СЕКЦІЯ 8
ІНФОРМАЦІЙНІ СИСТЕМИ ТА ТЕХНОЛОГІЇ. КОМП'ЮТЕРНА ІНЖЕНЕРІЯ. КІБЕРБЕЗПЕКА. ІНФОРМАЦІЙНО-ВИМІРЮВАЛЬНІ СИСТЕМИ

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STRUCTURAL MODEL OF HUMAN INTELLIGENCE AND THE LIMITS OF ARTIFICIAL INTELLIGENCE REALIZATION IN INFORMATION SYSTEMS

The development of a structural-functional model of knowledge acquisition involves the formalization of links between the relevant functional areas of human intelligence and modern expert systems. First of all let's consider the main terms and their meaning for understanding what "abilities" an information system (IS) should have in order to be classified as artificial intelligence (AI) technology.

Intelligence is the quality of the psyche, consisting of the ability to recognize new situations, learning and remembering from experience, understanding and applying abstract concepts, and using one's knowledge to control the environment. In other words, it is the ability to learn, receive, adapt, modify and replenish knowledge in order to solve problems. Thus, human intelligence can be characterized by a number of basic parameters, including the amount of working memory, the ability to predict, think, cognize, understand, consciousness and memory.

The amount of working memory is considered as a cognitive system of limited capacity, which provides temporary storage of information available for direct processing. The ability to predict involves building cause-and-effect relationships, ie logical thinking, the ability to justify judgments about possible states of the object in the future and (or) about alternative ways and timing of their implementation, using logic - the science of correct thinking.

Thinking - a set of mental processes underlying cognition (understanding), which includes basic operations of analysis and synthesis, based on which the brain implements other typological units: comparison, classification, generalization, concretization and abstraction, which in turn provide implementation active side of cognition: attention, perception, association, creation of concepts and judgments as a result of understanding.

Consciousness is the state of the mental life of an organism, expressed in the subjective experience of the events of the external world and the body of the organism, as well as in the response to these events. Consciousness as a state of mind is also associated with the phenomenon of intuition and many other phenomena, such as [1]: the ability to distinguish, classify and respond to environmental irritants; integration of information by the cognitive system; monitoring and introspection about mental conditions; the system's ability to access its internal states; focus of attention; conscious control of behavior; difference between wakefulness and sleep. Intuition as a psychological phenomenon characterizes a person's ability to understand, form and penetrate the meaning of events, objects through an unconscious conclusion based on imagination and previous experience.

Memory is one of the properties of the nervous system, which is the ability to store information about events in the outside world and the body's response to these events, as well as repeatedly reproduce and change this information [2].

The result of cognition is knowledge that from a philosophical point of view can be logically or factually substantiated and empirically or practically verified. In the theory of AI and expert systems (ES), knowledge is a set of statements about the characteristics of objects, patterns of behavior of the system, as well as the rules of logical inference of statements based on rules and other statements for decision-making [3].

A simplified structural model of human intelligence and its connection with the most common structural model of the ES as one of the areas of AI research is presented in Fig.1. [4]. EC technologies are limited to the implementation of mechanisms of cognition (thinking), as one of the basic elements of intelligence. Upstairs is consciousness, the mechanisms of which go far beyond classical logic, where modern intelligent systems face difficulties and are virtually unrealized.
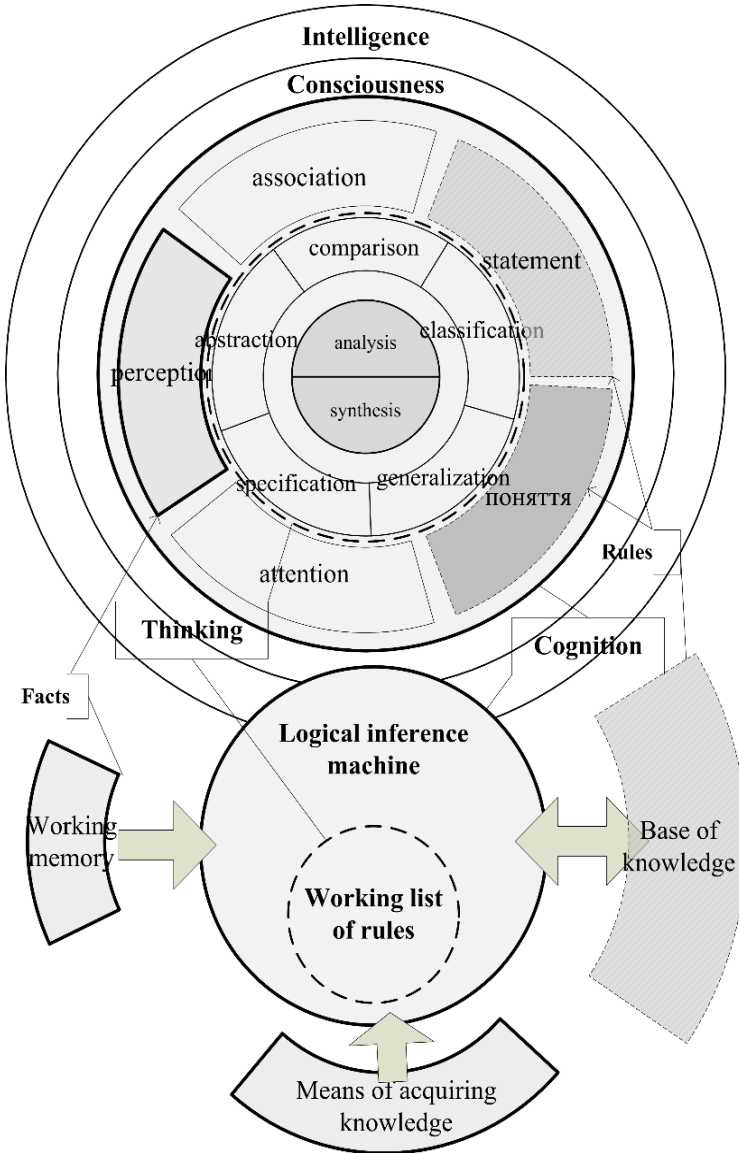

