Artificial Intelligence In The Modern Educational Space: Problems And Prospects

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Summary

The hypothesis of the study of the article is that the use of elements of artificial intelligence will increase the effectiveness of the educational process of the university if: a set of pedagogical conditions for the construction and use of an expert system with elements of artificial intelligence in the educational process of the university is revealed; a model for preparing a future teacher of vocational training for the use of elements of artificial intelligence has been developed; a special course has been developed that contributes to the implementation of the professional orientation of education. In accordance with this, the following tasks were studied in the article: An analysis of scientific and methodological research in the field of the current state, prospects for the development and use of elements of artificial intelligence in the preparation of a future teacher of vocational training and to determine the dynamics of the introduction of intelligent expert systems in education; A set of pedagogical conditions for the construction and use of an expert system with elements of artificial intelligence in the educational process of a university is revealed; It is substantiated to develop a model for preparing a teacher of vocational training to use elements of artificial intelligence.

Keywords:
artificial intelligence, innovation, intellectual information technologies, educational processes

1. Introduction

XXI Century. What does he bring us? I will try to summarize the most incredible predictions, but at the same time they are all based on current developments.

In the current situation, for various areas of human activity, the problem of the quality of training of specialists is characteristic. In this regard, for the university, one of the most important tasks is not only the maximum assimilation of scientific information by students, but also the formation of their professional skills at the proper level, the development of the desire and ability to independently organize their activities, think productively and update knowledge.

The introduction of modern intelligent information technologies, in particular, technologies with elements of artificial intelligence, allows a new approach to the problem of individualization of education.

Artificial intelligence (AI) is one of the areas of computer science, the purpose of which is the development of software and hardware tools that allow a non-programmer user to set and solve intellectual problems by communicating with a computer in a limited subset of natural language.

The use of expert systems (ES), which are one of the elements of artificial intelligence, primarily implements the ideas of student-centered learning, allows you to maximize the individualization of the educational process, improves the quality of education and contributes to the development of individual abilities of students.

One of the promising areas for the introduction of intellectual information technologies in education is the use of applied systems based on AI methods, such as expert systems, intelligent learning systems, expert learning systems. The intellectualization of teaching systems, the growth in the number of software systems that implement the ideas and principles of AI, have necessitated a science-based methodological system for teaching the basics of AI to future vocational education teachers.

Here are the core technologies that will shape our future in the next century.

Nanotechnology. This is a qualitative transition to a new technological level "…This is a leap from the manipulation of matter to the manipulation of individual atoms…" [4].

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Manipulations will be carried out with the help of nanomachines “…mechanisms and robots the size of a molecule…”. They will operate on atoms and molecules, assembling everything out of them “…just like a building is made of bricks.” Artificial intelligence. The brainchild of a man who will soon surpass him in capabilities (even in creativity). “...Because, unlike a person, he will have the opportunity not only to learn, but also to improve himself. He will be able to change the architecture of his artificial brain if this is required by new knowledge. Unlike a cyborg, a person who easily operates with three-dimensional objects will never be able to understand, say, five-dimensional objects…” [6].

Global telecommunications (primarily networks). Here is the forecast of the computer company Bell Labs. “The main element of their forecast is the global information network, called the “communications skin” (communications skin), which they believe the Internet will become by 2025. This “skin” will be able to feel anything from the state of the weather in any corner of the globe, to how much milk is left in any particular person’s refrigerator.” Each person will be able to wear portable devices “…the size of jewelry, controlled by voice. They will be so intelligent that they will be able to read web pages or e-mail messages for their owner, and dialing a phone number will forever become history, because in order to talk to the right person, it will be enough just to give the appropriate command. Anyone can be contacted anytime, anywhere, virtual offices will be huge, and the increased intelligence of the Web will allow people to get expert help or save money at any time. After all, if a person needs an international telephone conversation, then the computer will be able to choose the cheapest and most effective connection option ... " [8].

Robotization. Robots will perform tasks that are difficult or impossible for nanomachines, such as constructing large structures such as houses.

Genetic Engineering.

Mass space flights. Humanity will begin the conquest of the universe.

The main consequences of the introduction of these technologies are listed below.

Nanotechnology will solve the problem of hunger, since food can be obtained from anything.

