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ARTIFICIAL INTELLIGENCE MODELS.

Ibragimov Shavkat Mamirovich

(Senior Lecturer, Fergana State University)

Abstract: The article discusses the directions in the modeling of artificial intelligence. The emergence of other models that are usually known under the term "neural networks" (NN), the differences between these models in the structure of individual neurons, in the topology of connections between them and in learning algorithms. The most well-known now variants of neural networks with back propagation of errors, Hopfield networks, stochastic neural networks are considered.

The main promising directions in the study of artificial intelligence are analyzed. The first is to bring artificial intelligence systems closer to the principles of human thinking. The second is the creation of artificial intelligence, which is the integration of already created artificial intelligence systems into a single system capable of solving the problems of mankind.

Keywords: Neural networks, artificial intelligence, neurocomputers, industrial automation, thinking, algorithmic support, software, intelligence, modeling.

INTRODUCTION

Artificial intelligence, artificial intelligence systems, intelligent systems, intelligent systems are often written and spoken about. Much of what yesterday was called general and special terms is today called intellectual. Almost any information or technical object created, or rather, put on the market, is declared an intellectual system. In fact, this is partly a broad scientific and practical awareness of intelligence as one of the important characteristics of the world around us.

Approximately in the 70s of the last century - the beginning of the phase of

the computer revolution, a conceptual breakthrough was made in a new field of informatics and computer technology, called artificial intelligence. During these years, a new concept was adopted, which stated that the effectiveness of a program in solving a problem depends on the knowledge that it possesses, and not only on the formalisms and inference methods that it uses.

The most significant work in the field of artificial intelligence is the development of powerful computer systems or expert systems, i.e. knowledge-based systems. Such problem-solving programs with the representation and application of factual and heuristic knowledge, the joint work of experts and knowledge engineers, system developers and inference allow us to move to new information technologies, to a new programming technology.

Currently, there is a rapid development of intelligent systems, intelligent concepts and technologies. Disciplines related to artificial intelligence systems appeared in connection with the trends of the educational process in the areas of practical activity related to solving problems of interpretation, diagnostics, monitoring, forecasting, planning, design, training, management for poorly formalized problems and noisy data (knowledge) with limited resources. The modern approach to solving such problems is based on artificial intelligence methods.

LITERATURE ANALYSIS AND METHODS

Currently, there is a fairly extensive literature on artificial intelligence systems and programs in the "demo version", that is, with a relatively small knowledge base. But for a real subject area, the entire arsenal of tools and methods accumulated over the past 40 years is required.

Despite all attempts to give a precise definition of the concept of "artificial intelligence" (AI), a strict definition still does not exist, and even with the emergence of new scientific ideas, it changes. Let us define at least the boundaries of this concept. I. Rich defines artificial intelligence as a field of

study aimed at creating computers that perform functions that a person currently performs better [1].

Such functions that are manifested in a person include perception, analysis, reasoning, the use of knowledge, action planning, logical conclusion, etc. J. Allen gives a very close definition of artificial intelligence: “Artificial intelligence is the science of creating machines that solve problems that people can solve. . . » [2].

Here, the focus of artificial intelligence is on those tasks that are successfully solved by humans and poorly by computers. These two definitions compare the capabilities of man and machines. Back in 1950, A. Turing's empirical test was proposed to determine the level of intelligence of machines. In accordance with the test, the expert could enter into a dialogue either with a computer or with a person. Turing considered the behavior of a computer to be intelligent if the computer participated in the dialogue, and the expert was not able to determine with whom he was talking. Later, they began to believe that machine intelligence differs from human intelligence and, probably, an attempt to liken it to natural intelligence is erroneous. The importance of the Turing test is obvious for evaluating the quality of modern artificial intelligence programs, but it distracted scientific forces from solving the main task of artificial intelligence - developing a general theory of machine intelligence, and using this theory to develop intelligent systems that solve practical problems.

The well-known British specialist A. Andrew paid special attention to biological and biophysical problems and models of artificial intelligence; D. Hofstadter pointed out the close connection of artificial intelligence with fundamental mathematics, painting and classical music; T. Munakata's book recently published in New York presents neural networks and genetic algorithms, which are usually considered in the mainstream of artificial intelligence only as auxiliary technical means.

