The Universal Arrow of Time VI:

Future of artificial intelligence – Art, not Science or Practical Application of Unpredictable Systems.

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Perspective of an artificial intellect (AI) future is considered. It is shown, that AI development in the future will be closer to art, than a science. Complex dissipative systems which behavior cannot be understood completely in principle will be a basis of AI. Nevertheless, this not complete understanding will not be a barrier for their practical use.

Introduction

Now in the world the technologies relating to design of systems of artificial intellect (AI) actively develop. In this paper it would be desirable to consider not tactical, but strategic problems of this process. Now not many interesting papers on this topic are available, but they exist [1]. It is relating to a fact that most of serious experts is occupied by a solution of tactical problems and often does not think about farther prospects. However the situation at the beginning of cybernetics origin was not that. Then these problems were actively considered. Therefore we will construct our paper as a review of problems of cybernetics as they saw to participants of the symposium in 1961 [2]. We will try to give the review of these prospects from the point of view of the up-to-date physical and cybernetic science and its last reachings.

Problem analysis

The principal strategic direction in 1961 has been set by lecture of Stafford Beer «On a way to the cybernetic factory». He sees a control system as some black box with a large quantity of will be organized. Depending on its internal state the black box is carried out the different functions linking its input and output. Among all these functions the optimal function exists. This function realizes its operation by optimal way according to some measure of optimality. The feedback will be organized between an output of the factory and internal state of the black box ensuring optimality of search of the internal state.

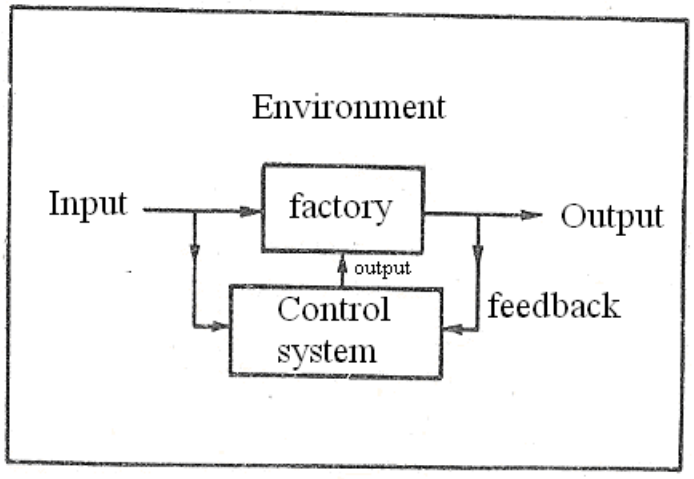

Figure 1. Diagrammatic representation of the factory controlling.

Here appear three difficulties:
1) It is clear, that the number of internal states of such black box should be huge to ensure realization of all possible functions. For this purpose the author suggests to use some block of the substance, possessing huge number of internal states at atomic level. It is something, for example, like the colloid system of Gordon Pask. This system realizes reversion of matrixes of the astronomical order.
2) Space of search of such box is huge and the search over all possible internal states is not real for reasonable time. Therefore the strategy, allowing to discover not the most optimum solutions, but, at least, "good" is necessary. Now such strategy is named as «genetic algorithm» [3], supplied *with the random generator*. Also the method of heuristics is widely used. [4] It is a set of empirical recipes for the search of optimum between the internal states. They are either found from the previous experience or defined by the external expert.
3) Criterion of optimality not always can be formulated accurately. Therefore "purpose" of such box can be made its physical "survival". Then it will search for such criterion itself. Or, its operations would be estimated by some external expert.

In the specified solutions of problems there is one very basic difficulty. Let our black box has n binary inputs and one binary output. Then number of all possible internal states of box is 2^{2^n}. Is how much this number great? The answer gives Willis D.G. «Set of realized functions for the complex systems». The physical calculation carried out there shows, that all molecules of the Earth is enough only for creation of the black box with maximum n=155. It does not make sense to reproduce his calculation here. The modern physics gives an exact method of calculation for the upper bound of memory through entropy of a black hole of corresponding mass [25]. (But it is problem to extract this information because of informational paradox.) The estimation for memory, however, will not be more optimistic. It is clear, that it is not enough such number of the inputs for controlling over the complex systems. Consequently the number of the possible functions, realized by box, should be some subset of all possible functions. How to choose this subset?