The economy (in the current sense) will disappear due to the uselessness of the distribution of material wealth.

The problem of poverty will be solved.

“Achieving personal immortality of people through the introduction of molecular robots into the body that prevent cell aging, as well as restructuring and “ennobling” the tissues of the human body. Revival and cure of those hopelessly ill people who were currently frozen by cryonics methods”.

This will greatly affect the psychology of a person. After all, a person will not need to fuss. He has all eternity ahead of him.

There will be a disappearance of crime due to the absence of a reason.

Industry will disappear “…Replacement of traditional methods of production by assembly of commodities by molecular robots directly from atoms and molecules. Up to personal synthesizers and copiers that allow you to make any object. This will solve the problem of environmental pollution. Space exploration will accelerate. “Apparently, the exploration of space in the “usual” order will be preceded by the exploration of it by nanorobots. A huge army of molecular robots will be released into near-Earth outer space and prepare it for human settlement - make the Moon, asteroids, the nearest planets habitable, build space stations from "improvised materials" (meteorites, comets). It will be much cheaper and safer than current methods” [1-3].

The degradation of cities will begin. Already in developed countries, most of the population lives in the suburbs. With the advent of a global network giving access to every person, there will be no need for offices, and factories will disappear due to nanotechnology. As a result, cities will only be centers of entertainment.

Global telecommunications will enable true democracy to develop, as each individual will participate in all social decisions that concern him.

Nanotechnology, robots and artificial intelligence will completely free a person from both physical and mental labor.

In connection with the latter circumstance, I would like to note that, apparently, the era of human domination is ending and a new force is entering the arena - artificial intelligence. Due to the fact that artificial intelligence will surpass human, we will no longer be able to be ahead of it in development. And we should prepare for new conditions, since the Western type of society will no longer suit humanity due to the needlessness of development, so we will live exclusively in comfortable conditions. People will be in relation to artificial intelligence in the same way as the animal world is in relation to us.

These circumstances and the intellectualization of teaching systems, the growth in the number of software systems that implement the ideas and principles of artificial intelligence, have necessitated the development of a model for using elements of artificial intelligence in the training of future teachers of vocational training.

The relevance of the use of elements of artificial intelligence in the preparation of a future teacher of vocational training is due to the presence of a number of contradictions between:

1. The need of modern society for highly qualified teachers of vocational training and the insufficient level of their preparedness;

2. The importance and growing role of artificial intelligence as one of the branches of information technology in education and the lack of representation of this area in the educational process of the university;

3. The lack of development of an optimal and clear model for preparing a future teacher of vocational training for the use of elements of artificial intelligence.

2. Theoretical Consideration

Different meanings are put into the concept of "artificial intelligence" - from the recognition of intelligence in computers that solve logical or even any computational problems, to classifying as intelligent only those systems that solve the entire complex of tasks carried out by a person, or an even wider set of them. We will try to isolate the meaning of the concept of "artificial intelligence", which is most consistent with real research in this area.

As noted, in research on artificial intelligence, scientists are distracted from the similarity of the processes occurring in a technical system or in programs implemented by it, with human thinking. If the system solves problems that a person usually solves through his intellect, then we are dealing with an artificial intelligence system.

However, this limitation is not sufficient. The creation of traditional computer programs - the work of a programmer - is not the construction of artificial intelligence. What tasks solved by technical systems can be considered as constituting artificial intelligence?

To answer this question, we must first understand what a task is. As psychologists note, this term is also not sufficiently defined. Apparently, the understanding of a task as a mental task that exists in psychology can be taken as a starting point. They emphasize that there is a task only when there is work for thinking, that is, when there is some goal, but the means to achieve it are not clear; they must be found through thinking. D. Poya said well about this: "... the difficulty of solving is to some extent included in the self-concept of the task: where there is no difficulty, there is no task." If a person has an obvious means by which one can probably fulfill a desire, he explains, then the problem does not arise. If a person has an algorithm for solving a certain problem and has the physical ability to implement it, then the problem in the proper sense no longer exists [9].

The problem understood in this way is essentially identical to the problem situation, and it is solved by transforming the latter. Its solution involves not only conditions that are directly specified. A person uses any information that is in his memory, a "model of the world" that is available in his psyche and includes the fixation of various laws, connections, relations of this world.

