INTRODUCTION OF ARTIFICIAL INTELLIGENCE TOOLS INTO THE TRAINING METHODS OF ENTREPRENEURSHIP ACTIVITIES

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ABSTRACT

The current article focused on the scientific mission of increasing the level of training of entrepreneurial activities based on the usage of artificial intelligence tools. The study defined fuzzy models from the standpoint of cognitive understanding of information and development of the entrepreneurial training. There was developed the model of neuro-fuzzy regulator, as well as justified the technology of introduction of the neural network in business training. Also, the study specified the M-machine concept for development of the artificial intelligence technology in provision of the entrepreneurial education.

Keywords: Entrepreneurial Activity, Training, Information Processes, Neuro-Fuzzy Systems, Cognitive Systems, Adaptive Regulator, M-Network.

JEL Classifications: I2, F6.

INTRODUCTION

In the modern transience conditions, the flow of information processes in the entrepreneurial activities of decision-making is realized on the basis of human-machine procedures in form of the cyclic interaction process of a person and computer (artificial intelligence system). Generally, such action as decision-making is previously analyzed in detail and formed by the regulatory environment of the information system, which performs the functions of expert on actions of the person, namely the entrepreneur.

REVIEW OF PREVIOUS STUDIES

In the process of conducting entrepreneurial activities, the business owner often faces various abnormal situations that develop under uncertainty, in terms of operational work with high flows of commercial information in real time (Cooke, 2002; Dirican, 2015). Therefore, introduction of the decision-making training system does not exclude the right to make a decision and the level of liability for the certain person, but highlights the expedience and need to create the artificial intelligence shells to solve the issues of choosing alternative *"joint actions"*, and training in entrepreneurship activities (Bilan et al., 2019).

The reporting approach can provide a representation of mental models of entrepreneurship activities and the artificial intelligence system in form of the cognitive concepts and rules (Dalevska et al., 2019).

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METHODOLOGY

The methodology of the study is formed by the analytical groups of approaches to development of the entrepreneurial training:

1) Hypertext training systems. The modern trends of open education mainly focused on foundation and application of the effective training systems, which use the hypertext system of representation of the material. The artificial intelligence systems are components of the complex conversational system, which combines the parts, reflecting different forms of human expression (Davis et al., 2009; Felt et al., 2016; Martinez-Lypez, 2014; Kwilinski, 2019). The reporting integration allows achieving the effect of training in entrepreneurship activities through the usage of all multimodal forms of expression, as opposed to only oral and written types of expression of knowledge, which are the characteristic components of the classical education system.

2) Method of the index graduation (addressing) of the subject area. In terms of the gradual development of the information systems, it emerged that the reporting form was not the single form of intelligent choice and search. In addition to the text form, there are widely applied the methods of non-text search, based on the features of cognitive (image) perception using data visualization by the person's spatial memory through symbols, sounds, geometrical relations, etc. A group of researchers (Brynjolfsson & McAfee, 2014; Duncan et al., 2013; Siau & Yang, 2017) noted that such cognitive methods systematically form the active vector of development of application of the artificial intelligence technologies in the training process, because they appeared to be even more effective for the learning computer systems in entrepreneurship activities compared with the oral or written formation of the search direction.

RESULTS AND DISCUSSIONS

Development of the annotated reference technology is possible by creating the intelligent measures of *"cooperative training in entrepreneurship"*, based on different knowledge models, different types of thoughts, as well as image processing.

Cognitive Neuro-Fuzzy Model of Training in Entrepreneurship

As was stated above, the poor interpretation caused by distribution of the information stored in the neural networks is one of the major failures of the networks, therefore: a) it is almost impossible to understand how the large-scale training network solves its assigned task, and b) it is not allowed to put in the network the known beforehand information about the method of solving the problem. The advantage of fuzzy systems in entrepreneurial training is their ability to represent and use the business knowledge of the entrepreneur, expressed in its natural linguistic form, which allows describing the complex economic and business processes. However, from the standpoint of cognitive understanding of the information (information presented through the image), the fuzzy models is the basis of formalization and manipulation with symbols without any appeal for their meaning. At the same time, the neural networks represented in form of image through the graph pattern, can become the basis for appeal to meaning under the lens of cognitive image in the entrepreneurial training (Metelenko et al., 2019; Kwilinski et al., 2019). The Table 1 covers the right order of development of the cognitive neuro-fuzzy model of training in entrepreneurship activities.