Now the methods based on neural networks [26] or fuzzy logic [27] actively develop. They allow to realize easily many "intuitive" algorithms which are used by people. Besides, for them there are well developed methods of training or self-training. However for both methods it is shown, that any possible function is realized by these methods. On the one hand it is good, as proves their universality. On the other hand it is bad, as this redundancy do not allow us to lower space of search of the black box, using these methods.

In his lecture Willis offers a solution, which is actual even now. He suggests to use a subset of all functions of n variables. This subset can be realized by a combination of p functions with k variables where

$$p << 2^n \quad (1)$$
$$k << n \quad (2)$$

This class is small enough, so it can be realized.

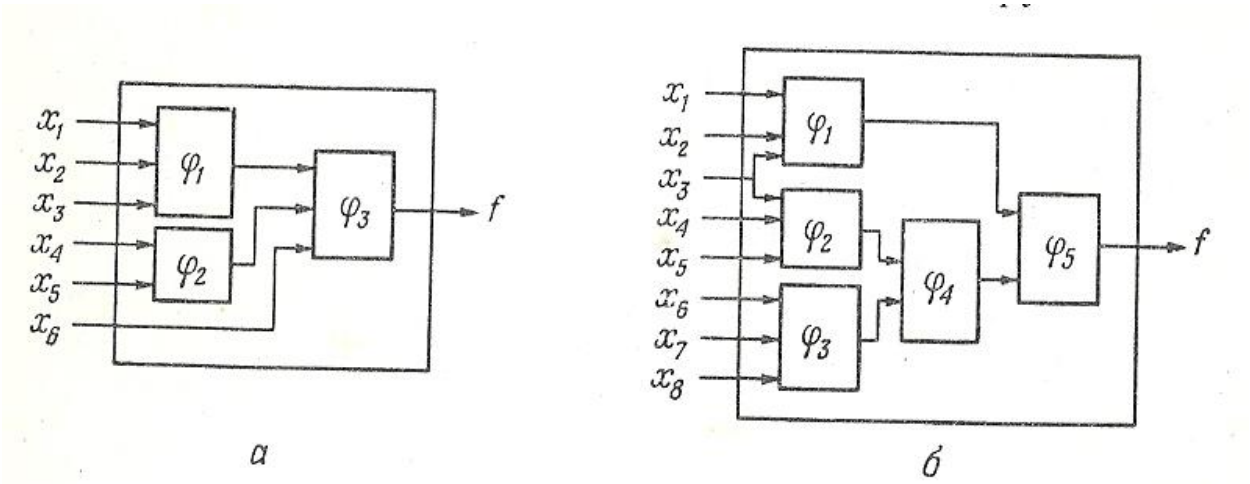

Figure 2. Exact expansion of switching functions on functions with smaller number of variables.
а) n=6, p=3, k=3 б) n=8, p=5, k=3

This solution is acceptable for a wide class of problems. For example, the neural network was used for recognition of the handwritten digit highlighted on the screen [28]. The screen was divided into meshes (pixels). The mesh could be black or white. Thus meshes were divided into groups of neighboring meshes (k cells). Each group arrived on input of the network with one output. These outputs were grouped also in k the nearest groups which moved on inputs of the network etc. As a result there were only 10 exits which yielded outcome of classification. The specified network uses restrictions relating to "locality" of our world.

But it is possible to introduce other similar criterions restricting space of search by less hard way. For example, we can use only the requirement (1) and not use the requirement (2). Instead of (2) we restrict type of used functions, i.e. we create some "library" of the useful functions.

For example, for existing field of the pattern recognition such set of functions already exists. It is software packages of functions for images processing. Example of such package is Matlab [29]. Combining these functions, it is possible to create a large number of the useful features for recognition. To select useful superposition of functions it is possible to use a random search of the genetic algorithm. But it can be made also using human intuition: the person can combine these functions so that they reproduced some intuitively felt feature of an object. The person himself cannot mathematically specify this feature without such search. These are human-machine systems of search.

