An approach to creating a thinking process in systems empowered with intelligence using 3D environments

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Abstract. The study is aimed at solving the problem of thinking and the sources of building thought processes in systems empowered with intelligence as one of the fundamental steps to the creation of artificial intelligence. Artificial intelligence performs creative functions traditionally considered human prerogative, using computer programs to understand human intelligence and not being limited to biologically plausible methods. In this regard the evolution of a traditional computer program into a system capable of self-creation is being implemented, depending on the conditions of the external and internal events and processes. The article authors present a number of intermediate results of the research in the field of advanced technologies and artificial intelligence achieved on the basis of experiments run on the study of the semantic structures construction – sources aimed at shaping a thinking process in systems empowered with intelligence. The research carried out by the authors of the article contributes to building of basic algorithms as a parametrically polymorphic system. Scheme of one of the main functions of the master algorithm is presented. An array of constructions, semantically related and called by a route determined by a vector, the direction of which is aimed at minimal costs winning, which together act as the fundamental method for creating a master algorithm. Keywords: Artificial intelligence, 3D modeling, Machine learning, Deep learning, Genetic programming.

1 Introduction

The creation or genesis of artificial intelligence is followed by the solution of various logical and mathematical problems that, in the modern view of creators and architects of systems, overlap the integrated machine learning at the stage of evolutionary transition to artificial intelligence systems with actual difficulties of «translation».

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At present, the cornerstone problem in the development and formation of the scientific field involved in the creation of machines – systems empowered with intelligence, is attempts to divide and establish the form factor of artificial intelligence – AI. It is natural for a human being to be afraid of what he cannot fully comprehend at a certain point of time when this event occurs – technologies, systems or machines.

The most pronounced division of AI nowadays would be «strong» and «weak» intelligence. This presents a challenge for creating such a system that would be as close as possible to human intelligence, which leads to veering off the main problem, for such division builds the application of all methods, approaches and developments vital for the basis of AI not in sequence, but in parallel form, which does not allow recreating the evolutionary dynamics of these systems.

The authors accent the importance of algorithmic models that can correspond to the processes of formation of human experience, skills and thinking in the process of designing self-organizing systems [1].

For the past years, researchers in genetic programming and other program synthesis disciplines have used the General Program Synthesis Benchmark Suite to benchmark many aspects of systems that conduct programming by example, where the specifications of the desired program are given as input/output pairs [4].

Our datasets follow the model of other machine learning datasets such as Penn ML Benchmarks and the UCI ML Repository [5, 8, 12].

The founder of theoretical and practical creation of machines capable of thinking, Alan Turing, proposed an effective bionic approach to perception when developing systems or machines empowered with intelligence: a machine should be perceived as a child capable of developing, initially solving simple machine problems, self-learning via solving which allows him, to develop intellect to a level comparable to an adult [11].

Artificial Intelligence has been defined from the very beginning as an integrable model, a kind of closed in architectural sense, but is still an embedded system, which is capable of thinking and integrating into the systems being created around or already existing ones to bring them to the next level of development [3]. The source of the reasoning process is a set inherent to a human being of methods aimed at solving problems, where a method is understood as the process of accessing a memory area – a part that stores knowledge in semantically and contextually related explainable, verified and confirmed by a weight coefficient or logically suitable for the event of instructions, elements and «lifting» them in an algorithmic sequence built on the fly, which dynamically and equally directionally determines, first of all, the vector of passage of the knowledge graph – the order of attaching elements of the set and the type of algorithmic sequence.

The results of the authors’ research show that the fundamental parameters for creating such an integrable model are, first of all, the genome – as a source of the system architecture, its behavioural model in particular, and secondly – thinking, where it is singled out as the defining vector of the development of the behavioural model. These parameters allow us to speak of this model as an evolutionary information model, which is capable of modeling the distribution of sequence variations between the system analysis flows that occur in the master algorithm on an ongoing basis, which is a process of thinking and decision making.

Machine learning is a part of artificial intelligence, within which impressive results have been obtained in recent years in the processing of various types of signals and data [7].

Existing approaches to machine and deep learning models based on a data stack – dataset – still solve only special cases of problems. One algorithm - one modality. In rare cases, hybridization of machine learning methods or deep learning methodology when building algorithms are used as follows: one algorithm – several modalities [6, 9, 10].