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In the general case, the artificial intelligence training systems contain: a) linguistic processor of communication with the user; b) *"blackboard"* that serves as the communication environment; c) knowledge base, containing heuristic knowledge; d) database, containing the catalogue of subsystems and elements listed in the object; e) interpreter that forms its solution to the problem, based on the input data, knowledge base, and database, in other words, determines the information from the knowledge base to be used, selects the necessary data from the database and makes conclusion on the created situation (Salamzadeh & Kesim, 2015).

Table 1
ORDER OF DEVELOPMENT OF THE COGNITIVE NEURO-FUZZY MODEL OF TRAINING IN ENTREPRENEURSHIP ACTIVITIES

Stage	Actions
1. Identification	Definition of the task characteristics
2. Conceptualization	Search for concepts to represent knowledge
3. Formalization	Development of the structures for knowledge organization
4. Realization	Formulating of the rules that introduce knowledge
5. Testing	Estimation of the rules with the embodied knowledge

We propose to realize the further modification of the architecture of the fuzzy system of regulator by introducing the training neural networks in business activities. The reporting modification allows presenting the additional adaptive parameters-images, in order to take into account their significance at the level of cognitive image. The possibility to incorporate the knowledge of the entrepreneur in form of images and the possibility to learn through experience is the distinctive feature of such model of neuro-fuzzy regulator. Also, it is important to note that the issue is about presentation of information through the graph pattern (Snow et al., 2017). By making the reporting remark, therewith we brought restrictions on the way of presentation of information for the cognitive neuro-fuzzy model of training. Hereinafter, the proposed distribution of the pattern graph by grid of scales even more strengthens the cognitive significance of such images in terms of distribution and recognition of information.

Graph Models of Training

The graph models in form of the semantic network include the huge cognitive *"charge"* for the visual thinking of the entrepreneur. It is especially important in terms when the classical analytical approaches to solving tasks do not allow to describe the real world using the integro-differential equations, and take into account the infinite set of parameters of the initial conditions.

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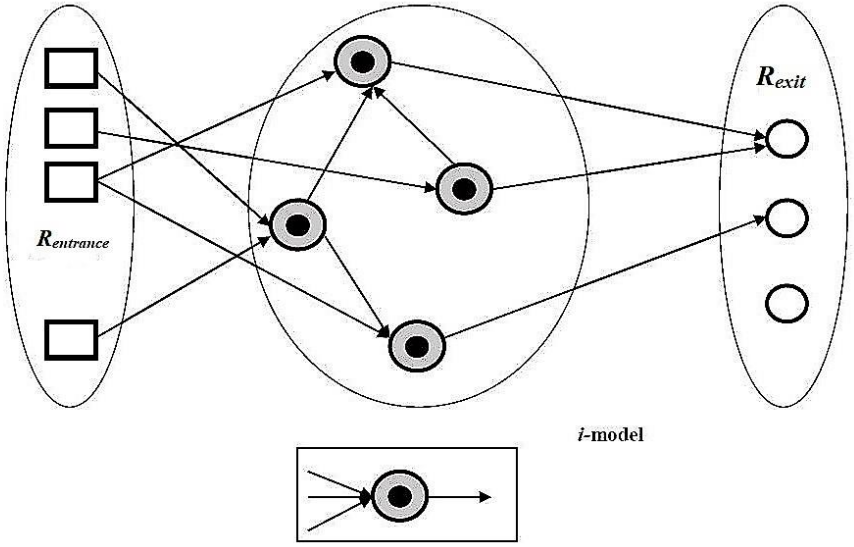
Architecture of the *M*-network:

– Topological structure (connection graph of *i*-models of the network);
– Logical structure (rules for making connections, and logic of the network work).

$$M = (R, A, D)$$

Where:

$R = \{ri\}$, $i=1,..., n$ - final infinity of $R_{entrance}$ and R_{exit} receptors;
$A = \{ai\}$, $i=1,..., k$ - final infinity of *i*-models;
$D = \{di\}$, $i = 1, ..., e$ - final infinity of the arcs, connecting the *i*-models and receptors.



$$a_i = (P, K)$$

where:

$P = \{Pi\}$, $i=1,..., k$, P - excitation threshold of the vertex (*i*-model) of a_i;
$K = \{Ki\}$, $i=1, ...,w$, - infinity of the weight coefficients (k_i can take the positive and negative values).