Back in the 1200s, there were attempts to create an artificial man and his

mind. Inventor Raymond Lully designed a machine consisting of circles marked with letters and painted in different colors, which symbolized various concepts, elements of the elements, subjects and objects of knowledge. Their diverse combination led with the help of logical operations to the conclusion of "knowledge formulas".

In the 40s of the 20th century, with the advent of electronic computers, artificial intelligence gained a second birth.

Artificial intelligence research has two goals:

• clarification of the essence of natural intelligence (human intelligence);

• use of machine intelligence to transform new knowledge and to solve intellectual problems.

In the late 1950s, the first neural networks and neurocomputers began to be developed and created by American scientists W. McCulloch, W. Pitts, F. Rosenblatt, which still represent the neurocomputer direction of artificial intelligence systems.

RESULTS AND DISCUSSION

Work in the field of artificial intelligence began with the birth of neurocybernetics. Since the human brain consists of many nerve cells - neurons, the researchers tried to build intelligent machines, imitating the behavior of a group of neurons.

Therefore, any thinking device must necessarily be made in the image and likeness of the human brain, reproduce its structure, its principle of operation. Thus, neurocybernetics is engaged in hardware modeling of the structure of the brain and its activity.

In 1943, W. McColack and W. Pitts proposed a model of a formal logical neuron that could be in two stable states. D. Hebb in 1949 developed a simple rule that allows you to change the weights of connections between neurons in order to train them. In 1951, M. Minsky and D. Edmonds developed a neurocomputer that contained 40 neurons.

The term "artificial intelligence" was proposed at a seminar at Dartsmouth College (USA) in 1956. The first work on artificial intelligence was carried out at the Massachusetts Institute of Technology under the leadership of M. Minsky and J. McCarthy, at Carnegie Mellon University under the leadership of G. Simon and A. Newell. They are considered the "fathers" of artificial intelligence.

A. Newell and G. Simon, after analyzing the solution methods, began to synthesize general methods for finding solutions, developing the following program - the "Universal Problem Solver" or GPS (General Problem Solver). It was developed to simulate the process of solving problems by a person and was based on the ideas of heuristic search. GPS was based on a maze search model. According to this approach, the solution of an intellectual problem was carried out by sorting through a huge number of options, which was presented as a movement through a maze.

Thus, by the end of the 1960s, the main attention in the field of artificial intelligence began to be paid to the methods of problem representation and solution search, in particular, the representation of problems in a logical form and automatic theorem proving based on the resolution method.

The DENDRAL program, developed in 1969 by E. Feigenbaum, B. Bukchenen, E. Liderberg, contained detailed information about the field of organic chemistry and helped specialists determine the molecular structure of organic compounds from data obtained using a mass spectrometer. The mass spectometer, dividing the molecules into fragments, measures the mass and electric charge of each of the fragments. To determine the many forms of molecules that can be composed of such fragments, the program used the empirical knowledge of chemists, presented in the form of "if-then" rules. This made it possible to drastically reduce the number of proposed solutions.

DENDRAL was the first successfully implemented program to accumulate expert knowledge. Such programs are called "expert systems". They contain a

large amount of practical knowledge, which allows you to get answers (solutions).

Further, E. Feigenbaum, B. Bukhenen, E. Shortliff develop the MYCIN expert system. It contains about 450 rules for diagnosing infectious blood diseases. MYCIN already allows processing and generating plausible conclusions based on uncertain (unreliable) knowledge. For this purpose, the facts and the rules themselves in the system were characterized by a numerical membership function - the coefficient of confidence (degree of certainty).

After the knowledge base was removed from the MYCIN system, the EMYCIN shell was introduced (only the rules management logic was left), which could be filled with knowledge.

From that moment on, artificial intelligence ceased to be a science and began to bring practical benefits. The PROSPECTOR expert system (1979) used in geological exploration of deposits had a huge success. With the advent of expert systems, business in the field of intelligent information technology for the first time becomes profitable. In the PROSPECTOR system, the knowledge base was represented as a semantic network and the system provided interaction with the user in natural language.

In 1981, Japan announces the start of a 5th generation machine project based on the principles of artificial intelligence. This project has contributed to the intensification of research in the field of artificial intelligence in many countries.

