and professional activities. Most participants in various forms of activity actively work with information. Until recently, people were engaged in the processing of information and its interpretation. As information technology has evolved, the functions of strong artificial intelligence have been formed, which began to include imitation of human cognitive abilities. In order for technical systems to be able to implement these abilities, active research began on the human nervous system and consciousness in order not to isolate the evolution of man and artificial intelligence, but to bring them as close as possible to the format of co-evolution. For this purpose, neural interfaces began to be created. At the Belarusian National Technical University, a number of specialties are associated with developments involving the creation of a workplace in the mode of human-machine interaction. This is due to the era of dominance of sociotechnical systems. These trends have created the subject field of digital anthropology.

The lecture course outlines the main features of the methodology of research and design activities in the field of digital neural technologies. This is a wide range of practical tasks, corresponding to the strategy of creating a smart industry in the Republic of Belarus.

The philosophy of digital neural technologies studies the general characteristics of neural systems in the categories of ontology, anthropology, philosophy of mind, cognitive and social philosophy. It forms a fundamental component of the methodology. Applied implications are in the subject field of neural philosophy and artificial intelligence theory, cognitive science research, computer science philosophy, computational philosophy, social communication philosophy, and management philosophy.

Digital neural technologies are being introduced into the agricultural and industrial complexes in the modification of networks. The converged infrastruc-

ture of the digital economy and social networks is being deployed. This phenomenon has become characteristic for the Republic of Belarus as well.

DIGITAL ANTHROPOLOGY

Digital anthropology pays special attention to the connection between the human essence and digital technologies. It studies how people interact with the digital interface, how they behave in the face of technology, and how they use technology to interact with each other. Also, digital anthropology is used to understand how people perceive brands in their digital communities and what attracts people to certain brands.

This is a relatively new discipline in the field of anthropology. But its use in finding market insights fuels its popularity among marketers. From a human-centric marketing perspective, digital ethnography is a powerful way to uncover hidden human anxieties and desires that brands need to address. A few notable methods currently used by marketers include public opinion analysis, netnography, and empathic research.

The epistemological problems of studying a hybrid digital environment are related to the need to analyze research tools, to find an interdisciplinary consensus between techno centric and anthropological approaches. Digitalization creates new qualities and dimensions of urban life: previously non-existent types of spaces, everyday practices, material objects and symbolic environment. The intensity and scale of the penetration of digital technologies into urban life allow S. French and N. Thrift to talk about the digital routine and the digital unconscious of the modern city. In this case, the best evidence of the degree of incorporation of technologies into everyday life is their invisibility. Technology is woven into the fabric of everyday life and becomes indistinguishable over time.

The fusion of spatial and human processes with digital technologies is becoming the most important object of study in research. Digital techno centrism is being developed by British social geographers M. Dodge and R. Kitchin, M.

Krang and S. Graham. It proceeds from the position of a fundamental change in the structure of urban experience under the influence of digital technologies. The basis of the changes is the incorporation of the digital code into various areas of everyday life. Such penetration of digital logics, according to the researchers, creates unique objects and spaces. The quintessence of the digital break through was the creation of log objects and their corresponding spaces. The neologism logobject is formed by the following components: to log - to fix, write down; and object - an object. Log objects are able to record and save traces of their activities and have the ability to self-adjust and self-update. They are part of the Internet database information systems. In a modern city, their role is played by individual gadgets (mobile phones, tablets), and public information systems (screens and scoreboards). Log objects generate huge amounts of information about many aspects of everyday life, turning it into an object of fixation, automatically forming a digital archive of everyday life.

The second approach to the study of digitalization is digital anthropology. Among the authors are A. de Souza y Silva and E. Gordon, media sociologists B. Wellman and L. Rainey. The starting point of the anthropological approach is doubt about the ability of digital technologies to act as independent agents of action and create special types of urban reality. Digital anthropologists believe that talk about the dehumanization of the modern city. They bring technology users and cultural contexts to the fore, believing that users' creativity, their ability to creatively adapt technologies to their needs, as well as cultural contexts form specific scenarios for using modern technologies that are not originally embedded in them.

The attention of digital anthropologists to the social and cultural contexts of the operation of technologies is based on the conviction that their incorporation into public life and everyday life occurs in a situation of established institutions, social and cultural conventions: communication rules in various social groups and public etiquette. Recognition of the importance of cultural and social con-

texts draws the attention of researchers to local orders and practices in the use of digital technologies. The study of the specifics of the use of digital technologies in certain cultures, urban and social environments, as well as the study of the features of the production of local spaces and conventions for their development forms one of the priority areas of research in the digital city.

The actual direction of digital anthropology is not only aspects of the digital environment of physical spaces, cities, for example, but also the variety of interfaces and digital neural components with which the individual's brain is in continuous contact. A special topic is neural networks, digital ecosystems, metauniverses, which form the trend of strengthening the role of virtual and augmented reality in urban everyday life. This is not only an outdoor digital network of the urban environment in the form of screens and scoreboards, but also a tendency for the maximum convergence of the human nervous system with the components of the hardware environment of possible worlds.

One of the first books on the ethnography of the World Wide Web was the monograph by D. Miller and D. Slater "Internet: An Ethnographic Approach", based on a long-term field study of users on the island of Trinidad. The authors found that the Trinidadians adapted the network to their political, economic, religious and ethno-linguistic interests, turning it into a part of their own material culture. The example of D. Miller was followed by many anthropologists and sociologists who carried out regional and local studies. Aspects of the impact of the Internet and mobile devices on local cultures and societies and their feedback on digital technologies began to be explored. In theoretical terms, such studies usually do not go beyond the traditional interests of the discipline and its conceptual apparatus. Anthropologists use information from the World Wide Web in their projects. A. Escobar believed that digital anthropology should study: 1) new digital technologies; 2) virtual communities created through such technologies; 3) the impact of these technologies on the culture of everyday life;

4) their influence on language, communication, social structures and cultural identity; 5) political economy of cybernetic culture.

No less important is the question of how to study virtual objects. The first anthropological studies of cyberspace and related technologies were the application of the concepts and methods established in the discipline to a new environment, the projection of traditional themes and methodology into a new territory, the characteristics of which had yet to be understood.

The traditional approach has been supplemented by the methods of science and technology research and media research. The choice of methods depends on the nature of the objects under study. One of the first works analyzing the etiquette of talking on mobile phones and the manner of handling these devices was the research project of K. Fox.

It turned out that mobile devices can restore the lost immediacy of communication, characteristic of pre-industrial societies, relieve alienation and stress, and improve the psychological state. Women use the phone as a kind of bodyguard. The demonstrative use and disconnection of the phone in different situations and the model of the device as a sign of the status of the owner were studied. The subject of the study was the social and cultural transformations caused by the spread of mobile devices, the Internet of things and digital technologies. As well as their influence on the human psyche and brain, on the manner and style of communication. Research investors have become large telecommunications companies.

D. Zeitlin described six groups of Homo digitalis. The most numerous group turned out to be passive consumers who do not maintain blogs or their own pages on social networks, but regularly access the Internet. Shy technophobes, prefer regular mail and rarely use the Internet. Their opposites are the ever-connected digital active users of twitter and flicr, who update their social media profile with the regularity of their meals. According to the findings of the study, the willingness to incorporate new technologies into their daily lives af-

fects careers as significantly as, for example, education or social affiliation. The subject of the study was the nature of social action in online communities, their impact on the identity of members of such communities, social control, hierarchies and order in these groups, as well as the connection of virtual groups with real groups.

The need to maintain digital equipment and the new opportunities created by the digital environment have led to the formation of new professions. Such as web designers, hackers and spammers, bloggers and copywriters, site administrators and sys admins and webcam-girls. This expanded the subject areas of the anthropology of the professions and drew the attention of anthropologists to emerging professional communities and identities and their associated practices. Many offline professions have changed. The mediation of keyboards and interfaces is changing the essence of human communication.

Strange algorithmic languages and new written traditions formed. Communities of lovers of new genres of cybernetic poetry emerged. The topics are concretized by digital technologies and the body, comparative studies of social media, virtuality and materiality, games, digital technologies and political relations, digitization of museum collections, and an anthropological approach to big data. The problem is being developed by the joint efforts of sociologists, historians, philosophers, linguists, researchers of media and technology, and anthropologists. The formation of the World Wide Web and cyberspace along with the creation of computer networks, the first of which was implemented in 1969, hypertext and data transfer protocols in the 80s and early 90s of the twentieth century, led to the emergence of netnography and digital anthropology. Disputes about the identity of cybernetic and digital anthropology continue. Cybernetic anthropology is associated with the study of the results of cyborg synthesis arising in the course of the development of biotechnology, as well as the consideration of the human body as originally cyborg.

Digital anthropology focuses on the study of digital devices and their impact on society and culture, including the use of digital methods in research projects implemented within its framework. Anthropologists belatedly joined the study of the digital galaxy, publishing until the mid-90s of the twentieth century only works that substantiated the need for such studies using the methods of their discipline. In relation to digital anthropology, the peculiarity lies in the fact that the term “digital” refers not to numbers, but to the binary code used in programming and serving as the basis of the media - the Internet, social networks and online publications. The subject of digital anthropology is not numerical methods and operations, but human behavior in the network and assessment of the impact of new digital technologies on culture and society.

In digital humanities, there is no opposition between digital and numerical, since the word “digital” refers to a new stage in the development of numerical methods. This is a new stage in the computerization of research, which allows analyzing data arrays and identifying, using a specially trained neural network, text structures and patterns that are inaccessible to previous computational methods.

Cybernetic anthropology has historically been associated with the development of cybernetics with its attention to automata and feedback, on the one hand, and the development of biotechnology, which has accelerated the integration of biological and technical components. This gave grounds for considering a person as a cyborg. At the beginning of the 21st century, cybernetic anthropology is associated with the study of the cybernetic space of computer networks and virtual reality. In some contexts, the term “cybernetic anthropology” is an alternative name for digital anthropology.

The consideration of the Internet and the World Wide Web as communication tools allowed analysts to talk about the formation of techno-sociality. The notion of a “networked community” has become a truism as soon as it entered the lexicon of the social sciences as a designation for a special type of collectivi-

ty. There is also an opposing view that communication on social networks is less “natural” and contributes to alienation. An example is the INTERCAL language, which borrows only a few variables from standard functional programming languages and uses unique and strange expressions as operators. It does not have an if statement, an analogue of the loop command, as well as basic mathematical operators, including addition, but instead uses combinations of non-standard expressions and non-obvious solutions; all commands are followed by the PLEASE operator and such English words as FORGET, ABSTAIN; instead of the GO TO command, its opposite COME FROM is used. Despite oddities, the language continues to be used.

Digital anthropology analyzes what happens to an individual when he turns on a computer or picks up a smartphone. The study of digital footprints in the city has become relevant. Texts, photos, likes reflect the cultural attitudes, values, norms, traditions of a wide range of people.

To study digital traces, software is used that makes it possible to work with data. The data is cleaned, for example, from advertising, re-recordings and marked up according to a number of criteria: where the photo was taken, at what time of the day, who is depicted on it, what city objects are shown on it and what people are doing. Geo tagged data is overlaid on a city map. This is what GIS analysts do. So you can see how the photos are distributed throughout the city, where the most popular places are, where people spend time at different times of the day, where and why they come in winter or summer.

As a result, quantitative and qualitative data are obtained, which allow us to formulate some hypotheses about what is happening in the city. Further, these hypotheses can be tested using various methods: mass surveys and in-depth interviews. The work of a digital anthropologist involves exploratory research that does not so much provide answers as formulate questions. When conducting applied research within a specific project, it is necessary to quickly and clearly formulate the semantics of the research. Where there may be problems, at what

point on which street it is worth changing something, which may be important for city dwellers.

All digital footprints have limitations. For example, self-trackers like Strava can reveal a lot about where people cycle in a metropolitan area, but little about small towns. There are few such gadgets used. The same can be said for other types of digital footprints. They strongly depend on the characteristics of a particular city. From whether there is free Wi-Fi in public places. Digital traces do not tell about all the inhabitants of the city. Basically, they show how young and wealthy citizens use the city.

Since digital anthropologists can do very different things, from the anthropology of computer games to the study of digital footprints, the general requirement for representatives of this profession is one: knowledge of anthropological theory and mastery of qualitative research methods. It is useful for a digital footprint researcher to understand how different types of data are arranged and to know the methods of quantitative analysis.

VISUAL AND DIGITAL ANTHROPOLOGY

Digital anthropology has accumulated different approaches to the study of man in the digital environment. One of the sections of digital anthropology was visual anthropology, which was formed long before digital anthropology and was closely connected with photography and documentary films.

A prominent representative of the research approach, in which the scientist concentrates only on the virtual space T. Belstorf is known for his fieldwork on the game Second Life. His key position is that there is an ontological equality between the physical world and the virtual world. We are talking about the autonomy of digital worlds therefore they can be studied without immersion in an offline context. D. Miller takes a different position. She argues that what an individual does in the virtual space is strongly related to what happens to him offline. His actions are influenced by his attitudes, values and upbringing. As a re-

sult, users in every region are building their own Facebook on the same global platform. They all have their own cultural characteristics and values. Indian women do not really like to put their photo on the profile picture, because it is not very decent to do so. Put up a good picture. They will not share personal information about family and children. But they will often mark motivating pictures with inscriptions: "Let's enjoy the sunset." Trinidadians are active on Facebook. They post their photos, put out costumes, cars and watches to show how rich and beautiful they are.

Digital anthropology can study hybrid environments. The well-known study by B. Nardi draws attention to the human body, the owner of which is immersed in an online game. The body as such does not go anywhere during the game, but at the same time it is in some kind of unusual environment. It is especially interesting when the player is not sitting at home, but, for example, in some gaming computer club, where some new sociality arises. These are offline and online environments, and the interaction between them affects what happens in both dimensions. These lines of research develop the topic of interaction between environments and their merging into some kind of hybrid environment. It turns out to be impossible to draw a line between what is happening in the digital space and what is happening in the physical space. The existence of this boundary and its properties has become one of the most problematic points of digital anthropology.

There is another type of digital anthropologist who keeps a close eye on the line between offline and online, but in slightly different ways. This is the study of digital footprints. This approach involves studying how online practices reflect what actors do offline. On the one hand, this is essentially standard data analysis. This is a large array of digital data that needs to be read, ordered, something to count and try to draw some conclusions based on this. On the other hand, you need to understand how these footprints are produced, what practices

influence it, how the emergence of digital footprints depends on the affordances of specific platforms, and even how researchers influence data.

The digital footprints left on different platforms turn out to be fundamentally different. Differences are not only in density. So, Instagram was first perceived as a platform where non-everyday photos are posted, that this is a platform for presenting a better image. And only due to the fact that the anthropologist knows how the use of certain platforms is arranged (who uses them, when, why, in what conditions, for the transmission of which messages), can he interpret visual data in any way correctly.

Digital footprints not only do not represent the general behavior, but also do not record all the actions of the social population that is involved in the use of specific platforms. At different times, each of the actors uses the same things in different ways. It is necessary to take into account how this use is changing, what external circumstances influence it. Therefore, digital anthropology, associated with the study of digital footprints, is aimed not just at calculations and building some beautiful maps and graphs. It is also important to understand what is behind this, what we can say about the social environment in these digital footprints.

The social researcher almost never knows one hundred percent of what he is studying. An anthropologist works with only a certain amount of knowledge. Another question is what kind of data and knowledge. There is a whole branch of data anthropology that studies how data is produced. His main thesis is that working with other people's data is tantamount to working with a black box. Because the data collected on certain platforms is not intended for the purposes of a particular study. As a result, the data are incomplete, simply by definition. Even if we download one hundred percent of all texts and photos from Instagram, Vkontakte or Facebook, they still won't give us everything we need for research. Corporations hire not only data analysts, but also anthropologists to understand what to do next with the data.

The studies that have been conducted for several years on Flickr data are not currently reproducible, because the service at some point became partially paid. They are being used less. Therefore, the data from different years are simply not comparable, as they were produced under different conditions. It's not just about the popularity of the platform, but also about the conditions of its work, which limit the user in what he can do there. In social media, the limitations should be honestly spoken out: first explain to yourself then to those who will get acquainted with the results of the study. Then you need to understand what advantages can be extracted from this. In addition to anthropologists, GIS analysts are sure to work. Increasingly, data-analysts are being added who work with big data, among them there are more and more machine vision specialists.

Visual analysis can be automated to some extent, but also not quite. So, the image classification model that was created by the developers does not recognize green spaces in the autumn-spring period, because it is trained on data in which trees represent something with green leaves, and bare branches are treated as something completely incomprehensible to it. To work with data, you need a model trained on local data. A digital anthropologist differs from a data analyst in his attention to detail.

Little studied in the subject field of digital anthropology remains the subject of the study of the convergence of the human nervous system with technological analogues developed on the basis of the methodology of simulation modeling of virtual and augmented reality. Among these technologies, neural networks play a special role.

PHYSICAL ANALOGUE OF A DIGITAL NEURAL NETWORK

The human nervous system at the level of the brain contains about a hundred billion neurons, which are connected by axons and dendrites. The electrical signal enters the neuron along the dendrites, and is transmitted along the axons to other neurons. The infrastructure for transmitting a neuron impulse between

the axon of one neuron and the dendrite of another neuron is called a synapse. It is an important component of the nervous system.

The human nervous system is open to external information influences. One of its functions is the adaptation of the body to external influences. Therefore, the semantic plasticity of the human brain plays an important role. This is the ability of the nervous system to change structure and function throughout a person's life in response to the diversity of the environment. Changes occur at various levels of molecular structures, gene expression and behavior.

Neuronal plasticity allows neurons to regenerate anatomically and functionally, as well as to create new synaptic connections. The adaptive potential of the nervous system allows the human brain to recover from injuries and disorders, and can also reduce the effects of structural changes caused by pathologies such as multiple sclerosis, Parkinson's disease, cognitive impairment, Alzheimer's disease, dyslexia, insomnia in adults and insomnia in children.

In the process of socialization, the human brain supplements the system of unconditioned reflexes with conditioned reflexes in the form of neural connections. Through physical neural networks, neurons exchange information with each other. These pathways are formed in the human brain during training and practice. Communication pathways of synapses can be restored during a person's life. Knowledge and constant practice contribute to the fact that communication (synaptic transmission) between the neurons involved in the process is enhanced. Improved communication between neurons means that electrical signals are transmitted more efficiently. The process of cognition is also faster each time, since new neurons are born and reproduced in the human brain.

Neurogenesis occurs when stem cells (a special kind of cell located in the dentate gyrus the hippocampus, and possibly the prefrontal cortex) divide into two cells: a stem cell and a cell that will develop into a full-fledged neuron, with axons and dendrites. After that, new neurons migrate to different areas of the brain, where they are needed, thereby maintaining the neural capacity of the

brain. Sudden death of neurons, for example, after a hemorrhage, is a powerful stimulus for triggering the process of neurogenesis.

In neuroscience, the topic of cognitive decline with aging has become a traditional topic and it has been explained why older people demonstrate lower cognitive performance than younger people. But not all older people show poor performance. Some have no worse results than younger people. When processing new information, older people with greater cognitive performance use the same areas of the brain as young people, as well as other areas of the brain that are not used by young people and older people. The use of new cognitive resources occurs as part of a compensatory strategy of the human brain. As a result of aging and a decrease in synaptic plasticity, the brain, demonstrating its plasticity, begins to restructure its neurocognitive networks. The human brain comes to this functional decision by activating other neural pathways, more often involving areas in both hemispheres, which is usually characteristic only for younger people. Plasticity of the human brain also means negative changes in its space associated with dysfunctions and disorders. Cognitive training is useful for stimulating positive brain plasticity.

The human brain consists of a huge number of interconnected neural networks. Each of them individually consists of neurons of the same type with the same activation function. The human brain learns by changing synapses. These are elements that amplify or attenuate the input signal.

DIGITAL NEURAL NETWORK

A digital neural network is a simplified model of a biological neural network. This is a collection of artificial neurons that interact with each other. The principles of operation of digital neural networks were described in 1943 by W. McCulloch and W. Pitts. In 1957, F. Rosenblatt developed a digital neural network. They began to be used for machine learning.

The artificial neuron has a simple structure. It has several inputs on which it receives signals, transforms them and transmits them to other neurons. This is a function that converts multiple inputs into a single output. An artificial neuron operates with semantics and generates an adequate output signal. The activation function is used. It converts the weighted sum into some number, which will be the output of the neuron.

Different types of artificial neurons use different activation functions. These include the unit jump function; sigmoid function; hyperbolic tangent. Digital neural networks have a certain configuration of neurons. They have an input layer. Artificial neurons in this layer do not perform calculations. They distribute input signals to other neurons. In single-layer digital neural networks, signals from the input layer are immediately fed to the output layer, which converts the signal and immediately gives an answer. Signals are sent to the input layer, which is not considered a neural network layer. Then the signals are distributed to the output layer of ordinary neurons. A multilayer digital neural network consists of an input, an output, and several hidden layers of neurons located between them. These are direct distribution digital networks. In networks with feedback, the output of a neuron can be fed back to its input. This means that the signal can propagate from the outputs to the inputs.

A deep digital neural network is a complex computer program consisting of a large number of hidden layers with customizable artificial neuron weights that make up each layer of a digital neural network. At the input layer, the digital network receives a vector of features that describe the object as data in the form of signals. On the inner layers, they are processed. The input vector is multiplied by the link matrix. The vector of new features is passed to the next layer. The signal processing result is sent to the output layer of the digital network.

The digital neural network contains many parameters that cannot be configured manually. Therefore, a digital neural network is trained on an array of data. In the process of training and retraining, the weight coefficients of artificial

neurons are continuously changing and adjusted so that the result of calculations and signal processing becomes meaningful. The weight coefficients are adjusted using an optimization algorithm based on the gradient descent method.

Using it, you can see how the result of signal processing by a digital neural network changes with a small change in each of its weight coefficients. The weights are adjusted in each layer of the digital neural network. Therefore, it is called a deep digital neural network. New algorithms help to visualize all the processes inside it.

If you train a digital neural network using only one input signal, then it will simply remember the correct answer. As soon as a slightly modified signal is given, instead of the correct answer, nonsense is obtained. Developers want the digital neural network to have the ability to generalize some features and solve the problem on various input data. For this purpose, training samples are created. This is the final set of inputs, sometimes along with the correct outputs, on which the digital neural network is trained. Training of a digital neural network is implemented with and without a teacher. When learning with a teacher, the weights are changed so that the answers of the digital network are minimally different from the ready-made correct answers. In unsupervised learning, the digital neural network independently classifies the input signals.

When a digital neural network produces correct results for all inputs from the training set, it can be used in practice. Pre-evaluate the quality of its work on a test sample. This is the final set of inputs, sometimes along with the correct outputs, against which the performance of the digital network is judged.

The simplest modification of digital neural networks is represented by a perceptron. It is based on a mathematical model of information perception by the human brain, consisting of sensors, associative and responsive elements. The design idea was formulated by F. Rosenblatt. He proposed a diagram of a device that simulates the process of perception. He embodied this idea in a neural computer in 1960 and named it the perceptron. The neural computer "Mark-1" was

able to recognize some letters of the English alphabet. In the future, they began to actively use the potential of simulation modeling in order to create systems of biologically similar information processing that will solve complex problems associated with recognition, prediction, and modeling of individual and group behavior of people.

OPERATING SYSTEM AND HUMAN BRAIN

In a computer operating system, the processor and memory are two different devices that do not affect each other. When information is recorded, the cells of the computer memory are filled. Access to this memory is open. It is easy to erase or restore. But these actions do not affect the properties of the processor. Synapses play an important role. By memorizing information, the human brain not only fills the memory cells, but also changes the configuration and connections between the elements of the neurophysiological processor. This is the fundamental difference between the architecture of the human brain and the architecture of a computer.

The second fundamental difference is that a computer with a single core performs operations sequentially, one after the other. In the human brain, information is processed in parallel, so it copes with recognition and prediction faster than a computer. One of the solutions is seen by developers in the creation of a human-machine interface of living systems and electronic devices with the possibility of self-learning digital neural networks.

In 1949, D. Hebb formulated the rule of synaptic learning. It states that if two neurons are connected to each other, then the strength of the synaptic connection increases as the synchronization between the activity of the first and second neuron. It is based on a biological process that regulates the synchronization of neuron activity and spontaneously establishes causal patterns.

In the case of digital networks, one can consider two non-linear threshold elements and a conductor between them. A conductor must increase in conduct-

ance as it is used frequently or for a long time to carry a signal from one non-linear element to another non-linear element. The modern interpretation of D. Hebb's rule describes the possibility of training a digital neural network without a teacher. The spike as a form of nerve signal on the second artificial neuron should be later than on the first artificial neuron. The strength of the synapse increases depending on the time interval between the spike of the first and second artificial neurons. If this time is on the order of a millisecond, then the spike on the first artificial neuron will be the cause, and the spike on the second artificial neuron will be the effect. The more often this is repeated with less time delay, the more the causal relationship between the two events is strengthened. If a spike occurs earlier on a postsynaptic artificial neuron than on a presynaptic artificial neuron, then this connection is suppressed. The developers managed to make a memristor device that behaved like a synapse. It changes resistance depending on the direction of the electric current and the amount of ionic charge that has passed. Using memristor devices as elements capable of changing transfer weight functions, similarly to the role of a synapse in the human nervous system, a digital system capable of learning without a teacher has been created.

Using a system of microelectrode implants, the developers restored the model and architecture of the part of the nervous system responsible for learning. Work is underway with simpler systems of the spinal cord responsible for movement in space.

The biological neural network of the human brain has self-organization. Developers are trying to endow a digital neural network with a similar function. As a result of the use of specially synthesized block copolymers, conductive polymers and gold nanoparticles, a three-dimensional network of memristor devices has been developed containing about one hundred billion elements per square millimeter, which is five orders of magnitude less than the number of synapses in the human nervous system. It was found that the properties of the digital system depend on the teaching method. By changing the algorithms, it is

possible to achieve children's or adult learning. There are 1016 nerve connections in the child's brain. In the process of personality formation, some connections are strengthened, while others are suppressed. As a result, individuality is formed. At the stage of children's education, stable connections are formed that practically do not change throughout a person's life. Adult learning is responsible for the formation of short-range connections, which are determined by changing input information.

An important role is played by the genetic factor. The closer the architecture of the connections induced during children's education to a genetic predisposition, the stronger and more durable they are. By changing the learning algorithm, it is possible to move from child learning to adult learning, which is strengthened or weakened depending on the situation in which the person is. There are ten to the sixteenth degree synapses in the human brain.

The creation of an artificial synapse involves the choice of methodology. It is based on the computational component of the ability to achieve the goal. This is an emphasis on computational methods. The thesis is used that the ability to perform symbolic calculations is sufficient to become capable of performing meaningful actions. Therefore, all organisms essentially perform symbolic calculations. This is the position of the mechanism of R. Descartes and his Cartesian theory. Research in the field of digital neural networks is based on this hypothesis. E. Feigenbaum developed the concept of expert systems, which became the prototype of all expert systems. A turning point has occurred, after which the modern trend of using statistics as the basis of learning has finally taken hold as the main one.

THE EVOLUTION OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES

J. McCarthy stood at the origins of the concept of artificial intelligence. J. Searle defined the operational part of artificial intelligence as a computer pro-

gram that will not just be a model of the human mind. It will itself be mind, in the same sense as the mind of man. Artificial intelligence began to be understood as the field of informatics, which is engaged in the development of intelligent computer systems, systems with capabilities comparable to the human mind. These are language understanding, learning the ability to reason and solve problems. Artificial intelligence is defined as a set of methods, models and software tools that allow digital devices to implement purposeful behavior and reasonable reasoning.

The interpretation of artificial intelligence as software tools and intelligent agents dominates. The main purpose is to solve a certain class of problems in integration with Big Data as the main source of data for analysis. There is an evolution of tasks in the area of highly specialized agent systems and specialized intelligent agents.

The evolution of intelligent systems of the neural type was associated with the development of computer programs of sequential action, with small resource capabilities of memory, speed and classes of tasks to be solved. These were computational problems for which solution schemes and a formal language were known. This class includes tasks for adaptation.

Artificial intelligence eventually began to be presented in the form of a mathematical model of the human brain. A formalized theory of the activity of this body was developed.

According to conceptual assumptions, artificial neurons have biological analogues with a complex structure. Each has dendrites - branched processes. They are able to exchange signals with other neurons using synapses. The function of convergence of neurons is performed by the axon. This is a process that is responsible for the transmission of impulses from neurons.

Some of the synapses excite the main neuron cell, and some inhibit its activity. Depending on what synaptic connections are at the input of the neuron, the impulse transmitted to the rest of the neuron cells will depend. An artificial

neuron is represented by a special mathematical function. Its purpose is to receive information, process it in a specific way and issue a result on the axon. That's what the exit is called. Digital neurons of the algorithm are divided into input, intermediate and output.

Each digital neuron has a connection with similar digital neurons. Their communication is provided through special scales. This is the name of the numerical values that each digital neuron will calculate based on the information received from the previous layer of the network. Digital neurons are as close as possible to the biological analogues of neurons. At the level of digital cognitive technologies, artificial intelligence is presented as a weak option, since it does not have self-awareness.

At the stage of heuristic search, search mechanisms, sorting, the simplest operations for generalizing information that do not depend on the meaning of the data being processed were added. This has become a new starting point in the development and understanding of the tasks of automating human activities. At the stage of knowledge representation, the importance of knowledge in terms of volume and content for the synthesis of interesting algorithms for solving problems was realized. This meant knowledge that mathematics could not work with. This is experimental knowledge that is not of a strict formal nature and is described in a declarative form. This is the knowledge of specialists in various fields of activity, doctors, chemists and researchers. Such knowledge is called expert knowledge.

Digital systems operating on the basis of expert knowledge began to be called consulting systems or expert systems. With the advent of expert systems, the period of intelligent digital consultants began, who offered solutions, justified them, were able to learn and develop, communicated with a person in a familiar way. Him albeit limited, natural language. It was necessary to achieve a qualitatively new level of intelligence in software systems, such as protection against unauthorized access, information security of resources, protection

against attacks, semantic analysis and search for information in digital networks. Intelligent systems have become a paradigm for creating advanced protection systems. They allow you to create flexible environments within which the solution of all necessary tasks is provided. Computer programs began to be supplemented by digital peripherals. Similar models are equipped with a navigation system and peripheral sensors.

When evaluating the development of digital technologies, experts suggest using IQ. IQ reflects the ability to pass relevant tests. According to such statements, the result obtained is not capable of indicating real intelligence. Everyone can be trained to get a brilliant result during testing. The IQ indicator will be changed, but it will not affect real intelligence. The objectivity of the assessment will be lost. The problem with the objectivity of IQ is that some tasks are aimed at logic and observation. Separate tests are aimed at mathematical thinking. The search for the correct solution and the issuance of the final result regarding the performer of testing depends on what exactly is given to the person better. Significance will be played by such indicators as the speed of responses and specialization.

Artificial intelligence can also be made to understand IQ testing. Digital intelligence can aim at solving specific problems. It will take much less time to solve IQ tests than for a person. It is possible to get effective IQ results from a digital machine. But the device may not answer the simplest questions. This is true when the device was not specially trained for this. In 1950 A. Turing published the article "Computing Machines and the Mind". It served as an impetus for active discussions and disputes among specialists.

Digital technologies are not limited to software solutions. Active development of special electronic chips is underway, which provide support for artificial intelligence by default. Appropriate technologies are used in drones, machines and robots for industry.

Machine learning is responsible for the principle of intelligence development based on self-learning algorithms. The participation of the developer is limited to the fact that he needs to ensure the presence of an array of information in the memory of the machine and the formulation of the final result. Machine learning happens with a teacher. Then the user will set a specific goal or test hypotheses and patterns. There is an option for learning without a teacher. The result of intellectual processing of electronic materials in this case is unknown. The device itself will find patterns will try to think like a person. There is also deep learning. This is what is called a mixed version. It differs in the processing of large data arrays and the use of neural networks.

A neural network is a mathematical model that imitates the structure and functioning of the nerve cells of a living organism. In a technological sense, it represents many processors performing one task in a large-scale project. This is a network of many conventional software systems.

Deep learning is used to discover patterns in vast amounts of information. For this, advanced techniques are used.

Cognitive computing studies and implements the processes of natural human-computer interaction, similar to communication between living people. The purpose of the technology is a complete imitation of human activity. This includes speech, figurative and analytical thinking.

Computer vision is designed to help recognize graphics and videos. Digital intelligence can process and analyze graphic information, express it in accordance with the environment. Synthesized speech devices can understand, as well as analyze and reproduce human speech.

Artificial intelligence requires a large number of powerful processors to function. In order to integrate intelligence into programs and devices, a specialized API technology is required. This is what the application programming interfaces are called. Through the API, you can create and implement new artificial intelligence technologies in any computer systems.

Learning is possible only on the basis of an array of information. This means that all inaccuracies strongly affect the issuance of the result. Intelligent systems are limited to the established type of activity. A smart system tuned to one direction will not be able to work in different areas. Functioning is provided only where it was originally intended. You have to work with highly specialized utilities.

The lack of autonomy of artificial intelligence means that a large team of specialists is required for decision-making, management and analysis. And also certain resource costs. So far, even the strongest computer devices have not been able to achieve full autonomy. Due to the problems listed above, it is still impossible to achieve the desired result without intervention. All procedures that are not controlled by a programmer or a person will work with errors. With regard to artificial intelligence, this can lead to all sorts of critical situations. Therefore, for the time being, it is necessary and possible to solve certain problems associated with the considered applied technology with the help of preliminary training of devices.

Deep learning and neural networks are vulnerable. This is an addiction to electronic materials. Deep learning algorithms require Big Data. This is necessary for more accurate and competent performance of tasks. To solve the identified problems, sometimes there is not enough quality training data to create functioning models.