FIGURE 1
CONCEPT OF THE M-MACHINE DEVELOPMENT OF THE ARTIFICIAL INTELLIGENCE TECHNOLOGY IN ENSURING THE VALUE OF ENTREPRENEURIAL EDUCATION

The proposed model of the cognitive neuro-fuzzy training systems in entrepreneurship shall be assumed that the above-mentioned problems of the traditional approaches to solution of the complex modeling problems can be completely removed or significantly reduced by taking into account the visual thinking of the person within frames of the human-computer interface.

The current article proposes the further development of the concept of M-machines and networks for solution of the fundamentally opposite task, which focused on *"switching"* of the visual thinking of the user of the artificial intelligence model to the loop of *"controlled object-training system"* (Ford 2015; Vasylieva et al., 2018). The semantic M-network is the static model that reflects the collection of objects (i-models) and their relationships (Figure 1).

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The features of description of the rules of operation of the i-model allow considering the M-network as neural network. Representation of information through the M-network bears the impress of the classical paradigm of modeling through decomposing of the complex object into parts, and establishing the relationship of each component of the object with the physical sense of each neuron or the neural ensemble on its own.

It is important to note that such representation of the neural network in form of the semantic graph is actually provided as the process of training of the neural network from the position of cognitive image. Let's call such training process as the cognitive training of the neural network. The reporting definition of the training process is fundamentally different from the training process of the classical neural networks, at the expense of the training samples-relationships of input-output (Russell & Norvig, 2010). The cognitive training in entrepreneurship activities is basically governed by two sequential procedures: 1) training through formation of the infinity of objects, and determining of their significance through the thresholds of neural-like units; 2) training through formation of the infinity of relationships between objects by setting the link weights between the objects, and thus setting the synapse weights of neural-like units. It is worth noting that the second factor of cognitive training usually reminds about training of the classical neural networks at its core, but not by the procedure. It should be noted that providing the i-models of the M-network with certain values of the synapse weights and thresholds is the laborious and heuristic procedure, which is undoubtedly connected with the specific character of entrepreneurial activity. In fact, each concept (object) of the M-network corresponds to the fuzzy concept specified through the expert estimations, expressed in the synapse weights and threshold values. The reporting situation allows mathematically describing the formal model of M-network with the help of the fuzzy logic apparatus, as the neural network of the architecture, and the fuzzy system - by the operation process. At the same time, it is possible to conditionally examine the source layer as the aggregator and defuzzifier, which generalize the fuzzy information coming from neurons. In such case, the parameters of all neurons-objects of the middle layer are presented as fuzzy concepts, which function is determined by the *"boosting-braking"* system (Gurkaynak et al., 2016; Walker, 2010).

The above-mentioned analysis of the issue allows describing the summary of the M-network functioning in entrepreneurial training. Let's look at the M-network as the cognitive neural network with focus on manipulating with the symbols values. So, there is a semantic network in form of the graph pattern: the vertices match with some objects, the links specify relations between the objects. The *"boosting-braking"* system controls the excitation process of i-models of the object elements (Figure 2). The management principle is quite simple: if the excitement level of the element is higher compared with some given parameter, or the excitement level of other elements, then the threshold of such element decreases. As a result, the source semantic graph can be represented as the sub-graph consisting of the vertices that demonstrate the increased excitement level and links between them (Hengstler et al., 2016). If one displays the significance of excitation at each object vertex with the help of figure, colour or other visual representation, then one gets the cognitive pattern graph.

The visual analysis of the reporting graph allows the entrepreneur to understand the existing situation at the conscious or unconscious levels, assess it and make the appropriate decisions and actions. Since the process of action of the *"boosting-braking"* system is a continuous process (Jarrahi, 2018), it is certain that the cognitive neural network carries information about the processes of situation changing in time. In such case, the visual

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representation of the semantic graph will change in the image space. In addition, the significance of the graph elements, expressed in cognitive form through figures, symbols, colours, annotated text-links, etc., also changes. Every time, the *"boosting-braking"* system, making impact on the neural M-network, demonstrates the entrepreneur the most active cognitive information and the process of its temporal changes for the purpose of self-training.