Since 1985, expert systems, and then systems that perceive natural language (NL-systems), and then neural networks (NNs) have been actively used in commercial applications.

Commercial successes to firms developing artificial intelligence systems did not come immediately. During 1960–1985 The successes of artificial intelligence have been mainly related to research developments that have demonstrated the suitability of artificial intelligence for practical use.

The beginning of the 21st century is characterized by the beginning of

research and development of systems with an intelligent interface: self-learning, adaptive, and then hybrid artificial intelligence systems that combine the capabilities represented by neural networks and knowledge representation models. Combining neural networks and knowledge bases can be done in various ways. In the simplest cases, a neural network performs preliminary or post-processing of information in knowledge-based systems. In more interesting cases, neural networks are embedded in knowledge bases, and vice versa.

Among artificial intelligence specialists there is no single point of view on the field of artificial intelligence. Currently, there are two points of view (directions) to the modeling of artificial intelligence (AI - artificial intelligence): artificial intelligence, aimed at modeling the internal structure of the system, and machine intelligence, which consists in strictly setting the result of functioning.

The division of works on artificial intelligence into two areas is associated with the existence of two points of view on the question of how to build artificial intelligence systems.

Proponents of neurobionics artificially model the processes that occur in the human brain. This path of artificial intelligence explores the understanding of the mechanisms of perception, the identification of ways the brain works, the creation of technical means for modeling biological structures and the processes occurring in them. This point of view is that it is the study of the mechanisms of natural thinking and the analysis of data on the methods of formation of reasonable human behavior that can create the basis for the construction of artificial intelligence systems, and this construction should be carried out, first of all, as modeling, reproduction of principles and specific features by technical means. functioning of biological objects.

In practice, this is the development of elements similar to neurons, their combination into systems - neural networks, neurocomputers. Currently, these technologies are very promising and rapidly developing.

Supporters of the second point of view are convinced that “the result is

most important", i.e. a good match between the behavior of artificially created and natural intelligent systems, and as for the internal mechanisms of behavior formation, the developer of artificial intelligence should not copy or even take into account the features of natural, living analogues.

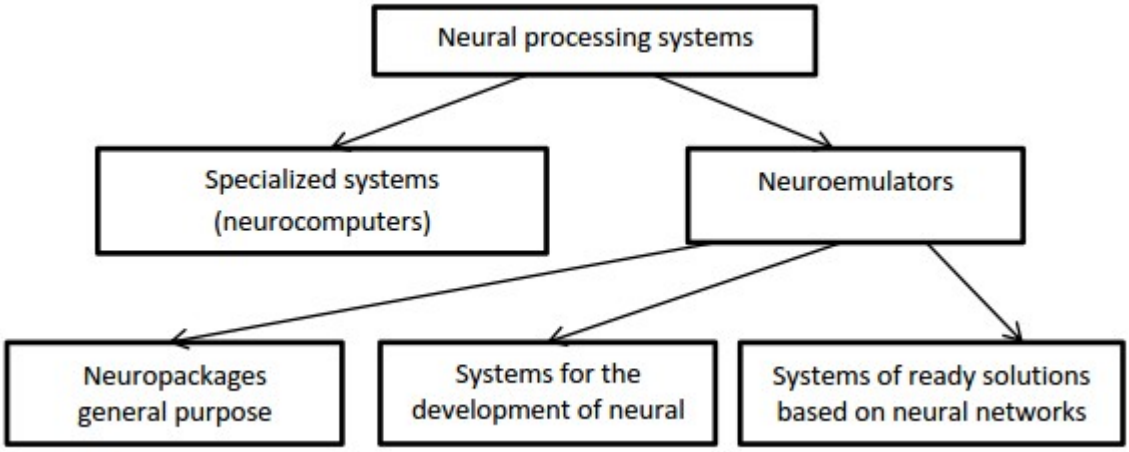
The second, but dominant point of view on artificial intelligence is called informational, where the main goal is not to build a technical analogue of a biological system, but to adequately model the functioning of the system, i.e., create means for solving problems that are traditionally considered intellectual.

In the fifties and sixties, a group of researchers created the first artificial neural networks. Initially designed as electronic networks, they were later transferred to a more flexible computer simulation environment.

The idea of a neurocomputer appeared almost simultaneously with the emergence of serial von Neumann computers. But the neurocomputer imposes strict requirements on the computing power of the device, and only in the seventies neural network methods for solving applied problems began to gain popularity.