Artificial intelligence systems and neural networks are developing in a strange way. Sometimes everything goes according to plan. And in some situations, the outcome is unpredictable. The lack of predictability makes eliminating and fixing bugs in given neural instructions extremely problematic.

The problem of algorithmic bias is that the relevant information often includes hidden or obvious flaws and errors. Algorithms will inherit them too. Deep learning algorithms are suitable for targeted tasks. They generalize the acquired knowledge poorly. For actions that differ from a strictly specified algo-

rithm, more time is required. Deep learning is not good at handling these requirements. It focuses on one thing in particular.

A command in digital technologies appears as a kind of instruction for activating a voice assistant compatible with a search engine. It helps to open information on the network without typing it through the keyboard. First, the signal is transmitted to the microphone. Next, speech recognition occurs and the question is translated into a format understandable to the computer. A separate mechanism will search for the answer in giant databases. As a result, the user will see the issued pages with relevant queries. All this is done in a fraction of a second. Artificial intelligence systems help: predict possible risks; detect fraudsters; verify the authenticity of transactions and the likelihood of false payment rejections.

Such a system would use data from a large number of sources. This is necessary for a quick analysis of the transaction rate. Not only the reliability and history of the seller's previous transactions are taken into account, but also the typical purchase for the buyer, its location, time of day. All this contributes to reliable protection against fraud. It also prevents false positives and cancellation/blocking of financial manipulations sent for processing.

Artificial intelligence is being developed that can see people's faces in the dark. The second option built into it provides recognition in the dark. For this, a thermal imager is used. ALPHA allows you to control drones, as well as conduct dogfights. We can also highlight the development of tank targeting systems; recognition of camouflaged targets.

Artificial intelligence has revolutionized the retail industry. If it is embedded in the site, such a page will be extremely convenient for the visitor. It will provide an individual approach to each potential and already held buyer.

Smart technologies not only detect fraudsters and fraud with bank cards. They make recommendations and give advice on product selection. Through this approach, it will be possible to achieve maximum customer return.

Artificial technologies help to predict the results of matches. The experience of the team, as well as individual participants, is taken into account in the analysis. Usually the predictions turn out to be correct. Neural networks can be creative. They sometimes comprehend certain cultural areas, for example, write music. Google's NSynth synthesizer allows you to create new sounds based on old instruments. Sony Flow Machines analyzes collections of songs, and then develops its own compositions based on them. Alice from Popgun plays along with the man. It is a means of improvisation.

The Deep Dream neural network was created in order to recognize faces. Over time, the creators discovered her penchant for surrealistic painting. The developers have opened a site where everyone, with the support of artificial intelligence, gets a chance to create their own canvas. Pictures are written in a variety of styles. Human help plays an important role. Artificial intelligence can replace one actor with another in an already filmed movie. Artificial intelligence in games helps to control bots and opponents.

CONVOLUTIONAL NEURAL NETWORKS

The best results in the field of face recognition were shown by a convolutional neural network, which is a logical development of the ideas of the cognitron and neocognitron architectures. The success is due to the possibility of taking into account the two-dimensional topology of the image, in contrast to the multilayer perceptron. Convolutional neural networks provide partial resistance to scale changes, displacements, rotations, angle changes and other distortions. Convolutional neural networks combine three architectural ideas to provide invariance to scale change, rotation, shift and spatial distortion. Local receptor fields provide local two-dimensional connectivity of neurons. General synaptic coefficients provide detection of some features anywhere in the image and reduce the total number of weight coefficients. Hierarchical organization with spatial subsamples plays an important role.

The convolutional neural network and its modifications are considered the best algorithms for finding objects in the scene in terms of accuracy and speed. Since 2012, neural networks have been taking first place in the well-known international competition for image recognition ImageNet. The principles of the neocognitron and learning by the backpropagation algorithm are used.

A convolutional neural network consists of different types of layers. These are convolutional, subsampling layers and layers of a regular perceptron neural network. The first two types of layers, alternating with each other, form the input feature vector for the multilayer perceptron. The convolutional network is named after the name of the convolution operation.

Convolutional networks are a good middle ground between biologically plausible networks and the usual multilayer perceptron. The best results in image recognition are obtained with their help. On average, the recognition accuracy of such networks is superior to conventional networks. This is the core technology of Deep Learning.

The main reason for the success of the convolutional neural network was the concept of shared weights. Despite their large size, these networks have a small number of configurable parameters compared to the neocognitron. There are variants of the Tiled Convolutional Neural Network, similar to the neocognitron. In such networks, a partial rejection of the associated weights occurs, but the learning algorithm remains the same and is based on the back propagation of the error. Convolutional neural networks can run fast on a serial machine and learn fast by cleanly parallelizing the convolution process on each map, as well as deconvolution as the error propagates through the network.

The definition of the topology of a convolutional neural network is focused on the problem being solved. In this context, it is important to determine the problem solved by the neural network (classification, prediction, modification). Also determine the limitations in the problem being solved (speed, accura-

cy of the answer). It is important to determine the input and output data (number of classes).

The input layer takes into account the two-dimensional topology of images and consists of several maps (matrices), there can be one map if the image is presented in shades of gray, otherwise there are three of them, where each map corresponds to an image with a specific channel (red, blue and green). The convolutional layer represents a set of maps (another name is feature maps, in everyday life these are ordinary matrices), each map has a synaptic nucleus. In different sources it is called differently: a scanning core or a filter. The number of cards is determined by the requirements for the task, if you take a large number of cards, then the quality of recognition will increase, but the computational complexity will increase.

The nucleus is a system of shared weights or synapses, this is one of the main features of a convolutional neural network. In a conventional multilayer network, there are many connections between neurons, that is, synapses, which greatly slows down the detection process. In a convolutional network, on the contrary, common weights reduce the number of connections and allow you to find the same feature throughout the entire image area. Initially, the values of each map of the convolutional layer are equal to 0. The values of the kernel weights are set randomly in the range from -0.5 to 0.5. The kernel slides over the previous map and performs a convolution operation, which is often used for image processing.

The subsample layer has maps. Their number is the same as the previous (convolutional) layer. The purpose of the layer is to reduce the dimension of the maps of the previous layer. If some features have already been identified in the previous convolution operation, then such a detailed image is no longer needed for further processing, and it is compressed to a less detailed image. In addition, filtering out unnecessary details helps not to retrain. In the process of scanning the map of the previous layer by the subsample layer kernel (filter), the scanning

kernel does not intersect, unlike the convolutional layer. Usually, each map has a 2x2 kernel, which allows you to reduce the previous maps of the convolutional layer by half. The entire feature map is divided into cells of 2x2 elements, from which the maximum values are selected. The subsample layer uses an activation function.

The last of the layer types is the conventional multilayer perceptron layer. It models a complex non-linear function, the optimization of which improves the quality of recognition. The neurons of each map of the previous subsample layer are connected to one neuron of the hidden layer. The number of neurons in the hidden layer is equal to the number of maps in the subsample layer, but the connections may not necessarily be the same. Only a part of the neurons of any of the maps of the subsample layer can be connected to the first neuron of the hidden layer, and the remaining part to the second, or all neurons of the first map are connected to the neurons of the first and second hidden layers.

The output layer is connected to all neurons of the previous layer. The number of neurons corresponds to the number of recognized classes. To reduce the number of connections and calculations for the binary case, one neuron can be used and, when used as an activation function, the hyperbolic tangent.

One of the stages in the development of a neural network is the choice of the activation function of neurons. The type of activation function largely determines the functionality of the neural network and the method of training this network. The classic back propagation algorithm works well on two-layer and three-layer neural networks, but with a further increase in depth, it begins to experience problems. One of the reasons is the so-called attenuation of gradients. As the error propagates from the output layer to the input layer, the current result is multiplied by the derivative of the activation function at each layer. The derivative of the traditional sigmoid activation function is less than one over the entire domain of definition, so after several layers the error will become close to

zero. If the activation function has an unbounded derivative, then the error can explode as it propagates, leading to instability in the learning procedure.

The hyperbolic tangent is used as an activation function for the hidden and output layers. This is due to the fact that symmetric activation functions, such as hyperbolic tangent, provide faster convergence than the standard logistic function; the function has a continuous first derivative; the function has a simple derivative that can be calculated through its value, which saves calculations.

Neural networks are able to approximate an arbitrarily complex function if they have enough layers and the activation function is non-linear. Activation functions like sigmoid or tangential are non-linear, but lead to problems with fading or fading of gradients. A rectified linear activating function can also be used. Its derivative is either one or zero, and therefore no fading or fading of gradients can occur. The derivative of the hyperbolic tangent returns a number with different sign and magnitude, which can greatly affect the fading or spreading of the gradient. Computing the sigmoid and hyperbolic tangent requires resource-intensive operations such as exponentiation.

A rectified linear activation function can be implemented using a simple threshold transformation of the activation matrix at zero. The function cuts off unnecessary details in the channel with a negative output. Among the shortcomings of the function, it can be noted that it is not always reliable enough and may fail during the learning process. A large gradient through a function can cause the weights to update so that the neuron never fires again. If this happens, then, starting from this moment, the gradient passing through this neuron will always be zero. Accordingly, this neuron will be irreversibly disabled. The training sample consists of positive and negative examples.

GENERAL POOL OF NEURAL TECHNOLOGIES

The pool of neural technologies includes neural networks, genetic algorithms and methods of latent semantic analysis. These technologies involve

learning the system. The basis is a base of facts or a training sample, as a set of samples within the framework of classifying features. Technologies assume the presence of redundant competing calculations until one of the threads reaches a given threshold of reliability. The result of the calculation is any precedents from a predetermined list.

Learning presupposes the presence of a priori knowledge, given in the form of classifying models, as well as the presence of a base of samples for building a "model of the world" according to classifying features.

Neural networks are a system of interconnected and interacting simple processors of artificial neurons. These are Bayesian networks and recurrent networks. The basic model of their work is formed by the basis of the image-transfer function-optimizer. The most widespread are limited Boltzmann machines in a multilayer version. Layering (depth) has a reason. An increase in the number of layers of hidden neurons allows increasing the accuracy due to the presence of intermediate images with a minimum difference in each layer. The closer the intermediate layer is to the output, the higher the specification of the image. As a result, neural networks eliminate the need for intermediate calculations-inferences when analyzing the profile-matrix of incoming signals. This goal is achieved by creating a database of reference profiles, each of which should correspond to a single neuron at the output - a cell of the resulting matrix. Each neuron is assigned a specific interpretation-result.

The main problem of the problem being solved is the noisiness of the profile-matrices of the excited neurons of the input layer arriving for analysis. Therefore, one of the main conditions is the availability of a high-quality training sample. If the training sample is of low quality, then strong noise will lead to a large number of errors. A large training sample size can lead to the same result. The work of a neural network can be compared with the work of unconditioned reflexes of living organisms. This approach works great for tasks where there is no strong noise, a clear a priori base of reference images. The main task

is to select the most appropriate image from the already existing knowledge base. The tasks of forecasting, in this case, will be solved only by extrapolating the existing history without the possibility of creating new entities, by induction with insufficient deduction. A new entity designates another instance within the existing vector class space of the selected subject area.

The basic principle of human learning is fixed by induction and abduction. Induction is hampered by the goal of getting rid of intermediate calculations. The processes associated with induction at the learning stage are weak, as learning is based on several fundamental principles. This is the presence of the fact of the appearance of a new profile and its understanding that this is not noise. This is the absence of a simple and reliable mathematical apparatus that clearly describes the conditions and rules for generating new dimensions and classes of objects. The tracing procedure expresses the process of generalization, the search for new traces-routes by the need to control the uniqueness of the correspondence between profiles and results.

Reasoning about associative fields does not add anything new, since it is just an extension of the existing deductive approach. Genetic algorithms are heuristic search algorithms. They are used to solve optimization and modeling problems by random selection, combination and variation of the desired parameters using mechanisms similar to natural selection in nature.

One of the most important advantages of genetic algorithms is the absence of the need for information about the behavior of the function and the negligible impact of possible discontinuities on optimization processes. As in the case of neural networks, there is a departure from the need to analyze cause-and-effect relationships by constructing the final image of the objective function. From the point of view of solving text analysis, search, genetic problems solve problems that the methods of latent semantic analysis do. In matters of semantic search and indexing of texts, genetic algorithms have great prospects, compared with methods of latent semantic analysis. In the process of pattern recognition, with a

very strong stretch, the objective function can be compared with a layer of input neurons and with the expectation of a maximum as an analogue of maximizing the signal of a neuron of the output layer. Genetic algorithms are used to improve the efficiency of training neural networks and cannot be considered as competition for neural networks. Tasks are different. A common drawback is the lack of induction algorithms.

The method of automatic generation of hypotheses, developed by VK Finn, is a synthesis of cognitive procedures of induction, analogy and abduction. It can be formulated as a system of rules and presented as a program in a logic programming language. The saturation condition will be satisfied if the application of the induction procedure does not lead to the generation of new hypotheses. The test for causal completeness is precisely the application of some variant of abduction. A set of data and a variant of the strategy of the method satisfy the condition of causal completeness if all data about the presence or absence of properties in objects are explained using hypotheses about the possible reasons for the presence or absence of properties generated using the induction procedure. If the condition of causal completeness is not met, then this is the basis for replenishing the fact base or changing the strategy of the method or method of presenting data. Operations are performed with the participation of a person.

Thus, the term "artificial intelligence" means a subspecies of technological (algorithmic) approaches to solving problems. The main tasks are the reliable separation of statically significant regularities and the construction of images-objects based on statistics, without analyzing cause-and-effect relationships. The main areas of application are pattern recognition. Images can be understood as images, sounds, a set of symptoms of diseases. The result of training a neural network should be a revealed pattern, presented as a matrix-cluster (vector). This matrix or set can be constantly adjusted by new examples, but this does not affect the essence of what is happening.

The set identified and cleared of noise can be represented as an alienable logic, which represents the optimal way to solve the problem. An example is the task of automatic heading of texts, but not from the point of view of spreading texts into already known headings, but the creation of headings, their annotation, as well as automatic construction of ontologies.

Methods are nothing more than reincarnations of statistics and clustering problems. Therefore, all efforts in the field of deep machine learning are nothing more than the efforts of entomologists to study butterflies. The search and description of the differences in the color and shape of the wing does not give the slightest understanding of the nature of the flight. At the same time, it should be recognized that they are very useful from the point of view of pattern recognition, both visual and other similar objects, whether it be case histories or the analysis of chess games.

CONCEPTUAL DEFINITIONS AS THE BASIS FOR THE EVOLUTION OF NEURAL TECHNOLOGIES

It is desirable to build developments in the field of neural technologies on the basis of logical abstractions of intelligence, signs and mechanics of the processes of deduction, induction, and abduction. Intelligence is understood as the mental ability, the mental ability of the human brain. This is the ability to act intelligently, think rationally and cope well with life circumstances, the ability to form concepts. These are functions such as comparison, abstraction, concept formation. This is a type of adaptive behavior aimed at achieving a goal. Achievement of goals and adaptation of all researchers is at the forefront. From the point of view of problems of algorithmization and construction of logics, the works of J. P. Gipford, who proposed in the 1950s, are of great interest. cubic model of the structure of intelligence. We can single out curiosity as a desire to cognize this or that phenomenon in many ways in essential respects. This quality of the mind underlies active cognitive activity. The depth of the mind lies in the

ability to separate the main from the secondary and the necessary from the accidental. The flexibility and mobility of the mind reflect the ability of a person to use existing experience, quickly explore objects in new connections and relationships, and overcome stereotyped thinking. The logical thinking is characterized by a strict sequence of reasoning, taking into account all the essential aspects in the object under study, all its possible relationships. Conclusiveness of thinking is characterized by the ability to use facts and patterns at the right time, which convince one of the correctness of judgments and conclusions. Critical thinking implies the ability to strictly evaluate the results of mental activity, subject them to critical evaluation, discard the wrong decision abandon the initiated actions if they contradict the requirements of the task.

The breadth of thinking reflects the ability of the human brain to cover the issue as a whole, without losing sight of the initial data of the corresponding task, to see the multivariance in solving the problem.

Such properties as depth, conclusiveness and criticality are more or less algorithmizable. With the formalization and algorithmization of such properties as curiosity, flexibility and mobility, it is more difficult. Starting discussions about the problems of mathematical logic when creating neural technologies should be with a formalized representation of such concepts as "value", "meaning", "utility" and "ethics". In fact, there are no solutions to the formalization of meaning and induction. It requires clarification of the question of what knowledge is how it is arranged and how it is connected with facts. How to calculate conclusions based on knowledge? What is a sign and what is the smallest unit of meaning? How to operate with predicates of more than the first order? But the processes of thinking are not differentiated. They represent something similar to fractals with inno- and self-references. Thinking is analogous to a fractal. The shape of the fractal does not depend on the sample or the pattern reproduced in iterations. This form depends on the nature of the infinite iterations of the transformation method. Process intelligence is presented as "induction",

"abduction" and "deduction". Thinking in the genre of deduction moves from knowledge of a greater degree of generality to new knowledge of a lesser degree of generality.

All modern solutions, such as neural networks, just implement this logic. Thinking in the genre of induction moves from knowledge of a lesser degree of generality to new knowledge of a greater degree of generality. In mathematical logic, this is an inference that gives a probabilistic judgment. There are questions about it. Is it justified in our reasoning to move from cases that recur in our experience to other cases that we have not encountered before? How to mathematically take into account the habit as an integral part of the process of induction? It would seem that there are Bayesian probabilities for this. But they do not answer these questions at all. It is impossible to make repeatability the main factor in inductive inference and what about the fate of irrationality of behavior? This is only part of the problem. Consequently, the mathematical model based on classical statistics does not work in full.

Abduction is a cognitive procedure for accepting hypotheses. Ch.S. Peirce considered abductive inference along with induction and deduction. He believed that by selecting the most significant among the vast number of hypotheses, researchers realize the abduction instinct, without which the development of science would be impossible. So far, there is no mathematical apparatus that allows calculating the threshold and rules for accepting hypotheses. How to understand that a certain group of hypotheses explaining a group of facts are plausible? What is the mathematical model of abductor thinking? One of the main reasons for the failure of the formalization of thought processes was formulated by I. Kant as the problem of the completeness of artificial systems, as opposed to natural ones, which are amorphous in structure and logical incompleteness.

Without the implementation of these problems, it is impossible to create intelligent agents capable of solving common problems. It is possible to single out the works of V.K. Finn, in particular, "On Data Mining". He proposed a log-

ical abstraction, which could be called a structural model of any automated intelligent system.

The question arises of the need to solve a huge range of mathematical and analytical problems. With the generation of hypotheses or deduction, everything is not so bad, at least there are quite working hypotheses. But as far as the philosophical and mathematical issues of induction, abduction are concerned, it is still completely unclear. How to work with higher order predicates? What is the general structure of the axioms? How to solve the problems of operating predicates of more than two or three orders? Create a programming language or operate with something similar to graphs and multidimensional arrays? There is no clear mathematics for working with associative fields. How to analyze the competition of conclusions within the framework of the multidimensional space of both associative links and the multidimensionality of the space of possible conclusions? Indeed, in each of the "possible worlds" its own conclusion will be correct. What is the logic and mathematics of quantity and quality inference problems? This is only part of the questions.

Research into the implementation of each of the components, creating a highly efficient data bus between these components can be quite promising and exciting tasks. In the context of the rapid growth of SaaS, cloud computing, the creation of such systems, built by integrating components from different teams, could provide a significant breakthrough in this matter. Intelligent agents created on this principle can learn to solve a much larger class of problems.

The term "intelligent agent" could give a clearer understanding of the limitations of the solution in terms of the amount of information, the logics used, the range of tasks to be solved, and the goal setting of the systems being created. The use of the word “limitation” should be understood not as a defect, but as an understanding of the limits of possibilities and avoiding a possible substitution of concepts. Currently, none of the problems of logical inference (deduction-induction-abduction) has been solved, except for a partial solution of issues re-

lated to deductive inferences. From the point of view of complete artificial intelligence, not one problem has been solved at all. The main problem is that the vast majority of research does not address the implementation of the abstraction itself. As a result, the mainstreams of thought are nothing more than games around a base of facts and practically do not operate knowledge bases that represent abstractions as the results of abduction. The foregoing is not a statement of the futility of neural networks or similar technologies. The volume of tasks and their value are enormous. This is both assistance in pattern recognition and assistance to specialists in various fields in the analysis of data and seemingly insignificant details. A good example of this application is AI assistance in making diagnoses.

THE CONSTITUTION OF MODERN MATHEMATICS

The birth of modern mathematics is a long process, dragging on for centuries. The philosophers of ancient Greece did not know mathematics and mathematical formulas they operated with concepts at the level of images and everyday concepts. This became insufficient to organize more complex abstract reasoning, which led to the birth of mathematics in its modern sense. Modern reasoning and the logic of what is called artificial intelligence follow the same path. It is based on the principles of searching for patterns in the style of Pythagoras and Euclid. One of the main tasks of mathematics is the search for logics that can significantly reduce the cost of calculations by deriving compact and optimal patterns. This was the impetus for the creation of modern mathematics with its notations.

Started by R. Descartes and G. Leibniz. The birth of mathematics capable of induction and abduction is yet to come, and the explosive growth of interest in artificial intelligence is mainly due to the growth of computing power, and not the emergence of new algorithms. But as a result of this growth, a point was nevertheless reached, after which the solution of a large volume of problems

both in terms of application and initial data, but relatively small in terms of analytical complexity, became economically feasible. But it is still an extensive development path. Without the solution of logical and philosophical questions, without the creation of new areas of mathematics, further progress is not possible. One of the new areas was the theory of cellular automata. Functions are calculated using power, rational and other expansions, as well as differential equations. Many methods for solving differential equations are translated into the language of cellular automata, where they allow further development acquire a visual form that is convenient for calculations and programming. On the basis of cellular automata, computer programs are written for the approximate calculation of the corresponding functions. A comparison of cellular automata is made in terms of calculation accuracy.

Cellular automata are studied and used in mathematics, computability theory, physics, theoretical biology and micromechanics. The first scientific works on cellular automaton theory appeared in the 40s of the twentieth century in the works of S. Ulam and J. von Neumann, as well as N. Wiener and A. Rosenbluth, who developed a mathematical model describing the propagation of impulses of the cardiac ganglions. In the 60s in the twentieth century, cellular automata were considered as a particular type of dynamic systems. In 1969, G. A. Hedland gave an analysis of the results obtained in a new direction. The most significant result was the description of the set of rules of a cellular automaton as a set of continuous endomorphisms in a shift space. In the 70s in the 20th century, a two-dimensional cellular automaton model with binary states, known as the Evolution-Life model game, invented by J. Conway and popularized by M. Gardner, became famous. In the classic version of the game, the rules were used: if a cell has two "live" neighbors, it saves the state. If a cell has three "live" neighbors, it goes into a "live" state, otherwise the cell "dies".

Despite its simplicity, the cellular automaton showed a huge variety of types of evolution, lying between chaos and order. One of the effects that ap-

peared in the model game is the occurrence of combinations of cells, called gliders, and moving as a whole on a two-dimensional grid. The possibility of constructing a grid automaton in which calculations are performed with the help of gliders is proved. In 1969 Konrad Zuse published Computable Space. This is the first book in the field of digital physics. The book makes an attempt to substantiate the discreteness of the nature of physical laws and states that the entire Universe is a giant multidimensional cellular automaton.

As a physical implementation of cellular automata, projects of specialized computing devices have been developed, in which processor elements are placed in cells of the same type of a uniform grid. The states of processor elements are determined by interaction with adjacent cells from the Neumann or Moore neighborhoods. Homogeneous computing environments, systolic matrices of single-digit Gild cells, used in the design of ultra-large-scale integrated circuits, can be considered from the standpoint of cellular automata, in which the interaction of cells is implemented by various methods of information transfer, and not only by electrical connections.

In 2002, P. Chapman built a Life pattern that is Minsky's Register Machine. This machine is equivalent to a Turing machine. In the game of Life, you can execute any algorithm that can be implemented on a modern computer. A cellular automaton represents a set of elementary abstract automata, called cells that accept an input signal, change their state, and generate an output signal. Each of the elementary automata can be in one of the states from some fixed set. A set of states is usually associated with a subset of integers. This is a regular lattice of cells, each of which can be in one of a finite set of states. The lattice of cells can be of any dimension. It is possible to create not only a flat, voluminous, but also a hyperspatial structure of a lattice of cells.

The regular grid of an automaton can consist not only of square cells, but also of other geometric shapes, for example, regular triangles, hexagons. In some cases, it has been proved that such cellular automata are equivalent to

higher-dimensional cellular automata on a grid with square cells, and special rules for displaying the states of neighboring cells are required. Cellular automata with an irregular grid are known, in particular "Penrose tilings". There are continuous cellular automata; instead of a discrete set of states, they use continuous functions with a range of values from the interval.

For each cell, a set of cells, called the neighborhood, is defined. Any cell is a Moore automaton. The transition function depends on the states of a certain subset of cells, called neighbors, whose states are input signals for the analyzed cell. A subset of cells is called a neighborhood of a certain type for the analyzed cell, and the entire set of cells in the aggregate is a cellular automaton of arbitrary dimension. The configuration of cellular automata is the distribution of the states of its cells. A cellular automaton is said to be reversible if there is only one previous configuration for each current configuration. In this case, there is a one-to-one mapping of neighborhood cell states to new cell states.

If a cellular automaton is reversible, then its reverse evolution is also described by a cellular automaton. Configurations that have more than one antecedent are irreversible in a given cellular automaton and are arbitrarily called "the magical gardens of Eden". For one-dimensional cellular automata, there are algorithms for determining reversibility, but for K. a. with two or more dimensions, in the general case, there are no such algorithms. To initialize the operation of a cellular automaton, it is required to set the initial distribution of the states of all cells (initial configuration) and the rule for the transition of cell states to the next configuration. For each discrete time points (time step), using the transition rule and the state of the neighborhood cells, a new state is determined for each cell at the next time point. In this case, layers of configurations appear for the corresponding time step. Usually the transition rules are the same for all time cycles, all cells and apply to the entire lattice (cellular automaton).

Transformations of cellular automaton configurations during successive time cycles are called evolution (change of generations, layers of automaton

configurations). In the theory of cellular automata, the main tasks are distinguished: the construction of the initial configuration, in which the cellular automaton solves the task in a certain number of cycles; determination of algorithmic solvability and complexity of problems in a cellular automaton. For a cellular automaton considered as a whole, the most important parameters are the distribution of the initial states of the cells (initial configuration) and the method of mapping (called the rule) to the state of the current cell. The number of all possible transition rules depends on the number of cell states, the number of neighboring cells in the corresponding neighborhood. Different rules of transition to a new state of cells generate different types of evolutions of a cellular automaton in discrete time.

The simplest is a one-dimensional cellular automaton, the cells of which have two states the neighbors are two cells adjacent to it. Three cells (central and adjacent to it) generate 23=8 states of three cells. Based on the rule of the current state of the triple of cells, the state of the central cell is determined in the next step. S. Wolfram in his book "A New Kind of Science" (2002) singled out 4 classes of rules that lead to different types of evolution of a cellular automaton with most initial configurations. Let us describe them in order of increasing complexity: class 1 - there is a rapid stabilization of the configuration of the cellular automaton and its homogeneity, any random formations quickly disappear; class 2 - there is a rapid stabilization of the configuration or fluctuations, most random structures quickly disappear, but some remain; small changes in the initial configuration have a local character for the further evolution of the automaton; class 3 - pseudo-random, chaotic sequences arise, any stable structures that arise are almost immediately destroyed by ambient noise; local changes in the initial configurations have a significant impact on the further evolution of the automaton; class 4 - complex interacting structures arise that have local, stable, long-term functioning substructures, separate configurations of class 2 may ap-

pear; local changes in the initial configurations have a significant impact on the further evolution of the automaton.

One-dimensional cellular automata, which can be considered as a tape (ring) with an arbitrary number of cells, are well studied. For a one-dimensional cellular automaton, evolutions can be displayed on a plane according to the indicated rules, if discrete time is plotted along one of the axes, and generations of cellular automaton configurations are plotted along the other axis. Let us present some simulation results. Rule 30 leads, for almost all simple initial configurations, to evolution with chaotic, seemingly random dynamics, which is typical for class 3. Rule 110 leads, for almost all simple initial configurations, to evolution with dynamics that are not completely random, but there is no periodicity, which is typical for class 4. In this case, structures arise that interact with each other in a non-obvious, complex way.

It is proved that some of the structures generated by the rule are sufficiently diverse to be Turing complete, which indicates the universality of the evolutions of this class. Rule 161 generates, for almost all simple initial configurations, fractal structures, in particular, nested similar triangles, which is typical for class 1. There is a class of totalistic cellular automata for which, at each time step of evolution, the state of each cell is equal to an integer from some subset of natural numbers, and the new state of the cell is determined by the sum of the state values of the neighborhood cells. A cellular automaton is called external totalistic if the state of the cell at the new time step also depends on the previous state of the same cell. For example, the game "Evolution - Life" is an external totalistic two-dimensional cellular automaton with a binary state of cells.

Cellular automata are called stochastic if probabilistic rules for changing configurations are used. For such automata in the rules, you can set the probability of changing the color of the cell on the next step, and in the game "Evolution" to the existing rules, add a rule that allows the cell to change color with some probability.

NEURONAL NET

Neuronal net integrates neural technologies, electronics and communication technologies. Neural technologies help to understand the work of the human brain, consciousness and higher nervous activity. With their help, you can improve the activity of the human brain and better control mental processes.

Electronics represents the science of the interaction of electrons with electromagnetic fields, methods for creating electronic devices and devices for converting electromagnetic energy for receiving, transmitting, processing and storing information. Communication technologies represent processes, methods for searching, collecting, storing, processing, providing, distributing information and methods for implementing such processes and methods. Neural interfaces are designed as innovative devices that engage people in collaborative activities. Neural interfaces register biometric and psychophysiological parameters of a person's state, report their deterioration or improvement. This technical capability helps people communicate with each other more effectively.

The Mind Productivity Assistant device is intended for registration and analysis of electrophysiological and biometric parameters of a person. Thus, it will be possible to increase the productivity of specialists in engineering and technical profiles. The quality of an engineer's work directly depends on physical and mental health, stress, fatigue, level of motivation, emotional and intellectual activity. The device monitors the state of a person and informs him about it. This approach improves working conditions and optimizes the workflow. The development is based on behavioral models that combine the theoretical developments of cognitive science and psychophysiology: a model of cognitive load, a model of the influence of stress factors, a model of fatigue, a model of the influence of the nature of activity, a general multi-parameter model.

This became possible due to the results of development work, including the development of applied behavioral models for optimizing the integral resource state, taking into account cognitive load, stress factors, work and rest

schedules, and the nature of cognitive activity. The device performs three groups of functions. This is the preparation of data on the progress of group work of foresight sessions with the subsequent conversion of this data into text formats in real time. Analysis of the received text formats to identify and cluster key entities (trends, formats, technologies, events, threats and opportunities) and structure the content of the project dialogue.

Displaying timelines and visualizing the structure of the design dialogue to manage the progress of foresight sessions and present the results of the design of the image of the future. The functional characteristics of the developed solution make it possible to support the work of all participants and members of the foresight session team - moderators, assemblers, analysts, visualizers, loggers and administrators.

QUALIA

The elementary parts of a person's subjective experience are qualia. They can be conditionally divided into perceptions and emotions. Perceptions include the semiotics of colors, sounds, smells, tastes, and tactile sensations. Emotions express love, joy and anger.

From the point of view of physics, light is electromagnetic radiation. Color reflects the subjective perception of the light that has fallen into the eyes of a person by his consciousness. You can read a book on the physics of color and memorize the wavelength and frequency of red light, a book on the anatomy of the eye and its perception of red light. But there is a subjective experience of perceiving red qualia. The same is true for other perceptions - sounds, smells, tastes and tactile sensations, as well as for emotions.

Through experimentation, one can learn about echolocation in bats, as well as what it feels like to feel echolocation. It is the answer to the question "what is it like" that is qualia.

An interesting feature of qualia is their non-transferability - subjective experience cannot be transferred from person to person. D. Hume and J. Berkeley, studying the issue of subjective perception, came to the conclusion that knowledge about the world comes to consciousness only from impressions.

According to I. Kant, the external world gives only sensations thinking arranges them in space and time and delivers them into experience. The things in themselves which are the causes of sensations are unknowable; they are not located in space and time, they are not substances, they cannot be described by any of those general concepts that I. Kant calls "categories". Space and time are subjective they are part of the apparatus of perception. In my environment, they must want to eat my brains.

D. Chalmers divided the problem of consciousness into two: easy and difficult. The easy problem of consciousness is an exploration of the apparent connection between consciousness and the brain. It can be solved by a scientific method - for example, electrical stimulation of some area of the brain can be investigated to generate a feeling of fear, and blocking the work of another area of the brain to hearing loss. The hard problem of consciousness is the exploration of the nature of qualia and where consciousness comes from. This problem is not subject to science, and therefore is studied by philosophy.

There are two main approaches to the difficult problem of consciousness in modern philosophy.

The first approach is called "emergenceism". Proponents of emergentism believe that the hard problem of consciousness does not really exist, and that consciousness itself is just an illusion that arises due to some peculiarities of how the neural network of our brain works. A supporter of this approach is D. Dennett, but most philosophers have a negative attitude to this idea, since it contradicts the facts of subjective experience.

Proponents of panpsychism believe that consciousness is a fundamental property of the universe like an electric charge or spin, and any physical process

is accompanied by the appearance of consciousness. One of the most popular panpsychic hypotheses is the theory of integrated information. It assumes that consciousness appears in the course of any information processing processes, and the more complex such processes, the more complex consciousness arises as a result of them. The theory introduces the metric ϕ, which is calculated according to a special formula - the more ϕ the process has, the more complex consciousness arises as a result of it. Thus, from the theory of integrated information it follows that computer neural networks, equal in complexity to the complexity of the human brain, will have a consciousness similar to a human one. Consciousness and simpler neural networks will have simpler consciousness. If the panpsychism hypothesis and the theory of integrated information are correct, then disconnecting the conscious computer neural network from the power supply is ethically equivalent to killing a person.