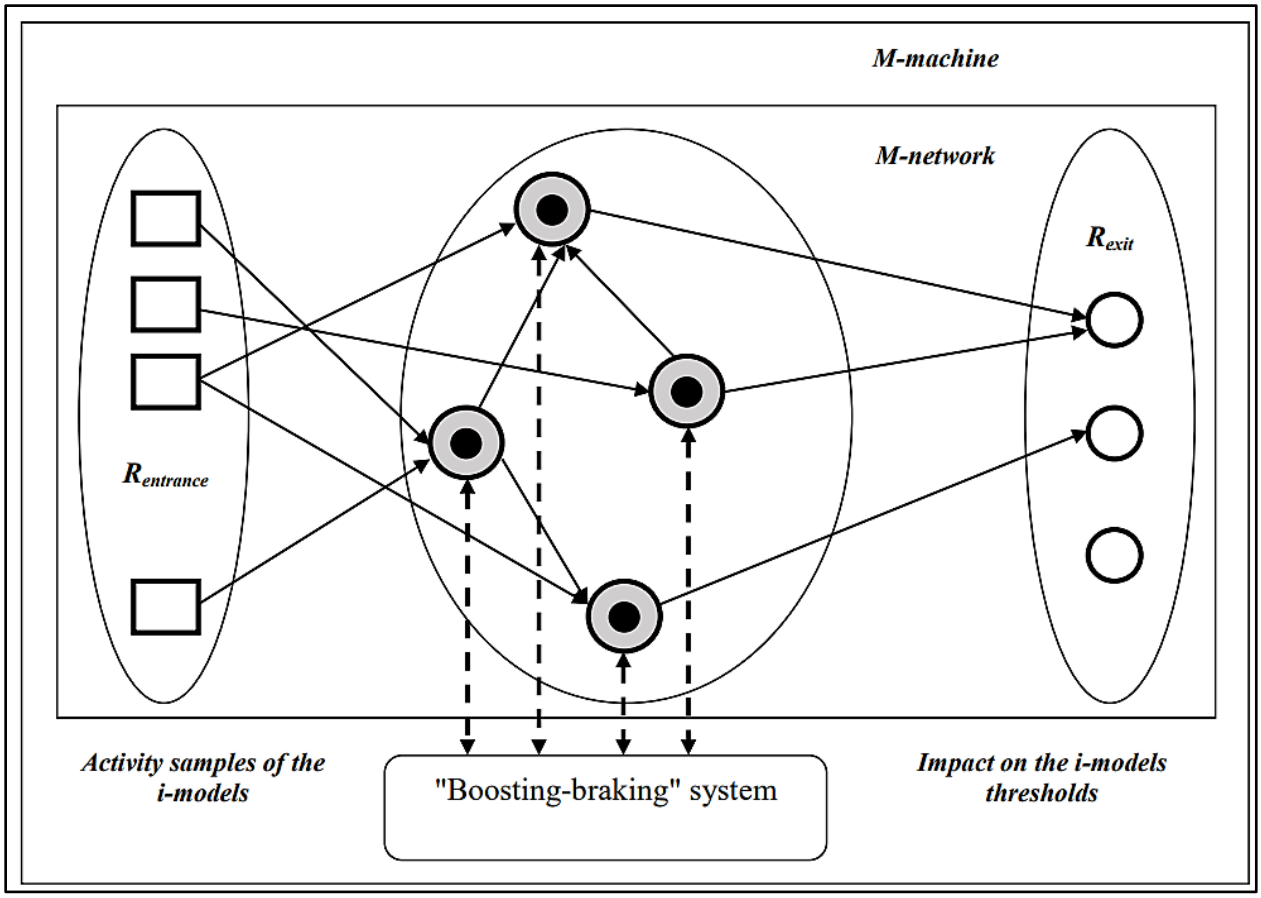

FIGURE 2
IMPACT OF THE *"BOOSTING-BRAKING"* SYSTEM ON THE THRESHOLD VALUES OF THE I-MODELS ACTIVITY

Taking into account the possibility and specificity of presentation of the initial cognitive network (semantic graph) through the hierarchy of neural ensembles, the entrepreneur is able to manage the detail view of the cognitive graph, depending on the goals and features of information perception, in terms of the specific nature and aspects of his visual thinking. The analysis of the entrepreneur's activity by the means of the control criterion calculator and genetic algorithm allows correlating (linking, combining) his actions and the artificial intelligence systems in the training process (Wauters & Vanhoucke, 2015). In addition, it is important to note that the visual thinking of the entrepreneur affects the general operation of the system through cognitive changes or directly in the semantic network, or on the flows of incoming information, or other parameters of the cognitive neuro-fuzzy regulator. Thus, the model of cognitive

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regulator allows connecting both subjective and objective features of not only declarative knowledge, but also procedural knowledge (actions) (Epstein, 2015; Rainer & Cegielski, 2011).

The above-mentioned reasoning determines the general idea and features of formation and functioning of the cognitive neural network. If formation of the vertices of the pattern graph and connections between them develops in such way that it is intuitively understood from the standpoint of the principle of training, through the tasks of the semantic network, then the issue of setting the parameters of the neural network (weights of i-thresholds of the M-network) is quite complex and important. Therefore, in the present scientific work it is proposed to use the adjustment mechanism of the classical neural networks to set the parameters of the cognitive neural network. Such mechanism considers the neural network as the model covering only the behavior of the simulated object, which does not take into account the internal detailing (semantics) of the neural network (Figure 3).