If the task is not mental, then it is solved on a computer by traditional methods and, therefore, is not included in the scope of artificial intelligence tasks. Its intellectual part is made by man. The machine is left with a part of the work that does not require the participation of thinking, that is, "thoughtless", non-intellectual.

The word "machine" here means a machine together with its total mathematical software, which includes not only programs, but also the "models of the world" necessary for solving problems. The disadvantage of this understanding is mainly its anthropomorphism. It is advisable to define the tasks solved by artificial intelligence in such a way that at least a person is absent from the definition. When characterizing thinking, we noted that its main function is to develop schemes for expedient external actions under infinitely varying conditions. The specificity of human thinking (in contrast to the rational activity of animals) is that a person develops and accumulates knowledge, storing them in his memory. The development of schemes of external actions takes place not on the basis of the "stimulus-response" principle, but on the basis of knowledge obtained additionally from the environment for behavior in which an action scheme is developed.

This way of developing schemes of external actions (and not just actions on commands, even if they change as functions of time or as unambiguously determined functions of the results of previous steps), in our opinion, is an essential characteristic of any intelligence. It follows that artificial intelligence systems include those that, using the rules of information processing embedded in them, develop new schemes of appropriate actions based on the analysis of environmental models stored in their memory. The ability to rebuild these models themselves in accordance with newly incoming information is evidence of a higher level of artificial intelligence [6].

Most researchers consider the presence of their own internal model of the world in technical systems as a prerequisite for their "intelligence". The formation of such a model, as we will show below, is associated with overcoming the syntactic one-sidedness of the system, i.e. with the fact that the symbols or that part of them, which the system operates on, are interpreted, have semantics.

Describing the features of artificial intelligence systems, we point out: 1) the presence in them of their own internal model of the external world; this model provides individuality, relative independence of the system in assessing the situation, the possibility of semantic and pragmatic interpretation of requests to the system; 2) the ability to replenish existing knowledge; 3) the ability to deductive conclusion, i.e. to the generation of information that is not explicitly contained in the system; this quality allows the system to construct an information structure with new semantics and practical orientation; 4) the ability to operate in situations related to various aspects of fuzziness, including the "understanding" of natural language; 5) the ability for dialogue interaction with a person; 6) the ability to adapt.

To the question whether all of the above conditions are obligatory, necessary for the recognition of an intellectual system, scientists answer in different ways. In real research, as a rule, the presence of an internal model of the external world is recognized as absolutely necessary, and the fulfillment of at least one of the above conditions is considered sufficient [11].

P. Armer put forward the idea of a “continuum of intelligence”: different systems can be compared not only as having and not having intelligence, but also according to the degree of its development. At the same time, he believes, it is desirable to develop a scale of the level of intelligence, taking into account the degree of development of each of its necessary features. It is known that at one time A. Turing proposed as a criterion for determining whether a machine can think, “the game of imitation”. According to this criterion, a machine can be recognized as thinking if a person, conducting a dialogue with it on a sufficiently wide range of issues, cannot distinguish its answers from the answers of a person.

Turing's criterion has been criticized in the literature from various points of view. In our opinion, a really serious argument against this criterion lies in the fact that in Turing's approach an identity sign is put between the ability to think and the ability to solve certain types of information processing problems. A successful “imitation game” cannot be recognized as a criterion of its ability to think without a preliminary thorough analysis of thinking as a whole [9].

However, this argument misses the mark if we are talking not about a thinking machine, but about artificial intelligence, which should only produce physical bodies of signs interpreted by a person as solutions to certain problems. Therefore, arguing that it is most natural, following Turing, to consider that a certain device created by a person is an artificial intelligence, if, having a sufficiently long dialogue with it on a more or less wide range of issues, a person cannot distinguish whether he is talking to a rational living creature or with an automatic device. If we take into account the possibility of developing programs specifically designed to mislead a person, then perhaps we should talk not just about a person, but about a specially trained expert. This criterion, in our opinion, does not contradict the features of the artificial intelligence system listed above.

At the initial stages of the development of the problem of artificial intelligence, a number of researchers, especially those involved in heuristic programming, set the task of creating intelligence that would function successfully in any field of activity. This can be called the development of “general intelligence”. Now most of the work is aimed at creating "professional artificial intelligence", i.e. systems that solve intellectual problems from a relatively limited area (for example, port control, function integration, proving geometry theorems, etc.). In these cases, "a fairly wide range of subjects" should be understood as the relevant area of subjects [7, 13].