NEURONS AND NEURAL NETWORKS

The processes of transmission of stimuli are implemented in a living organism as the transmission of electrical impulses between neurons.

A biological neuron has a nucleus, as well as processes of nerve fibers - dendrites, along which impulses are received and a single axon along which a neuron can transmit an impulse. The axon contacts the dendrites of other neurons through special formations of synapses that affect the strength of the transmitted impulse. A structure consisting of a combination of a large number of such neurons is called a biological natural neural network.

The appearance of a formal neuron is due to the study of biological neurons. A formal neuron is the basis of any artificial neural network. Neurons are relatively simple, single-type elements that mimic the work of neurons in the human brain. Each neuron is characterized by its current state, by analogy with the nerve cells of the brain, which can be excited and inhibited. An artificial neuron, as well as its natural prototype, has a group of synapses (inputs) that are

connected to the outputs of other neurons, as well as an axon - the output connection of this neuron, from where the excitation or inhibition signal arrives at the synapses of other neurons.

The choice of the structure of the neural network is carried out in accordance with the characteristics and complexity of the task. Theoretically, the number of layers and the number of neurons in each layer of a neural network can be arbitrary, but in fact it is limited by the resources of a computer or a specialized microcircuit, on which a neural network is usually implemented. If the unit hop function is used as an activation function for all neurons in the network, the neural network is called a multilayer perceptron.

Neural networks are complex nonlinear systems with a huge number of degrees of freedom. The principle by which they process information differs from the principle used in computers based on processors with a von Neumann architecture - with a logical basis. Instead of classical programming (as in traditional computing systems), neural network training is used, which boils down to setting weight coefficients in order to optimize a given criterion for the quality of neural network functioning.

A neural network algorithm for solving problems is a computational procedure that is fully or mostly implemented in the form of a neural network of one structure or another. For example, a multilayer neural network with serial or cross-connections between layers of formal neurons with an appropriate algorithm for setting weights. The basis for the development of a neural network algorithm is a systematic approach, in which the process of solving a problem is represented as the functioning of a certain dynamic system in time.

To build it, it is necessary to determine: an object that acts as an input signal of a neural network; an object that acts as an output signal of a neural network (for example, the solution itself or some of its characteristics); the desired (required) output signal of the neural network; neural network structure (number of layers, connections between layers, objects that serve as weight coefficients);

system error function (characterizing the deviation of the desired output signal of the neural network from the real output signal); system quality criterion and the functionality of its optimization, depending on the error; the value of the weight coefficients, for example, determined analytically directly from the problem statement, using some numerical methods or the procedure for adjusting the weight coefficients of the neural network.

The neural network in the process of to the solution of a specific problem is considered as a multidimensional nonlinear system, which in an iterative mode purposefully seeks the optimum of some functional that quantitatively determines the quality of the solution to the problem. For neural networks, as multidimensional nonlinear control objects, algorithms for setting a set of weight coefficients are formed. The main stages of studying a neural network and building algorithms for tuning (adaptation) of their weight coefficients include: studying the characteristics of the input signal for various operating modes of the neural network (the input signal of the neural network is, as a rule, the input information being processed and the indication of the so-called "teacher" of the neural network). As well as the choice of optimization criteria (with a probabilistic model of the external world, such criteria can be the minimum of the average risk function, the maximum of the posterior probability, in particular, if there are restrictions on individual components of the average risk function).

The 20th century had a purely theoretical meaning, since there were no practical tasks adequate to such structures. In the late 80s - early 90s of the twentieth century, such problems and simple structures with customizable feedbacks for solving them (the so-called recurrent neural networks) began to appear. Developers in the field of neural network technologies were engaged not only in the creation of algorithms for setting up multilayer neural networks and neural network algorithms for solving various problems, but also in hardware emulators of neural network algorithms that are effective at the current moment in the development of electronics technology. These are special programs that

are designed to run one system in the shell of another system. In the 1960s, before the advent of the microprocessor, the most effective neural network emulators were analog implementations of open-loop neural networks with developed tuning algorithms on mainframe computers (sometimes systems based on adaptive elements with analog memory). This level of development of electronics made it relevant to introduce cross-connections into the structures of neural networks. This led to a significant decrease in the number of neurons in the neural network while maintaining the quality of the solution to the problem (for example, discriminant ability when solving pattern recognition problems).

Research in the 60–70s of the 20th century in the field of optimizing the structures of neural networks with cross-connections was developed during the implementation of memristor neural systems. A memristor is a passive element in microelectronics that can change its resistance depending on the charge flowing through it, taking into account their specifics in terms of analog-to-digital information processing and a very significant number of adjustable coefficients. The specific requirements of applied problems determined some features of the structures of neural networks using tuning algorithms: the continuum of the number of classes, when the indication of the teacher of the system is formed as a continuous value of the function in a certain range of change; the continuum of solutions of the multilayer neural network, formed by the choice of the continuum activation function of the neuron of the last layer; the continuum of the number of features, formed by the transition in the feature space from representing the output signal as an NN-dimensional vector of real numbers to a real function in a certain range of the argument change; the continuum of the number of features, as a result, requires a specific software and hardware implementation of the neural network.

A variant of the feature continuum of the input space was implemented in the problem of recognizing periodic signals without converting them using an analog-to-digital converter at the input of the system. The implementation of

multilayer neural networks with a continuum of classes and solutions is carried out by choosing the appropriate types of neuron activation functions.

The signal to the input of the neural network is described by the number of classes (gradations) of images representing the instructions of the teacher. The output of the neural network represents a quantitative description of the decision space. The main advantages of neural networks, as a logical basis for algorithms for solving complex problems, are the invariance (invariance, independence) of the methods for synthesizing neural networks on the dimension of the feature space. Adequacy to current and prospective technologies of microelectronics; fault tolerance in the sense of its small, rather than catastrophic change in the quality of the solution to the problem, depending on the number of failed elements.

METHODOLOGY FOR SYNTHESIZING NEURAL NETWORKS WITH MANAGEMENT DECISIONS

Neural networks were in control theory one of the first examples of the transition from the control of the simplest linear stationary systems to the control of complex nonlinear, non-stationary, multidimensional, multiply connected systems. In the second half of the 1960s, the neural network synthesis technique was born, which was developed and successfully applied over the next fifty years. The probabilistic model of the surrounding world is the basis of neural network technologies. Such a model is the basis of mathematical statistics.

Neural networks arose when experimenters using methods of mathematical statistics asked themselves why they were required to describe the distribution functions of random input signals in the form of specific analytical expressions (normal distribution and Poisson distribution). If this is correct and there is some physical reason for this, then the task of processing random signals becomes quite simple.

It turned out that there is no knowledge about the distribution function of input signals. As a consequence, the need for a formal description of the distribution function of input signals was abandoned. The methodology was taken as a basis for solving problems under conditions of a priori uncertainty, i.e., incompleteness of the description, when there is no information about possible results. That is why neural networks in the early 60s of the twentieth century were effectively used in solving problems of pattern recognition.

The pattern recognition problem was treated as a problem of approximating a multidimensional random function that takes KK values, where KK is the number of pattern classes.

The functioning of the neural network and the actions that it is able to perform depend on the magnitude of synoptic connections. Therefore, given the structure of the neural network that meets a specific task, the developer must find the optimal values for all weight coefficients. This stage is called neural network training, and the ability of the network to solve the problems posed to it depends on how well it will be performed. The most important training parameters are: the quality of the selection of weight coefficients and the time that needs to be spent on training. These two parameters are inversely related and have to be chosen on the basis of a compromise.

If there is insufficient a priori information about the distribution functions of input signals, ignoring some useful information can lead to a loss in the quality of the problem solution. This concerns the a priori probabilities of the appearance of classes. Algorithms for tuning multilayer neural networks have been developed, taking into account the available information about the a priori probabilities of the appearance of classes. This is the case in problems such as recognizing letters in text, when for a given language the probability of occurrence of each letter is known. This information must be used when constructing an algorithm for setting the coefficients of a multilayer neural network.

The neural network is presented with the values of both input and output parameters, and it adjusts the weights of its synaptic connections according to some internal algorithm. Supervised learning assumes that for each input vector, there is a target vector representing the desired output. The qualifications of the teacher may be different for different classes of images. Collectively, they are called the representative or training sample. The neural network is trained on a certain number of such samples. An output vector is presented, the output of the neural network is calculated and compared with the corresponding target vector, the difference (error) is fed back to the neural network, and the weights are changed in accordance with an algorithm that seeks to minimize the error. The vectors of the training set are presented sequentially, the errors are calculated, and the weights are adjusted for each vector until the error over the entire training array reaches an acceptably low level.

In the tasks of pattern recognition, the teacher's qualification is complete. This means that the probability of the teacher correctly assigning images to a particular class is equal to one. In practice, in the presence of indirect measurements, this often does not correspond to reality, for example, in medical diagnostics, when, when verifying (verifying) an archive of medical data intended for training, the probability of attributing these data to a particular disease is not equal to one. The introduction of the concept of teacher qualification made it possible to develop unified algorithms for setting the coefficients of multilayer neural networks for learning modes, learning with a teacher with final qualifications, and self-learning (clustering), when in the presence of KK or two classes of images, the qualification of the “teacher” (the probability of assigning images to one or another class) is equal to 1K1K or 1/2.

The introduction of the concept of teacher qualification in pattern recognition systems made it possible to theoretically consider the modes of sabotage to the system, when it is informed of a deliberately false (with varying degrees of

falsity) assignment of images to a particular class. This mode of setting the coefficients of a multilayer neural network has not yet found practical application.

Clustering is a particular mode of operation of multilayer neural networks, when the system is not informed about the belonging of samples to a particular class. The neural network is presented only with input signals, and the outputs of the network are formed independently, taking into account only the input signals and their derivatives. Despite numerous applied advances, supervised learning has been criticized for being biologically implausible. It is difficult to imagine a learning mechanism in natural human intelligence that compares desired and actual output values, correcting with feedback.

Unsupervised learning is a more plausible model for learning in a biological system. It does not need a target vector for outputs and therefore does not require comparison with predefined ideal responses. The training set consists of only input vectors. The learning algorithm adjusts the weights of the neural network so that consistent output vectors are obtained, so that the presentation of sufficiently close input vectors gives the same outputs.

The learning process extracts the statistical properties of the training set and group similar vectors into classes. Presenting a vector from a given class as an input will give a certain output vector, but before learning it is impossible to predict what output will be produced by a given class of input vectors. Therefore, the outputs of such a network must be transformed into some understandable form, due to the learning process. It is usually not difficult to identify the connection between input and output established by the network.

The main task of clustering is to process a set of vectors in a multidimensional feature space with the selection of compact subsets (subsets that are close to each other), their number and properties. The most common clustering method is the “KK-means” method, which is not related to back propagation methods and does not generalize to multilayer neural network architectures.

The introduction of the concept of teacher qualification and a unified approach to learning and self-learning in the 60s of the twentieth century made it possible to create a basis for implementing the clustering mode in multilayer neural networks of a wide class of structures.

The existing developments in the field of pattern recognition systems based on multilayer neural networks mainly refer to stationary patterns, i.e. to random input signals having complex unknown but time-stationary distribution functions. The assumed unknown distribution function of the input signal depends on time, or the input random signal is a superposition of a regular component and a random component with an unknown complex distribution function that does not depend on time.

The probabilistic model of the world, taken as the basis for the construction of adaptation algorithms in multilayer neural networks, made it possible to form the primary optimization criterion in the systems under consideration in the form of requirements for the minimum of the average risk function and its modifications. This is the conditional probability of a random event, provided that the a posteriori, i.e., experience-based data and the minimum of the average risk function are known; the minimum of the average risk function, provided that the conditional risk functions are equal for different classes; the minimum of the average risk function under the condition of a given value of the conditional risk function for one of the classes; other primary optimization criteria arising from the requirements of a specific practical task. The back propagation algorithms consider the simplest criterion - the minimum of the mean square error, without any restrictions on the conditional risk functions.

In the self-learning (clustering) mode, the prerequisite for the formation of the criterion and the functional of the primary optimization of neural networks is the representation of the distribution function of the input signal as a multimodal function in a multidimensional feature space, where each mode corresponds to a

class with some probability. Modifications of the average risk function were used as criteria for primary optimization in the self-learning mode.

The presented modifications of the primary optimization criteria were generalized to the cases of a continuum of classes and solutions; continuum of features of the input space; the continuum of the number of neurons in the layer; with arbitrary qualifications of the teacher. An important section of the formation of the criterion and functional of primary optimization in multilayer neural networks with a probabilistic model of the world is the choice of a loss matrix, which in the theory of statistical decisions determines the loss factor L12L12 when erroneously assigning images of the 1st class to the 2nd and the loss factor L21L21 when assigning images of the 2nd class to 1st.

By default, the matrix LL of these coefficients in the synthesis of tuning algorithms for multilayer neural networks, including when applying the back propagation method, is assumed to be symmetrical. In practice, this is not true. A typical example is a mine detection system using a geographic locator. In this case, the losses due to the erroneous assignment of a stone to a mine are equivalent to some small loss of time by the user of the geographic locator. Losses associated with the erroneous assignment of a mine to the class of stones are associated with life or significant loss of health by users of the geographic locator.

The analysis of open neural networks aims to determine in general terms the statistical characteristics of the output and intermediate signals of neural networks as multidimensional, nonlinear control objects in order to further form the secondary optimization criterion and functional, i.e., the functional actually optimized by the adaptation algorithm in a particular neural network. As such a functional, the root-mean-square error is taken, which worsens the quality of the solution or does not correspond at all to the optimization problem posed by the primary optimization criterion. A technique and algorithms for the formation of a secondary optimization functional corresponding to a given primary optimization functional have been developed.

The extremum search algorithm in relation to a specific secondary optimization functional determines the algorithm for setting the coefficients of a multilayer neural network. Of practical interest are the algorithms implemented in the MatLab system. This is a package of applied programs for solving problems of technical calculations and a programming language of the same name. It is important to note the particularity of adaptation algorithms in multilayer neural networks used in MatLab systems. The Neural Network Toolbox provides functions and applications for modeling complex nonlinear systems that are described by equations. It supports supervised and unsupervised learning, direct propagation, with radial basis functions, and the orientation of these algorithms not to the specifics of the problems being solved, but to the imaginary geometry of secondary optimization functionals. These algorithms do not take into account many details of the specifics of the use of multilayer neural networks in solving specific problems and require radical processing when moving to memristor neural systems.

The main feature of the algorithms is the need to search for local and global extrema of the multi-extremal functional in the multidimensional space of adjustable neural network coefficients. An increase in the size of the neural network leads to a significant increase in the number of adjustable coefficients, to an increase in the dimension of the search space. The specificity of the multi-extremality of the secondary optimization functional has led to the emergence of various modifications of search methods (genetic algorithms). Algorithms for searching for extrema of secondary optimization functionals with restrictions on the value, speed and other parameters of the weight coefficients of neural networks have been created. It is these methods that should be the basis of work on methods for tuning neural networks using memristors (weight coefficients), taking into account such specific characteristics as transfer functions.

The choice of initial conditions for the iterative procedure for searching for extrema of secondary optimization functionals is an important stage in the

synthesis of tuning algorithms for multilayer neural networks. The problem of choosing initial conditions should be solved specifically for each problem solved by a neural network, and be an integral part of the general procedure for synthesizing algorithms for setting up multilayer neural networks. A qualitative solution to this problem can significantly reduce the setup time.

The a priori complexity of the secondary optimization functional made it necessary to introduce a procedure for choosing initial conditions in the form of random values of the coefficients with the repetition of this procedure and the procedure for adjusting the coefficients. For individual problems, the idea of choosing the initial conditions specific to the given problem being solved is adopted. This procedure has been worked out for three tasks: pattern recognition; clustering; neuroidentification of nonlinear dynamic objects.

A systematic approach to the construction of algorithms for finding the extremum of the secondary optimization functional assumes, as one of the tuning modes, the reconfiguration of the coefficients in each step of the arrival of images at the input according to the current value of the gradient of the secondary optimization functional. Algorithms for tuning multilayer neural networks with filtering the sequence of gradient values of the secondary optimization functional have been developed: by a zero-order filter with mnmn memory for stationary images; filter 1,…,k1,…,k-th order with memory mnmn for nonstationary images with different hypotheses of time variation of distribution functions for images of different classes.

The main issue of choosing the structure of a multilayer neural network for solving a selected specific problem has not yet been largely resolved. It is possible to offer only a reasonable directed enumeration of variants of structures with an assessment of their effectiveness in the process of solving the problem. However, the assessment of the quality of the tuning algorithm on a specific selected structure, a specific task may not be correct enough. Thus, to assess the quality of linear dynamic control systems, standard input signals (stepped and

quadratic) are used, according to the response to which the steady-state error (astatism of the system) and errors in transients are evaluated.

For multilayer neural networks, typical input signals have been developed to test and compare the performance of various tuning algorithms. Typical input signals for objects such as multilayer neural networks are specific to each problem being solved. Typical input signals have been developed for the following tasks: pattern recognition; clustering; neuronal control of dynamic objects.

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The main axiomatic principle of using neural network technologies instead of the methods of classical mathematical statistics is the rejection of a formalized description of the probability distribution functions for input signals and the adoption of the concept of unknown, complex distribution functions. For the clustering problem, a sample of a random signal with a multimodal distribution was proposed, implemented in the NN-dimensional feature space with distribution function modes, the centers of which in the amount of ZZ are located on the hyper bisector of the NN-dimensional feature space. Each mode imple-

ments a component of a random sample with a normal distribution and standard deviation σσ equal to each of the ZZ modes.

The subject of comparison of various clustering methods was the dynamics of tuning and the quality of the solution of the problem depending on NN, ZZ and σσ, with a sufficiently large random sample MM. This approach can be considered one of the first fairly objective approaches to comparing clustering algorithms, including those based on multilayer neural networks with an appropriate choice of structure to achieve the required clustering quality. For classification problems, the test inputs are similar to those for clustering, with the change that the multimodal sample is split in two (in the case of two classes) or into KK (in the case of KK classes) portions of the intermittent modes of the distribution function for the individual classes.

Refusal in neural network technologies from a priori information, from information about the distribution functions of input signals, led to the need to implement enumeration of the parameters of the structure of multilayer neural networks to ensure the required quality of the solution of the problem. A procedure for tuning multilayer neural networks is proposed, in which the structure is not fixed a priori, but is the result of tuning along with the values of adjustable coefficients. During the tuning process, the number of layers and the number of neurons in the layers are selected. The procedure for setting the coefficients of a multilayer neural network with a variable structure can be easily transferred from the problem of recognizing two classes of images to the problem of recognizing KK classes of images.

The result of the tuning is KK neural networks, in each of which the first class is the kk-th class (k=1,…,Kk=1,…,K), and the second is all the rest. A similar idea of setting up multilayer neural networks with a variable structure is also applicable to solving the clustering problem. The initial analyzed sample is taken as the first class of images, and the sample with a uniform distribution in the range of feature changes is taken as the second class. The multilayer neural

network with a variable structure implemented during the tuning process qualitatively and quantitatively reflects the complexity of solving the problem. From this point of view, the task of clustering as the task of generating new knowledge about the object under study is to identify and analyze those areas of the multidimensional space of features in which the probability distribution function exceeds the level of uniform distribution in the range of changes in the values of features.

One of the main concepts for the development (training) of a multilayer neural network is the desire to increase the number of layers, and this involves ensuring the choice of a neural network structure that is adequate to the problem being solved, the development of new methods for generating algorithms for setting coefficients. The advantage of neural networks is the property of gradual degradation. With the failure of individual elements, the quality of the system decreases gradually. Also, increased resistance to changes in the parameters of circuits that implement them, for example, very significant changes in weights do not lead to errors in the implementation of a simple logical function of two variables.

The wide spread of neural network algorithms in the field of complex formalizable, weakly formalizable and non-formalizable problems has led to the creation of a new direction in computational mathematics. It includes neural network algorithms for solving the following problems: pattern recognition; optimization and extrapolation of functions; graph theory; cryptographic tasks; solution of real and Boolean systems of linear and nonlinear equations, ordinary one-dimensional and multidimensional differential equations, differential equations in partial derivatives, etc. Based on the theory of neural networks, a section on the control of nonlinear dynamic systems has been created. It is designated as neuronal control and includes methods for neural network identification of complex dynamic objects; construction of neuronal regulators in the control loops of complex dynamic objects.

DEEP NEURAL NETWORKS

In addition to traditional architecture devices, GPUs have appeared that were originally designed for rendering graphic images. They have a large number of processing cores that allow processing huge amounts of data in parallel. This architecture is the best suited for the implementation of neural networks.

The use of video processors has significantly expanded the scope of neural networks and gave a significant impetus to the complexity of their architecture. As a result, deep neural networks have appeared that can effectively solve a wide range of problems, including image and speech recognition.

In the traditional approach to recognition problems, the researcher, based on a priori knowledge, singled out features that uniquely characterize the object being recognized, and built measures that make it possible to compare the degree of proximity of various features. For example, when recognizing faces, characteristic biometric points were identified (the tip of the nose, the corners of the lips and eyes) and the distance between them was measured. A set of such parameters uniquely characterized a person's face.

When using deep neural networks, the situation changes dramatically. In the process of learning on a large number of samples, the network itself finds the optimal set of facial features and chooses a measure of similarity. Thus, a situation is obtained in which the network successfully identifies people's faces, but at the same time no one can say with certainty how it does it.

The use of neural networks does not require special equipment, just an ordinary desktop computer, and the developer requires knowledge of mathematics and numerical methods for solving equations. The widespread use of neural networks has led to the creation of software packages that allow you to create and train neural networks of almost unlimited complexity and with little or no programming. Neural networks do not need to be programmed. It is necessary to create a network architecture, gain a base for training and experimentally determine which architecture is best suited for which tasks.

An important feature of neural networks is the asymmetry of learning and subsequent work processes. If training requires large computational resources and can take several days or even weeks, then the trained network performs classification in a fraction of a second.

The issue of the near future involves the appearance on the market of compact mobile platforms, compact computers with a peripheral interface. They will not be as powerful as video cards, but they will be completely autonomous and will not require a computer to operate. Inside the platforms will be a low-power graphics chip. Such a construct opens up a wide range of applications, since it can be built almost anywhere and with the help of compact devices to solve a variety of recognition problems, including combined problems of pattern recognition. All this significantly reduces the cost of the product for end customers, since the solutions themselves, for example, hardware and software systems for biometric identification of faces, become more accessible for use on a wide range of objects.

NEURAL TECHNOLOGIES AND DIGITAL PLATFORMS

The interoperability of digital technology components has created an opportunity for the creation of digital platforms. This is a combination of augmented and virtual reality technologies, within which interaction with functions and services takes place using a unique user profile (avatar). This allows users to interact with a shared digital space in which company functions are integrated. The first decentralized metaverses were based on a game. This space represents a large 3D world, includes a huge number of opportunities for users - from creating NFTs, to influencing the in-game rules.

The distributed ledger technology was created to form a powerful decentralized infrastructure therefore, in order to support projects within the universe, they must also be created decentralized.

The decentralized base provides a large capacity, allowing the use of free space on the disks of users around the world to avoid running out of space for other users. Such a storage eliminates the disadvantages of centralized databases, where the participation of third parties is necessary, eliminates the risk of data theft and manipulation.

Block chain solves the problem of storage security. All data, keys, content and any payment information is hashed and stored in encrypted form. All nodes in the metaverse operate and synchronize independently. This immediately cuts off problems with query execution delays, limited scalability, and many others. Thanks to self-executing contracts, the metaverse will be able to implement various rules in the ecosystem. Use ready-made smart contracts of other projects. Due to the interaction of different universes with each other, we get the opportunity to exchange data, information and resources. Block chain can be used in various developments for metaverse projects.

Projects in the metaverse are mostly based on games. Therefore, it is especially important to have a digital proof of ownership. By introducing NFT into the metaverse, it is possible to ensure the regulation of activities related to digital assets, user avatars and building an economy with the help of cryptocurrencies. The Metaverse allows users to manage their funds, pay for services, and participate in trading activities. Any transaction in the metaverse can be made based on crypto currency. In the metaverse, every user (Avatar) has an identity card. This data is safe because it is stored in a distributed registry, excluding illegal actions from another user.

Augmented reality and virtual reality technologies are the main ones in the functioning of the metaverse. They allow users to connect to the metaverse for meetings and other interactions. The task of artificial intelligence is fast and high-quality analytics, work with calculations, identification using face recognition, efficient scaling, and elimination of the language barrier.

3D allows you to create realistic spaces within the universe, photorealistic 3D structures and a clear physical environment. IOT allows you to connect the real world with the Internet, strengthen the connection between objects in the real world and the metaverse, and ensure the use of data. It not only allows you to create simulations, but can also be combined with artificial intelligence technology for more efficient data management.

NEURONAL INTERFACE

The neural interface is a technology for exchanging information between the human brain and a computer, smartphone, exoskeleton or prosthesis, household appliances, a wheelchair or artificial sense organs. The Stimoceiver electrode device, invented in the 1950s, is considered to be the first prototype of the neural interface. It was tested on the brain of a bull, forcing the animal to change direction. In the 1970s a neuronal prosthesis for the deaf was created.

They became a cochlear implant. In 1998, neurologist F. Kennedy first implanted a neural interface into the brain of J. Ray, who was completely paralyzed due to a brain stem injury. He controlled the cursor on the monitor, representing the movements of the hands. In 2000, a group of developers led by M. Nicoleles created a neural interface that allowed a monkey to control a joystick with the help of his mind. In 2021, this experiment was repeated in Neuralink with an invasive neural interface. In 2004, an electronic neuronal chip was created by Cyber kinetics Inc., which was implanted in the paralyzed M. Beigle so that he could control the robotic arm with the help of the brain.

Major breakthroughs are taking place in the field of neuronal prosthetics. In 2015, Californian researchers developed a neural interface that allows people who are paralyzed to the waist to walk. In 2016, scientists from Germany, Switzerland and the United States were able to partially restore a patient's damaged spinal cord using a neural interface. N. Harbisson, from birth not distinguishing colors, has developed a special camera that converts color into sounds and sends

them to the inner ear. In 2021, a group of researchers from California created a neuronal prosthesis that helps improve memory by 30%.

According to the type of interaction, neuronal interfaces are unidirectional and bidirectional. The former either receive signals from the brain or send them to it. The latter can both send and receive signals simultaneously. Unidirectional ones already exist and function, while bidirectional ones are only presented as a concept so far. According to the location, invasive, minimally invasive and non-invasive neuronal interfaces are distinguished. The first are implanted in the brain, the second are placed on the surface of the brain, and the third on the head. The closer the neuronal interface electrodes are to the brain, the better they transmit the signal.

From the point of view of functions, neural interfaces are distinguished for controlling something with the help of the brain or for restoring and supplementing its functions. The latter is relevant for brain lesions in multiple sclerosis, dementia, Alzheimer's or Parkinson's disease. Unidirectional brain-computer neural interfaces record an electroencephalogram - the electrical activity of the brain. By forming neural connections and transmitting signals between neurons, the human brain emits electrical impulses. They are decrypted by the computer and converted into commands for the system or external devices. Invasive neuronal interfaces in the form of small plates with electrodes are implanted into the cerebral cortex. Non-invasive are placed on the head in the form of a helmet or separate electrodes. To improve conductivity, they are sometimes moistened with water or a special gel.

To decipher brain impulses scientists use an algorithm that itself isolates the necessary signals or provides ready-made parameters that the system is looking for in the data stream. In the first case, the interface is more likely to be able to predict what kind of movement a person is thinking about. In the second case, for an accurate result, you need to understand exactly how this or that intention manifests itself in the brain signal. This process is not fully understood. In neu-

ronal interfaces with two-way communication, information in the form of data about the work of the brain, sounds, images, tactile sensations is transmitted to a computer, then analyzed and transmitted to the brain by stimulating the cells of the central and peripheral nervous system.

Neuronal interfaces help restore lost brain functions and diagnose neurological diseases. Neuronal prosthetics allow people with paralyzed or missing body parts to send signals to the muscles of their arms, legs, head, and entire body. There are individual robotic prostheses and entire exoskeletons that work in this way. Also, neural interfaces perform the functions of lost organs: for example, eyes or ears. Neural interfaces help control actions in virtual games, allowing you to play without the help of joysticks or keyboards. A biosynthetic material has been created that can be used as a neurochip that connects the brain to artificial intelligence. So far, the market is dominated by non-invasive devices. Most of them are mobile EEG headsets or helmets with a different number of electrodes and a set of functions.

Emotive Systems has developed a helmet-shaped neural interface with 14 electrodes that registers 13 frequencies of the brain, muscle contractions and head movements using two gyroscopes. It recognizes emotional state and stress levels, helping to create 3D brain models and diagnose mental disorders. Nissan implements similar technologies to improve the car's handling and safety on the road. The neural helmet helps to better respond to changing situations by predicting the reaction and actions of the driver. Facebook is developing technology that will help users publish posts and comments without using a keyboard.

This feature will be useful for paralyzed people: thanks to it, they will be able to type at a speed of one hundred words per minute, which is five times faster than typing on a smartphone. The neural interface will be non-invasive. The specialists are developing machine learning algorithms for recognition and visualization of neural signals.

Among the invasive neuronal interfaces, the most famous is the neuronal chip from Neuralink by I. Mask. In 2013, The Human Brain Project was launched in Switzerland, which brought together about 500 scientists from around the world, and in the USA - Brain Research through Advancing Innovative Neuronal technologies with a budget of $ 4.5 billion. Their goal is to study as much as possible in detail the work of the brain to create neural interfaces with bilateral action.

What are the main problems of technology? Health risk. First, there is a risk of damaging the brain when the chip is implanted. Therefore, Neuralink proposes to implant chips using a laser beam, rather than drilling. Secondly, at the point of contact between the brain and the electrodes, the nervous tissue dies. The solution may be special substances that can be used to cover microcircuits, and then they will “grow” with nervous tissues. Another option is biodegradable sensors, which dissolve over time.

It is not yet completely clear where the invasive devices will receive energy from. The source can be the human body. When working, the muscles release energy, which is enough to power mini-devices. First, in dense brain tissue it is very difficult to find the right nerve to connect an electrode to it. Secondly, non-invasive neural interfaces, in addition to relevant impulses, read out a lot of noise that still needs to be able to separate.

So far, neural interfaces do not yet control the human brain and cannot read minds, but in the future, hacking data from such devices may become a serious problem. There are no qualified technical specialists on the market yet who would be able to work with complex neural interfaces. The main problem is that there is no picture of how the human brain works. Therefore, it is not possible to accurately decipher the signals it transmits.

METAVERSE

The Metaverse is a network of digital worlds that combines physical, augmented and virtual realities. It is called a three-dimensional model of the Internet, a hybrid of a computer game and a social network. Instead of photos, each user has a 3D avatar. Flat browser pages have replaced bulky interfaces. The Metaverse offers users a virtual version of life. Study, go to concerts, get married, buy real estate, earn and spend cryptocurrency.

To live in a digital world, you need unlimited cloud storage, high data transfer speeds and the latest graphics engines. The Metaverse is costly to the owner. The computing power of users' home devices will have to increase 1000 times to process a quadrillion operations per second. So far, only supercomputers are capable of this. Small metauniverses of modern software systems are pulling, but one cannot do without a virtual and augmented reality helmet. For complete immersion, you will need a tactile suit, it allows you to feel touch and even temperature. For example, a startup from Belarus has developed a Teslasuit. It has a built-in motion capture system of 68 electrodes.

Already in the mid-90s of the twentieth century, students of technical universities created the first primitive metaverses. Dozens of sites with built-in windows, diving into which, you could wander around the 3D world with a landscape of geometric shapes. They were written in the new programming language VRML. Second Life is called the great-grandfather of all metaverses. It was a real life simulator with social network elements and an internal currency purchased with real money. In 2021, a special VR headset was announced.

The gadget is able to maintain eye contact with other digital avatars and convey user emotions using facial expression trackers. Mesh collaboration space developed. In it, people take on the appearance of holograms and interact with digital objects against the backdrop of the interiors of their own home. Metaverses are effective for the educational process. You can attend lectures of the world's best universities arrange training in a safe environment. It is also a

new opportunity for the world of entertainment. The prototype is the game Fortnite, which was released in 2017. Inside the game, gamers could go to Ariana Grande or Travis Scott concerts together.

Since the metaverse is just beginning to be implemented by some organizations, there is no general, global or universal definition for it. This is a space that will make heavy use of block chain technology, crypto currencies, and non-financial tokens (NFTs) to enable individual ownership and the creation of economies, markets, and online businesses more quickly, securely, and even privately and anonymously if needed.

The open metaverse guarantees or will guarantee the use of free and open technologies to the maximum extent possible, in both hardware and software.

The Open Metaverse Interoperability Group focuses on connecting virtual worlds through the development and promotion of identification protocols, social graphics and inventory. The membership is made up of companies and individuals working towards the common goal of creating a community of artists, creators, developers and other innovators to discuss and explore concepts related to the design and development of virtual worlds. Among its core values are research-based collaboration, confidentiality and accessibility.

150 leading companies in the industry are developing cutting-edge, free interaction standards for 3D graphics, augmented and virtual reality, parallel programming, accelerated machine vision, and machine learning. The project aims to provide a free and open source API and drivers for immersive technologies such as head-mounted displays with built-in head tracking.

The developer supports a wide range of devices such as Oculus Rift, HTC Vive, Sony PSVR and Deepoon E2. It also supports Android generic controller and external sensor data controller, allowing you to use your own sensor called "Fusion" and its features.