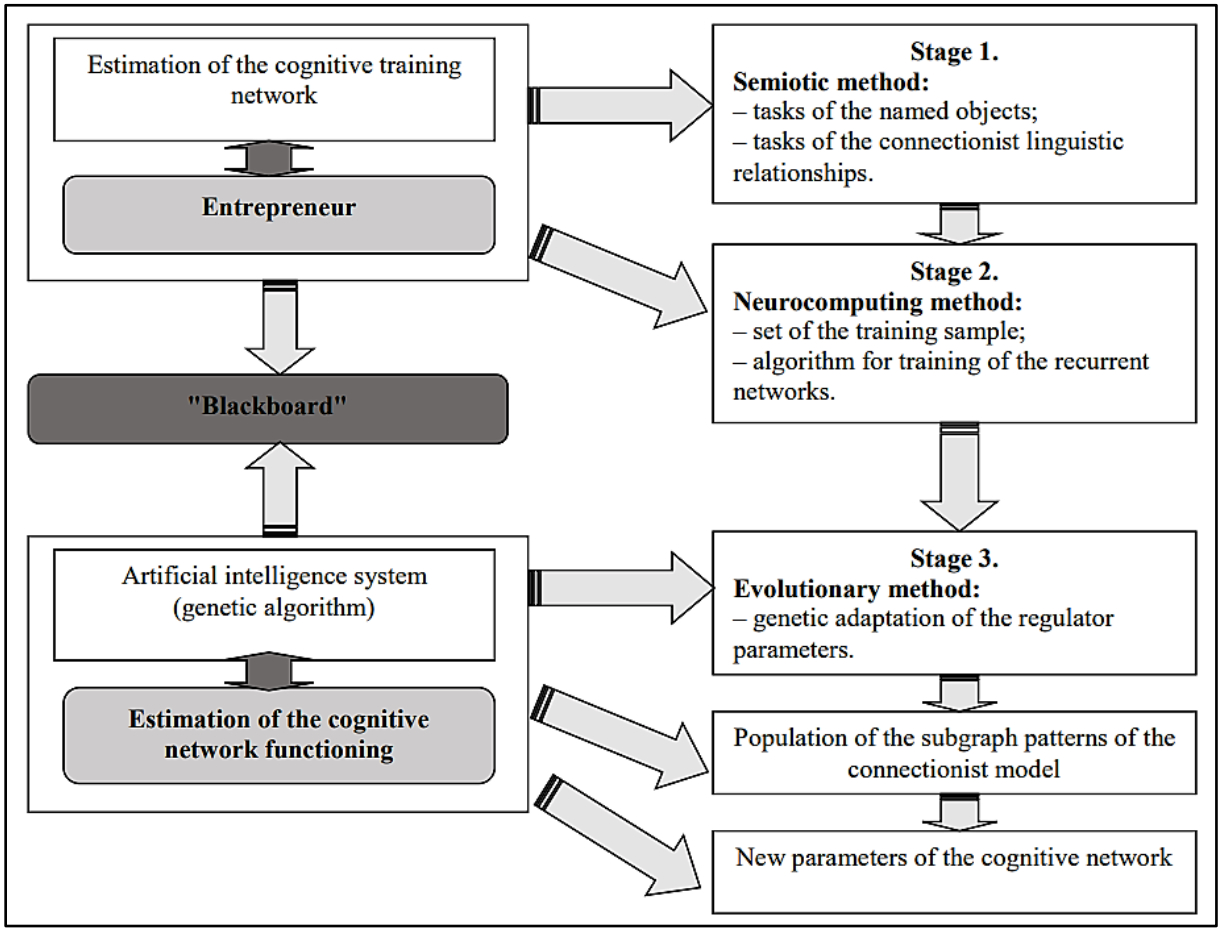

FIGURE 3
TRAINING STAGES OF THE COGNITIVE NEURAL NETWORKS IN THE ENTREPRENEURIAL ACTIVITIES

The procedure of forming of such model is actually the procedure of cognitive compression of information about the object through training of the neural network, in

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accordance with the given training sample. The task of the neural network synthesis has its own challenges, because it is impossible to forecast in advance, which neural network architecture to become the best for realization of the necessary mapping of input signals into output signals, in terms of solving the problems, which we are interested in.

Generally, it should be noted that the problematical character and complexity of prior configuration of the cognitive neuro-fuzzy systems significantly depend on the nature of the active task. If the cognitive neuro-fuzzy system is used in the control loop of the dynamically changing environment, then the whole benefits of the cognitive neural networks can only become clear in good time. In other words, the visual thinking of the entrepreneur in the training process can be used only after the certain period of working with the controlled object within frames of the standardized principles of formation the decision making support systems or consulting systems.

RECOMMENDATIONS

Increasing of the efficiency level of the neuro-fuzzy systems significantly depends on the effectiveness of the training algorithm of the neural network. Developments in the sphere of adaptive models of optimization of the neuro-fuzzy systems using the genetic algorithm, are quite perspective. The search procedure can be realized without the usage of a-priori knowledge about the nature of performance of the control criterion, but only on the basis of its values, received by the trial parameter values of the given genetic algorithm. As a result, it will be possible to improve the methodology of entrepreneurial training at the expense of finding the set of parameter values, the qualitative features of the training, optimizing the linear criteria.

CONCLUSIONS