Fig. 1 – Structural models of human intelligence and expert system

Modern IS with large amounts of RAM and computing power can implement almost all the basic elements of human intelligence: working memory, long-term memory, thought and prediction processes except for consciousness and intuition. It should be noted that the process of cognition of intellectual IS is also limited at the present stage of their development only by logical cognition, i.e. due to clearly structured rules and logic. But the process of human cognition can be carried out on an intuitive principle, i.e. knowledge of a phenomenon without understanding how this knowledge is obtained.

Many IPs have the means to acquire knowledge by deriving rules by induction based on examples, ie teaching with a teacher. A number of methods are used to develop rules in machine learning, such as ID3, C4.5, C5.1, artificial neural networks and genetic algorithms [5]. The peculiarity of the development of rules by machine learning methods is the inability to explain why they were created. At first glance, this is very similar to the process of intuitive human cognition, but it is only a superficial view without taking into account the unconscious inference in the case of man.

Obviously, the concept of AI, founded in the 50s of last century, was considered in the perspective of the development of this branch of science with the ultimate goal of implementing in IS a fundamental element of human intelligence - his consciousness, or so-called strong AI, or general AI, GAI. At present, we should discuss artificial thinking and logical cognition, which reflects the real limits of the processes of modern "intelligent" systems, or as accepted in the scientific literature - weak or narrow AI (WAI, ANI).

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ANALYSIS OF MODERN METHODS FOR ESTIMATING THE BRAIN LEVEL OF BRAIN TIRES OF OPERATORS OF EXTREME ACTIVITIES

The problem of fatigue is one of the most complex and multifaceted in the physiology and psychology of work, not only for operators of extreme activities (EMS) but also for ordinary workers. It has long been of interest to researchers in many fields of science. Theoretically, the importance of studying fatigue is due to the fact that it is an intermediate state between normal and pathology. The practical significance of such a study is determined by the impact of employee fatigue on reduced productivity and quality of work, and social - with temporary disability and disability of those workers who perform work in conditions of overstrain of physiological systems.

The central-cortical concept of the development of brain fatigue was developed in the works of IP Pavlov, ME Vvedensky, OO Ukhtomsky, MI Vinogradov, PK Anokhin, SO Kosilov, VV Rosenblatt and others . She received her experimental confirmation, which boils down to the following conclusions:

1) Accumulation of lactic acid in the muscles is not the main cause of fatigue, and in the whole human body fatigue is not directly dependent on the accumulation of metabolites. The person gets tired and at performance of easy and mental work when there is no accumulation in muscles of lactic acid;

2) The main share in the mechanism of fatigue belongs not to peripheral but to central processes. This is evidenced by the extremely low fatigue of peripheral devices and the impact on the development of fatigue of the central nervous system (emotions, automatism);

3) The primary link of the central mechanism has a cortical nature. The lower the level of conscious control over the performance of work, ie the lower the level of excitation and, consequently, the energy expenditure of cortical centers at work, the less it is tiring, although the nature of muscular loads and efforts does not change;

4) An important role in the development of fatigue is played by the process of inhibition in the cortical center of the musculoskeletal system.

Shifts in the state of the cortical centers are due to many reasons. The main one is that the cortical centers, having the lowest level of efficiency, carry a large load associated with the processing of various information and regulation of all organs and systems of the body, namely:

- streams of afferent impulses in relation to the work task are directed to the cortex;

- the cortex generates impulses to contract muscles;

- from the working muscles come signals about the chemical changes that occur in them under the influence of the work performed;

- similar signals come from other organs and systems that ensure the performance of work (cardiovascular, endocrine, respiratory, etc.);

- part of the information is in the form of the results of mental activity of the brain (memory, imagination, thinking, etc.);