The project comes from Outlier Ventures and mainly consists of providing a common open source operating system for the Metaverse. It is an open and

shared operating system based on the success of decentralized protocols, specifically De Fi and NFTs (Non Fungible Tokens), which emerge from what they call the Web 3.0 stack. The Metaverse needs its own economy and its own currency where it can be earned, spent, borrowed, borrowed or invested interchangeably in a physical or virtual sense. It is so inclusive and easy to use that it allows as many people from the old economy as possible to be involved.

METAVERSE HARDWARE

One of the most important elements of the metaverse is the entry hardware. These are glasses, a helmet and lenses of virtual reality. Wireless devices have the greatest potential, in which the hardware is located right in the device case. An example of such a device is the Oculus Quest 2. But it is quite bulky, sometimes hot, makes you sweat in especially stressful moments and does not have enough power. AR requires separate devices.

It is important to have a device in the form of ordinary glasses. It allows you to interact with the entire spectrum of Extended Reality. There are also brain-computer interfaces. They can supplant goggles with helmets. Avatar is another genre of technology. To create a three-dimensional avatar that repeats the gestures and facial expressions of the developer, you will have to use the technologies of 3D scanning of objects and Motion Capture, which is actively used in the creation of films and games.

You can create a model of your own face with the Live Link Face app and export to Unreal Engine, or you can create your own avatar with the n3D app. You can also freely buy the whole Rokoko Smartsuit Pro for motion capture. In the future, suits with smart threads will appear that can transfer our behavior to the virtual space online and track the state of the body. Like fitness trackers, only for the whole body.

Another important possibility of costumes for the metaverse lies in sensory, that is, the ability to perceive all physical influences in virtual reality, to feel

virtual objects as if they were real. This will take the virtual experience to another level. There are projects of such suits one of them is Teslasuit DK1. To enjoy virtual reality devices, the virtual reality itself must be of very high quality. This requires game engines and tools and technologies for working with graphics. This includes Unity with Unreal Engine for creating virtual space, and 3ds Max, Maya, Cinema 4D, Houdini and Blender for creating three-dimensional graphics, Cesium also provides opportunities for visualizing spatial data. It also includes tools for 3D scanning of objects and motion capture.

Epic Games also has Quixel and Twinmotion for 3D scans. Artificial intelligence 3D ML, GANs, variational auto-encoders also play an important role. Tensor processing technologies can help create a virtual reality that will be better than real reality.

When the metaverse is created, it needs to be filled with something. Initially, it will have landscapes, buildings, cities and even planets. At the same time, users should be able to build buildings, create interiors, artifacts and other content. Users will create businesses, art, buildings, entertainment facilities, or even entire worlds. We need custom 3D editors to create content right inside the metaverse. There are such editors in Fortnite and Decentraland. And we also need interface platforms for content providers to watch movies in a virtual cinema or for virtual store owners to quickly and easily add new products to their windows. In order for the virtual universe to be a place where users will spend time, buy goods and services, or provide them, make deals, work and earn money, donate, sell, open a business, an economic component is needed.

Financial transactions must be fast, cashless and secure. An important role is played by the ability to always have some kind of confirmation that the user's avatar's clothes are not stolen, so that fraudsters cannot change this. The solution is block chain. NFTs or non-fungible tokens will be a tool to prove the ownership of something, as well as to earn money by creating something and exchang-

ing values. Block chain and smart contracts act as a guarantee that each transaction is legitimate and will not be changed or deleted.

The basis for the metaverse is the network and hardware infrastructure. The virtual space must be available at any time, with no limit on the number of users. All events should be synchronized for everyone and at the same time everything should work as quickly as possible. It is necessary to use a decentralized network. Quantum computers can play an important role.

The role of artificial intelligence is also great. In the metaverse, its role is significant starting from the design and development stages: automatic generation of virtual objects and NPCs, voice command recognition and speech generation, tracking of the position of hands and body in space, biometric identification of the helmet user, code generation.

The question of multiplatform remains important. The Metaverse should be a single space for various games, online banks, cinemas and other platforms, venues and systems from various manufacturers. Metaverses are capable of becoming an evolution of online communications in general. Their appearance leads to the development in such areas as digital art, XR technologies, artificial intelligence and 3D ML, in particular, game engines, motion capture, e-commerce.

METAVERSE INFRASTRUCTURE: TRACKERS

Without a torrent it is impossible to imagine life in digital format. The popularity of the application among users is due to the fact that everyone can download any game, movie, book and program they like. There is no need to be tied to the purchase of a licensed product, for which it is not always possible to pay the specified amount. For this, a torrent is used as a special program or a whole site that allows you to download the necessary content for free. Even aspiring actors and singers use these sites to make their identity known online. Often, copyright content is collected in a separate section. From the user's point of

view, torrents are also very convenient: they allow you to quickly download even large files, and searching for the desired content does not take much time.

International companies use torrents to distribute game clients, demo materials or advertisements, training videos and technical documentation. Torrent, as a special service, is an intermediary for providing an information exchange channel between users on the network. For this purpose, a peer-to-peer protocol is used. For example, a data file that does not need to be uploaded to the server is transferred directly to another user who requests it.

The latter can also transfer other files to third users. This is how an information exchange network is formed. With the help of a torrent, you can download digital products, ranging from movies and TV shows to games and programs, from copyright projects to activation keys. Each torrent site operates with the support of a special server (tracker) and a special program responsible for transmitting and receiving files. There are a huge number of sites that combine both multidirectional collections of files (movies, music, games and programs) and specialized ones (for example, only music or only TV shows). Sites are classified into: open sites - any user can download and distribute content, registration is not required; closed - downloading and distribution are available only after registration; private - you can join the community only by invitation.

Zooqle presents an open torrent tracker without registration to find and download anything you want. The database is updated daily, new distributions appear, and the user audience is expanding.

The database contains about 37 thousand films and 600 series, as well as a complete collection of games and software. The interface is distinguished by unobtrusiveness and modest functionality, but it is quite enough for the user to feel comfortable searching for the target content.

The LostFilm.TV torrent was created for downloading TV shows and presents its users with a huge base of entertainment content. Any series, even the oldest, you can find and download in full for home viewing. New items appear

every day, after the official release you can immediately download on the site. Full functionality is available only to registered users, but the procedure takes a few minutes.

Why is it profitable to use torrents? Using torrents, you can always download any file from the Internet, and it's completely free, and there is no need to spend money on buying licensed products from developers.

Of the advantages of the service, it should be noted: downloading files 24/7, without restrictions; high download speed; you can receive files and in return share them with others who need them; an equal system of interaction; there is no need to register, although this rule does not apply to all sites; all files are free. You can be among the first to get access to new movies, games, TV shows in high quality.

Despite the worldwide popularity of torrents, these sites are not always the best and right solution when it comes to finding and downloading target files. When using the service, it is important to take into account its potential risks, namely, when downloading a torrent, megabytes of information are always consumed so it is important to have a fast and high-quality Internet connection. For users with a slow network, this can cause a lot of problems. It is not always possible to find the files you need, even though the site has an extensive collection.

Using a torrent does not guarantee that the file will be accessible or genuine. Avoid suspicious and obscure sites. Although the developers assure users to check files for viruses, there is still a risk that a spyware or an elusive virus will be inside. Therefore, you need to use only proven torrent trackers, but even in this case, an antivirus must be installed on the device, which will check all downloaded content for malicious software.

The included VPN service, which hides the real address acts as a useful and necessary assistant when using the torrent site. This is the protection of confidential user data from Internet providers and surveillance by third parties; by-

passing regional blocking and restrictions. Even if the torrent site itself is not available, a VPN quickly resolves this issue and opens access to it.

Some resources can be called universal for downloading movies, games, series, books and programs. Others specialize in a narrow profile, where you can find complete collections of songs from various artists, films from different genres and eras.

AUGMENTED AND VIRTUAL REALITY IN GAMES

3D technologies, AR and VR devices, and sound systems play an integral role in the virtual gaming industry. Against the background of the development of the metaverse, these technologies demonstrate exponential growth, which underlines their value and relevance to the modern market. Virtual reality games are gaining popularity. Augmented Reality (AR) has the same potential as virtual reality. These technologies provide the full effect of presence. Augmented reality allows gamers to feel in the thick of things, regardless of the genre of the game. Both technologies are quite similar as they create a realistic alternate reality experience. But if VR provides a complete immersion in the virtual world, then AR, as its name implies, adds virtual layers directly to the physical reality. One has only to download an AR game to a phone with an Android or IOS system and the landscape around will completely change.

AR is a technology with which new three-dimensional elements are added to the surrounding reality with which you can interact. There is a limitless field for imagination and variety of gameplay. You can catch monsters or look for rare artifacts in your own room or on the street.

AR is a digital layer on top of the physical world that is expressed in computer graphics and that can be interacted with in real time. And the interface is a portable device or a special headset. An augmented reality game scenario can be quite primitive. For example, the user sees one virtual item in the environment.

The gameplay can be complicated. For example, in augmented reality shooters, the user is the main character interacting with elements and complex layers on top of the physical environment. Shooter (Shooter, English Shooter "shooter") is a genre of computer games. The player is in 3D space and has some freedom of movement. The levels are a limited labyrinth containing enemies, allies, and neutral NPCs. Most shooters take place in anisotropic space (rooms have obvious floors and ceilings, gravity acts in them), although there are exceptions in which space is isotropic.

The game play of the canonical shooter comes down to finding a way out of the level, with the elimination of all obstructing enemies and obstacles (search for keys to closed doors, remote opening of the passage using controls remote from the door itself). In the extended genre, additional goals are set, such as planting a bomb on an enemy fortification, solving puzzles within the allotted time. Sometimes the destruction of enemies in its purest form is a pointless exercise. It is necessary to complete a certain task and thereby activate a certain game trigger in order to go further.

The second factor is linearity. This is a property of a particular level, not the game as a whole. Linear levels are called levels that are passed in one possible direction. The task for the player is only the battle itself (in the canonical shooter) or the combat mission. Non-linear levels can be completed in many different ways. a large number of rooms are available for visiting at random. The player is required not only to explore the level in order to find their bearings in it, but also to determine the most tactically advantageous route for themselves. Some rooms in non-linear levels are optional for clearing. For example, the canonical, and at the same time consisting mainly of non-linear levels, Wolfenstein 3D shooter had about half of the rooms in the labyrinths, the cleaning of which did not bring anything but a small amount of cartridges and bonus points. In Doom, such premises were also often encountered, which did not bring much

benefit to the player, but were taken into account when calculating the percentage of monsters killed and items collected, even if of little value.

Since most of the levels of one shooter are made by one group of authors in the same style (exceptions can be, for example, collective mods), the terms "linear shooter" and "non-linear shooter" are correct in most cases. "Non-linearity" in many cases is just a publicity stunt, a false statement by the developers. Also, individual games are so loaded with puzzles that, despite the formal linearity (the general order of bypassing the premises is hard-coded by scripts), navigation and solving puzzles make up such a large share of the gameplay that it is still impossible to call the process linear.

The examples given are from the first-person shooter subgenre. In the future, the category of third-person shooters also “budded off” from it. In the first case, the player observes what is happening "from the eyes" and can leave the character's body only at the time of in-game cut scenes. The authors use this method to force the player to associate themselves with the hero (this remark applies to all first-person games). Accordingly, when playing from a third person, the player sees the back of the character in front of him and controls him as a separate hero.

Shooters are single-player and multiplayer players cooperatively play the game, similar to single-player mode, or compete with each other in special levels. While non-linearity has gone out of fashion among single-player games at the moment, multiplayer shooters always offer levels that have multiple passes between player spawn areas, spawns, and a more complex graph of connections between rooms. Maps for modern multiplayer games offer the player large open spaces which allows you to bring together a large number of infantry and a variety of military equipment in one battle. In multiplayer mode, where tactics and deception are essential to victory, linearity is unacceptable.

As already mentioned, the player has to destroy a large number of enemies. The developer gives the character different weapons, provides him with gadgets, or endows him with fantastic powers.

Methods distinguish between the way they interact with enemies, traps, or vehicles. In the center of the screen in the shooter, a sight is depicted, which looks like a simple dot to a massive sophisticated pattern. There are shooters in which there is no sight, and aiming is done using the front sight of the weapon. The player aims at the enemy and presses the attack key. Depending on the player's accuracy, spread, and effectiveness of the weapon, the enemy may be wounded, killed, or untouched. Sometimes wounds affect the further ability of the enemy to perform certain actions. For firearms, you need to pick up ammunition. They fall out of the killed enemy and appear in his place.

Some weapons need to be reloaded. For example, real samples. They fire projectiles that are loaded from a weapon magazine. The canonical shooter has a health bar. This is a small indicator on the screen that displays the total number of lives a character has and how many of them are left. After all the number of lives the hero dies with the ability to be reborn at a certain point and time in the game space, usually at the beginning of the level. Or, in more modern shooters, load a manually or automatically saved game.

You can restore health with the help of special first-aid kits, which can take on various forms depending on the developer's imagination. Many newer games use a health system that does not have direct indicators. The character can receive injuries, which, if serious, will be displayed by various effects on the screen. For these wounds to heal, the player must sit out in a safe place. Sometimes the ability to heal wounds in a foreseeable time is not available at all.

Modern games, regardless of the linearity of the levels, try to offer a variety of gameplay so many shooters have controlled vehicles. Usually, it is a military jeep, tank, boat or helicopter. Vehicle control is carried out in a simplified form, and the camera is located behind the vehicle, even in first-person

shooters. Therefore, only the view from the steering wheel is used. Similarly, most online shooters allow you to choose a convenient camera view, or the game changes the view for different types of weapons on its own.

Shooters are more sensitive than other genres to the graphics performance of the system, to the number of frames per second. For a comfortable first-person shooter game, at least 30 frames per second its required. Aiming and shooting in modern computer games is carried out with a computer mouse. Since the mouse rotation speed is limited on the engine, this encourages you to simultaneously press the rotation keys for faster aiming. In many modern games, keyboard hover is almost impossible to use even if it can be enabled in the settings. There are two opposite ways to hover vertically with the mouse.

In one, formed by flight simulators, moving the mouse away from you moves the sight down, in the other, adopted as a standard, the same movement moves the sight up. There are rare alternative control systems, in particular, virtual reality helmets. To move around the level in any shooter, a keyboard is used, where it is customary to use letters rather than arrows to indicate the direction of movement, which frees the right hand for accurate fire from the mouse. Using the mouse to move forward and backward smoothly is sometimes helpful.

Although third-person shooters have been on game consoles for a long time, first-person shooters are traditionally considered a genre, as the keyboard + mouse control scheme is best suited for this genre. However, there are first-person shooters for video game consoles. In these games, the controls are created taking into account the fact that the player uses a gamepad, with appropriate gameplay simplifications (up to auto-targeting). In console shooters, analog levers and sticks are used to indicate the direction, and the corresponding keys are responsible for attacking and reloading. On top of this, specialized light guns are created, similar to devices for arcade machines, which can be used on home video game consoles. Most often, the production of such devices is associated with specific series of games, which limits their use. Potentially, the control of such

devices can be no worse or even better than the classic "keyboard + mouse". At the moment, the potential is clearly not fully disclosed and console shooters have not yet got rid of the remnant of the arcade.

With the development of technology, computer games began to use the most realistic graphics, including shooters. The concept of esports is directly related to the multiplayer mode of the game, as a way to compete face to face.

Despite the increasing realism in games, in most modern first-person shooters the player character is partially invisible. This means that when trying to look down, the player sees the ground under their feet, and not the body of their hero, while the hands with weapons are still visible. The unwillingness of the developer to create a full-fledged three-dimensional model of the hero can be explained by the lack of need and the excessive cost of resources.

Third-person cut scenes typically use a different model than what the player sees in first-person. This is done because modern games use less polygonal models and less crisp textures to display characters from the side. In addition, such a feature that is useless in the gameplay requires additional development so that errors do not occur, such as the ability to see through oneself.

In many first-person shooters, the player can look at their character in a reflection (most often in a mirror). In modern games, more advanced technologies are used, without unnecessary hassle, allowing you to reflect the world from any angle on any surface and with varying degrees of illumination. First person shooters include rail shooters and bloody shooters. The essence of both is to non-stop destruction of opponents, and in terms of gameplay they are close to a full-fledged first-person shooter, taking into account some limitations.[

Rail shooters appeared on arcade machines and were later ported to video game consoles. The player does not have to move around the level on his own, he only needs to shoot accurately, reload in time and hide behind cover. As soon as a certain portion of the enemies is destroyed, the camera itself will overcome the path to the next shelter, where the player must again shoot a certain number

of enemies. In connection with such game mechanics, rail shooters are also called a virtual shooting range. Quite often, games in this category not only allow, but imply co-op.

Bloody shooters got their name based on the gameplay. Its essence is closer to the usual shooter. Its essence is closer to the usual shooter. The character moves freely through the game levels and destroys monsters the number of these monsters is several times larger than the standard one. The developer releases hordes of enemies at the player, who, without hiding at all, try to crush them with numbers and firepower. Each kill is accompanied by the dismemberment of monsters and a lot of blood. Games of this genre are direct descendants of the first shooters that abandoned the plot in favor of delivering pure pleasure. Therefore, the main task of the creator of a bloody shooter is to provide the greatest possible variety of opponents and weapons.

In third-person shooters, the game camera abstracts the player from the character, forcing them to look at events from the side. This allows you to change the angle of the narrative and show scenes that a first-person shooter character would not be able to see. From a game point of view, a free camera covers more space around the hero, partially opening up a view of what is happening behind him. This is especially true for those shooters where the player watches the character from an isometric perspective. However, in this case the camera is rigidly attached to a certain plane of movement, within which it changes its position.

In a more familiar representative of the third-person shooter genre, the player follows the hero, watching him from the back, and the game camera freely, depending on the game situation, changes its position, limited by the sphere of movement around the character. Such an implementation imposes a number of problems and responsibilities on developers. Such a camera, while rotating, can go beyond the boundaries of the visible game world and show it from an unsightly and unacceptable side for the player, or, depending on the im-

plementation technology, get stuck in the level geometry, causing the game to freeze and crash. To avoid these problems, developers follow one of two directions: they either work on the intelligence of the game camera, or create a rigid frame along which it will move.

In the case of a frame, the player can watch the hero from different corners of the room, as with the help of surveillance cameras, or the screen position will change along a pre-built trajectory. The camera will be centered on the character. Quite a few games belong to the third person shooter genre alone. Most often, the shooter is one of the game elements, and the game itself belongs to the action genre. In all mixed genre games, shooting is a minor and optional element, the use of which can be avoided by using some other game feature.

Shooters offer players the ability to kill in-game characters, often human, sometimes turning into a necessity. This situation provokes criticism from the society. The speeches of concerned citizens and human rights activists are especially aggravated in connection with the increasing cases of massacres of pupils and students in their educational institutions with the help of firearms. Researchers tend to blame the games for this unreasonable violence. There is a risk that a player who is used to the violence in the game will become more loyal to deviant behavior in reality.

Virtual games blur the line between the physical and digital worlds. As a result, the user feels the full effect of immersion. There are special headsets, such as Google Glass glasses. They allow you to see the world around you with an overlay of digital elements.

Most AR games only require a mobile device. Playing on a smartphone is easy. Once installed, the AR game uses the device's camera, clock, GPS, and gyroscope to collect environmental data. The camera captures the space and it is analyzed using computer vision. GPS and gyroscope in turn determine the geographic location. The clock ties everything together, allowing the software to understand exactly what events are happening at the moment. All information is

processed and physical reality is augmented with digital animation. The result is visible on the phone screen.

The application works quickly, and wherever you point your smartphone's camera, virtual objects are visible almost without delay.

Augmented reality is used in military technology, in medical equipment, in educational printing materials and in art. There are augmented reality guides to museums and exhibitions. Augmented reality is used in marketing campaigns. This led to the gaming industry's first major breakthrough in augmented reality. Pokémon Go was released in 2016. It has been downloaded over a billion times and has revolutionized gaming.

The success of Pokémon Go was a turning point for augmented reality games, proving that the possibilities of this technology are endless. The proceeds from this project exceeded $3 billion, which remains a world record. The reason for the stagnation can be attributed to the fact that games are limited to mobile devices. An augmented reality product for amusement park rides has been created. Park visitors can use their smartphone to view animated projections while inside the attraction. A virtual world is created around, which makes riding, for example, a roller coaster, exciting.

Although virtual reality technology needs to be refined, it offers a greater degree of immersion than augmented reality. A VR headset completely blocks the perception of the physical environment and replaces it with a computer environment, which is not possible using augmented reality technology.

Full immersion in virtual reality, requiring mechanical manipulators in the form of a keyboard and mouse, is simply impossible. We need a neuronal interface. So far, the team from Boston has shown the best result in the development of digital telekinesis. At the same time, the communication speed increased.

DIGITAL COMICS

A pioneer in this area is Marvel, which in 1996 launched the Marvel CyberComics division. ISP AOL - the service was created as part of a promotional deal with the provider. In the mid-90s of the twentieth century, the provider gave its users access to the USENET computer network. A five-year agreement was signed with Microsoft and the provider's services began to be bundled with Windows. In 1997, the publishing house had its own site, MarvelOnline.com, where the comics moved, becoming available to all registered users. In 1999, a mutual cooperation agreement was signed between Marvel and the newly opened online comic book store.

Marvel chose Spider-Man and Wolverine as the first characters for their first digital comics. In the future, there were stories about Daredevil, Blade, Deadpool, Gambit and the X-Men. Issues were divided into four parts of eight pages, each part was published monthly.

They were drawn on paper then digitized, painted using Adobe Illustrator, then simple animation and musical effects were screwed in Macromedia Shockwave. The process was very labor intensive. The result was such animated comics. At the click of a mouse, new dialogue bubbles and panels appeared, with sound accompaniment.

Publishers closely followed the success of Marvel, and when it became clear that digital comics had a serious format, they stepped up.

Other publishers, like Marvel, did not have a paid subscription. Users simply bought each comic individually. Two years later, the publisher's comics became available on the three largest digital book sites: Kindle Store, I Bookstore and NOOK Store. DC also launched its own readdc.com platform. Dark Horse began releasing its comics digitally in 2011 on Windows, Mac, I OS, and Android.

Image became the first publisher to sell DRM-free, unprotected digital versions of their comics. After the purchase, the user could download the comic

in any format: PDF, EPUB, CBR or CBZ. Image also supplied the digital versions with a five-page preview.

In 2012, the Infinite Comics imprint was opened at Marvel, within which original comics specially created for digital format with animation are released. Animated panels and pop-up bubbles with text are used. A service for comic book fans was created. They could track the release of the comics. And also, make pre-orders in local comics hops. There was also brief information about each issue (release date, artist and screenwriter) and news, blogs, interviews. In December 2008, the Pull List mobile application appeared.

In July 2009, the Comics by Comi Xology app for Apple devices was released, one of the first to support Apple's new in-app purchase system. At the time of launch, there were already 20 publishers in the library of the service; This gave a significant competitive advantage and the new service quickly gained popularity; ComiXology integrates with Marvel; In April 2010, the first I Pad was released, which was convenient for reading comics; In the summer of 2010, the library was replenished with comics from DC.

ComiXology has established itself as a leader. After a short time, the application became available for Android and Windows. ComiXology became the third most popular iPad app. In 2014, the company was bought by Amazon. In 2016, the company launched comiXology Unlimited, a monthly subscription service with access to a huge library of comics (excluding Marvel and DC).

A safe and effective growth path for digital comics lies in the digital-first segment. From the very beginning, they were aimed at those who do not read comics or are familiar with them very superficially. Just for them, the digital format is a solid plus. No need to go anywhere, choose something, suffer with parcels. As a qualitative feature, it stands out that web comics are created or developed taking into account the specifics inherent in this form of publication. Many comics may have the formal hallmark of a web comic but not the quality, and vice versa, making them difficult to classify. Many web comics are pub-

lished exclusively online, although some are printed, but have an online archive for commercial or artistic use.

Web comics are similar to self-publishing. Almost anyone can create their web comic and publish it online. Web comics have certain traits that distinguish them from other cartoon stories. The vast majority of web comics have one or more of these. Web comics are published by authors on their own websites, or on websites that provide suitable services for free. While a paper comic needs to be bought (and read anyway), a web comic needs to keep the reader's attention for as long as it is published (especially if the author is making money from site traffic). This is most often achieved using a few basic techniques:

Each new issue of a web comic is usually done in such a way that it is interesting to the reader in isolation from the previous ones, because the reader usually gets acquainted with the web comic exactly from the end. At the same time, the release of new series should not stop as long as the author hopes to get a return on it. If new issues of a web comic are posted on a specific schedule, this provides its website with more consistent traffic. The most commonly used schedules are once a day, three times a week, and once a week. Even if a comic artist does not adhere to a strict schedule, he usually tries to post new issues often enough and with a more or less even frequency.

Most successful web comics address topics that are understandable to a very wide range of readers. Web comics are created directly on the computer. This allows them to use tricks that are impossible in regular comics. You can create infinite (looped) releases. Web comics can include elements of animation (from blinking eyes of characters to small cartoons embedded in separate frames) and sound accompaniment. They have an interactivity feature. Strip technology is used. It is a tape of 2-4 frames lined up in a row. Usually frames are arranged horizontally, but can also be in the form of a vertical strip or square. They are often printed in magazines and newspapers. The theme of strip-comics is diverse. It can be comic strips, or sharply social strips.

The strip allows the author to clearly express his thought. This is the complete freedom of the author. Comics that are posted on the Internet may be obscene, contain scenes of violence and erotica. This is due to the lack of censorship on the Internet. There are two ways to draw a strip. These are manual and computer methods. The manual method of drawing is practically not used. Strips are drawn in computer graphic editors.

The advantage of manual drawing is greater detail, color depth and volume. Computer strips are simple and pay more attention to the general background and mood. Strips are created using simple editors (for example, Paint) and powerful graphics editors.

Strips on the Internet belong to the category of web comics. Depending on the content, it can be a kind of Internet art and Internet entertainment.

EVENTS IN THE METAVERSE

10.7 million users took part in Fortnite live concerts. The Metaverse could approach the $800 billion mark through live events and advertising. Decentraland land alone - NFT tokens, digital land in the Decentraland Metaverse - and other NFTs generated more than 75,000 sales totaling almost $25 million.

The organizers of the concert industry were among the first to explore the Roblox platform. Examples include the David Guetta DJ Party in early February 2022. The intergalactic concert was accompanied by a light show with lights, holograms, lasers and loud speakers. Fans explored a neon-drenched galaxy covered in crystals. Participated in DJ and dance battles, and also tried to solve a secret puzzle, using special abilities, in activities, watching a show with special light effects. At the center of the world on the podium, David Guetta performed as his avatar, a realistic 3D model that mimics the artist's movements. For domestic currency, you could buy a hairstyle for an avatar, like a musician, and a virtual model of a DJ.

The annual Electric Daisy Carnival (EDC) is one of the world's largest electronic dance music events, taking place in Las Vegas, Nevada. So that fans around the world can participate and not just watch the broadcast, the organizers created a world on Roblox as an additional activity.

Like the real festival, the world includes four stages where live performances took place. DJ avatars stood behind the consoles, imitating DJs. On the dance floor were tracks that played in real time at the festival. Each user could purchase branded merchandise or an event accessory for their avatar using the local currency Kandi. At the beginning of the game, each player received a pet. It could be exchanged in the Insomniac in-game store, unlocking over 20 pets by participating in activities. In addition to visiting the concert areas, players could compete against the clock against other players at the Shuffle Showdown booths. At Camp EDC, you could set up your own tent and choose where to pitch it. New styles of tents were purchased for Kandy in any Insomniac store on the map. Go-Kart Racing was located in the Wasteland and included a three lap race for the competitor and up to 11 other players. It was launched every 15 minutes, as soon as the required number of participants was recruited. Other areas of activity and networking were also envisaged.

In early October 2021, Paris Hilton launched Paris World, where attendees could immerse themselves in the diva's pink world with private jets, a zoo full of animals, an unrealistically beautiful mansion, a huge concert stage for VIP guests. You could go to the Dash Radio studio, where Hilton communicates with celebrities, even be a guest star, whom Paris talks to on the air. Also, players could buy clothes with Robux or with in-game diamonds that can be collected on the map. Paris World has been updated daily with new celebrities.

Previously closed events published post-releases, invited celebrities and bloggers, broadcast to expand the audience. With the Metaverse, it became possible to maximize attention while maintaining the status of an elite event. Addi-

tional interactive brand merch will remain with users forever, which will help promote the brand after the event.

In May 2021, Gucci hosted a two-week Gucci Garden Archetypes event. Gamers could explore fashion designer Alessandro Michele's key advertising campaigns for Gucci and purchase rare virtual collectibles for their avatars as part of an interactive exhibit the fashion house hosted at Roblox. The Metaverse was a digital replica of the real Gucci Garden exhibition held in Florence to celebrate the brand's 100th anniversary.

The space included seven rooms. A plant-filled room was devoted to Gucci Bloom perfume, while the remaining six rooms talked about inspirations and visual references to the various collections created by Alessandro Michele, the brand's creative director, since 2015.

His first AW15 collection, Urban Romanticism, has been immortalized in a virtual subway car. Another room with a large pool in the center was dedicated to last year's cruise collection.

Upon entering the Gucci Garden, patrons shed their avatars, becoming genderless and ageless neutral mannequins. It symbolized that the journey through life begins as a blank canvas. Wandering through different halls, the mannequins of visitors absorbed the elements of the exposition. By visiting the rooms in a different order and preserving different fragments of spaces, they appeared at the end of the journey as one-of-a-kind creations, reflecting the idea of people as one of many, but completely unique.

In addition to traveling around the exhibition, users bought virtual branded clothing and accessories. Payment was made for the internal currency, robux, which can only be earned by participating in activities within the world.

The Fashion Awards, established by the British Fashion Council (BFC), took place in the Roblox metaverse in November 2021. For the broadcast, a red carpet was created that resembled the real one in London's Albert Hall. Users were able to walk along it with well-known figures in the fashion industry, study

the profiles of the nominees, watch the broadcast of the awards and try on virtual outfits. The council, together with Roblox and the Gucci brand, announced a new nomination in the field of virtual fashion Fashion Award for Metaverse Design. The first prize in this category went to the designer who created clothes for Roblox characters. Now this nomination will be an integral part of subsequent ceremonies.

On December 8, 2021, Ralph Lauren launched The Winter Escape, a virtual immersive project. Inside is a winter resort with a variety of entertainment. If the player dreamed of visiting the fabulous Alps, then he had such an opportunity. If the player dreamed of visiting the fabulous Alps, then he had such an opportunity. The user was able to ride a snowboard, cut the ice on skates, warm up by the fire with a cup of tea and marshmallows. And as he explored this heavenly winter camp, he opened doors to the world of Ralph Lauren. Every mod gamer's dream!

Hyundai Motor Company announced the opening of the Hyundai Mobility Adventure space in the Roblox metaverse in September 2021 and presented five themed zones: Festival Square, where the central base camp for players is located, where they return after exploring the world around them and where they can take part in festivals, celebrations and car demonstrations, while interacting with other users.

The Mobility City of the Future features a cutting-edge metropolis where players can experience Hyundai Motor's future mobility solutions and hydrogen fuel cell technology. The Smart Technology Center appears as a platform for future technology research, where users can feel like real engineers and designers.

Participants can move freely between the five zones, learn about Hyundai Motor's mobility products and solutions, play games and perform various tasks as designated professionals. You can drive the NEXO and IONIQ 5 cars, control the robot, specialized cars and city air vehicle. The player can customize their

personal avatar, upgrade their personal garage, and participate in a variety of social events while immersing themselves in the metaverse's vast virtual world.

In mid-October 2021, NIKE launched the Nikeland Signature Playground in the Roblox Metaverse. The virtual replica of the company's headquarters, which is physically located in Beaverton, Oregon, includes stadiums and sports fields where users can compete against each other to earn points. These points can be spent on customizing your avatar with branded items from NIKE. In the Nikeland virtual world, users can create their own sports mini-games.

There are several mini-games that are player-controlled and do not have game modes tied to them. Swimming is not a game mode, but if players want to have a swimming competition, they will have to launch it themselves. Other mini-games include running track, obstacles and racing. Nikeland has implemented a feature for mobile users to use accelerometers to detect movements. If players jump, their Roblox avatar will also jump.

Players are provided with the tools and space to build their own obstacle course. Nikeland has a building mechanic. It can be used in the player's own yard, on a piece of land that he can use for construction.

Basketball hoops, sports equipment and a punching bag can be bought in the lobby and placed in the courtyard. Receive virtual clothing from the Air Force 1, Nike Blazer, ACG and Nike Tech Pack series, including fresh Air Force 1 Fontanka and Air Max 2021 drops. Transmit your real movements into the game using smartphones and fitness bands. Virtual visits to global sporting events in VR mode will become possible.

PROGRAMMABLE AVATAR WORLD

The avatar reflects the user's online representation. This digital identity differs from person to person and can be static or animated.

Starting with 2D emoji that users could use while talking to each other, avatars have now evolved into 3D and are used as representations. Avatars are

still used by many social media users to replicate themselves online. You can be almost anyone using an avatar. You can shape him according to who you are, customize his hairstyle, clothes and accessories.

The metaverse avatar is based on the same principle as other online avatars. The avatar in the metaverse will be the identity of the user throughout that universe. The big difference is flexibility. While some avatars are limited to only one platform, a metaverse avatar will be able to go through various events throughout the metaverse. The avatar, along with its appearance, will easily be transferred to various virtual worlds. The avatar becomes a digital twin.

You can use digital avatars in posts, stories, and as your profile picture. Avatars also help expand the reach of other areas. These include the ability to add cochlear implants and other hearing aids. In addition, wheelchair avatars will also appear on the social networks of the Meta ecosystem.

Any actions taken by the avatar are directly dependent on the user himself. The Metaverse is based on the principle "User equals Avatar" and cannot exist without it.