It was stated that from the standpoint of cognitive understanding of the information, presented through the image, the fuzzy models is the basis of formalization and manipulation with symbols without any appeal for their meaning. At the same time, the neural networks, represented in form of image through the graph pattern, can become the basis for appeal to meaning under the lens of cognitive image. The approach, based on the *"combined"* synthesis of the artificial neural networks and the fuzzy systems, generates a model of the cognitive neuro-fuzzy regulator, which has the possibility to incorporate knowledge of the entrepreneur in form of images and training opportunities. The model of semantic M-network in form of the graph includes the cognitive *"charge"* in terms of information visualization, for *"switching"* of the visual thinking of the entrepreneur. Representation of the neural network in form of the semantic graph is actually provided as the process of training of the neural network from the position of cognitive image. Every time, the "boosting-braking" system, making impact on the neural M-network, demonstrates the entrepreneur the most active cognitive information and the process of its temporal changes. The distribution of the pattern graph by grid of scales even more strengthens the cognitive significance of such images in terms of distribution and recognition of information.

The developed cognitive model assumes that the above-mentioned problems of the traditional approaches to solution of the complex modeling problems can be completely removed or significantly reduced by the semiotic modeling, in terms that the entrepreneur has the ability to manage the detail view of the cognitive graph, depending on the features of his visual training.

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At the same time, the processes of adaptation to external conditions and changes of the internal parameters of the integration computer system are achieved on the basis of the genetic mechanisms of birth and death of populations of objects and solutions at the levels of symbolic and visual thinking.

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