The starting point of our reasoning about artificial intelligence was the definition of such a system as solving mental problems. But it is also faced with tasks that people usually do not consider intellectual, since in solving them a person consciously does not resort to restructuring problem situations. These include, for example, the task of recognizing visual images. A person recognizes a person whom he has seen once or twice, directly in the process of sensory perception. Based on this, it seems that this task is not intellectual. But in the process of recognition, a person does not solve mental problems only in so far as the program of recognition is not in the sphere of consciousness. But since the model of the environment stored in memory participates in solving such problems at an unconscious level, these tasks are essentially intellectual. Accordingly, the system that solves it can be considered intelligent. This is all the more true for the “understanding” of phrases in natural language by a machine, although a person usually does not see this as a problem situation.

The theory of artificial intelligence in solving many problems faces epistemological problems [10].

One of these problems is to clarify the question of whether the possibility or impossibility of artificial intelligence is theoretically (mathematical) provable. There are two points of view on this. Some consider it mathematically proven that a computer can, in principle, perform any function carried out by natural intelligence. Others consider it mathematically proven to the same extent that there are problems that can be solved by the human intellect, which are fundamentally inaccessible to computers. These views are expressed by both cybernetics and philosophers.

The problem of artificial intelligence

The epistemological analysis of the problem of artificial intelligence reveals the role of such cognitive tools as categories, a specific semiotic system, logical structures, and previously accumulated knowledge. They are revealed not through the study of the physiological or psychological mechanisms of the cognitive process, but are revealed in knowledge, in its linguistic expression. The tools of knowledge, which are ultimately formed on the basis of practical activity, are necessary for any system that performs the functions of abstract thinking, regardless of its specific material substratum and structure. Therefore, in order to create a system that performs the functions of abstract thinking, i.e., ultimately forming adequate schemes of external actions in significantly changing environments, it is necessary to endow such a system with these tools.

The development of artificial intelligence systems over the past decades has followed this path. However, the degree of progress in this direction in relation to each of these cognitive tools is not the same and, on the whole, is still insignificant [10-12].

1. To the greatest extent, artificial intelligence systems use formal logical structures, which is due to their non-specificity for thinking and, in essence, algorithmic nature. This enables relatively easy technical

implementation. However, even here cybernetics has a long way to go. In artificial intelligence systems, modal, imperative, question and other logics are still poorly used, which function in the human intellect and are no less necessary for successful cognitive processes than the forms of inference that have long been mastered by logic, and then by cybernetics. Raising the "intellectual" level of technical systems is, of course, associated not only with the expansion of the applied logical means, but also with their more intensive use (for checking information for consistency, designing calculation plans, etc.).

2. The situation is much more complicated with semiotic systems, without which intelligence is impossible. The languages used in computers are still far from the semiotic structures with which thinking operates.

First of all, in order to solve a number of problems, it is necessary to consistently bring the semiotic systems endowed with a computer closer to natural language, more precisely, to the use of its limited fragments. In this regard, attempts are being made to endow the input computer languages with language universals, for example, polysemy (which is eliminated when processed in a linguistic processor). Problem-oriented fragments of natural languages have been developed that are sufficient for solving a number of practical problems by the system. The most important result of this work is the creation of semantic languages (and their formalization) in which symbolic words have an interpretation.

However, many universals of natural languages that are necessary for them to perform cognitive functions are still poorly implemented in artificial intelligence languages (for example, openness) or are used to a limited extent (for example, polysemy). The increasing embodiment in semiotic systems of the universals of natural language, due to its cognitive function, is one of the most important lines for improving artificial intelligence systems, especially those in which the problem area is not rigidly defined in advance.

Modern artificial intelligence systems are capable of translating from one-dimensional languages into multidimensional ones. In particular, they can build diagrams, diagrams, drawings, graphs, display curves on screens, etc. Computers also perform reverse translation (describe graphs and the like using symbols) [12]. This kind of translation is an essential element of intellectual activity. But modern artificial intelligence systems are not yet capable of direct (without translation into symbolic language) use of images or perceived scenes for "intellectual" actions. The search for ways of global (rather than local) information handling is one of the most important promising tasks of the theory of artificial intelligence.