It is worth noting that the development of NVIDIA – data2vec framework – makes an attempt in this direction, but it's only an attempt, since the algorithm uses one and the same
method for solving learning problems, for example, for speech, text and images, but cannot invert its own structure when the data array changes, fed to the input, collectively representing the problem that will need to be solved. The human intellect is able not to use the same method in solving problems, adjusting the conditions to the problem, but inverting experience and knowledge to find a method – a solution depending on the conditions.

The researchers conclude that a predictive interface is a necessary condition for ensuring the creation of ethical artificial intelligence [2].

At the same time, real possibilities to create such models for machine learning that can move to the next evolutionary stage arise. A background cause for this is the appearance of the Grokking effect. Although the occurrence of this effect is based on a kind of neural network self-testing of its own learning with the same method, it shows the actual possibility of hybridization of machine and deep learning methods.

2 Materials and methods

The solution to the problem in question when creating a system empowered with intelligence lies in the thought process, thinking. Building such skill and developing it in a machine depend on the localization environment of a dynamic object endowed with a built-in behaviour management system – a carrier, such localization environment needs to be created. The technology, which is capable of being a tool-solution, developed alongside with such sciences as mathematics, geometry and computer technology, and is called virtual modeling. At the present stage, from the point of mathematics, modeling allows working with the coordinates of the surface of an object, placing them in three dimensions in a virtual environment, for example, the Maya 3D environment.

Modeling the equidirectional behaviour of the master algorithm and the localization environment in a 3D environment from logical and mathematical point of view solves the problem of machine learning, a system empowered with intelligence in the environment where the child is, and allows counting on the creation of a thinking process in the system.

Speaking about an array of constructures integration for building an algorithmic sequence when modelling in a three-dimensional environment, can be noted Yandex, which uses 3D environments for training drones. This case is a particular task of machine learning – finding the shortest route directly by the car. And since in such training a dynamic carrier object is trained on the prepared dataset with parameters defined, then it can be no talk about the emergence of a thought process in systems.

3 Results and discussion

The aim was set at building an algorithmic sequence for systems empowered with intelligence using three-dimensional space as a tool for creating an environment of localization and maintaining its dynamics (the emergence of events and processes), that can make structures of approaches to solving problems. For example, searching the best possible route (distance and time, the traveling salesman problem), for driving a vehicle and for moving in a room, while creating a thinking process in the algorithm.

Without disclosing the parameter matrix embedded in the built modeling environment, but it can be noted that this matrix acts as the gold standard for self-assessment of the result of the master algorithm; when comparing the result with the matrix the algorithm starts the «decomposition» of actions similar to the error backpropagation method recorded in the process of solving problems, including events and processes for which there was no reaction from the algorithm.
Based on the experiments performed, the authors obtained results that allow us to draw the following conclusions. The mechanics of the operation of the control system for the behavior of dynamic objects, based on the approach using a genetic algorithm with the method of back propagation of errors and virtualization of designed objects, physical environments in CAD and 3D environments, is a system solution aimed, for example, in the optimization problem, determining the optimal path along behavioral model and object design based on the achieved properties of parallelism and distribution of the system.

In relation to the research conducted by the authors of this article, optimization problems are a special case, expressed in the methodology for implementing the method of creating a real object - a product based on: the approach of prioritization and integration of technologies at a certain point in time; systems engineering as a method; multi-level requirements matrix; a family of interdisciplinary mathematical models expressed in a three-dimensional environment.

Separately, it should be noted that the mechanics is achieved by orchestrating the nested algorithms of the system, where the integration of the genetic algorithm allows, through interaction with a person or other dynamic object through a generative interface, to determine the best alternatives - solutions, the application of which, when the evaluation value corresponding to the boundary values is reached, are the arguments of the conditions collectively aimed at solving the problem of creating or releasing a new generation of a descendant object. The main thing in this approach is the integration of the master algorithm of nested and genetic algorithms and interaction with a person or other object of the localization environment of this carrier system, which creates response events perceived by the master algorithm, including through the prism of evaluation. Decisions made aimed at achieving a “win” by the system-carrier.

The mechanics considered by the authors of this article, presented in Figure 1, in general terms shows the implementation of the approach and methods for orchestrating nested algorithms and the interaction of a genetic algorithm with a person through a generative interface aimed at solving a specific problem, designing the design of the object being developed.

![Policy Gradient Learners](image)

Fig. 1. Scheme of one of the main functions of the master algorithm (compiled by the authors).

The object of approbation of the considered approach and method, as well as mechanics - the methodology presented in this article, the authors chose: a surface unmanned,
autonomous catamaran boat, the Aquatoria project and the Project Pathfinder unmanned aerial vehicle.