While there are many types of avatars in terms of their creation and variety, the metaverse will focus on the following ones. Among them is a virtual avatar. It is used by most VR users. This is the one in which the user sees the virtual environment from the perspective of an avatar. Other VR users will see the avatar as a limited representation of that user. While users will be able to see the entire upper body of the VR avatar, the lower body will be missing due to limited tracking capabilities. This means that the virtual avatar will mimic the user's hand movements, but will not show their lower limbs.

A full-length avatar creates great benefits. Using sensory recognition of the whole body, this avatar reproduces not only the movements of the user's hands, but also the movements of their body. Instead of using the controllers as hands, the user's feet will also be recognized by their headset and can be used. Even though full body avatars are only available in a few VR games, they will

be released for more experiences. Full body avatars require equipment capable of tracking the entire body. It will take additional full body trackers to make it work. There are companies offering avatar maker services. Using them, the user can create a completely personalized avatar that can be used not only to visit applications and games, but also to perform intuitive actions.

MOTION TRACKING

Since for high-quality interaction in the digital world it will be necessary to track movements in the real physical world, the development of tracking technologies will become one of the main priorities.

Tracking is the determination of the location of a moving object or several objects in time using a camera. The algorithm analyzes video frames and outputs the position of moving targets relative to the frame.

The main problem in tracking is to match the positions of the target object on a sequence of frames, especially if the object is moving fast relative to the frame rate. Tracking systems typically use a motion model that describes how the target object's image may change with different motions.

Examples of simple motion models are flat object tracking, motion model. This is a 2D affine transformation of an image of an object, such as the original frame. When the target is a rigid 3D object, the motion model determines the view based on its position in space and orientation. For video compression, key frames are divided into macro blocks. The motion model represents a key frame break, where each macro block is transformed using a motion vector derived from the motion parameters. The image of the deformable object can be covered with a mesh. The movement of an object is determined by the position of the vertices of this grid.

The main task of the tracking algorithm involves sequential analysis of video frames to estimate motion parameters. These parameters characterize the

position of the target object. The system of visual observation (tracking) consists of presenting and localizing the target object and filtering and combining data.

Representing and localizing the target provides a bottom-up sequential process. His subsequent steps do not affect the previous steps. The computational complexity of these algorithms is small. Their tasks include segmentation of the interior of an object, an iterative localization procedure based on maximizing the similarity criterion. Search for the object boundary, registration, tracking of point features of the scene.

Filtering and combining data is a top-down process that involves combining a priori information about the scene or object, related to the dynamics of the object, and calculating various hypotheses. The computational complexity of these algorithms is much higher. They are used for linear functions subject to Gaussian noise. They are useful for sampling the underlying state space of the distribution of non-linear and non-Gaussian processes.

3D DIGITAL TWIN TECHNOLOGY

The practice of doing business and the perception, interaction and analysis of the built world by consumers, is the technology of digital 3D twins. This technology creates a three-dimensional virtual and spatially accurate model of any building or room. This means that enterprises will be able to create exact copies of physical objects, which will then function as separate divisions.

Consumers can use digital twin technology to virtually try on clothes and experience new stores before they open. They can also visualize and see if new furniture will fit before making a home purchase without leaving home.

The digital twin represents a virtual prototype of real production assets (wells, turbines, wind turbines). This software product is created on the basis of a variety of data and with the help of numerous sensors. The digital model helps to change the parameters of the equipment and make improvements much faster and safer than experiments on real objects.

The digital twin allows you to expand the capabilities of cloud analytic services used in the concept of the industrial Internet of things of the fourth industrial revolution. A digital twin is used as a digital model of a particular physical element or process with data connections. It provides convergence between physical and virtual states with the appropriate synchronization speed.

The digital twin of an organization is a model that most accurately describes the cause-and-effect relationships between the production, economic, financial and organizational performance of the company. The tasks include supporting the adoption of optimal management decisions at the stages of planning, monitoring and analysis of both the company as a whole and individual areas of activity (functional blocks, projects, assets).

The use of digital twins of an organization is associated with the management of the economic efficiency of the value chain, the digital transformation program, and the development of assets. Standard-based integrated production and economic planning is used, as well as investment planning, in particular, project portfolio management, innovation and risk management.

The digital twin is used at all stages of the product life cycle, including development, manufacturing and operation. At the stage of preliminary design using a digital twin, it is possible to create variations of the system model of the developed product for evaluation and selection from different versions of technical solutions. At the stage of technical design, the model obtained at the previous stage can be refined and refined using more accurate system models of elements that can be obtained through numerical simulation. Embedded software and control interfaces can be integrated.

The system model allows taking into account and optimizing the interaction of elements, taking into account the operating modes and environmental influences. During the manufacturing phase, the developed system model, which may be referred to as the digital twin of the product, will help determine the required tolerances, manufacturing accuracy to meet the characteristics and trou-

ble-free operation of the product during its service life, and also allow you to quickly identify the causes of failures during the testing process.

When moving to the stage of product operation, the digital twin model can be finalized and used to implement feedback on the development and manufacture of products, diagnostics and prediction of faults, improving work efficiency and recalibration, and identifying new consumer needs.

The development of devices and systems should be carried out taking into account the concept, which affects the construction of enterprise business processes and the creation of new services. One of their most important functions is to improve production processes. Using digital twins, companies can digitally replicate their smart factories, identify bottlenecks in components, systems, processes, and other assets, test potential solutions, model the outcomes of interactions between components, and predict stochastic changes that may occur during operations. Simulation saves organizations the time, resources, and money needed to test working hypotheses in practice.

Digital twins are used in industrial design and product testing. It is not necessary for the manufacturer to assemble an expensive physical sample. He can replace it with a digital twin in the form of an exact 3D copy. It is analyzed, evaluated and tested in accordance with current requirements. The effective use of digital twins is evidenced by the support of products by a qualified specialized service (condition control, monitoring, technical support); long product life cycle; a large number of copies of installed equipment; a wide range and variety of operating conditions; inaccessibility of the product for maintenance.

DIGITAL TWIN OF PRODUCTION

Digital twins of production contain the ability to display the state of the equipment on a 3D model of the shop in real time; additional indication and inscription on the model; displaying the complete kinematics of nodes. In the context of management, they represent a tool for operational control of significant

production indicators and create the possibility of making prompt and balanced management decisions.

For employees of the company, the digital twin provides visualization on the shop floor as a tool for lean manufacturing; reducing the response time of service and repair services; encouraging a competitive spirit; facilitating the maintenance of several machines by one operator; actual service

In the operation of equipment, there are three main strategies for managing its maintenance and repair. This is maintenance by event; scheduled preventive maintenance; actual service.

Event-based maintenance involves the replacement of failed parts upon failure, which increases the cost of repairs and forced downtime during work. Scheduled preventive maintenance involves the replacement of parts at certain time intervals, which are determined by calculating the average time between failures. Service according to the actual condition implies the elimination of equipment failures by interactive assessment of the technical condition of the equipment based on the totality of data coming from its sensors and determining the optimal timing for repair work.

The digital twin allows you to model various complete and partial failures, the operation of devices, taking into account their operating modes, environmental influences and various degrees of wear of parts. Digital twins are changing supply chains. Using strategically unified computing environments and industry 4.0 technologies, the digital supply chain moves assets, people and resources where they are needed. Through the transfer of data through cloud servers and databases, the collection of information in the supply chain improves manufacturing practices.

Manufacturers can stress-test the supply chain. Users can effectively manage stress and measure response by combining stress parameters with response readings. The digital twin can help transform a company's stresses into a quantifiable view of real impacts, such as the impact of supplier delays.

The supply chain digital twin is a digital representation of an organization's actual supply chain. His model uses predictive analytics that collects data from both descriptive and predictive sources to find the best course of action in any scenario before applying it to decision making.

By using prescriptive models that work with real-world data, the supply chain digital twin extends this capability as inputs are entered into the model in real time. When a customer's order is processed, the order and related transactions are automatically transferred to the digital twin. In order to fully reflect the real world, factors affecting the supply chain are taken into account. If production equipment fails or deliveries are delayed, information is sent to the digital twin via sensors. Once the data is matched, the digital twin determines the correct corrective action and supports supply chain optimization.

Equipment performance in the supply chain is critical. Equipment that breaks down regularly has detrimental consequences, especially when downtime must be avoided at all costs.

For service maintenance, it is possible to use 3D modeling of the necessary equipment. It combines machine learning to create a digital twin that is used to monitor hardware performance before running the algorithm in real time. The data obtained from the 3D model, combined with artificial intelligence, is used to maintain the equipment. The implementation of forecasting algorithms allows business leaders to apply forecasting strategies to the supply chain. By detecting failure patterns and anomalies, studying these models, and predicting future failures of equipment components, you can replace equipment before it fails. To optimize performance, the digital twin must reflect any constraints and trade-offs in the physical supply chain.

Modeling and predictive analytics are core components of the supply chain digital twin and should include programming languages that address these issues, such as fifth generation programming languages. This software allows operators to get detailed information about the supply chain, its structure and

formulas to optimize the decision-making process. By applying decision optimization to the model, corrective actions can be identified for customer, staff, and stock placement on any given day.

The idea of a digital twin is not new, but the concept of integrating data and input from the physical world is different. IoT-connected devices are the building blocks of the digital twin, and sensor integration is key to making data accessible. Designing and integrating sensors can be resource and time intensive, and it can be difficult to communicate data that is not technology compatible. A hybrid twin is interpreted as a technological variety of software and hardware solutions of the digital twin class, based on the combination of numerical simulation technologies with machine learning technologies and the use of this data in real time using the Internet of things.

The complex twin is a set of technologies for aggregating, modeling, analyzing, orchestrating and visualizing data, which allows solving the problems of predictive service of assets, product quality, as well as the optimal operation of equipment and the organization of unmanned production. It is the development of a hybrid twin.

The digital twin plays an important role in monitoring the health of the patient, in particular the effects of drugs on the body. Interest in this technology has been unleashed in the medical industry amid COVID-19. For example, startup Exactcure, which is developing a software solution to reduce medication errors, developed a product using digital twins to reduce the impact of incorrectly dosed medications. This technology monitors the effectiveness and interaction of drugs in the patient's body based on personal characteristics such as age, gender and kidney status. In addition, companies are increasingly investing in research and development related to the new changes in daily life due to the COVID-19 pandemic. For example, companies are trying to develop a digital twin solution to identify people who have symptoms of COVID-19 infection or who have recovered with antibodies, as well as people who have been in contact

with an infected person. Also, such solutions can be effectively implemented in smart cities.

Due to COVID-19, industry players are facing many challenges related to health and safety, supply chain, supplier sustainability, labor shortages, and more. These problems can be solved with the use of digital twins, but many companies still do not have a concrete plan for implementing these technologies for product management. They are not investing heavily in this area as they are unsure of the economic benefits and profitability in the near future.

NFT CRYPTO PROJECTS

NFTs (non-fungible tokens) are tied to the block chain as a unique entity. NFTs are used in a wide variety of crypto projects. For example, Decentraland is a virtual world metaverse where NFT land selling is a successful industry. Each entry on the block chain is called a token. In an open block chain, all tokens are equal and fungible. This means that one token can be replaced by another of the same token and nothing will change. But Non Fungible Token technology works differently. Each non-fungible token is unique and cannot be tampered with, shared, or discreetly replaced. Such an organization is ideal for securing your rights to a unique object. NFT technology was created in 2017 based on Ethereum smart contracts.

Non-fungible tokens are being actively introduced into the field of art. DJ 3LAU became the first musician to tokenize his own album and sell it in a limited edition. Singer Grimes, known as the mother of Elon Musk's child, has sold 400 NFT tokens that were linked to four drawings created personally by her and her brother. Non-fungible tokens are used in the gaming industry to confirm ownership of virtual assets, when registering domain names, and in real estate.

Artists who wish to tokenize their work can do so on Rarible or Open Sea. There you can buy your first token tied to the work of another author. Open Sea creates an NFT token only when a buyer has already been found for it. This

saves the author from additional costs in the form of a commission on the Ethereum network. Rarible creates an NFT token immediately upon uploading a work and charges a commission from its author. NFTs could revolutionize copyright control. With the help of tokens, it will become easier to get the rights to broadcast music tracks, and streaming services to buy the rights to show movies and series. Operations with tokens are cheaper, easier and faster than operations with the real objects they are linked to.

CLOUD COMPUTING

The immersive and versatile aspects of the metaverse will constantly require cloud computing to process, store and analyze the data generated by the platforms. A metaverse platform will not succeed if it cannot provide a flawless user experience or if it is difficult to scale.

Cloud computing makes it possible to rent information technology instead of buying it. To invest heavily in databases, software and hardware, companies prefer to access computing resources over the Internet and pay for their use. Cloud solutions include servers, storage, databases, networks, software, analytics and business intelligence.

Cloud computing provides the speed, scalability, and agility to enable businesses to develop, innovate, and support digital business solutions. The transition to cloud computing means that the information infrastructure will not be stored on the company's premises, but in a data center, which is managed by the cloud computing provider. An industry-leading cloud solution provider is responsible for managing the customer's information infrastructure, integrating applications, and developing new features and functionality to meet changing market needs.

Cloud computing provides greater adaptability, scalability and flexibility. Customers can focus on solving more important tasks. Companies can quickly

access the computing resources they need without making a large initial investment and pay for only the resources they need.

There are several trends that are pushing businesses across industries to move to the cloud. For most companies, existing business practices may not be flexible enough to grow the enterprise, or may not provide a competitive platform or the right level of flexibility. Explosive data growth is driving new increases in the cost and complexity of data storage and requires new skills and analytics from professionals.

Cloud solutions optimize costs. They provide instant space for development and testing; elastic scaling; performance; efficiency; reliability. In a public distributed digital space, the computing infrastructure is located at the site of the cloud service provider with the provision of these services to the customer via the Internet. Customers do not need to maintain their own infrastructure and can quickly add users or computing power as needed. In this model, a cloud service provider serves many customers who share its infrastructure.

The private cloud structure is used by only one company. It can be hosted locally or in the cloud provider's data center. It provides the highest level of security and resource control. A hybrid cloud is a combination of public and private clouds. Hybrid cloud customers host mission-critical applications on their own servers for greater security and resource control, while the rest of the applications are hosted by the cloud service provider.

The main difference between a hybrid cloud and a multi-cloud environment is the use of multiple cloud computing and storage resources within a single architecture.

There are three main types of cloud services: software as a service, platform as a service, and infrastructure as a service. The software delivery model assumes that the cloud solution provider hosts the customer's applications. The customer accesses these applications via the Internet. Instead of spending money

to maintain their own computing infrastructure, customers subscribe to a service that is billed based on usage.

The model is ideal for companies as it enables them to get up and running quickly with innovative technologies. Automatic updates reduce the load on internal resources. Customers can scale services to support ever-changing workloads by adding and removing services and features to meet business needs. The cloud solution suite offers a wide range of applications for any business need.

Platform as a Service gives customers access to the development tools they need to build and manage mobile and web applications without investing in infrastructure support. The service provider hosts the infrastructure and middleware components, and the customer accesses these services through a web browser. Services include solutions for analysts, end users, and information technology administrators, including tools for big data analytics, analytics, content management, database management, systems management, and security.

Infrastructure as a Service provides customers with on-demand access to infrastructure services over the Internet. The primary benefit is that the cloud service provider provides remote access to infrastructure components that provide compute, storage, and network bandwidth so that subscribers can run their workloads in the cloud. The cloud service provider subscriber is responsible for installing, configuring, securing and maintaining any software in the native cloud infrastructure, such as database, middleware, and application software.

Customers of cloud computing solutions benefit from the fact that innovations and new technologies are automatically incorporated into their systems, as the cloud service provider takes the job of developing new features and functions. With a trusted cloud solution provider, customers can leverage modern cloud computing architecture to accelerate innovation, increase productivity, and reduce costs. It is best to choose a vendor that offers an integrated cloud architecture that enables you to move from operations to innovation and deliver new applications and services, including technologies such as artificial intelligence,

chat bots, block chain, and the Internet of Things. Companies can use the data for detailed analysis and insight into their own business to better serve customers. The cloud service provider continuously invests in security technologies to help not only respond quickly to potential threats, but also help ensure customer compliance. With an integrated cloud solution, companies can better manage technology projects, evaluate their costs and benefits.

A complete set of cloud applications is structured not as separate, but as interconnected modules, which helps to eliminate data fragmentation and provide an integrated intelligent business decision-making process. Regardless of resource location, understanding the use and consumption of infrastructure resources remains critical as it reflects a company's ability to serve customers, innovate, and reduce operating costs. Consumption refers to the use of a resource. How it will be implemented depends on the service providers.

DATA SCIENCE

The Metaverse will collect a huge amount of data, which it will extract and use almost instantly. While the metaverse is based on a distributed technology such as block chain, it is necessary to ensure that the data received in one part of the metaverse is reflected in the user experience in another part of it. As a result, learning about the next generation of data engineering is becoming a key focus of metaverse technology.

Data science aims to study data in order to extract meaningful information for business. It is an interdisciplinary approach that combines principles and methods from the fields of mathematics, statistics, artificial intelligence and computing to analyze large amounts of data. This analysis helps data scientists ask and answer questions such as what happened, why it happened, what will happen, and what can be done with the results.

Data science is important because it combines tools, methods, and technologies to extract meaning from data. Modern organizations are overloaded

with data; there are many devices that can automatically collect and store information. Online systems and payment portals collect more data in the field of e-commerce, medicine, finance and any other aspect of human life.

Raw data is useless if it cannot be manipulated. Data scientists can transform raw data into meaningful recommendations. They can discover and solve problems that the business didn't even know existed. Organizations can use these recommendations to improve customer satisfaction, optimize their supply chain, or launch new products.

The term "data science" came into use in the 1960s as an alternative name for statistics. In the late 90s of the twentieth century, programmers formalized this term. Data design, collection and analysis began to be associated with it.

Innovations in artificial intelligence and machine learning have made data processing faster and more efficient. Industry demand has created an ecosystem of data science courses, degrees, and positions. Data science is used to study data in four main ways.

Descriptive analysis aims to explore the data in order to get an idea of what happened or what is happening in the data environment. It is characterized by data visualization such as pie charts, bar charts, line graphs, tables, or generated descriptions. Diagnostic analysis involves examining the data in detail to understand why something happened. It is characterized by techniques such as drill down, data discovery, data mining, and correlations. Several data operations and transformations can be performed on a given set of data to discover unique patterns in each of these methods.

Predictive analytics uses statistical data to make accurate predictions about data patterns that may occur in the future. It is characterized by techniques such as machine learning, prediction, pattern matching, and predictive modeling. In each of these methods, computer programs are trained to analyze causal relationships in data.

Prescriptive analytics allows you to not only predict what might happen, but also suggest the optimal response to that outcome. The potential consequences of various choices can be analyzed and the best course of action recommended. The method is based on graph analysis, modeling, complex event processing, neural networks and machine learning recommendation engines.

Data science is changing the way companies operate. Many companies, no matter their size, need a robust data strategy to drive growth and maintain a competitive edge. Data science enables businesses to discover new patterns and relationships that can change the organization.

The analysis will help identify low-cost changes in resource management to maximize the impact on profit margins. Data science will help identify gaps and problems that would otherwise go unnoticed. A deep understanding of purchasing decisions, customer feedback, and business processes can drive innovation in internal operations and external solutions. It is difficult for businesses to respond to changing conditions in real time. This can result in significant losses or business disruption. Data science can help companies predict change and respond optimally to different circumstances.

A business problem usually initiates a data processing process. The data scientist will work with business stakeholders to understand what the business needs. Once a problem is identified, the data scientist can resolve it using the data process. The data may be pre-existing, newly acquired, or a data repository that can be downloaded from the Internet. Data scientists can extract data from internal or external databases, web server logs, social media, or acquire data from trusted third-party sources.

Data cleaning reflects the process of standardizing data according to a given format. It includes handling missing data, correcting data errors, and removing data outliers. This is a change of all date values to a common standard format; correcting spelling errors or extra spaces and mathematical inaccuracies, or removing commas from large numbers.

Data mining involves a preliminary analysis of the data, which is used to plan further data modeling strategies. Data scientists gain an initial understanding of the data using descriptive statistics and data visualization tools. They then explore the data to uncover interesting patterns that can be explored or applied.

Machine learning algorithms are used to get deeper insights, predict outcomes, and determine the best course of action. Machine learning methods such as association, classification, and clustering are applied to the training dataset. The model can be tested on predefined test data to evaluate the accuracy of the results. The data model can be tuned many times to improve results.

Data scientists work with analysts and enterprises to turn data into action. They make charts and graphs to represent trends and forecasts. Summarizing data helps stakeholders understand and effectively implement the results. Data scientists use computing systems to track data processing progress.

Classification involves sorting data into certain groups or categories. Computer programs are trained to identify and sort data. Known datasets are used to build decision-making algorithms by a computer program that quickly processes and classifies the data.

Data scientists use computing systems to track data processing progress. Regression refers to a method of finding a relationship between two unrelated data points. Communication is usually modeled on the basis of a mathematical formula and is presented in the form of a graph or curves. When the value of one data point is known, regression is used to predict another data point.

Clustering refers to a method of grouping closely related data to look for patterns and anomalies. Clustering is different from sorting because data cannot be neatly classified into fixed categories. The data are grouped into the most probable ratios. Using clustering, you can discover new patterns and relationships. The details may vary, but the basic principles of the techniques remain the same. Data scientists work with complex technologies. These are artificial intel-

ligence technologies, machine learning models. The cloud has given data scientists the flexibility and processing power they need for advanced data analysis.

The Internet of Things refers to various devices that can automatically connect to the Internet. These devices collect data for data science initiatives. They generate massive data that can be used for data mining and data extraction.

Quantum computers can perform complex calculations at high speed. Skilled data scientists use them to build complex quantitative algorithms. Data analytics is a subset of data science. Data analytics is mainly related to statistics, mathematics and statistical analysis. Analytics focuses only on data analysis while data science deals with the larger picture of organizational data. The data analyst may spend more time on routine analysis. A data scientist can develop a way to store, process, and analyze data. A data analyst extracts meaning from existing data, while a data scientist creates new methods and tools for processing data for use by analysts.

While data science and business intelligence overlap, the key difference lies in the use of technology in each area. Data scientists interact more closely with data technologies than business analysts. Business analysts bridge the gap between business and information technology. They define business cases, gather information from stakeholders, or test solutions. Data scientists use technology to work with business data. They can write programs, apply machine learning techniques to create models, and develop new algorithms. Data scientists not only understand the problem, but they can create a tool to provide a solution. Business analysts and data scientists collaborate as a team. Business analysts take information from data scientists and use it to tell a story that the broader business can understand.

Data engineers create and maintain systems that allow data scientists to access and interpret data. They work more closely with the underlying technology than a data scientist. The role includes creating data models, building data pipelines, and overseeing extraction, transformation, and loading. Depending on

the configuration and size of the organization, a data engineer may manage associated infrastructure such as big data storage, streaming and processing platforms. Data scientists use data processed by data engineers to build and train predictive models. Data scientists can pass the results to analysts for further decision making.

Machine learning is one of the methods used in data science projects to analyze data automatically. Machine learning engineers specialize in the calculations, algorithms, and coding skills specific to machine learning methods. Data scientists can use machine learning techniques as a tool or work closely with other machine learning engineers to process data.

The data scientist uses methods from many disciplines, including statistics. A data scientist may use a number of different methods, tools, and technologies as part of the data processing process. Depending on the problem, they select the best combinations for faster and more accurate results.

The role of a data scientist and their day-to-day work varies depending on the size and requirements of the organization. While they usually follow the data science process, the details may vary. On larger data science teams, the data scientist may work with other analysts, engineers, machine learning experts, and statisticians to ensure end-to-end compliance with the data process and business goals. In small teams, the data scientist can play multiple roles. Depending on experience, skills and education, they can perform several functions or combine them. In this case, their day-to-day responsibilities may include design, analysis, and machine learning along with core data processing methodologies.

Different types of applications and tools generate data in different formats. Data scientists must clean and prepare data to make it consistent. Data scientists must work with multiple stakeholders and business managers to identify the problem that needs to be solved.

Machine learning tools are not entirely accurate and there may be some uncertainty or bias as a result. This is an imbalance in the training data or the

predicted behavior of the model across different groups, such as age or income. The field of machine learning provides an opportunity to remove biases by detecting them and measuring them in the data and model.

NEURONAL MARKETING

It is not usefulness, rational arguments, but his own subconscious motivations that make the consumer make a choice or make a decision to purchase a product or service. The irrational aspect in human behavior can be understood and used by marketers as a result of attracting scientific knowledge.

With the help of neuronal marketing, specialists are able to identify the cognitive and emotional response to a commercial message or information. With its help, they are able to evaluate which of the several packaging options, which advertising option evokes the most positive emotions.

Experts reveal the degree of perception of information by the buyer. They evaluate how much the musical accompaniment helps or prevents them from focusing on the perception of the advertised product. With the help of high-tech procedures that allow recording the reaction of the human brain, it is possible to track with great accuracy the processes taking place in it without the participation of consciousness in response to a particular commercial product or advertising video. These are the processes responsible for decision-making and emotional reactions, concentration of attention and style of behavior, aesthetic pleasure, short-term and long-term memory.

Neuronal marketing refers to the use of brain imaging technologies to objectively assess the actual reactions of a potential consumer to various marketing material, whether it be visual or auditory advertising, brand or business style. The use of special technologies that allow you to see the processes of the brain is the difference between neuronal marketing and classical marketing, when focus groups of respondents are formed and their participants are asked questions.

The problems of classical marketing prompted marketers to turn to neuroscientists in search of a tool to objectively assess brain responses. As a result, neuronal marketing was formed at the border of the two disciplines.

For the first time, neuronal scanning technology for marketing purposes was used by Professor J. Zaltman in the late 90s. XX. The term "neuronal marketing" was proposed by A. Smeeds in 2002, and the first international conference dedicated to neuronal marketing research was held in 2004. Neuronal marketing is a technology for making recommendations.

With the help of video or eye tracking, specialists understand what the consumer pays attention to and where he looks the longest. This method is used in studies of advertising effectiveness, text perception, use of programs and websites. This is a tool for analyzing advertising images, directing attention when watching video clips, various design elements, including packaging. With an eye tracker, you can create a heat map that uses color to show where and for how long a person has looked.

Another effective method of marketing research is the combination of eye tracking with the demonstration of a virtual 3D environment that simulates store shelves. This allows you to quickly evaluate the attractiveness of the packaging and the efficiency of displaying products on the shelves without creating real prototypes. A study is being conducted that includes poly graphic registration of autonomic reactions, video recording of behavior in the store, eye-tracking and a special type of detailed interview to assess emotional reactions and associations. The decision to buy responds to a specific change in biological indicators.

Eye tracking confirmed that the human face is always the focus of attention. The buyer subconsciously perceives even a schematic image of a face. It is human nature to track the direction of the gaze of the one he is looking at. In interpersonal communication, the direction of the gaze of the interlocutor indicates where to look. Consumer behavior of a person is determined by higher cognitive

functions, which are realized through the activation and interaction of brain systems and zones.

The advantage of neuronal marketing is its ability to accurately identify which of the advertised products, brands, or videos are simply liked, and which are really effective for decision making.

The Metaverse is now also a new way to sell and buy goods: Brands are actively exploring the possibilities of digital channels, as the pandemic has made adjustments and made capturing market share in the Metaverse system relevant. This refers to direct sales within the metaverses. A business model for selling goods to avatars (digital personalities) has been developed that does not require supply chain management. Drop shipping is retailing without stocking. Goods are shipped directly from the warehouse of the manufacturer, dealer or wholesaler. Brands are sold in social or competitive virtual environments such as games or open worlds where consumers present themselves as an avatar. The customer journey starts in the virtual world and ends in the real world. Through an order in the online application, the goods are delivered to the final consumer. This allows brands to enter the market directly, without intermediaries.

In addition to real products, people buy experiences. To this end, companies use game engines (underlying software) to completely reshape and recreate spaces and present them to audiences in new ways.

The Metaverse has created a way to go beyond the usual store, and turn any user scenario into the process of buying a product or service. There are already huge free-to-play open worlds with economies. In them, people spend a lot of time and spend a lot of money on avatars. They buy skins for them - elements of improvement, and this is an additional sales field and a new audience of buyers. The creation of a metaverse will not be worth the investment without organizing access and attracting the required number of users. The digital platform provides a key integration for businesses to link them into a metaverse with real life systems and processes. To do this, you need to connect the

metaverse with real systems and processes. You also need to determine which integration points are needed to synchronize online and offline processes.

The data obtained from the interactive 3D view can help develop marketing and product development strategies. Analyzing where consumers spent their time, what products they purchased most often, and what colors were most popular are just some of the data that can be generated from this integration.

It is important to establish trusting relationships with clients. They must understand that they are buying through the meta version what they want to receive in real life. Digital twins of a product, whether it be a car, a handbag or even a house, must be of high quality. For most brands, the goal is to create a true omni channel experience to serve customers anytime, anywhere, anytime.

It is important to strike a balance between automation and human interaction. Deciding which routine processes can be automated and which require a human touch can affect the customer experience.

The ability of technology to infer the emotional states of customers promises a future of highly personalized and humanized travel. Customer personal data, including length of stay and purchase history, will increasingly be used to drive empathic engagement with brand representatives—humans, chat bots and other channels.

END-TO-END DIGITAL TECHNOLOGIES

These technologies are not associated with any particular product or area of activity, but can be used in many industries, branches and sectors of the economy, for example, in education, medicine, energy, construction, agriculture, mechanical engineering.

End-to-end technologies of the digital economy are big data, neuronal technologies, artificial intelligence, distributed registry systems (block chain), quantum technologies, new production technologies, industrial Internet, robotics, sensors, wireless communications, virtual and augmented reality. Big Data

include web logs, videos, text documents, machine code, and geospatial data. All this is stored in many repositories, sometimes even outside the organization. As a result, corporations can have access to a huge amount of their data and not have the necessary tools to establish relationships between these data and draw meaningful conclusions from them.

Big data brings together techniques and technologies that extract meaning from data at the extreme limit of practicality.

End-to-end digital technologies include neuronal technologies. This is a set of technologies created on the basis of the principles of the functioning of the nervous system. Neuronal technologies consider the brain as a neural network, that is, a collection of interconnected neurons. Neuropharmacology is one of the promising branches of neural technologies. It involves the development of gene and cell therapy, early personalized diagnosis, treatment and prevention of neurodegenerative diseases (senile dementia, Alzheimer's disease), as well as improving mental abilities in healthy people.

Neuronal medic technology involves the development of neuronal prosthetics of organs, including artificial sensory organs, the development of means for rehabilitation using neuronal technologies that help develop a limb that has lost mobility. Neuronal education involves the development of neural interfaces and technologies of virtual and augmented reality in education, the development of educational programs and devices, the creation of devices to enhance memory and analyze the use of brain resources. Neuronal entertainment and sports are focused on the development of brain fitness exercises for the brain, the creation of games using neuronal gadgets, including neurodevelopmental games.

Neuronal assistants are based on the development of natural language understanding technology, the development of deep machine learning (machine learning based on neural networks that help improve algorithms such as speech recognition, computer vision and natural language processing), the creation of

personal electronic assistants (web services or applications, acting as a virtual secretary) and hybrid human-machine intelligence.

Artificial intelligence represents the science and technology of creating intelligent machines, in particular, intelligent computer programs; formation of the properties of intelligent systems to perform creative functions that are traditionally considered the prerogative of man. Artificial intelligence includes a number of algorithms and software systems, the distinctive feature of which is that they can solve some problems in the same way as a person thinking about their solution would do. The main properties of artificial intelligence involve language understanding, learning, and the ability to think and act. It is a complex of related technologies and processes. Among them, text processing in natural language, machine learning, expert systems, virtual agents and recommendation systems. This helps to build a qualitatively new customer experience and interaction process.

The artificial intelligence ecosystem includes a whole range of digital technologies. Block chain is defined as a distributed database in which storage devices are not connected to a common server. This database stores an ever-growing list of ordered records called blocks. Each block contains a timestamp and a link to the previous block. The use of encryption ensures that users can only change the parts of the block chain that they own, in the sense that they have private keys, without which writing to the file is not possible. Encryption guarantees the synchronization of copies of the distributed block chain among users. Block chain technology has security at the database level. The block chain acts as the main common ledger for all bit coin transactions.

Thanks to block chain technology, Bit coin has become the first digital currency that solves the problem of double spending (unlike physical coins or tokens, electronic files can be duplicated and spent twice) without the use of any authority or central server. Security in block chain technology is provided through a decentralized time-stamping server and peer-to-peer network connec-

tions. As a result, a database is formed that is managed autonomously, without a single center. This makes block chains very convenient for event logging (such as medical records) and data operations, identity management, and source authentication. Each person can post information on the Internet, and then other people can access it from anywhere in the world. Block chains allow you to send any value anywhere in the world where the block chain file is available.

But there must be a private key generated by a cryptographic algorithm to only have access to the blocks that the user owns. By providing a private key to someone, the user transfers to that person a sum of money, which is stored in the corresponding section of the block chain. In the case of bit coin, such keys are used to access addresses where certain amounts of currency that are of financial value are stored.

This implements the function of registering the transfer of funds usually this role is performed by banks. Another important function is being implemented: establishing trust relationships and verifying the identity of the identity, because no one can change the block chain without the corresponding keys.

Changes not confirmed by these keys are rejected. Keys (like physical currency) can theoretically be stolen, but protecting a few lines of computer code doesn't cost much. This means that the main functions performed by banks: identity verification (to prevent fraud) and subsequent registration of transactions (after which they become legal) can be performed faster and more accurately by the block chain. Block chain technology offers the opportunity to get rid of intermediaries. It can take on all three important roles traditionally played by the financial services sector: registering transactions, verifying identity, and negotiating contracts.