3. The implementation of analogues of categories into information arrays and programs of artificial intelligence systems is still at an early stage. Analogues of some categories (for example, "whole", "part", "general", "single") are used in a number of knowledge representation systems, in particular as "basic relations", to the extent that this is necessary for certain specific subject or problem areas with which systems interact.

In the formalized conceptual apparatus of some knowledge representation systems, separate (theoretically significant and practically important) attempts were made to express some moments of content and other categories (for example, "cause", "consequence"). However, a number of categories (for example, "essence", "phenomenon") are absent in the languages of knowledge representation systems. The problem as a whole has not yet been fully comprehended by the developers of artificial intelligence systems, and a lot of work remains to be done by philosophers, logicians, and cybernetics to introduce analogues of categories into knowledge representation systems and other components of intelligent systems. This is one of the promising directions in the development of the theory and practice of cybernetics.

4. Modern artificial intelligence systems almost do not imitate the complex hierarchical structure of the image, which does not allow them to rebuild problem situations, combine local parts of knowledge networks into blocks, rebuild these blocks, etc.

The interaction of newly incoming information with the total knowledge fixed in systems is not perfect either. In semantic networks and frames, methods are still insufficiently used, thanks to which the human intellect is easily replenished with new information, finds the necessary data, rebuilds its knowledge system, etc.

5. To an even lesser extent, modern artificial intelligence systems are able to actively influence the external environment, without which they cannot; self-learning and general improvement of "intellectual" activity.

Thus, although certain steps have been taken towards the embodiment of the epistemological characteristics of thinking in modern artificial intelligence systems, in general, these systems are still far from mastering the complex of epistemological tools that a person has and which are necessary to perform the totality of functions of abstract thinking. The closer the characteristics of artificial intelligence systems are to the epistemological characteristics of human thinking, the closer their "intelligence" will be to the human intellect, more precisely, the higher will be their ability to combine symbolic structures perceived and interpreted by a person as a solution to problems and in general the embodiment of thoughts.

This raises a difficult question. When analyzing the cognitive process, epistemology abstracts from the psychophysiological mechanisms through which this process is realized. But it does not follow from this that these mechanisms do not matter for the construction of artificial intelligence systems. Generally speaking, it is possible that the mechanisms necessary to embody the inherent characteristics of an intelligent system cannot be implemented in digital machines or even in any technical system that includes only components of an inorganic nature. In other words, in principle it is possible that although we can cognize all the epistemological regularities that ensure the fulfillment by a person of his cognitive function, but their totality is realized only in a system that is substratively identical to a person.

The significance of "bodily organization" for understanding the features of mental processes, in particular the possibility of perception, deserves attention. Qualitative differences in the ability of specific systems to reflect the world are closely related to their structure, which, although it has relative independence, cannot overcome certain limits set by the substrate. In the process of biological evolution, the improvement of the property of reflection occurred on the basis of the complication of the nervous system, i.e., the substrate of reflection. It is also possible that the difference between the substrates of a computer and a person can cause fundamental differences in their ability to reflect, that a number of functions of the human intellect are in principle inaccessible to such machines.

Sometimes in philosophical literature it is argued that the assumption that a technical system can perform the intellectual functions of a person means reducing the higher (biological and social) to the lower (to systems of inorganic components) and, therefore, contradicts materialistic dialectics. However, this reasoning does not take into account that the ways of complication of matter are not unequivocally predetermined and it is possible that society has the ability to create from inorganic components (abstractly speaking, bypassing the chemical form of motion) systems no less complex and no less capable of reflection than biological ones. The systems created in this way would be the components of society, the social form of movement. Consequently, the question of the possibility of transferring intellectual functions to technical systems, and in particular the possibility of endowing them with the epistemological tools considered in the work, cannot be resolved only on the basis of philosophical considerations. It must be analyzed on the basis of specific scientific research.