The first experimental neurocomputer Snark was built by Marvin Minsky in 1951, but the first success of neurocomputing is associated with the development of the perceptron (from English perception - perception) by the American Frank Rosenblatt. It was one of the first neural network models that generated a lot of interest because of its ability to learn to recognize simple patterns. The perceptron consisted of binary neuron-like elements and had a simple topology, which made it possible to fully analyze its operation and create numerous physical implementations.

Neural processing systems can be classified as follows (Figure 1.1).



Rice. 1.1 - Classification of neural processing systems.

Information direction.

The information direction is divided into three.

1. Heuristic programming is the development of original methods, algorithms for solving problems similar to human ones, and in some cases even better. A heuristic is a rule, strategy, method, or technique used to improve the efficiency of a system that tries to find solutions to complex problems. A heuristic program is a computer program that uses heuristics. According to Webster's Dictionary, "heuristic" means "promoting discovery."

Heuristic programs can play chess, checkers, card games, find answers to questions, find solutions from the field of mathematical calculations; prove theorems in mathematical logic and geometry; able to learn from experience; solve different classes of problems. Here, the researcher reproduces in the computer the methods used by people, because. Human intelligence is higher than computer intelligence.

2. Systems based on knowledge. The second, main, direction in artificial intelligence forms its foundation. It is here that the theory of this scientific direction is created, the main problems associated with the central object of study of artificial intelligence - knowledge-based systems are solved.

Any subject (problem) area of activity can be described as a set of information about the structure of this area, its main characteristics, the processes

taking place in it, and also about the methods for solving the problems that arise in it. All this information forms knowledge about the subject area. When using intelligent systems to solve problems in a given subject area, it is necessary to collect information about it and create a conceptual model of this area. Sources of knowledge can be documents, articles, books, photographs, filming and much more. From these sources it is necessary to extract the knowledge contained in them. This process can be quite difficult, because it is necessary to assess in advance the importance of certain knowledge for the operation of an intellectual system. The professionals who deal with all matters related to knowledge are now called knowledge engineers or knowledge engineers. This new profession is generated by the development of artificial intelligence.

Currently, four main knowledge models are used in intelligent systems. The first model is perhaps the closest to how knowledge is represented in natural language texts. It is based on the idea that all the necessary information can be described as a set of triples of the form: (a R b), where a and b are two objects or concepts, and R is a binary relation between them. Such a model can be graphically represented as a network in which objects or concepts correspond to vertices, and relationships between them correspond to arcs. The arcs are labeled with the names of the corresponding relationships. This model is called the semantic network.

Two other common knowledge models rely on the classical logical inference model. These are either logical calculi, such as the predicate calculus and its extensions, or production systems, i.e., rules of the form: “If A, then B”, which specify the elementary steps of transformations and inferences. These two models of knowledge differ in a pronounced procedural form. Both types of knowledge can coexist with each other.

Knowledge representation systems are often framed as knowledge bases, which are a natural evolution of databases. Knowledge base theory is part of modern artificial intelligence.

In intelligent systems, specialists seek to reflect the main features of human reasoning, the experience of those specialists who have professional skills that are not yet fully available to artificial systems. Therefore, the area that in artificial intelligence is called the modeling of human reasoning is rapidly developing.

These include reasoning based on existing knowledge, reasoning by analogy and association, justifying the conclusion in the system of existing pragmatic values, and much more that people use in their practice. Bringing all these techniques into intelligent systems will no doubt make their reasoning more flexible, successful and human.

3. Intelligent programming. This direction in artificial intelligence corresponds to the programmer's view of this area. The complexity of developing intelligent applications depends on the language used, tool systems, programming paradigm, development tools for artificial intelligence systems and knowledge acquisition, cognitive graphics systems.

Tool systems are developing quite rapidly and are designed for rapid design and development of a wide variety of intelligent systems. The general idea is to create some kind of prototype system, spending a lot of effort to create it. But then use it to solve problems in a specific subject area.