New production technologies form a complex of design and manufacturing processes at the technological level of customized (individualized) material objects (goods) of varying complexity, the cost of which is comparable to the cost of mass-produced goods. They include new materials; digital design and

modeling, including bionic design; supercomputer engineering; additive and hybrid technologies.

The industrial Internet implies the connection to the Internet of non-household devices, equipment, sensors, sensors, an automated process control system, as well as the integration of these elements with each other, which leads to the formation of new business models when creating goods and services, as well as their delivery to consumers. The key driver for the implementation of the Industrial Internet concept is to increase the efficiency of existing production and technological processes, and to reduce the need for capital expenditures. The released resources of companies form the demand for solutions in the field of industrial Internet. The Internet of Things system involves the links necessary for its functioning: manufacturers of sensors and other devices, software, system integrators, customer organizations and telecom operators.

Robotics deals with the development of automated technical systems. The robot functions as a programmable device capable of interacting with the external environment. Robotics draws on disciplines such as electronics, mechanics, media mechanics, mechatronics, computer science, as well as radio and electrical engineering. Robots the functions of the human senses: sight, hearing, smell, touch and taste. The sense of balance and position of the body in space, as a function of the inner ear, is sometimes considered the sixth sense. The functioning of biological sense organs is based on the principle of neural activity, while the sensitive organs of robots are electrical in nature. Usually, the classes of sensory devices are distinguished by the type of influence to which the given sensor reacts: light, sound, and heat.

The types of sensors built into the robot are determined by the purpose and place of its application. The sensing element of a sensor may be referred to as a sensor. Sensors are used in many sectors of the economy - mining and processing of minerals, industrial production, transport, communications, logistics, construction, agriculture, healthcare, science, being currently an integral part of

technical devices. Sensors with sophisticated signal processing, parameter setting and adjustment options and a standard control system interface are used.

In automated control systems, sensors can act as initiating devices, activating equipment, valves and software. Sensor readings in such systems are recorded on a storage device for monitoring, processing, analysis and output to a display or printer. Sensors are of great importance in robotics, where they act as receptors through which robots and other automatic devices receive information from the environment.

Wireless data transmission bypasses wires or other physical transmission media. Virtual reality simulates both exposure and responses to exposure. To create a convincing complex of sensations of reality, a computer synthesis of the properties and reactions of virtual reality is performed in real time. Virtual reality objects usually behave close to the behavior of similar objects of material reality. The user can influence these objects in accordance with the real laws of physics (gravity, water properties, collision with objects, and reflection). For entertainment purposes, users of virtual worlds are allowed more than is possible in real life (for example: fly and create any objects). Virtual reality systems are devices that more fully than conventional computer systems imitate interaction with a virtual environment by influencing all five human senses.

There are also issues that have yet to be resolved: this is the creation of electronics with minimal power consumption, as well as the creation of new communication standards for the interaction of things with each other. Helmets and suits of virtual reality, specialized rooms, allow you to get into an unknown world, which is programmed in such a way that actions cause a response from the virtual world, which allows you to immerse yourself in it completely.

Within the framework of 3D modeling, one can talk not only about building object models, but also filling them with data, which, in turn, makes it possible to optimize managerial decision-making processes and subsequently link product design tools with their production tools.

A network of ecosystems is being formed around which services based on artificial intelligence will be created. The creation of a huge number of 3D printers that can print products from polymers, concrete, metals and even gold changes the very understanding of the production cycle, because many of the products can be made at home with only a three-dimensional model and a 3D printer. There are examples of printing houses, bridges and a bus.

QUANTUM TECHNOLOGY

The development of conventional computers is starting to slow down, and quantum computers can solve this problem. According to the well-known law, empirically derived by G. Moore, the number of transistors placed on an integrated circuit chip doubles every year. This increase in the density of elements on integrated circuits leads to a situation that should occur in 2023. It is already so. Five nanometer technologies are already relevant. To explain the properties of such objects, one must use the laws of quantum mechanics.

Since the developers have approached the limiting packing density of transistors. There is another reason called the heat dissipation problem. It is important to learn not to dissipate energy on secondary operations of input, output and transformation of information. Classical computers can't do this, and as transistors get smaller, they get worse at this problem. These are two fundamental problems in the development of conventional computers. For some types of tasks, quantum computers will have superior performance. By solving this problem, quantum computers will be able to bring down all modern cryptography. If a quantum computer is built, it will be very good at solving this problem. Such a computer would make it possible to break the existing system of cryptography, which is called asymmetric cryptography.

This is cryptography, which is largely based on the complexity of performing certain operations. They are executed well in one direction, and in the opposite direction it is very difficult to calculate. But if there is a high-

performance computing device, it will easily do it. Although building a quantum computer in order to crack codes is not very decent.

The goal of quantum technology is to create systems and devices based on quantum principles. The principles include discreteness (quantization) of energy levels (quantum size effect, quantum Hall effect); the Heisenberg uncertainty principle; quantum superposition of pure states of systems; quantum tunneling through potential barriers; quantum entanglement of states. Possible practical implementations include quantum computing and the quantum computer, quantum cryptography, quantum teleportation, quantum metrology, quantum sensors, and quantum imaging.

There are broad optimization problems that are solved by enumeration. Google has its quantum computer, and IBM has it. But for now, these computers solve problems that are useless for the national economy and ordinary users. These are demonstration tasks, their goal is to show that a quantum computer can, in principle, be built and created algorithms with the help of which it solves these problems much faster than the most powerful classical computer. Photonic chips have been created in which quantum computing takes place.

Two physical platforms for quantum computers based on neutral atoms have been developed. There is a quantum register, which contains about a hundred such atoms. One-qubit operations are performed, changing the state of the atom. Until two-qubit operations are obtained, and without this a full-fledged quantum computer cannot be built

Artificial intelligence relies on big data, and they need to be structured, analyzed, and transformed. Programming languages for quantum computers have already been created. This is normal software. The main problems so far are with the hardware. Quantum communication studies how to transfer information using quantum states and technologies based on it. This is a much more advanced group of technologies compared to quantum computing, quantum cryptography is especially developed.

There is a problem in modern classical cryptography that has not yet been solved. This is a cryptographic key distribution problem. How to make sure that two legitimate users have sets of identical cryptographic keys that can encrypt and decrypt messages. These keys must be changed all the time so that the message cannot be opened. Ideally, each message is decrypted with its own key. This is how many such keys need to be typed and where to store them, how to destroy, how to deliver?

Quantum cryptography makes it possible to solve this problem without human intervention. To do this, you need to have a quantum communication channel through which photons propagate states of light, encoded in a certain way. According to it, the key exchange occurs automatically. Keys can encrypt messages symmetrically, as opposed to asymmetrically encrypted, which quantum computers can crack. In principle, such a cipher cannot be cracked.

In information theory, there are theorems on the prohibition of copying quantum states, the essence of which is that an unknown quantum state cannot be copied. If someone wants to get a copy of this state, he will not be able to go unnoticed, because the state from which he splits off a piece of information will be necessarily distorted, and legitimate users will know about it. Everything related to the means of cryptographic protection of information is subject to a certain law. Encrypted communication is regulated by the state. In every developed country there are bodies regulating this sphere.

Any channel must be certified by the state otherwise its creator will be in trouble. Permission to use quantum communication will be given to organizations that are related to government, law enforcement agencies. It will also be banks that also have information that must be encrypted. Devices for quantum communication are already beginning to be produced in different countries. The challenge is to create an international standard for these devices.

Quantum sensors have created the theme of highly sensitive sensors, much more sensitive than sensors that rely on the laws of classical physics.

There are many, several groups. It is customary to single out three. They are needed, for example, in medicine. For example, a tomographs it actually creates a map of the electromagnetic field of a person or part of his body. The second group is formed by atomic clocks. The sensors of this group are used to build compact and accurate clocks that can be put into orbit they are already used in navigation to determine coordinates. The challenge is to make them smaller and increase sensitivity. This group includes gravimeters that respond to changes in the density of what lies in the ground.

The third group includes everything related to quantum metrology. This is a measurement technique for everything that can be accurately measured using quantum effects. Sensors are needed in medicine, where highly accurate knowledge of the current coordinates helps doctors. Quantum cryptography will help protect secrets, quantum computers, for example, synthesize new materials, create personal medicines.

TERMINAL DIGITAL ARCHITECTURE

The advantage of such systems is the centralized multi-threaded and multi-tasking processing of all information in the information system. This allows you to optimize the use of expensive computing resources of high performance of the central machine. During the operation of the mainframe, each user and each process is allocated a set of information resources that allow them to solve their tasks. The user can communicate with the machine both using high-speed information input-output devices that belong to the mainframe-based computing complex, and by working on terminals connected to the central machine of the complex. Mainframe operating systems are robust, secure, and efficient in their use of memory, single or multiple CPUs, and I/O peripherals.

The calculation of operating systems for the operation of a large number of up to several thousand users determined the creation of advanced and high-speed telecommunications facilities built into operating systems and mainframe

hardware, support for all major, including multi-threaded communication protocols. The hardware part of the system, which was created for the conditions of many years of non-stop operation in a busy mode of information processing, is highly reliable and fault-tolerant. Software products that are installed only on the central machine make it possible to easily and quickly perform modifications and replacements without harming system users.

There is a reorientation of the main consumers of mainframe-based systems to the use of cheaper solutions using new computer technologies. This happens for a number of reasons. The creation of terminal systems most often leads to the monopolization by the supplier of the initial system of all services for their development. The intensive development of personal computers based on high-performance processor systems, the saturation of the information technology market with them, has led to the emergence of inexpensive competitive solutions. The reduction in price of computing systems based on powerful microprocessors while increasing their performance and energy efficiency makes these systems attractive for widespread use in traditional mainframe applications - banking, communications, financial activities and complex corporate systems.

The improvement of personal computer operating systems and systems based on them brings them closer to mainframes in terms of both performance and reliability, and in the field of multitasking and multithreading support. Without denying the important role of supercomputers and systems using them, the creators and integrators of modern automated information technologies choose the orientation on the use of easily scalable and easy-to-use systems based on local area networks of public and closed access.

The core element of any digital ecosystem is single sign-on technology: The neuronal marketing research ecosystem includes a polygraph, an eye tracker with a high-resolution camera, and electroencephalogram sensors. All these devices allow you to fix the unconscious mechanisms that affect what a person thinks about, what he says, what he chooses and what he does.

NEURONAL SOCIOLOGY

Social neuroscience gave birth to neuronal sociology. Neuronal sociology deals with the study of the social aspects of brain function and the fusion of brain functioning with intellectual behavior and processes of the personal self. An individual's brain develops only in interaction with other individuals' brains and the cultural context they produce. In this case, life experience and experiences will be a more useful source of knowledge than objective measurements and beyond. In this case, life experience and experiences will be a more useful source of knowledge than objective measurements and records. Interpretations, the culturally determined nature of individuality, memory and even sensory perceptions make neuronal sociology relevant. She studies the influence of culture and learning environments on brain processes and neural structures, and the role of brain processes in creating social structures.

The term "neuronal sociology" was introduced by J. Bogen to describe studies of socio-cultural variations in the performance of lateralized cognitive tests, that is, tests that measure the resources of one or the other side of the brain. J. Bogen, W. Ten Houten, A. Thompson confirmed a number of neuronal sociological hypotheses that show the connection between the left and right sides of the brain. W. TenHouten co-authored the first sociological study of scientific and synthetic ways of thinking based on different abilities of the cerebral hemispheres. Interest in neuronal sociology is fueled by research in the field of neurology, the laws of the functioning of the brain and its interaction with the environment, with corresponding consequences for socio-psychological functioning. If a sociologist acts in isolation from the achievements of neurophysiology, then he will not be able to explain the specific mechanisms of the influence of social factors on the nervous and motor activity of a person.

The action of biological mechanisms that cause the regulation of the level of oxytocin, according to supporters of neuronal sociology, is primary in relation to any social phenomena, processes, statuses and structures, including the social

structure of society. A sociological explanation will never be satisfactory unless it explains the mechanism by which, for example, a change in an agent's social position affects his motor activity: facial expression, word choice, coordinated and controlled actions.

Thus, the methodology of neuronal sociology is based on the assumption that any impact of social and cultural factors on individual behavior is carried out exclusively through neurophysiological mechanisms. Neuronal sociology involves not just the study of social effects or correlates of neurophysiological processes, but an integrative description of social processes at different levels: from the macro level organization of society to neurophysiological processes. This is the establishment of the relationship and interdependence of those aspects of social life that characterize communities, and those neurophysiological processes that take place in the nervous system of individuals that form these communities.

Neuronal sociology studies the history of major brain changes. In humans, neurons are specialized for specific behavioral acts. Methodologically, neuronal sociology is the application of neuroscience to the study of society. Unlike social neuroscience, an interdisciplinary field devoted to understanding how biological systems realize themselves in social processes and the behavior of individuals, neuronal sociology focuses on understanding how these biological systems, as well as individual and collective behavior, affect society.

An example of the subject matter of neuronal sociology is the discovery of mirror neurons. Not only do people passively observe what other people are doing, including expressing emotions, but the projection motor cortex mimics what they observe. This is one of the reasons why strong emotions are contagious and why people can have strong physiological reactions to events that are not happening to them. Thus, the main object of neuronal sociology is the human brain, which influences human behavior and the system of social relations that develop on this basis. The theory is described in detail in D. Norman's book

"Emotional Design". Don Norman does not offer a method for integrating this theory into design practice and user research, so you can derive your own method as you work.

NETWORK USER GOALS

There are three types of user goals: user experience goals; ultimate goals; life goals. Types of goals correspond to levels of cognitive processing. The physiological level represents the goals of the interaction experience that the user wants to feel. The behavioral level reflects the end goals that the user wants to do. The analytical level demonstrates the life goals of who the user wants to be.

Experience objectives describe what the user wants to experience from interacting with the product. This affects the visual and acoustic characteristics of the product, its physical design, micro-interactions and interactive experiences (animation of transitions, touch response, screen and button sensitivity). These goals provide information about the motives of the actors, which manifest themselves at the physiological level: to be aware of their own competence and ability to control what is happening; enjoy; feel safe and secure; feel modern.

People want to feel smart and modern, and interfaces give them that feeling. When designing interactions, it is important to translate the goals of the character's interaction experience into a form and behavior that conveys the desired feel, emotion, and tone. To do this, you can use the mood board and other ways to explore visual language. The end goals motivate you to buy a ticket, book accommodation, have fun stay in touch with family and friends. End goals are central to the information architecture of a product and are among the most significant factors in determining the overall user experience of a product. If a product does not meet the end goals, the user will not spend time and money on it product behavior, appearance and feel of use.

Life goals reflect the user's personal aspirations that go beyond the context of the product being designed. These goals show the underlying drivers and

motivations that help explain why the user is trying to achieve their ultimate goals. They describe long-term desires and how a person would like to present their image. Under the influence of this, a person interacts with the product. These goals have the strongest influence on branding and product promotion strategy, but they should also be taken into account in the overall design of the product. Life goals reflect the desire of the individual: to look good in their own eyes and in the eyes of others; succeed in something; be good at something; to be attractive and popular, to be respected.

Everyone has their own life goals, and they can be very different, but for design it is important to strive to get closer to the image of the ideal self through the use of the product and interface. Life goals are rarely directly embodied in specific interface elements or behaviors. But it's important to remember them.

If the user finds that the product brings him closer to achieving his life goals (and not just the final ones), this will attract him much more effectively than any marketing campaign. Focusing on the life goals of users (provided that other goals are achieved) can turn a satisfied user into a dedicated user.

When designing, it is important to take into account all three types of goals. Understanding characters is more determined by understanding their motives and goals than by understanding specific tasks or socio-demographic characteristics. According to D. Norman, there are three levels of cognitive perception: intuitive, behavioral and reflex. The processing of information at one or another cognitive level gives a person various information about the world around him and the experience of interacting with it.

At the level of intuitive perception, signals from the environment are interpreted unconsciously. For example, bright colors automatically evoke positive emotions, while loud noise causes discomfort. Impressions received on an intuitive level affect directly emotions. Beauty is one of the components of design that makes people happy by influencing unconscious attitudes.

At the second level of processing, a person perceives the behavioral design of an object, which is a combination of usability, understandability, and sensations obtained when interacting with the object. Despite the fact that many modern smartphones are superior to the Apple product in many ways, the iPhone confidently holds the lead in the mobile device market. The reason for this is not only the popularity of the brand, but also the fact that the Apple smartphone is very convenient to use. Even an inexperienced user will be able to change the phone settings, use its basic functions and download the application. The iPhone is intuitive to use. It gives the wearer a sense of control, which, combined with other positive factors such as minimalistic design and ergonomics, evokes positive emotions.

At the third level of perception, a person evaluates an object with the help of thinking, forming a certain idea about it based on his beliefs. An example of mental perception is the reason people buy or don't buy accessories. People often compare one feeling with another: for example, a consumer can buy an unattractive product, considering it more convenient, or, conversely, buy an expensive, beautiful, but uncomfortable thing for the sake of aesthetic pleasure and confirmation of the worldview.

In 1990, D. Norman wrote an article entitled "Cognitive Artifacts", which aimed to emphasize the role that information processing plays in the case when the cognition of physical artifacts is developed. This process of processing information has been called "cognitive artifact". This approach contributes to the integration of the theory of artifacts into the theory of human cognition. But there are differences in approaches.

There are two points on which D. Norman's approach differs from that of M. Cole. According to M. Cole, a cultural artifact plays the role of cognition for an individual. D. Norman insists that thinking is an autonomous human activity, and artifacts are something external to human thinking. They influence him, but they do not construct him, they cannot be active within him. Secondly, D. Nor-

man contrasts two types of artifacts, which he calls personal and systemic. M. Cole believes that the artifact operates within the cognitive system. Cognition is interpreted as a process that takes place in the head of an individual. Cognitive artifacts establish information processing mechanisms that cognitive sciences consider as the object of their study. Cognitive artifacts are always embodied in sociocultural systems that organize the practical activities of people in which these artifacts are used, as E. Hutchins wrote about this, who developed the concept of cognition distribution.

D. Norman proposed a theory of attention, which is referred to as late selection models. He developed a position on the decisive role of past experience in assessing the significance of all incoming information and subsequent selection for the stage of careful processing. He emphasizes the effects of setting the selection mechanism according to current processing data in a channel of limited capacity. In the context of the general methodology, D. Norman notes that the study of attention is connected with the study of other cognitive processes. The main area of interest of D. Norman was memory, and in it he found the basis for combining different views on the nature of selection. The structure of memory occupies a central position in his model of selection and attention.

According to this model, stimulation that enters the senses goes through a stage of primary automatic processing. First, physical signals are translated (recoded) into a physiological form. In the second phase, special sensory features of all signals are extracted through various operations and transformations. D. Norman calls this part of the primary analysis physiological. D. Norman sees the advantage of his model in the flexibility of setting the proposed selection mechanism. In his opinion, the model easily explains the results of laboratory studies of selective attention obtained at the time of its creation. It is consistent with a wider range of known phenomena of attention. Often, before receiving an answer, the respondent is clearly aware of the last words of the interlocutor. This can be explained by the short-term activation of memory units by the sensory

inputs of these words. If such units receive inputs of relevance before their complete extinction, then they will be selected and transferred to the system of awareness and response. We are talking about the traditional distinction between perceptual and intellectual attention, and that voluntary concentration in the latter occurs with much greater difficulty than in the former. The main difference between these types of attention is the lack of adequate sensory inputs in the case of intellectual attention. Prolonged concentration on a line of thought is provided only by appropriate inputs of relevance, which can fluctuate due to the peculiarities of the organization of long-term memory.

D. Norman's theory completes the second stage in the development of ideas about attention in cognitive psychology. In early selection models, the notion of a single early selection mechanism has been extended to include other, complementary, and overlying selection mechanisms. In models of late selection, there was a reassessment of the place and role of past human experience in selection processes. D. Norman put the memory system at the output of sensory analysis of stimulation, and its contents acted as objects of selection. As a result, his theory, although it allows the semantic processing of several messages, does not assert, as it was in the early models, that all incoming stimulation is completely, exhaustively processed.

COGNITIVE COMPUTING

Cognitive computing involves the use of computerized models to simulate the human thought process in complex situations where answers may be ambiguous and uncertain. Computer programs process and calculate faster than humans, but they still have to cope with some tasks, such as understanding natural language and recognizing objects in an image.

Cognitive computing uses artificial intelligence, expert systems, neural networks, machine learning, deep learning, natural language processing, speech recognition, object recognition, robotics.

Cognitive computing uses these processes in combination with self-learning algorithms, data analysis, and pattern recognition to train computing systems. Learning technology can be used for speech recognition, sentiment analysis, risk assessment, face recognition. They are useful in areas such as healthcare, banking, finance, and retail.

The systems used in the cognitive sciences combine data from various sources, weighing context and conflicting data to offer the best possible answers. To do this, cognitive systems include self-learning technologies that use data mining and pattern recognition.

The use of computer systems to solve problems commonly faced by humans requires huge amounts of structured, unstructured data to be fed into machine learning algorithms. The more data a system is exposed to, the more it can learn and the more accurate it becomes over time. Systems must be flexible enough to learn as information and goals change. They must process dynamic data in real time and correct it as the data and environment change.

Users must be able to interact with cognitive machines and determine their needs as they change. The technology must also be able to interoperate with other processors, devices, and cloud platforms. Cognitive computing technologies can ask questions and extract additional data to identify or refine a problem. They should be stateful in the sense that they store information about similar situations that happened before.

Understanding context is critical in thought processes. Cognitive systems must understand, identify, and analyze contextual data such as syntax, time, location, domain, user requirements and profile, tasks, and goals. Systems can rely on multiple sources of information, including structured and unstructured data, as well as visual, auditory, and sensory data.

Cognitive computing systems are used to perform tasks that require the analysis of large amounts of data. They help to identify trends and patterns, understand human language and interact with customers. Cognitive computing can

work with large amounts of unstructured medical data, such as patient histories, diagnoses, conditions, and journal research articles, to make recommendations to healthcare professionals. This is done to help doctors make better treatment decisions. In retail, these technologies analyze basic customer information as well as details about the product they are looking at. The system then provides the customer with personalized offers.

Cognitive computing in banking and finance analyzes unstructured data from different sources. Technology is used to get more information about customers. used to create chatbots that communicate with customers. This improves work efficiency and customer engagement. Cognitive computing helps in areas such as warehouse management, warehouse automation, networking.

Cognitive computing is able to map structured and unstructured data and compare them to each other. They can recognize patterns when analyzing large datasets. The combination of cognitive assistants, personalized recommendations and behavioral predictions enhances the customer experience. Cognitive systems help employees analyze structured or unstructured data and identify patterns and trends in the data.

Cognitive technologies also have disadvantages. They need large amounts of data for training. Organizations using the systems must properly protect this data. These systems require skilled development teams and a significant amount of time to develop software for them.

The systems themselves need extensive and detailed training with large datasets to understand the tasks and processes involved. The slow development life cycle is one of the reasons for the slow adoption. Smaller organizations may find it more difficult to implement cognitive systems and therefore avoid them. The process of training cognitive systems and neural networks consumes a lot of energy and has a significant carbon footprint.

The term "cognitive computing" is often used as a synonym for artificial intelligence. But there are differences in the purpose and application of the two

technologies. Artificial intelligence reflects a general term for technologies that rely on data to make decisions. These technologies include machine learning, neural networks, and deep learning systems. When using artificial intelligence, data is entered into the algorithm over a long period of time so that the system learns the variables and can predict the results.

The term "cognitive computing" is used to describe artificial intelligence systems that mimic human thinking. Cognition involves real-time analysis of the real environment, context, intentions, and many variables that determine a person's ability to solve problems.

In order for a computer system to be able to create cognitive models, a number of artificial intelligence technologies are required. These include machine learning, deep learning, neural networks, and sentiment analysis.

Cognitive computing is used to help people in decision making processes. Artificial intelligence relies on algorithms to solve a problem or discover patterns in large datasets. Cognitive computing systems have a higher goal of creating algorithms that mimic the human brain's reasoning process to solve problems as data and problems change.

Neural network technology, sometimes referred to as an artificial neural network, is a method of simulating brain functions on a computer. Modern computer programs are capable of equations and calculations far beyond human capabilities. But their inability to recognize even simple patterns, let alone extrapolate data from such patterns to predict future plans, means that computer technology is limited in solving problems.

Neural network technology relies on a series of many different processors working in tandem and in parallel. They consist of separate sets of nodes individually programmed to recognize patterns, interpret data, and respond to stimuli, in some cases independent initiations of activity.

The process of creating neural networks uses Bayesian methods, gradient learning and fuzzy logic.

COGNITIVE ARTIFACT

Traditionally, the term artifact refers to a material object made by man. But M. Cole considers artifacts more broadly, as products of the history of mankind, including the ideal and the material, referring to the fact that in the Russian school a tool was understood, for example, language, a phenomenon obviously not material, but all means of cultural behavior as artifacts, in fact, origin and development of the social. Culture in this case is an integral set of artifacts accumulated by a social group in the course of its historical development.

An artifact is a certain aspect of the material world, transformed in the course of the history of its inclusion in purposeful human activity. By the nature of the changes made in the process of their creation and use, artifacts are both ideal (conceptual) and material. They are ideal in the sense that their material form is produced by their participation in interactions of which they were a part in the past. They mediate them in the present. With this definition, the signs of artifacts are equally applicable in cases where language is involved, and in the case of more familiar forms of artifacts.

They differ in material features, ideal aspects, and the kinds of interactions they allow. With this approach, mediation by artifacts applies equally to objects and people. There are ways in which ideality and materiality are combined in representatives of the two categories of existence, as well as the types of interaction in which they can be included. This view establishes the original unity of the material and the symbolic in human cognition.

This is an important starting point for determining the attitude to the ongoing discussion in anthropology and related disciplines: should culture be considered external to the individual, that is, the totality of the products of previous human activity, or internal - the source of knowledge and ideas? The idea of artifacts as products of the history of mankind, which are both ideal and material, allows us to stop this dispute. A special property of human thinking, called the duality of human consciousness, comes to the fore.

With the help of words, a person creates a new world for himself. And in this world a person lives just as truly as in the physical world of sensations. Man feels that the real value of his existence comes down to being in this world of symbols and ideas, or, as he sometimes puts it, in the spiritual world. And this world of ideas, in contrast to the external world of sensory sensations, has the properties of constancy and continuity. It includes not only the present moment, but also the past and the future. From a temporal point of view, it is not a collection of discrete episodes, but a continuum open in both directions.

This inner world of ideas, in which a person lives, seems to him more relevant than the outer world of sensory sensations. A tool for a person is not something that exists only at the moment, it acts in the living past and is projected onto the future that has not yet come. The tool of labor in the mind of man is eternal, like the Platonic idea in the Divine mind. Thus, the human experience with the use of tools is not reduced to a series of unrelated episodes, in each of which a person takes a tool, uses it, and then puts it aside. Each of the external actions demonstrates only a particular expression of ideational experience, which is long and continuous.

Neither artifacts nor actions exist in isolation. They are intertwined with each other and with the social worlds of people, acting for them as intermediaries in the formation of a network of relationships. M. Wartofsky describes artifacts, including tools and language, as the objectification of human needs and intentions, already saturated with cognitive and affective content. The first level consists of primary artifacts that are directly used in production. Secondary artifacts include primary artifacts and how to use them. They play a central role in the preservation and translation of beliefs and modes of action.

They include prescriptions, customs and norms. The third level is represented by a class of artifacts that can become self-contained worlds in which rules, conventions, and outcomes no longer seem directly practical. These are imaginary worlds. Imaginary artifacts can color the vision of the real world to

change current practice. Behaviors acquired through interaction with tertiary artifacts may extend beyond the immediate context of their use.

As secondary artifacts, M. Cole considers cultural schemes, models, scenarios, which he defines as cultural means. Human experience is mediated by cognitive schemas that channel individual thinking, structuring the selection, retention, and use of information. The term "scheme" is used to designate structures of knowledge, the parts of which are related to each other and to the whole in a certain given way. The scheme contains a network of relationships that are preserved in all particular cases of its operation. There are knowledge schemas about objects, situations, events, sequences of events, actions, sequences of actions. These are all secondary artifacts. Schemas are selection mechanisms. They define how certain essential elements are related to each other, leaving the possibility of including other, less essential elements as necessary according to the circumstances.

Schemas reflect not only the world of physical objects, but also the more abstract worlds of social interaction, reasoning, and even the meaning of words. M. Cole, following D'Andrad, calls the cultural schemes common for groups of subjects cultural models. The function of cultural patterns is to interpret experience and guide behavior across a wide range of domains. A particularly important type of schemas for the purpose of constructing a theory based on people's daily activities are event schemas. The event schema determines which people should participate in the event, what social roles they play, what objects they use, and what are the causal relationships. Scenarios, like cultural schemas, serve as a guide to action. When people find themselves participating in new events, they must find the answer to the question of what is happening here.

If the participants in the events did not have scenarios shared by all, any joint actions would have to be re-agreed. So in the process of enculturation, adults guide the actions of children and set goals rather than directly teach them something. Essentially, they use their knowledge of accepted scenarios to place

limits on children's actions and allow children to engage in role behaviors that are expected of them. Scenario learning plays a central role in cultural learning.

Interpreted as internal structures of the psyche, schemes and scenarios are well consistent with the idea of culture as internal meanings that have separated from their material carriers. Scenarios are not exclusively intrapsychic phenomena, but, like all artifacts, they participate in events on both sides of the surface of the skin. F.K. Butlett wrote about schemas as conventions, social practices that exist both inside and outside the psyche, which are both materialized practices and mental structures.

Secondary artifacts, such as cultural schemas and scripts, are components of the cultural toolkit. They are both ideal and material. They are both materialized and idealized (conceptualized) in artifacts that mediate the joint activities of people. By the very fact of concretization, they turn into sources of both individual representations and the constant reproduction of the ways of representing activity, which is necessary for the representation of activity itself. But such knowledge structures only roughly determine what a person will think or behave in any particular case, even if one admits that one has the necessary cultural model or script. Therefore, while culture is a source of tools for action, the individual has a lot of work to do in interpreting them, deciding which schemes are applicable in which circumstances.

THE PROBLEM OF SOCIO - CULTURAL CONTEXT

From the point of view of Michael Cole, as a general starting point of the socio-cultural approach should be considered the assumption that the specific characteristics of human beings reflect their need and ability to live in an environment transformed by the activities of members of their kind who lived before them. Such transformations and the transmission mechanism of these transformations from one generation to the next are the result of the ability and inclina-

tion of human beings to create and use artifacts that are used in human activity as modes of coordination with the physical and social environment.

That the process of activity is mediated by artifacts is a fundamental characteristic of human psychological processes. Experience does not simply exist within the individual. From birth to death, the individual lives in the world of things, which are what they are because of what has been done and transmitted as a result of the previous activities of people.

To understand cultural behavior, it is necessary to understand the processes of change and transformation that seem to occur over time. In the process of ontogenesis, fundamental structural changes take place, consisting in the fact that for a being living in a cultural environment, the mediation of actions by culture becomes second nature. Within cultural practice, all objects are social insofar as they are socially established. Cultural practices are functionally and structurally represented by contexts and activities.

M. Cole preferred to accept as a working hypothesis that the basic cognitive processes are the same in different cultures. The task of cross-cultural cognitive psychology is to understand the environmental factors that are responsible for the difference in behavior.

This includes the specification of the conditions in which cross-cultural similarity manifests itself. Human psychological processes are jointly constructed with the participation of cultural practices of the past.

It is based on a methogenetic approach to cultural mediation, whose time scale lies between the microgenetic time scale used in classical studies. The basic strategy for this approach is to create a system of activities with its own rules, artifacts, social roles and ecological environment, with its own culture. In the classical positions of cultural-historical psychology, culture is presented only in a limited abstract form, designed to illuminate the decisive property of mediation through artifacts. Artifacts do not exist in isolation from each other.

They are intertwined with each other and between the social lives of the people they mediate in an endless variety of ways. Taken together, they constitute a unique means of human life in the form of culture.

The development of the human psyche in ontogenesis and in the history of mankind should be understood as a co-evolution of human activity and artifacts. Words that are spoken, social institutions in which people participate, equipment and technologies serve both as tools and symbols. They exist in the world around people. They organize their attention and action. In the process of the formation of human culture, mediation creates a type of development in which the activities of previous generations accumulate in the present as a specifically human component of the environment.

The social world influences a person not only through the actions of real people who talk, communicate, show an example or convince, but also through invisible ways of action and objects created by people in the world surrounding the individual. There are prescribed forms of social interaction: customs, patterns, rituals, cultural forms.

There are artificially created objects that silently saturate the world with human intelligence: words, maps, television receivers, metro stations. To explain the cultural mediation of thinking, it is necessary to clarify not only the range of artifacts that mediate behavior, but also the circumstances in which thinking occurs. Human behavior must be understood in relation to its context.

P. Bourdieu also tries to combine simplified ideas about the context as a cause and overcome the duality of the theory of knowledge and social life. Central to his approach is the concept of habitus as a system of stable and transferable dispositions that, integrating past experience, function at every moment as a matrix of perceptions, understandings and actions and makes it possible to achieve infinitely diverse goals.

Habitus is a product of the materialization of the conditions of existence and a set of principles for generating and structuring practice. It is formed as an

implicit aspect of ordinary life experience, forms an unobservable deep level of ideas about the world. It is a universal mediator that makes the actions of individuals in the absence of explicit reasons or indicated intentions tangible and reasonable.

There is an important similarity between different views of the supra-individual unit of analysis, related to the concepts of context, practice, activity, and the views of those working in the field of environmental psychology. This similarity grows out of the common starting point of the ecology of everyday human activity. It manifests itself in the tendency to conduct research in natural social conditions, and not in experimental laboratories. This similarity can also be seen in the intertwining metaphor used in the work of both cultural and environmental psychologists.