X. Dreyfus emphasizes that the computer operates with information that does not matter, meaning. Therefore, a computer needs to enumerate a huge number of options. The bodily organization of a person, his organism makes it possible to distinguish what is significant from what is insignificant for life and to search only in the sphere of the first. For a "non-corporeal" computer, Dreyfus argues, this is not available. Of course, a particular type of body organization allows a person to limit the space of possible search. This happens already at the level of the analyzer system. The situation is quite different in computers. When a general task is posed in cybernetics, for example, pattern recognition, this task is transferred from the sensory-visual level to the abstract one. Thus, restrictions are removed that are not realized by a person, but contained in his “body”, in the structure of the sense organs and the organism as a whole. They are ignored by the computer. Therefore, the search space increases dramatically. This means that higher requirements are imposed on the “intelligence” of a computer (search in a larger space) than on the intellect of a person, to whom the flow of information is limited by the physiological structure of his body.

Systems that have a psyche differ from computers primarily in that they have biological needs, due to their material, biochemical substrate. The reflection of the external world occurs through the prism of these needs, which expresses the activity of the mental system. The computer has no needs organically connected with its substrate; for it, as such, information is insignificant, indifferent. Significance, genetically given to a person, has two types of consequences. The first circle of search is reduced, and thus the solution of the problem is facilitated. The second is that the fundamental needs of the organism, indelible from memory, determine the one-sidedness of the mental system. Dreyfus writes in this regard: “If we had a Martian on Earth, he would probably have to act in an absolutely unfamiliar environment; the task of sorting out the relevant and the irrelevant, the essential and the non-essential, which would be before him, would be as insoluble for him as for a digital machine, unless, of course, he can take into account any human aspirations. One cannot agree with this. If a “Martian” has a different biology than a man, then he also has a different fundamental layer of inalienable needs, and it is much more difficult for him to accept “human aspirations” than a computer that can be programmed for any purpose.

In principle, an animal cannot be reprogrammed with respect to this fundamental layer, although for some purposes it can be reprogrammed through training. In this (but only in this) sense, the potential intellectual capabilities of a machine are wider than those of animals. In a person, social needs are built over the fundamental layer of biological needs, and information for him is not only biologically, but also socially significant. Man is universal both in terms of needs and in terms of the possibilities of satisfying them. However, this universality is inherent in him as a social being, producing the means of expedient activity, including artificial intelligence systems.

Thus, the bodily organization not only provides additional opportunities, but also creates additional difficulties. Therefore, it is important for the human intellect to be armed with systems that are free from his own bodily and other needs, addictions. Of course, it is unreasonable to demand from such systems that they independently recognize images, classify them according to the features by which a person does it. They need to set goals explicitly.

At the same time, it should be noted that technical systems can have an analogue of a bodily organization. A developed cybernetic system has receptor and effector appendages. The beginning of the development of such systems was laid by integrated industrial robots, in which the computer mainly performs the function of memory. In robots of the third generation, the computer also performs "intellectual" functions. Their interaction with the world is designed to improve their "intelligence". Robots of this kind have a "bodily organization", the design of their receptors and effectors contains certain restrictions that reduce the space in which, abstractly speaking, a digital machine could search.

Nevertheless, the improvement of artificial intelligence systems based on digital machines may have limits, due to which the transition to solving higher-order intellectual problems that require taking into account the global nature of information processing and a number of other epistemological characteristics of thinking is impossible on discrete machines with an arbitrarily perfect program. . This means that the technical (and not only biological) evolution of reflecting systems turns out to be associated with a change in the material substrate and the design of these systems. Such an evolution, i.e., hardware improvement of artificial intelligence systems, for example, through more intensive use of analog components, hybrid systems, holography and a number of other ideas, will take place. This does not exclude the use of physical processes occurring in the brain, and those that the psyche does not use as its mechanisms. Along with this, the possibilities of improving artificial intelligence systems by using the epistemological characteristics of thinking in the functioning of digital machines, which were discussed above, are far from being exhausted.

Conclusions

The development of information technology has made it possible for a person to compensate for the psychophysiological limitations of his body in a number of areas. The "external nervous system", created and expanded by man, has already given him the opportunity to develop theories, discover quantitative patterns, push the limits of knowledge of complex systems. Artificial intelligence and its improvement turn the boundaries of complexity available to man into systematically pushable ones. This is especially important in the modern era, when society cannot successfully develop without the rational management of complex and super-complex systems. The development of artificial intelligence problems is a significant contribution to human awareness of the patterns of the external and internal world, to their use in the interests of society, and thus to the development of human freedom.

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