Below, the authors of this article present the intermediate results of one of the experiments aimed at solving the problem of improving the accuracy of the "Aquatoria" movement in the conditions of uncertainty of the localization environment and fuzzy data obtained by the behavior control system. The geometric interpretation of the behavioral model is expressed as: a motion trajectory built in a virtualized space, replicas of the physical marine and coastal environment, passing through a shear directed against the oncoming current. The presented interpretation of the problem exists according to the ongoing experiment until the moment when the real movement of the "Aquatoria" corresponds to the optimal points of the route, built according to a schedule that reflects a certain scenario of the object's behavior. The adaptive functions of the master algorithm and nested algorithms provide asymptotically accurate movement along a given trajectory, taking into account variable data on the speed and direction of the flow.

The results of the experiment carried out by the authors are shown in fig. 2. With the given attribute parameters \( k_i = 1, b_i = 0 \) (third curve), where the master algorithm is in a state of ideal conditions, a variability is introduced in which the master algorithm of the "Aquatoria" dynamic object behavior control system is in a continuous process of self-learning without support on the function of the error backpropagation method (first curve) at the time of the event, evaluates the situation by passing the scenario included in the behavior model for the first time, on the second pass, already using the adaptive correction of the magnitude of the error that has occurred (second curve), reconfigures the motion mechanics, including nodes and The "Water area" element ensures the exit of the ship's carrier object to the scenario trajectory \( V_x = 0 \text{ m/s}, V_y = 0.7 \text{ m/s} \).

![Fig. 2. The results of experiments with the master algorithm of the control system for the behavior of the dynamic object "Water area" when redefining the i-th section.](image)

As the authors of this article have already noted, when describing the mechanics of the control system for the behavior of a dynamic object, each experiment is also aimed at solving the optimization problem. A special case of solving the optimization problem in the experiment under consideration is obtaining results confirming the possibility of implementing a method for creating a digital analogue of a real dynamic object, a digital twin of a catamaran bot - "Aquatoria".

In the experiment, in parallel with the solution of the problem of holding the behavioral model trajectory specified by the "Water Area" scenario, the master algorithm and design, the design of the hull of the catamaran-bot, were worked out. The virtualized environment imitated the wave height - 7 m, maintained the water speed - 3 km/h, the wind speed - 20 m/s, the composition included the density and temperature of water and air. All parameters
were selected taking into account the region and the temperature regime of the season. The experiment involved the material: aluminum and composite. The results of modeling the influence of environmental parameters made it possible to determine the design of the geometry of the ship's hull, expressed by the constructive, bypass part of the ship, which best suits the implementation of the "Water Area" scenarios in marine conditions. The environment shown in the lower right corner of Figure 3.

![Image](image_url)

**Fig. 3.** Demonstration of the influence of environmental parameters and changes in the design of the "Water Area" geometry.

It should be noted that the considered approach, method and methodology make it possible to organize a single data structure about the designed object in the system for managing the behavior of a dynamic object: characteristics; components used; test results, diagnostics, optimization; defects, failures and repairs along the entire chain of industrial cooperation; storage and operation conditions; conditions for disassembly, destruction or recycling.

The obtained results of the research show that when an array of structures is placed in a virtual 3D environment and solves a problem not by searching in prepared data, but by modeling solutions based on existing or changing data, simulated processes and events taking into account such that cannot be controlled by the master algorithm. It finds itself in the same conditions of self-learning as a child, and a process of cognition arises: cognition of space as a set of objects and «things» related to the position, that have a definable shape, size and time required solving the problem associated with this space.

### 4 Conclusion

So, with the chosen design method of master algorithm and with the learning approach based on a 3D environment, can be observed the process of how the algorithm cognizes an object with complex geometry and makes decisions about the interaction with this object, about which the algorithm did not know and did not receive information from a prepared dataset and relied on its own memory area: a database with reference values, generating plausible synthetic observations as such.

Since the experiment takes place in 3D, this made it possible to dynamically change the structure, composition and line of the geometry of the object of study with each decision being made by the master algorithm under training.
A biological species has the ability to universally approach problem solving and invert the usual method that lies in the algorithmic sequence and aimed at solving, for example, in navigation, design, due to the process of thinking.

Thus, an alternative, hybrid way of designing a master algorithm and training it using 3D environments in order to arouse thinking in this process was proposed.

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