Cognitive graphics systems are one of the trends in intelligent programming. One of the central ideas of artificial intelligence is the idea that the essence of the phenomenon of intelligence itself is the joint work of two information processing systems: visual, which creates a figurative picture of the world, and symbolic, capable of abstract thinking, of operating with concepts that integrate images of the outside world. . The possibility of transition from a visual picture to its textual (symbolic) description and from a text to a certain visual picture is, apparently, the basis of what is called thinking.

Cognitive graphics deals with methods of correlating texts and visual images through a general representation of knowledge that integrates textual and

visual images. This direction is recognized as very promising: new ways of solving problems and the transition to a new technology for solving them.

Examples are programs for animating pictures, but not based on rigid procedures, but according to some texts in a limited natural language.

Tasks of artificial intelligence systems.

The tasks of artificial intelligence systems cover a variety of subject areas, among which business, manufacturing, medicine, design and control systems are in the lead.

The problems of data interpretation, diagnostics, decision support are related to the problems of analysis, the problems of design, planning and control - to the problems of synthesis. The combined type of tasks includes training, monitoring and forecasting.

A problem is considered well-defined if it is possible to specify a space of possible solutions (states) for it, as well as a way to view this space in order to find the final (target) state corresponding to the problem being solved. The search for the final state of the problem consists in applying an algorithmic procedure to each state in order to check whether this state is a solution to the problem. This procedure continues until a solution is found.

Examples of well-defined problems are: proving theorems, finding a route on a graph, scheduling a robot in an environment with obstacles, etc.

The process of solving a problem, as a rule, includes two stages: presentation of the problem and search (brute force). The success of solving a problem is largely determined by the form of its representation. The forms of representation of the problem can be different and depend both on the nature of the problem itself and on its solver.

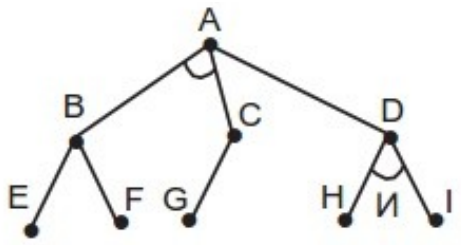
Various forms of describing the states of a problem are possible. In particular, strings, vectors, matrices, and graphs can be used.

The procedure for finding a state-space solution is to find a sequence of operators that transforms the initial state into the target state. The solution of the

problem is the specified sequence of operators.

A tree is a directed graph in which each vertex contains only one arc, with the exception of one vertex, called the root of the tree. Thus, in a tree, each vertex, with the exception of the root, is the end of exactly one arc and the beginning of one or more arcs.

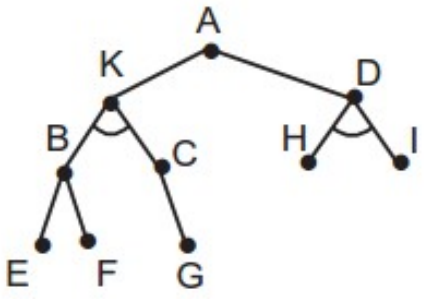
To describe the representation of reducing tasks to subtasks, you can use a graph called the task reduction graph (Fig. 1.1). In this case, tasks will correspond to vertices, and tasks reduction operators will correspond to arcs. The root corresponds to the original task, the vertices of the 1st level correspond to the tasks generated by the original task.



Rice. 1.1 - Problem reduction tree.

Problem A can be solved if problems B and C or problem D are solved. Problem B will be solved if problems E or F are solved. Problem C if problems G are solved. Problem D if problems H and I are solved.

A special curve is used to indicate the connectivity of vertices. If there are connected vertices (arcs), then usually, by introducing additional vertices if necessary, the problem reduction tree is transformed so that each group of connected vertices has a separate parent vertex (Fig. 1.2).



Rice. 1.2 - Transformed Reduction Tree.

CONCLUSIONS

So, in order for the system to make reasoning based on common sense, when working with incomplete (inaccurate) data and knowledge, it must be able to make assumptions, and when new information is received that shows the fallacy of the assumptions, it must abandon both the assumptions made and and from the inferences drawn from those assumptions.

Artificial intelligence is a very interesting and exciting topic at all times. Today, artificial intelligence, although it lags behind its level of development, nevertheless, it has achieved its heights. Artificial intelligence is our future, so this area of science needs to be developed. Of course, it is unknown what the ideal artificial intelligence will lead to, perhaps it will eventually become an indispensable human assistant.

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