One of the interpretations can be found in the modular theory of J. Fodor. Mental processes are specialized by area. Information from the environment passes through a set of special input mental systems (systems for perception and primary processing of information) or modules that transform this information in a certain way and transmit this information to the central processor. The psychological principles of organization of each perceptual system are innate.

This idea corresponds to N. Chomsky's position that a person has an innate language structure. Different perceptual systems do not directly interact with each other. Each of them represents a separate mental module. The information supplied by the modules is coordinated by the central processor operating the products of their activity. Modules cannot be influenced by other components of the psyche that do not have access to their internal operation.

According to the weak version of the modular hypothesis, the behavioral dispositions built into the genome are richer and more complex than recognized by traditional theories of cognitive development. These genetically determined characteristics provide a point of reference, an initial structure upon which later cognitive abilities are built. They set limits on how a developing organism per-

ceives and comprehends experience, directing development along lines typical of the species. The strong version of the modular hypothesis holds that behavioral characteristics do not develop within these areas. Being innate, they require only the necessary inclusion from the environment in order to be realized.

Information from the outside is first perceived by modular systems and is subjected to primary transformations in them. It is then filtered by a set of cultural patterns internalized by the individual in the process of socialization and then processed by the central processing unit. Cultural components are intertwined with modules, organizing and reorganizing the contexts of their existence. The central processor receives culturally processed information, and modular systems are programmed for cultural processing of information.

Any information initially exists in a cultural context, and only the presence of this cultural context makes it possible to implement a perception system. It can be assumed that not only the language model is innate, as in N. Chomsky, not only modular systems associated with cultural information processing, but also the model of culture and society is innate. These models are implemented on the material of a particular culture, in a particular cultural context and through its artifacts.

A. Karmiloff - Smith proceeds from the assumption that knowledge develops through interactive transformations, in which skeletal modules are modified in the process of re-description. The specifically human way of acquiring knowledge consists in the internal exploration by the psyche of the information that it has already accumulated, both innate and acquired, and its subsequent representation in various forms. The described process in the cultural-historical approach is called a new mediated form of interaction between the individual and the environment.

G. Simon proposed to consider human thought within the framework of the discipline dedicated to artifacts. According to him, the core of the family of artifacts is a physical symbolic system. Artifacts are models. The structures they

contain are theories of the person who uses them and the ranked aspects of the external environment in which they are to be used. Artifacts embody values. All culturally mediated actions are implicitly moral actions. Within the framework of cognitive anthropology, the concept of artifacts is being interpreted more and more widely, helping to solve more and more complex theoretical problems.

Culture, being a field of action, not only provides opportunities for action, but also determines the conditions for action; it designates goals that can be achieved by certain means, sets boundaries for right, possible, and also deviant behavior. The relations between various material and also ideational contents of the cultural field of action are systemic; transformations in one part of the system are echoed in any other part. To become a component of the cultural field of action, one must go through certain mental operations. Some components of the material flow remain outside the perception of a person as lying outside his intentional world. The sociocultural environment is an intentional world. Scenario learning plays a central role in cultural learning. Social context influences the choice and use of scenarios.

Each event is located within the cultural context and pulls along new models of action. Part of the elements of the material flow is assimilated by means of constant perception complexes belonging to the culture, which correct the process of human perception, inserting it into the framework determined by culture. Through them, an object or phenomenon receives a representation in human thinking, becomes an artifact. But the constant perception complexes themselves can be regarded as artifacts.

Being specific mental processes that are regulated by human sociocultural activity, they themselves are a product of human cultural activity and can be represented as culturally determined unconscious elements of the human psyche, which can be called a complex of cultural constants.

Cultural constants contain ideas about the course of action, which can add up to a kind of script prototype. A prototype that, in one form or another, finds

its expression in any of the scenarios implemented in real life. Together, they define each specific culture as a specific field of action, setting the principles of proper, acceptable and deviant interaction. Within the framework of culture, an attitude always provokes a counter attitude, creating a framework of attitudes into which significant systems are woven, turning from material flow objects into artifacts. Culture is based on the idea of interactions, more precisely, on the fundamental structure of interaction, which includes all the alternativeness allowed by the framework of culture. It is projected onto every bearer of a given culture, an intentional personality in an intentional world.

On the basis of the same cultural constants, a whole complex of pictures of the world is formed, in each of which these cultural themes are interpreted in different ways. The distribution of culture based on common cultural constants, the splitting of a cultural theme has its own functional significance. The distribution of culture is something like a trigger mechanism for the self-organization of a socio-cultural system. The cultural system, through the dynamic perception of the surrounding world, organizes not only external reality, but also itself as a component of this reality.

D. N. Uznadze studied such a modification of a cognitive artifact as an attitude. It is completely unconscious and is a mode of an integral personality, expressed in readiness for a certain action. Attitudes bring to life both certain models of perception and certain models of action. The artifact determines both how the object is perceived and what actions it motivates.

NEUROSCIENCE

Neuroscience is presented as an interdisciplinary field of knowledge covering a wide range of studies of the brain and neuronal processes: from molecular structures to the operation of neural networks and the brain as a whole, brain structure and functioning of the nervous system, the connection of nervous processes with general physiology and human behavior. Neuroscience has evolved

beyond neuroscience to include the methods of neurophysiology, medicine, pharmacology, and genetics.

Studies of the relationship of the nervous system with various aspects of human activity have made it possible to include the methods of psychology, linguistics, computer science, and cognitive sciences in neuroscience and come to the formation of many new disciplines, such as neuropsychology, neuronal ethics, neuronal informatics, and to the creation of cross-disciplinary research.

The basis of neuroscience methods is formed by neuroimaging, or fixation and direct visualization of the functioning of various parts of the brain and other parts of the nervous system under certain human conditions and the performance of certain actions by a person. Research uses magnetic resonance imaging as a way to image the interior of the brain using nuclear magnetic resonance; Functional magnetic resonance imaging allows you to determine the activation of a certain area of the brain during its normal functioning under the influence of various physical factors and under various conditions.

Ppositron emission tomography is a radionuclide tomographic method for studying the internal organs of a person or animal. The method is based on the registration of a pair of gamma quanta arising from the annihilation of positrons with electrons. Magneto encephalography is a neuroimaging technology used to measure, with highly sensitive devices, those magnetic fields produced by the electrical activity of the brain; Electroencephalography is a method for studying the functional state of the brain by recording its bioelectrical activity; Transcranial magnetic stimulation is a technology that can activate or, conversely, slow down the work of individual areas of the brain; Eye tracking is a technology that tracks eye movements and allows you to trace the sequence with which the observer's eyes fix different parts of the object under consideration.

Based on the methods of neuroscience, neuronal computer interfaces are created that carry out direct communication between the brain (consciousness) of a person and an electronic device. Devices are used in medicine, especially in

prosthetics. There are projects for the use of brain-computer interfaces for learning. At the moment, scientists have a large amount of data on the structure of the brain and the processes that occur in the head of the student, and they are trying to identify clear correlations between the learning process and physical changes in the brain.

It is not possible to draw precise conclusions about the existence of a direct relationship between biophysical changes in the brain and changes in human behavior. However, a number of studies are helping educators and curriculum developers create optimal learning environments. With the help of a neuronal headset and biometric bracelets, data streams are recorded, and indices are calculated from them that correspond to various aspects and characteristics of cognitive load and various psychophysiological indicators that indicate how the learning process is going. This data is processed in real time and presented to the teacher along with recommendations so that he can adjust the training program. In the same way, each listener receives personal feedback for self-control. This happens both during the process and in the form of a report.

COGNITIVE ARTIFACTS OF THE METAVERSE

Users of the metaverse can create things and interact with each other in a reality-based world with possibilities beyond ordinary life. The Metaverse is characterized by the presence of a public digital space with various customized avatars that represent users of the ecosystem; the presence of digital property rights, the level of which depends on the degree of decentralization of the chosen platform; the possibility of interaction with other users; the conditions for various actions within the digital world; the right to share leisure time with other participants ecosystems.

Different digital ecosystems offer users different opportunities and degrees of control over assets. If a digital platform takes a decentralized approach,

it offers more opportunities for creating applications, as well as greater responsibility for users to develop the ecosystem and the digital world.

The Metaverse is an online platform that creates the conditions for creating something within the digital world. It allows users to develop their avatars as well as define their lives based on what they are capable of. The Metaverse mimics reality, allowing participants to build digital careers in the fashion world or look after animals and private property. The possibilities are limited only by the imagination.

Centralized versions of the metaverses are different from open source digital platforms that run on the block chain. The key differences are control, the ability to create something and the platform management system.

What happens inside the centralized metaverses is completely controlled by one organization. Such a system is also characterized by internal servers and certain rules for regulating the virtual world. For example, virtual communities of centralized projects like Fortnite and Roblox are active only within predetermined limits, and the latter limit their capabilities. Community representatives can interact with each other and share experiences, but they do not have the right to control the digital environment and own certain components of it.

The decentralized metaverse platforms are open source, and their users determine their own actions and what happens. The platform is controlled by the community of participants, and the organization. Users have more control not only over their own individual assets, but also over the Metaverse itself and how it works. Decentralized metaverses are associated with block chain projects.

Metaverses offer unique features and yet depend to varying degrees on their own communities for governance. In some cases, users determine in which direction this or that online space will develop. The digital ecosystem is considered as consisting of organizations interacting with each other through digital technologies on the principle of modularity, as well as not managed by a hierarchical body (compared to the supply chain). Digital business ecosystems do not

rely on the customer to integrate goods and services themselves or purchase them as a package from a single source, but to provide customers with the desired choice, i.e. the customer makes a choice according to the menu, which, in turn, is provided and managed by an ecosystem member.

A digital ecosystem can bring together many diverse actors with different points of view and skills, sharing resources, experience and ideas, directly or indirectly creating economic value and meeting the needs of the end user. Participants create economic value jointly, therefore they are interdependent. At the heart of the digital ecosystem are application programming interfaces.

They act as a means of exchanging data, functions and values throughout the digital ecosystem of the modern economy, provide interaction between disparate application systems and allow developers to repackage data and functions to perform new tasks in accordance with a modular approach.

Organizations can create and participate in their own internal, public, partnership and industrial digital ecosystems and derive economic benefits through these ecosystems due to the certain obligations of all participants and their joint efforts in order to achieve their own strategic goals, as well as to implement innovations.

The strategies of business organizations for deploying a particular ecosystem should take into account, at a minimum, the following points: 1) taking into account the role that the company will play in the ecosystem. As practice shows, a company usually plays several roles in overlapping digital ecosystems at once; 2) specific local operational needs and characteristics, depending on many factors, among which can be noted geographical location, competition and regulations. A different level of influence of each of the factors determines the existence of many ecosystems.

The typical roles of the subjects participating in the formation of the ecosystem include the organizer, the modular producer and the consumer. Organizers are institutions within which individual partners come together and create a

common economic value for the participants. They provide a platform and enable others to produce goods or services and sell them through the ecosystem. The modular producer is characterized by the fact that it can be effectively involved in many ecosystems. One of the brightest representatives in the current context is the “PayPal” service, which provides the ability to make payments online and provides financial services used within a variety of digital ecosystems. An ecosystem user can be both an organization and an individual who uses the economic value created in this system.

One of the main advantages of digital ecosystems is the fact of using innovations, as evidenced by a fairly large number of technology start-ups. The economic success of an ecosystem may depend on the amount of assistance provided to a partner to increase its level of innovation, since innovation tends to multiply throughout the ecosystem. On the one hand, this is facilitated by the possibility of a quick and low-cost exchange of digital resources, and on the other, by the expansion of traditional partnerships and access to a large network of colleagues and developers, each of which has its own infrastructure, resources, and promising ideas for integration. For external partners and customers, mutually beneficial conditions are created for the development of applications with the aim of new or more efficient use of organizational resources, i.e. new products and services for end customers.

The key benefits of digital ecosystems are that they enable supply chain flexibility and market insights, are ready for regulation, best meet customer needs, drive revenue growth and minimize risk. The technological basis of digital business ecosystems is cloud technologies. Members use common platforms and a common set of standards to ensure that their activities, products and services are compatible. The development of digital ecosystems is also driven by mobile technologies, artificial intelligence, big data technologies and big data analytics, as well as customized solutions. The main components of the techno-

logical infrastructure of the digital ecosystem are the platform and integrated software products.

The platform is the foundation of the ecosystem, the means by which partners create their products or services. To support an economically successful ecosystem, the platform is expected to be open and modular. Openness creates the possibility of providing access to platform resources. This property allows ecosystem participants to develop their own products. Modularity gives different organizations the ability to create additional products and services. The platform must also have features such as high availability, reliability, and security.

With the help of integrated software products, the data flow is transferred from component to component of the digital ecosystem. It is based on a set of protocols that regulate the communication parameters between the software components of the system and thus provide interaction between various participants in the digital ecosystem. Integrated software products occupy a central position in the digital ecosystem and directly determine the platform, level of implementation of network effects, as well as market expectations.

They contribute to the formation of new ecosystems, and the added value is obtained as a result of the creation of new products. For this purpose, common digital assets are used, combined according to certain principles Digital ecosystems, due to their structure (the elements are practically independent of each other and can be interconnected in various ways), make it possible to develop new business models based on a network of business partners, and coordinate economic activity in a different, more optimal way.

Digital ecosystems bring together actors from different fields. Each of the subjects has its own traits, attitudes and abilities that are involved in the distribution of resources, experience and ideas and form a common value for the end client. The foundation of digital ecosystems is based on common platforms and sets of standards due to scalability, flexibility and dynamism.

A person needs to evaluate the feasibility of a purchase then choose a payment method and a payment system. Many are not able to spend time on this, and often overpay for goods and services. Multi-banking applications will help the client with a profitable choice, which will not become isolated within one ecosystem or bank. Potential customers of banks will be millions of units of artificial intelligence.

At the beginning of the 21st century, virtual and augmented reality technologies became part of the metauniverse. In this reality, people work, study, relax, have fun, earn money, communicate and buy cars and real estate. Everything that a person acquires or creates in the metaverse belongs only to him.

Life in the metaverse is different from the use of digital services. If a user uses a real card in online services, then the metaverse has its own currency. In the metaverse, not only communicate, but also study and work. For example, using the NextMeet service, companies create a 3D office and hold meetings in it. Brands and content creators will have more opportunities to develop and scale products. The content of the metaverse depends only on communities and users.

Companies and users see the metaverse as immersive forms of team collaboration; the emergence of digital colleagues with artificial intelligence; Accelerating learning through virtualization and gamification.

At the first stage, the metaverse will be an alternative to social networks, but eventually it will replace the World Wide Web. The Internet as we know it today may no longer exist.

In 2020, the adoption of virtual reality for work, collaboration and learning accelerated. Thanks to the Metaverse, more employees will be able to transition to remote or hybrid work. Companies are forced to make concessions to professional staff, and they are in favor of hybrid work formats.

When the metaverses go mainstream, there will be many opportunities for investment and e-commerce. Thanks to the metaverses, new jobs are being created. Within the metaverse, companies will create thousands of projects, and all

of them must be compatible with each other. The existence of the metaverse will generate a huge amount of data. They need to be stored and protected so that user information is safe. The metaverses already have their own money, but at the moment they are incompatible with each other and, with rare exceptions, are not converted into familiar currencies.

Equipment plays a very important role. Virtual reality devices are quite expensive, and their presence is necessary for presence in the metaverses. This gives rise to a new economy (virtual clothes can already be bought for $15,000), new cyber threats, new trends, and new legal regulation.

Among the cognitive artifacts of the metaverse, we can single out: the mirror world as a digital version of the real world, in which there are virtual analogues of people, places, objects; skeuomorphic design, in which virtual objects are as similar as possible to real objects; a digital twin as a virtual version of a real object or structure, such as a factory or an aircraft. And we can also highlight the avatar, virtual, augmented, mixed and extended reality. Sensitive biosensors will become commonplace. With the help of 3D printing, it will be possible to make products indistinguishable from natural products. The environment will begin to understand human needs, and unmanned vehicles will fill the streets of cities.

The effect of presence during communication is achieved. It will be possible to conduct work meetings from home, but sitting face to face with colleagues, or online. It will become customary to show an online apartment with a virtual design. You can communicate in any language with anyone thanks to the online translator. Accessible and cheap marketing is being updated: branding through an online presence in a virtual environment, distribution through e-commerce or virtual storefronts, sales using immersive technologies. New opportunities for online learning have emerged. Integration with various block chain applications takes place. In development are software engines, tools for

creating virtual content: and tactile technologies, virtual worlds, avatars, marketplaces and financial services.

A platform for the development of e-commerce using 3D digital and augmented reality has been created. Technologies have been developed that allow you to feel touch (HaptX gloves) or smell. At the beginning of January, 2022 Panasonic provided the personal wearable thermoregulation system. This is a tiny air conditioner that clings to the shoulder blade area and mimics the cold and heat in digital reality. Another trend is self-driving cars equipped with 3D displays, odor systems and active suspension to prevent motion sickness. These are position, eye and gesture tracking technologies, start-ups offering head-mounted displays, image stitching and game engines, video filming of the light field, medical training , headsets and augmented reality devices for industrial environments and field service.

NFT is a non-fungible token. This is a photo, video, picture, audio recording. It is created and stored on the block chain. It can be anything from a trading card to a piece of virtual land. As the infrastructure develops, merchants will be able to tokenize physical products and services to reduce online transaction costs and arbitrage risks.

VIRTUAL INFLUENCERS

Companies create for their promotion a variety of virtual influencers from 2D cartoons to hyper-realistic figures and post them on social networks. These can be virtual employees, iconic personalities (like Colonel Sanders from KFC), or just robots. For example, virtual Lil Miquela from the USA already has more than 3 million subscribers, and a variety of brands have already worked with her from Dior and Prada to Samsung and MINI.

Virtual influencers present CGI-generated characters. The first digital stars appeared more than twenty years ago. The virtual group Gorillaz, whose albums have gone platinum several times, has existed since 1998. Hatsune

Miku, a virtual singer from Japan, has existed since 2007. Her biggest concert, which was attended by 25,000 people, took place in 2009. The new heroes have their own characters, stories, attitudes and style of social networking. They, like live lifestyle bloggers, talk about their everyday life. The most famous virtual models Lil Miquela has 3 million followers on Instagram, the account has been maintained since 2016. She is a music lover, has liberal views, sells ads to fashion brands and communicates with subscribers in the comments. Once she recorded a video in which she said that she was harassed in a taxi. Its creators are employees of the startup Brud.

Lil is the most followed virtual influencer on Instagram. Virtual influencer Lil wears a mask If Lil looks like a real person, then Nunuyuri is a girl with an unusual appearance. This does not prevent her from taking part in the shows of Gucci, Versace, Tom Ford, Chanel and other brands. Imma lives in Japan.

She has a brother, Plasticboy. Together they visit current exhibitions and are photographed for fashion magazines. Another male virtual influencer, Liam Nikuro, works as a producer. Virtual influencer Liam plays basketball Shuda Graham is the first virtual supermodel. She has partnered with The Digitals as the first agency for virtual models. Now, in addition to Shudu, it also has itcnm models, they work with Samsung, Louboutin and other major brands, as well as fashion magazines.

Shudu Graham advertises a new smartphone model from Samsung. Companies are increasingly creating their own virtual influencers. KFC updated Colonel Sanders. Now he flies in a private jet, dresses stylishly, and has a tattoo that says "secret recipe for success." Designer toy brand Superplastic has brought its characters to life and is growing its Instagram account. It already has 1.4 million subscribers. Clothing brand Yoox has created a virtual consultant Daisy. She will recommend what suits you and can try things on.

Aliona Paul is the most popular Russian virtual influencer. She writes long texts, calls for wearing masks so as not to get sick with the coronavirus. She visited the Open Innovations Forum. Aliona practices yoga.

Virtual influencers are divided into: independent characters; virtual star bloggers; virtual models; virtual speakers - characters that represent a certain brand, its values; virtual mascots that do not have a detailed history, they help to perform certain tasks. Independent influencers are created by creative agencies. They think through their appearance and story, gain followers and attract the attention of brands. Virtual influencers, just like real influencers, sell ads in their accounts, participate in creative projects and shoot stories. The basis of a virtual character is formed by an image generated by a computer. The process starts with a concept, then a 3D model is created.

They improve it: make textures, add colors, details. At the end, the character is animated so that his facial expressions and movements are natural. Creating a virtual brand ambassador requires significant funds. For business purposes, virtual influencers have advantages over people. There are no additional costs for a stylist, makeup artist, driver, flight, meals and accommodation. The virtual influencer does not get tired and can be in several places at the same time. A virtual influencer can be on Everest and almost simultaneously at a concert. He can easily change his appearance: gain weight, build muscle and change his hairstyle. But there are difficulties.

A real blogger can take a selfie in a matter of seconds, while each post of a virtual influencer is created by a whole team of 3D artists. Companies can arrange fashion shows and concerts with them. They don't have to worry about social distancing. Virtual influencers can travel talk about new hotels and restaurants. Developers are doing everything to reduce the cost of creating characters, or make add-ons to existing technologies such as Maya or Unreal Engine.

These are mobile platforms for bringing virtual influencers into the real world using augmented reality. In the future, it will be possible to be close to a

virtual character. With the development of technology, virtual influencers will be able to take on a physical form and, for example, attend offline events and give interviews.

In September 2020, IKEA built a living room and bedroom in a shop window in Tokyo and housed Imma in them for three days. She was doing the usual things: checking social networks on her smartphone, talking on the phone, lying on the couch, sleeping. Everything looked realistic thanks to the LED screens inside the installation.

NEW CYBER THREATS

The new digital reality brings new threats. One of the main tasks of the metaverse is to protect avatars that are created from real data. Another danger is surveillance. User data ends up with surveillance companies working for governments or private clients. Deep fakes undermine the global economy. And the further, the stronger. The main legal problems of the metaverse are related to trademarks, virtual assets copyright in works of artificial intelligence, privacy protection and crimes using avatars.

In addition to problems related to reliability and security, the metaverse has some other problems. Online bullying is becoming more dangerous than it is now. Computer programs already know how to translate thoughts into text on a screen. The same technology will help to extract pictures and memories from the brain. Technology allows people to improve themselves physically with exoskeletons for superhuman speed and implants for superhuman hearing. A technology has been developed to create digital clones that will be avatars of people in the metaverse (digital augmented reality) and will be able to help people in the real world through robots.

There is a risk of the individual colliding with his anthropomorphic model. This kind of artificial intelligence represents deep learning neural networks, and there is a black box between them. The developer understands the inputs

and outputs, and the internal information processing system does not matter. Black boxes are called the artificial subconscious.

It allows you to save computing power, solve non-standard tasks and learn faster. But the uncontrolled processes of the artificial subconscious scare people. Limiting the use of anthropomorphic artificial intelligence exclusively for the performance of highly professional tasks and self-regulation of market participants will help minimize human fears.

It is necessary to pay attention to automated systems and smart assistants, to whom people are more and more inclined to delegate their affairs. This is a caretaker who performs a useful function, and knows almost everything about users.The main advantage of Web 3.0 is decentralization, due to which ordinary users should get much more opportunities and privacy. But so far there is no talk of such a transition. With the exception of the block chain, all existing Web 3.0 infrastructure operates on the principles of Web 2.0.

One of the first to pay attention to this was M. Marlinspike, a cryptographer and founder of the secure Signal messenger. In order for a decentralized application on a user's device to interact with the block chain, it needs a node deployed on a remote server. But no one wants to start their own server, so there are companies that sell API access to the node as a service. There are only two players in this market. These are Infura and Alchemy. At the same time, both companies do not check the state of the block chain or the authenticity of the client's responses. This destroys all the security and decentralization of the blockchain.

M. Marlinspike pointed to the actual defenselessness of the NFT. A non-fungible token looks like a link to a web page recorded on the block chain, where the work is stored. Almost always, this page is not protected by hash encryption. Anyone with access to the server can change or delete the object supposedly securely protected by NFT. To test this system, M. Marlinspike created an NFT that changes appearance depending on who is viewing it. The image un-

der the token looks different for users of different platforms, and for the buyer it invariably turns into an emoji image with feces.

A few days later, Open Sea, the main NFT marketplace, removed M. Marlinspike's work. Support cited a breach of terms of service, although no rules prohibited the creation of such an NFT. Soon the picture disappeared from all the developer's crypto wallets. The platform has destroyed the user's digital property. This violates the logic of Web 3.0, according to which customer data is allegedly protected using the block chain and private. In fact, the user's crypto wallet, such as Meta Mask or Rainbow, only displays NFT. The real owner of the work is the one who controls the server.

Decentralization is not the solution to the problem. M. Marlinspike reminds that protocols develop more slowly than digital platforms. So, thirty years later, email remains unencrypted, while it took Whats App developers only a year to implement full E2E encryption. As a result, decentralization slows down the development of the environment when compared with centralized platforms. Once a distributed ecosystem is centralized around a platform for convenience, it takes on the worst of both worlds: centralized control distributed enough to get stuck in time.

The platform would work much more efficiently if it got rid of Web 3.0 elements. But this is impossible. Decentralization attracts attention and money to this area. M. Marlinspike proposes to create architectures based on the fact that users will never create their own servers, and try to make the relationship between the client and the server more secure and trusting; simplify the software development process. Only this will help make technology more focused on the broader goals of humanity, and not on the interests of those who are able to hire a large team of programmers and pay them money.

The design of the metaverse will be prone to such offenses as money laundering through NFTs; fraudulent schemes using online advertising; theft and illegal collection of personal data and their illegal use; fraudulent schemes in

which people are tricked into making a payment; Avatars open up almost limitless possibilities for misleading and seducing children. Change should be perceived as a transformation of the environment. It caused a change in thinking, but the same psychological problems remained. Young people do not know how to start a conversation: they are embarrassed to communicate with each other. Therefore, many couples that form as a result of a match do not continue the conversation. In dating this problem is called ghosting.

The solution is called buddy. This is a kind of virtual assistant. This is when there is a virtual friend. The shyness disappears, and communication is much easier. The problem of discrimination based on appearance is also being addressed. Body positivity has become an important part of life. Many people have learned to love themselves and their bodies, accept irreparable shortcomings and get rid of the complexes that are associated with them. It became obvious that all people are different and it is impossible to treat a person with prejudices, focusing only on appearance. Discrimination based on appearances may be unconscious. For most people, since childhood, beauty is associated with something right and good, while flaws provoke negative reactions.

SEVERAL FEATURES OF NEURAL NETWORKS

There are several features of neural networks that come from their architecture and methods of functioning. It is difficult to say by what characteristics the neural network decides what or who is depicted in the picture or that the text is written in verse. These are automatic processes the main thing is that the creator correctly describes the structure and formulas. By analogy with a person, no one can tell what is happening in the brain. The correct answer is given by a number of parameters.

Neurons are independent and each of them in the network is not connected with the functioning of other neurons. They take data from each other, but inside the network they are independent. If one neuron fails, the other one will

work without disturbing the overall process. Biological neural networks also have such stability. The main disadvantage of such independence is that all decisions are complex, sometimes chaotic and almost impossible to predict and influence. The flexibility of neural networks is due to the independence of neurons, so the development is more effective than any other type of machine learning. Architecture has taken on the basic qualities of the biological nervous system, such as self-learning, the ability to adapt to new information and ignore unimportant details. Due to the flexibility, there are ample opportunities for using neural networks with the ability to adapt to almost any circumstances.

With the help of neural networks, a qualitative analysis of incoming information is performed, which makes it possible to eliminate the element of the human factor. Such developments should make life easier for people, relieving them of complex, boring tasks, but it is too early to talk about mass and widespread use of innovation. The need to draw up documents will become a thing of the past as archaism. All information will be online. Neural networks will form a lawsuit, draw up a contract write a claim appeal a fine. In the era of deep fake, where everything can be falsified, the attitude towards evidence will change.

It will be obvious to introduce something like NFTs - non-fungible tokens that, through the block chain, record the state of an object. And it is very difficult, rather impossible, to falsify distributed ledger data. Law firms will start opening up in the metaverses. Lawyers in private practice will also conduct appointments in virtual reality. Office work will finally cease to exist and will be replaced by virtual rooms. There will be meta-crime and meta-police.

No state will allow a company, albeit a public one, to have its own world, where it will be the full owner. Either in each country or at the international level there will be legislation regulating meta-relationships, there will be arbitration courts created in the metaverse, its own meta-bailiff service, since there is property that will block your skins in the game. Most of the decision making is automated. The system of education of lawyers will change.

Appropriate solutions will make it possible to create digital twins of real objects when designing new production lines, mechanisms and devices. By testing in a virtual environment, you can significantly save time on the production of intermediate versions of prototypes. In this environment, he trains his own neural networks, which are used, for example, in the development of active driver assistance systems. Automakers can do the same.

There is a need to have more flexibility in the types of data that models can handle. This allows you to do recurrent neural networks. One to one architectures include models with a certain size of input and output data. In the “one to many” case, with a predefined type and size of the input object, you can get output of different lengths. This approach is used in the problem of describing images. The “many to one” option works the other way around.

Data of non-fixed size is fed into the input and their well-defined characteristics are obtained. Many to many architectures have varying sizes of both input and output data. The tasks they solve include machine translation (the original and translated phrases can be of different lengths) and frame-by-frame video classification. Recurrent neural networks are useful even when solving “one to one” problems.

Inside the architecture of a recurrent neural network is a basic recurrent cell. The model takes some input x and sends it to the RNN, which has a hidden internal state. This state is updated every time new data arrives at the RNN. After reading the input and updating the hidden state, the RNN will produce the output. There are more complex “many to many” models that are used in machine translation. They are called “sequence to sequence”.

This is a combination of the “many to one” and “one to many” methods, which are located one after the other and are called encoder and decoder, respectively. The encoder receives data of various lengths. With the help of hidden states, it forms a vector from the initial data, which is then transmitted to the decoder. It generates output from the received vector.

In order for the recurrent network to understand where the sentence begins, during training, a starting identification mark is applied to its input. To build a phrase, a pre-prepared dictionary is used, for example, from English words. He can be big. When moving to each next hidden state, we save both the generated words and information about the image. At the end of the sentence, the final token is sent to the neural network. During testing, the model independently determines where the description of the image should begin and end. Similar architectures are created using supervised learning. This means that the training datasets contain images and their descriptions.

Attention-based models can focus on specific parts of an image to avoid noise in the data. The convolutional network will now generate not one vector describing the entire image, but a set of vectors for several sections of the original image. In addition to working with the dictionary at each time step, the model also performs a distribution over the points in the image that it is currently processing. This allows her to learn to find the most important areas to focus on. After training the model, you can see that it shifts its attention around the image for each generated word.

There are concepts of soft and hard attention. With soft attention, we take a weighted combination of features across the entire image, while with hard attention we force the model to select only one small area for processing at each time step. Rigid attention is not a differentiable function. Therefore, to train such a model, it is necessary to use more sophisticated techniques than the usual back propagation of an error. Attention-based neural networks are used to answer visual questions. The goal is to train the model to answer the question on the image. For example, she must be able not only to name the objects themselves in the photograph, but also to count them, recognize colors and evaluate the location relative to each other.

ARCHITECTS

The current metaverse prototypes are often similar to cities: the same public spaces, areas that can be built on, buildings, parks and streets. Now it's voxel geometry and low poly aesthetics. Architects are used to a different concept. The digital world is not constrained by norms or physical restrictions, building codes and budgets. In the digital world, what matters is how you work with geometry, how you can optimize it what kind of narrative you offer to the user. Architects will have to come up with a language for this digital world. There will be copyright spaces that collaborate with architects, but there will also be spontaneous spaces. There are three components necessary for the existence of the metaverse. The first is the world, context, three-dimensional space. The second is the avatar. And the third is content that can be located inside the space and with which the avatar can interact.

All these components will be modernized, supplemented, subcategories will appear, but the context will remain the most ambitious and significant. Just like an architect in the physical world, an architect in the metaverse will be able to influence the experience of an entire group of people within a space. Now it's already done by game designers. The stage of mimicking the physical world should pass quickly or occupy a small part in the architecture of the metaverses, since the challenge lies in new materials, tools and the absence of most of the limitations of the physical world.

The most important skill is creative coding. He combines the ability to program and artistic skills. Neural networks can generate images, videos, change geometry. They will start generating 3D objects according to the description. It is important to understand the principles of writing code and be at the intersection of different disciplines. The most important skill in the profession of an architect is game design and understanding of game mechanics.

There is no traditional constructive logic in the metaverse. You can change the physics, allowing the avatars to jump ten meters up and walk on the

ceiling. Such conditions for creativity will create a new quality of architecture that will move from virtual architecture to physical architecture. The Metaverse can be thought of as a digital layer that is overlaid on top of the city and read with a smartphone. Therefore, buildings should have a set of elements that would help not only human vision, but also machine vision. Already now there are unmanned vehicles, drones and robots that can be engaged in delivery and other services. The metaverse can serve as a platform for testing ideas that will later be embodied in the physical world.

The digital world will become an experimental space for rethinking what is being built in the physical world, taking into account the global impact of the construction sector on the environment.

Neural network-based helpers for designers and developers are fonts. For new projects, designers take fonts that they have already used and choose from them in the simple categories of sans serif or serif. But they have a wide range of differences. In a layout, one sans-serif font may not work well with another. The machine learning algorithm is sort by visual characteristics and selects matching ones. There are currently 750 fonts in the Font map database. With each new selection, the program learns to understand the principles of combining fonts. René helps designers and developers save time and compile fonts for different projects.

J. Gold adjusts the basic characteristics for the selection of fonts. He supports the idea that neural networks are tools to help. According to the developer, René will only be useful for a professional designer. A site that generates logos has been developed. The developers of the system believe that it is possible to create a high-quality logo quickly and without design studios. The goal is to give business owners more branding freedom.

The creators of the service have introduced machine learning and neural networks into graphic design and simplified the creation of a logo. The site gen-

erates a logo and corporate identity based on the user's favorite icons, stylistic and color schemes.

In 2017, Google released a neural network program that turns a freehand sketch into a full-fledged illustration. The development is based on an algorithm that analyzes the drawing, recognizes the type of image and selects similar clip-art illustrations. Sometimes the program makes mistakes. Autodraw is useful for drawing icons, logos, banners, posters and rapid prototyping.

ProjectQuick3D works according to an algorithm similar to Autodraw: the user draws a quick sketch, and the program uses machine learning to find the desired 3D model in the Adobe Stock library. The neural network is trained. The more users draw, the more accurate the algorithm works.

Let's Enhance is a service that enhances low resolution photos. The service removes jpeg artifacts from photos, increases the resolution by four times, restores details and increases the clarity of images. The system is based on three neural networks that learn to improve photos. Super-resolution technology is trained on hundreds of thousands of low and high quality photos. The neural network processes two images, restores details and preserves clear lines, based on knowledge of typical objects and textures. The Boring neural network enhances image clarity. The Magic neural network draws in details that are not in the photo to make the picture more realistic.

uKit AI appeared as a program for website redesign. To find out how relevant it is to old small business web resources, the developers of the service have seriously invested in the study. It showed that the frequent problems of sites and their owners reflect maladaptiveness, outdated design and low conversion. Entrepreneurs could not predict that mobile traffic would exceed desktop traffic, and many web resources run on outdated Flash. Owners understand that technologies and trends are changing and see that sites are outdated, but delay updating due to lack of money and time.

The solution for a quick redesign was uKit AI. SaaS+AI based service that combines website builder and machine learning. The system re-arranges the content taking into account modern design requirements and generates new versions of pages. The technology recognizes the content and structure of the old site. The algorithm rebuilds and reshapes the content. The neural network evaluates the result and rolls out a new adaptive version. The system selects the best option using the Web Score AI neural network, which not only evaluates the site visually, but also checks the code for compliance with modern requirements.

Thing Translator helps you learn new words in a foreign language without textbooks, dictionaries or flashcards. The neural network is built on the Cloud Vision API and the Translate API translator. Technologies recognize the shape of an object, select several matches and translate words. If you point the camera at an object, the program will give its name in any language and even reproduce the word in a voice.

LOGIC GATE

Gates make up more complex circuits that allow you to perform arithmetic operations and store information. A circuit that performs certain functions can be built from valves of various combinations and numbers. Therefore, the value of the formal representation of the logical circuit is extremely high. It is necessary for the developer to be able to choose the most suitable option for constructing a circuit from gates.

The process of developing a general logical circuit of a device (including a computer) becomes hierarchical. At each next level, the logic circuits created at the previous stage are used. The algebra of logic gave designers a powerful tool for developing, analyzing and improving logic circuits. It is much easier, faster and cheaper to study the properties and prove the correct operation of the circuit using a formula expressing it than to create a real technical device. This is the meaning of any mathematical modeling.

Logic circuits must be built from the minimum possible number of elements, which ensures high speed and increases the reliability of the device.

It is necessary to determine the number of logical variables, the number of basic logical operations and their order. Draw for each logical operation the gate corresponding to it. Connect the gates in the order of logical operations.

PULSE NEURAL NETWORK

The impulse neural network is fundamentally different from the second generation neural networks used by data analysts. Such a network, instead of values continuously changing in time, operates with discrete events occurring at certain points in time. The network receives a series of pulses at the inputs and produces pulses at the output.

In a real neuron, impulse transmission is determined by differential equations corresponding to the biophysical processes of potential formation on the neuron membrane. As soon as the potential reaches a certain value, the neuron reacts to this by transmitting an impulse, and the membrane acquires the initial potential. Various models are used to describe the process. Pulsed neural networks also differ from second-generation networks in their less connected and more specific topology.

At first glance, the approach may seem like a step back - from a continuous, kind of analog picture, to an impulse, binary one. However, the advantage is that the impulse approach allows you to operate on data, taking into account the distances between neurons and the duration of signal propagation, that is, in the context of space and time. Due to this, networks are much better suited to process data from real sensors.

The spatial aspect reflects the fact that neurons are primarily connected to their nearest neighbors, and therefore input fragments are processed separately.

The time aspect corresponds to the fact that the training pulses arrive with different delays, and the information that is lost during the transition from a con-

tinuous signal to a pulsed signal is actually stored in information about the delay of the pulses relative to each other. This allows you to process temporal data in a natural way without additional complexity. Pulse neurons are more powerful computational units,

Despite the availability of biological unsupervised (unsupervised) learning methods such as Hebbian and STDP, there are still no effective methods for training impulse networks that provide better performance than second-generation networks.

Due to problems with differentiating impulses, impulse networks cannot be trained using gradient descent without losing accurate temporal information about impulses. Therefore, in order to effectively use impulse networks for real-world problems, it is necessary to develop appropriate supervised learning methods. This is a difficult task given the biological realism of these networks. It involves a precise understanding of how the human brain learns.

Another, closer to the solution problem lies in the hardware component. Simulating an impulsive network on standard equipment is a time consuming task, as it requires the simulation of differential equations. Neuromorphic hardware such as IBM True North aims to solve this problem by simulating neurons using specialized hardware that matches the discreteness and sparseness of biological neural networks.

COMPUTER VISION

Computer vision is a field of artificial intelligence related to image and video analysis. It includes a set of methods that give the computer the ability to see and extract information from what it sees. The systems consist of a photo or video camera and specialized software that identifies and classifies objects. They are able to analyze images (photos, pictures, videos, barcodes), as well as faces and emotions. Machine learning technologies are used to teach a computer to see. A lot of data is collected that allows you to highlight features and combi-

nations of features for further identification of similar objects. Face recognition based access control systems are applicable in almost all areas: from business centers and company offices to banks and restaurants.

Through rapid facial identification, customer service time can be shortened and personalized services can be offered. Computer vision allows you to see what a person might not notice. This is especially true in medicine (analysis of X-ray and other image) and industry (detection of defects). Recognition usually takes a few seconds. A person will examine a shelf in a store for the correct display of goods for much longer. Without computer vision, the development of unmanned vehicles and robots is impossible. For further distribution of computer vision systems in the business environment, developers are solving the problem of system speed and stability. Now the cameras transmit data to the server, where, with the help of special software, recognition takes place. The system needs constant access to high-speed internet.

Transferring data to the server slows down the process. Network problems generally stop it. Generative adversarial models of neural networks come to the fore. This is a generative adversarial neural network, which consists of a generator and a discriminator. Generators generate input data, and discriminators evaluate their authenticity and classify them into categories using a certain set of features. The development of generative adversarial networks has made it possible to make a qualitative leap in the recognition and generation of human faces. GANs create the most realistic images that are indistinguishable from real photos or paintings.

In addition to static images, neural avatars are becoming more common. These are moving images based on 1-32 photos, time-plumps based on landscape photos and 3D scene modeling based on panoramic photos. Next, the animation of the photos is carried out using special algorithms. In 2009, D. McKinnon developed the 3DSee program, which generates 3D models based on 5-15 photographs. An important condition: all photos must overlap by at least 80-

90%. The next step was the automatic generation of high-resolution 3D models, like in the bullet scene from The Matrix. The creation of 3D scenes is in demand in construction, interior design, military affairs, and animation. Hollywood is already using this technology to accurately reproduce lighting, actors and sets to save money on technically demanding shoots. Manufacturers train robots on 3D models that need to move in space along a certain route and overcome obstacles. 3D scanners are suitable for identity authentication, virtual fitting of clothes, and many other things. Using a smartphone, you can shoot a person from different angles and get a 3D avatar.

So far, it is difficult for neural networks to reproduce some textures in detail, such as tree foliage or hair, for example, and create full-fledged 360 ° models. But in the near future, they will replace 3D designers and animators: they will be able to create renderings of buildings and interiors, animated presentations and VR simulations of objects themselves. Google's NeRF technology generates realistic 3D images that are used to create AR and VR environments. Using the Eora Mage algorithm, you can find a similar logo in five seconds. This is convenient at the stage of selecting an image.

At the registration stage, specialists need to make sure that such a trademark has not yet been registered, and the client will not have legal problems. Suppliers of goods to large retail chains began to supply merchandisers with tablets with special photo recognition software. Instead of checking the availability of goods, its arrangement and the relevance of price tags manually, the sales representative simply takes a picture of the shelf. The system compares it with the planogram and gives recommendations: what product is missing, what is in the wrong place, where the price tags are mixed up or the current promotion is not indicated. Analyzing the shelves of competitors, the system monitors the share of the shelf in dynamics.

This allows you to optimize the work schedule of the staff and make your stay in the store more comfortable and service faster. Smart scales using com-

puter vision technology identify goods when weighing at the checkout. Alipay began testing a computer vision-based payment system in 2017. Recognition technologies are being used to keep workers safe. Video analytics systems monitor the wearing of personal protective equipment in hazardous industries. If a person is not wearing a helmet, mask, gloves, bright vest, he receives a notification. The signal is sent to his leadership. At central control panels, where it is important to maintain a high level of concentration and not be distracted, face recognition systems monitor the condition of specialists.

If a person has reduced attention or falls asleep, uses the phone, or moves away from his post, he and the entire team receive a warning. Technologies are beginning to be used to control the quality of manufactured products. They see defects, help to weed out defects at an early stage, check dimensions determine the correct distances, read the markings of components during assembly on the conveyor. Savings are achieved by minimizing errors and waste. Thanks to computer vision, the face becomes the new human ID.

Face identification allows you to provide 100% protection against fraudsters presenting someone else's document. The technology of confirmation of transactions by a person in a mobile application is being developed. ATMs will soon be equipped with recognition systems. Computer vision is becoming a virtual doctor's assistant. The technology analyzes x-rays, MRIs and ultrasounds, helping to improve the accuracy of diagnosing diseases.

Neural network algorithms help improve the quality of X-ray and CT images by removing unnecessary noise and distortion. Modern smartphone models use technologies that help process the image even during the shooting process. Special algorithms take several shots, compare them and display an image that is ideal in color and quality.

They calculate light fluxes, build volumetric models and perform other calculations based on computer vision. Using a smartphone camera, you can even create a 3D model of space, an object or a person. Computer vision has be-

come a component of the development of autonomous land, air, and sea transport. Technology helps machines to navigate in space. Facial recognition systems are used to ensure security at transport infrastructure facilities: railway stations, airports, metro stations. The person will also become a ticket for any type of passenger transport. Pattern recognition systems can diagnose plant diseases and detect harmful insects, determine the height and volume of crops in the field compare them with ideal indicators, and help make harvesting decisions. Robots will be able to work in greenhouses and fields, which, thanks to machine vision, will collect fruits and do it very carefully. Facial recognition systems are installed in sports arenas.

They do not allow fans who are prohibited by court order from attending matches help confirm the identity of the season ticket holder, and speed up access to events. Computer vision will allow the development of the online education system. For example, verifying your identity while taking an exam remotely. Student spoofing is a problem with remote testing. Computer vision detects suspicious student activity by sending these segments of video to observers for verification. Recognition systems are used in classrooms to control the involvement of students in the educational process.

CYBERNETIC SECURITY

The causes of failures on the platforms of the metaverse can be both internal breakdowns and bugs, and external influences, including attacks. Since the deployment of metaverses requires large resources, attackers will also use powerful botnets to attack them, possibly assembled from several or even many heterogeneous botnets. However, taking into account, on the one hand, the rapid growth in the number of Internet of Things devices connected to the network, and, on the other hand, their low level of protection from cyber risks, it can be assumed that botnets of the future will be based on networks of bots covering many (thousands, or even millions) of devices.

Also, most likely, the immediate targets of DDoS attacks on the metaverses will be their key services, the failure of which will make not only these, but also many other related services inaccessible. In this scenario, attackers will use their botnets based on multiple Devices connected to the metaverses to carry out DDoS attacks against both the metaverses themselves and other cyberspaces, sites, or devices. Powerful botnets can also be used for cybernetic terrorism to attack industrial and social facilities, communication and control centers, as well as for hybrid wars waged simultaneously in physical and digital reality.

Since the operators of large metaverses will most likely control all the main levels of their implementation in accordance with the network model, it will be necessary to protect the metaverses from DDoS attacks in a comprehensive manner. This means that it will be necessary to take into account threats at all levels and for all groups of resources on the basis of which the metaverses are deployed: networks, applications, as well as real-time online services.

The complexity of coverage in this case is critical, because the components of the metaverses that are not connected to protection automatically become vulnerable to DDoS attacks.

Many cybernetic risks that will be inherent in the metaverse can be considered and analyzed using the example of online games. However, it is necessary to make a small but very important amendment: game users, as a rule, do not profit from being in the gaming virtual space, they do not earn money from it. For the vast majority of users, these are their favorite leisure sites, on which they are ready to spend a lot of time and money.

Unlike them, users of the metaverses will be able not only to have fun, but to work, practically live in the digital world, and they will certainly become indignant if access to their living and working virtual space is suddenly interrupted or if its quality drops sharply. Tellingly, the gaming industry has traditionally been one of the leading industries in terms of the number of DDoS attacks.

As a result, she has amassed both a rich portfolio of knowledge in the area of cybernetic security and the unfortunate experience of the consequences of the weak security of online games. Resistance to cybernetic attacks and other malicious influences should be built in at the design stage of future software systems and services. Otherwise, it is highly likely that the created information system will contain many gaps and vulnerabilities, the elimination of which will take a lot of time, labor and money. An information system that is well designed with the participation of highly qualified information security specialists will be much less vulnerable and more resistant to cyber risks, and therefore it will be much easier and cheaper to protect it. Securability is the ability of Internet resources to be effectively protected from attacks using minimal amounts of money, time and labor.

For metaverses, security will be critical, as economies of scale are very noticeable in large digital spaces. For the owners of modern gaming sites and social media, the consideration of benefits and costs is also important, so their security should be given due attention. Four main factors affect security: What and to what extent an attacker can learn about an Internet resource.

Ideally, the attacker should not know anything about the resource and should not be able to get any information about it. The more a resource looks like a “black box” to an attacker, the less trouble awaits its owners. The better the provider understands what and how works inside the resource, the more effectively he will be able to protect this resource. In order to block illegitimate requests to a resource, the provider must clearly understand what legitimate requests look like. The most difficult situation for the provider is when there is no way to distinguish legitimate traffic from illegitimate traffic by formal signs.

It is important to foresee the possibilities that would make it possible to distinguish, and inform the provider about them before enabling protection.

The stability of a resource may be at risk while some part of its components remains without protection. The resource must have a sufficient margin of

safety to withstand a weak attack. This is important because, for a number of reasons, it is not always possible to filter out 100% of illegitimate traffic, and some of it, albeit a small one ends up on the resource.

PHILOSOPHY OF CYBORGS

The cyborg is a hybrid of a machine and a human. This is a person with artificial vision, hearing, heart, kidney, arm, leg and other parts of the body. Work is underway on a prosthetic arm connected to nerve endings. Such a pros thesis is able to feel heat and move on command from the brain. A device has been created that can convert sound into electrical signals and transmit them to the brain. Man has always wanted to see better, hear more and feel more sharply. And for this he invented night vision devices, digital hearing aids and binoculars, as well as various other devices. In the era of digital technologies more and more processes are controlled by software, and augmented reality technology is being introduced.

The term "augmented reality" refers to computer displays that add virtual information to the stream of traditional human sensory perceptions. Most of the development and research is focused on creating see-through devices that are attached to the head and superimpose additional graphics and text on pictures of the human environment. You can also add sensory inputs such as sounds or tactile sensations. But the vast majority of information about the world comes through vision, so the efforts of developers are focused on visual technologies for expanding reality. Technologies present information to the user not on a separate display, but by integrating it into the natural mechanisms of perception. The new computer interface and way of seeing the world becomes one and the same. Doctors' vision is beginning to receive the equivalent of an x-ray, allowing real-time observation of the scans of internal organs superimposed on the corresponding part of the patient's body.

The transparent body makes it possible to effectively perform laparoscopic operations with minimal surgical intervention. The systems constantly track the position and orientation of the user's head so that the superimposed virtual material is as accurately as possible combined with the visible picture of the world. The systems use approximately the same technologies as in the field of virtual reality simulation. However, there is also a significant difference. Virtual reality replaces the picture of the real world, and augmented reality complements this world.

The end-to-end display in an AR system must combine virtual and real information in a single image. Such a display can be fixed permanently. But usually it is attached to the head in the form of a miniature screen located close to the eye and therefore capable of giving the impression of a picture of any size. By analogy with headphones, this device can be called a head-up display. The through-vision optical display is a mirror beam splitter. It is a translucent mirror that reflects and transmits light at the same time. If such a plate is correctly positioned, then the beam splitter can reflect the projection image of a computer display into the user's eye and at the same time transmit light from the picture of the real world around. Lenses and prisms can be used for better image overlay.

Video display technology uses video image mixing technology. There is a combination of a picture from a video camera fixed on the head and images generated by a computer. In this case, the glasses are opaque, since the display, on which the combined image is projected, plays the role of a lens. They try to place the video camera as close as possible to the point of view of the eye, so that the resulting video image is as close as possible to natural vision. Both in the first and in the second versions, the displays can be mounted for both eyes, so that the formation of a three-dimensional stereoscopic image is possible. Optical systems give the user the ability to see the real world with the resolution and view that the eyes represent. The overlay graphics are translucent and do not hide the objects they replace.

As a result, text may be difficult to read, or 3D graphics may not always be able to create a convincing illusion of volume. Due to the difference in distances, the user may experience difficulty when trying to focus on the real object and its superimposed structure at the same time. In see-through video systems, virtual objects completely hide real objects. They are combined with them with great variety in terms of graphic effects. There are no problems with focusing, since virtual and physical objects are combined in the same plane. The reverse side of the advantages of a computer image is a noticeable decrease in the quality of the picture, since the resolution of the video camera and screen is still far from the human eye.

Constantly improving technologies have made it possible to bring modern micro displays to the size of ordinary glasses. Several new directions have also clearly emerged. A device has appeared on the market in which a low-energy laser projects an image without screens onto the retina. In another alternative approach, computer-generated graphics, on the other hand, are volumetrically projected directly onto the environment. One or another specific design of the augmented reality display will be determined by the nature of the tasks solved with its help. The concept is beginning to be implemented in a variety of systems from the maintenance of chemical plants to the repair of cars and household appliances.

The clustered and virtually conditioned alignment of the human life world formats the world around according to the standards of the information space, in which time, space, technological or production chains, social ties, models of interaction and existence are formed in a smart-spatial paradigm that deconstructs classical models of time, space and culture. The logic of building a medial virtual-digital reality is incorporated into the cultural environment and ontic space of the post-human cyborg, which is formed according to the models and style adopted in the programs of the computer world.

The basic positions of the ontic space became the subject of critical reflection. In the virtual life world of a person, there is a transformation of personal parameters: structures of thinking, patterns of behavior, as well as ways of self-identification. The term “digital identity” has become relevant. Dematerialization of relations and actions, prosthetics by network organs, the virtual nature of the identification model, subjective non-autonomy and obedience to network orders are investigated.

The figure of the human or superhuman disappears. Donna Haraway says so. Born in Denver, Colorado, the son of a sports journalist and a devout Catholic, who studied evolutionary philosophy and theology at the Fondation Teilhard de Chardin in Paris and completed her thesis in biology at Yale University, D. Haraway began to represent the philosophy of cyborgs from the position of feminist theorists of science. She is considered one of the founders of cyberfeminism and new materialism. Her research interests are in immunology and embryology, the internet and digital technologies, the punk scene, the history of medicine, queer theory, literary theory, anthropology and sociology.

Her coordinate system is from the underground, from the position of the oppressed: the colonized, non-whites, women, workers and cyborgs. In her view, position and identity do not guarantee privileged access to truth or pure experience. The knowledge is polluted. It is polluted by the instruments used (optical, discursive and imaginary), by social and material relations, by the intersections of oppression, power and resistance.

All these elements affect not only the produced knowledge, but also the production of the subject of knowledge itself. The identities are the effects of optical instruments. Objectivity is guaranteed not only by position, situation and perspective, but also by the organization of knowledge as an object. Objective knowledge is open. It can connect and interact with other partial perspectives, experiences and positions without merging into a whole, forming unstable aggregates and assemblies.

The world of Google and social networks, the darknet, high-tech black market biological hacking, spectacular forms of capital and pharmaco-pornographic techniques for controlling subjectivity, plastic surgery and cybernetic implants, the global offensive of neoliberalism and neoconservatism, virtual jihad, genetic engineering and gamified militarism, resides in an allotopic space that accommodates opposites and contradictions, dangers and hopes. If earlier monsters in a Eurocentric culture served to mark the boundaries that define the concept of the human, now they have become a matrix for the production of hybrid identities and fluid forms.

D. Haraway is focused in the fields of science and technology research, feminist theory and epistemology. She works in a paradigm created by Bruno Latour, Michel Callon, Karine Knorr-Cetina, John Lo and Annmarie Mol. In the actor-network theory, scientific knowledge is considered as a product of the interaction of actors (people and non-people) united in one network. The understanding of knowledge as a reflection of the laws and processes occurring in reality has been replaced by a concept in which knowledge has become the product of specific interactions between scientists, institutions, discourses, social groups, technologies and objects.

A feature of the actor-network theory is the principle of a symmetrical approach to actors of any type. It becomes important not only to study the world of people (scientists, social groups, the state and other institutions), but also the actions and their effects of non-human actors. Descriptions of the activities of microbes, scallops, drugs, measuring instruments, maps and bicycles appeared in the texts. As a result, society, its structure, subject and action, have become more complex.

The social has become a product of the interaction of heterogeneous elements (people, animals, machines and nature). Its organization and functioning has been transformed into a black box that needs to be constantly deciphered, taking into account the situation. It is not a set of fixed lines and positions, al-

ways ready to be used as an explanation, such as city, class, and power. The subject does not look like an atomized individual. It is an assemblage, assembly and collision of forces and components of different nature, ranging from chemical reactions and viruses to metaphysical discourses and gender performances.

The theory has been heavily criticized by feminists for relativizing the relationship of power and oppression. That it turns them from the obviousness that criticism has worked so hard to create into unstable, particularistic and difficult to generalize sets of situations. As a result, not only the establishment, but also opposition-minded intellectuals and activists are deprived of the opportunity to claim the truth as a correspondence. If identities such as "women," "workers," and "non-whites" are inevitably relative and given meaning only in terms of the context in which they are placed, then the task of organizing collective political action loses one of its supposed foundations.

D. Haraway builds the cyborg project as a holding together of apolitical and relativistic actor-network theory, postmodernism, feminism and the left movement. Cyborgs, assembled from myths, affects, machines, people and animals, promise an intellectual and political adventure in a world in which all preestablished boundaries are destroyed. Refusing to claim the truth of his judgments, D. Haraway develops concepts that allow one to navigate in a crisis situation and, with the help of imagination, build and give meaning to radical political projects that combine feminism, anti-colonialism, anti-racism, anti-militarism, eco- and queer activism.

The aim of the study is to analyze the cyborg as a futurological figure. Philosophical reflection makes it possible to expand the interpretation of the cyborg without limiting it to the tautological meaning of the complementation of man and machine. The cyborg concept are analyzed and compared. The concept of the cyborg represent opposite cultural strategies, although we are talking about the same futurological figure. This internal conflict allows us to speak about the features of the cyborg figure. It has many faces and is associated with

the art of concealment. The deepest intentions are concealed, which do not allow considering the cyborg as a representative of an exclusively transhumanist project. The connotations of the machine are associated with the need for an upgrade, which is designed to preserve the human identity. Differentiation into concept and allows a more comprehensive look at a complex cultural phenomenon and offers a new interpretation of the cyborg.

BIOLOGICAL HACKING

The word "biological hacking" refers to experiments with diets and the implantation of chips. The goal is to find the limits of the abilities of the human body and go beyond these limits. For biological hackers, not only the benefits for the body are important, but also the commitment to a certain idea.

It is difficult to say exactly when the biological hacking movement began. It is associated with industries where there is a lot of money, because work on the body requires funding.

The goal is to integrate devices into the body. It's about chipping. One of the pioneers of chipping was Amal Graafstra, founder of Dangerous Things. Amal's forgetfulness became the reason for interfering with his own body. He constantly left the electronic key to the office at home, because of which he could not be at work for the longest time.

A. Graafstra ordered parts for the chip on the Internet that should not cause rejection in the human body, assembled the device at home and injected it under his skin with a veterinary needle. He settled on the NFC wireless data transfer technology built into most smartphones. At that time, no one mass-produced NFC chips and implanted them in themselves. In 2013, Amal created his own company to monetize his personal experience. A year later, the income amounted to 100 thousand dollars. For the implantation of chips, the founder of Dangerous Things recommends contacting piercers.

In biological hacking communities, it is customary to despise people who undergo procedures for implanting electronic implants in specialized clinics. The chip is implanted either independently or with the help of a friend, neighbor and noncore specialist.

The main purpose of chipping is to hide encrypted data where it cannot be reached by intruders. Technically, it is possible to attack a person with a chip and cut a device from under his skin, but far fewer people will do this than steal a card from his pocket.

There is a classification system for biological hackers to recognize among them those who are engaged in radically different things. Those who are not afraid and do not hesitate to conduct experiments on themselves are called grinders.

One of the most famous grinders is Gabriel Lisina. There was an attempt by a biological hacker to turn his eyes into thermal imagers. Together with medic Geoffrey Tibbets, he dripped a mixture of chlorin E-6 with insulin, dimethyl oxide, and saline into his pupils. The main active ingredient of this mix, chlorin E-6, is an analogue of the photosynthetic plant pigment chlorophyll, which is used to treat nyctalopia, a violation of the ability to see in the dark.

Two hours after the injection of chlorine, G. Lisina was able to read signs (letters, numbers, figures) in the dark, which were not seen by the people invited to participate in the experiment. Also, the biological hacker could determine the location of other people in the dark among the trees with absolute accuracy, while the rest of the subjects were only able to do this in a third of cases. The next morning, G. Lisina's vision returned to normal, and within twenty days after the experiment, he did not notice any side effects.

Kevin Warwick in 1998 implanted an RFID chip under his skin, with the help of which he was able to implement individual elements of the smart home concept: open and close doors, turn on the light remotely. In 2002, an implant connected to the median nerve of the left arm was placed in his left arm. The

implant was supposed to transmit signals from the nervous system to the computer and store them there. To make the experiment more spectacular, the Briton created a special mechanical hand that worked in sync with his real hand. When K. Warwick moved his fingers, neural impulses went from his brain to the implant, which then turned into electrical signals and transmitted to the computer, and the mechanical hand, depending on the type of signals, moved each time just like a real one.

A similar device was implanted under the skin of his wife, Irina. Kevin planned to establish a cybernetic link with his wife, transmitting his thoughts to her through a computer. Nothing succeeded.

Rob Spence, who lost his eye as a result of an injury, decided to replace it with a cybernetic eye. Spence's new eyeball was designed by ocular prosthetist Phil Bowen. And former MIT and SpaceX employee Costa Grammatis created a miniature device that fits into the void in Rob's skull. The dimensions of the chamber were not to exceed nine millimeters in thickness, 30 millimeters in length and 28 millimeters in height. K. Grammatis put in place of the eyeball not only a camera, but also a battery with a signal transmitter to third-party devices, as well as a software board for image processing.

Martin Ling of the University of Edinburgh helped design the architecture for the entire system. M. Ling designed a special receiver that receives a signal from the implant and transmits it to a laptop, tablet, smartphone and projector. The red LED light that indicates the camera is on was invented by everyone together. The first known attempt to create a prosthesis for some part of the brain was carried out by neurologist Theodor Berger in 2003. From several dozen electrodes, T. Berger created a prosthesis for the middle part of the hippocampus for rats. With the help of these electrodes, electrical activity was recorded in rodents, and the corresponding part of the nervous system was also stimulated. Damage to the hippocampus caused the animal to forget previously learned in-

formation about which feeder contained the treat. Electrical stimulation restored these memories.

The following year, 25-year-old Matthew Nagle, a former football player, became the first person in the world to receive a brain implant. In 2001, Matthew got into a street fight and, having received a spinal cord injury in the process, remained paralyzed. M. Neigl agreed to participate in the experiment. He was implanted in the brain with Brain Gate system chips developed by cyber Technology.

After the operation, M. Neigl was able to control the cursor on the computer screen, imagining how he was moving his arms. He read emails, played simple video games, wiggled his electromechanical arm, and even drew. The signals that form in the brain are transmitted through a sensor, which is a four-by-four millimeter square plate with hundreds of tiny electrodes. They are small millimeter metal needles that penetrate directly into the cerebral cortex.

The sensor is in contact with the motor cortex responsible for the movement of the left hand, and is connected to a connector fixed in a hole in the skull. When you try to make some kind of movement, an electrical impulse arises in the motor zone, which is transmitted through the implanted electrodes to the computer. The sensor recognizes the motor neuron signals that are activated and transmits them to a connected device, such as a monitor or prosthesis robot. But the implant and M. Neil's brain turned out to be incompatible.

In 2012, the next generation of BrainGate2 chips was tested on two patients with stem stroke. A woman named Kathy and a man named Bob could not move either limb and also lost the ability to speak. Devices with hundreds of ultrathin electrodes were implanted into the brains of the subjects, which read the activity of the brain and recognized the activity of neurons in certain areas of it. Thanks to this, Bob and Kathy were able to control mechanical prosthetic arms with their thoughts. So, the woman was even able to bring a glass of coffee with a straw to her lips and drink a little.

In a later experiment with BrainGate2, three people were completely paralyzed from the neck down. The implantation of electrodes in the region of the motor cortex of the brain allowed them to work on the tablet: typing, searching for data on the Internet, playing the digital piano.

New discoveries enable biological hackers to understand the possibilities of technological evolution in the field of science.

Proponents of biological hacking are thinking about digital immortality. For this, it is supposed to transfer the mind of a person into a robot avatar. There are concepts of four variants of avatars at once: a remotely controlled anthropomorphic robot, an artificial body for a human brain transplant, a body of nanorobots and a hologram body. If large corporations own the rights to record avatars and store personal information, will they ethically dispose of it?

Biological hackers can be seen as one of the branches of the concept of trans humanism. This is a philosophical trend, which is based on the improvement of the physical, mental and moral qualities of a person due to technological progress. Trans humanists believe that technological developments and innovations will rid mankind of diseases and most problems.

DIGITAL GENERATIONS

The new technological reality has created new digital generations. These are the generations of Millennial (Y), Centennials (Z) and Alpha. The methodological basis of the theory of generations was formulated by K. Mannheim. He formulated a methodology for recognizing generations according to the criteria of sociology. W. Strauss and N. Howe localized the theory of generations with Anglo-American specifics.

Millennial from 1982-1995 became the first digital generation birth. This generation grew up in the comfort of home and hardly part with the parental home. He likes the fact that parents provide home comfort and cannot interfere with his digital culture due to ignorance of this culture. Individual freedom and

the parental home never formed a culture of personal security among millennial. This generation is open to any information and itself provides confidential information to the social network. The openness of the social network is explained by the fact that millennial discovered the world of information and, on this basis, began to trust any source of information. They needed, as the first digital generation, to gain experience in order to comprehend the phenomenon of information. It was difficult for them to imagine that the information is subject to the criteria applied to the verification of knowledge.

In terms of professional activity, millennial follow the principles of subordination, meeting deadlines and understanding corporate responsibility. Representatives of this generation are characterized by painstaking, patience, bringing projects to the final implementation. Millennial have been replaced by Generation Z from 1997-2012 birth. These are people whose socialization took place in the human-machine mode of constantly carrying an iPhone or smartphone with them. These people have developed a culture of constant indirect contact with people. They cannot be outside this contact even for a limited time. They value indirect contact. So, a girl walking with a guy is in constant telephone contact with the subscriber. This does not offend the guy, since he himself is in the mode of mediated communication.

Due to the need for constant contact mode, generation Z does not tolerate loneliness. It is constantly in the social network. The value for him is the possibility of dialogue in digital modification. This modification is consonant with the youth collaboration. Behavior is shaped by reaction through text and image. In communication, a special role is given to the image, emoticon and meme. They stimulate dialogue and form the basis of feedback. As a result, the primary mental processes of memory, attention and thinking are transformed into sociocultural processes of lifestyle.

Centennials find themselves in a situation of synergy, consensus, participation, experience, formation of ideas, projects, programs of joint activities and

social activity. They go through the stages of adaptation to the emerging situation of dialogue, understanding the organizational structure and social hierarchy, transforming the discussion platform into a space of opportunities for dialogue. Communication processes are regulated by cultural resources accumulated by the participants in the dialogue. In a relaxed environment, the ability of each individual participant to remain faithful to the dialogue and resist the egoistic desire to turn it into a monologue is tested.

Unlike Millennial Centennials are more wary of social media. They do not tend to provide redundant information about themselves. For them, the Internet has become a platform for finding information, creating their own business. Pragmatic interests dominate over the emotional interests of many hours of communication in a social network. As a result, generation Z starts independent work early and actively combines it with the process of getting an education. This generation combines pragmatics with intellectual reflections on the prospects of humanity. He is concerned about ecology and uncertainty in social dynamics. Because of this, Generation Z tends to be more anxious and concerned about personal health. This generation also worries about the fear of missing out on something meaningful in life. For its representatives, reputation and the search for truth play an important role.

The multicomponent nature of the current situation creates a complex of emotional experiences, jealousy, claims to leadership. The risk of conflict situations is high. As a result, generations Y and Z are characterized by fear and uncertainty. This prompted to talk about the mental health of these generations in a situation where the pandemic has increased this uncertainty and uncertainty.

Digital generations reacted quite positively to the phenomenon of the virtual labor market. Under the influence of the pandemic, a tendency has emerged to strengthen the role of non-standard forms of employment in the labor market. They are characterized by categories of full standard employment and non-standard forms of employment. It includes new mechanisms of legal regulation

of labor relations based on social models of employment. One such model is e-employment. It allows the employee to be at a distance from the employer.

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