It is worthy of note that both creation of such "libraries" and human-machine search is not algorithmizable processes. They based on human intuition. For this reason we think that the artificial intellect is closer to Art, than to Science.

Let's consider problems which appear when this approach is used:

1) Those restrictions ("libraries") which we set on internal states of the black box are human formed. It makes this process labor-consuming and restricted by human intuition.

2) Human-machine search is more effective, than the genetic algorithm, but suffers from the two above-mentioned problems.

Let's consider the following lecture which, apparently, the most prophetical and gives a trajectory to a solution of these problems: Zopf George W. «Relation and context».

His main thought is that for construction an effective model for artificial intellect we should not use some mathematical scientific abstraction like a black box. To construct such model we need use properties of similar systems in around world. These are the living adaptive systems. What their properties allow them to overcome specified above restrictions and problems?

Their most important property is that such systems are not, like a black box, some external object in relation to around world. They inseparably linked within the around world. (So, Zopf pays attention that the features used for recognition of object, or even "code" of neurons of a brain (consciousness) are context-dependent. It means that they depend not only on internal state

of the object or the brain, but also their external environment.) It explains efficiency of restrictions on realized internal states of adaptive systems. They do not need to invent some "library" of search functions - it is already given them in many aspects from their birth. These systems have happened from around world and are relating to it already at their birth by a set of hidden connections. So their "library" of search functions is rather effective and optimal. The same is true for algorithms of adaptation - unlike «genetic algorithms» they are already optimally arranged with respect to around world. It allows to prevent search and verification of large number of unsuccessful variants. Moreover, "purposes" of adaptive systems are not set by somebody from the outside. They are in many aspects already arranged with respect to their search algorithms and around world restrictions.

We often perceive events in the world surrounding us as a set of independent, casual appearances. Actually, this world reminds a very complicated mechanism penetrated by a set of very complex connections. («Accidents don't happen accidentally») We cannot observe all completeness of these connections.

At first, as we are only small part of this world, it is not enough our internal states to map all its complexity. Secondly, we inevitably interact with around world and we influence him in during observation. The modern physics states, that this interaction cannot be made to naught in principle [6-12]. So to model and to consider this influence exactly we need observe not only the external world but we need observe ourselves also! Such introspection can not be made *completely in principle* at any our degree of internal complexity. Introduction of physical macrovariables only reduces acuteness of the problems, but does not resolve it.

Nevertheless, as already it was above-mentioned, we are a part of the around world and are related to it by the set of connections. So we are capable on so effective behavior. It creates illusion that we are capable effectively to foresee and to calculate everything. It is possible to name this property of adaptive living systems as superintuition[1] [13]. It considerably exceeds adaptive properties of any black box developed by purely scientific methods.

Hence, we should build our future systems of AI also on the basis of some similar "physical" adaptive systems possessing superintuition. We will give here the list of properties of such systems [9-10, 17-18].

1) The random generator of such systems (making selection of internal state) should not generate usual random numbers. Such numbers should be in the strong connection (correlation) both with the around world and with internal state of AI system, ensuring superintuition.

2) The internal state of system should be complex. It should be not equilibrium, but stationary. I.e. it should correspond to a dynamic balance. It is like a water wall in a waterfall. The internal state should be either for classical mechanics systems correlated, unstable (or even chaotic) or for quantum mechanics systems quantum coherent. Such systems are capable to conserve the complex correlations either inside of themselves or between themselves and the surround world.

3) The internal state of the system should be closed from external observation. It is reached, at first, by high internal complexity of system. Secondly, the system should change strongly the

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[1] The study conducted by Russian specialists under the guidance of Valeri Isakov mathematics, which specializes in paranormal phenomena. Data from domestic flights they could not be obtained, so the researchers used Western statistics. As it turned out, over the past 20 years of flight, which ended in disaster, refused on 18% more people than normal flights. "We are just mathematics, which revealed a clear statistical anomaly. But mystically-minded people may well associate it with the existence of some higher power "- quoted Isakov," Komsomolskaya Pravda ". http://mysouth.su/2011/06/scientists-have-proved-the-existence-of-guardian-angels/; http://kp.ru/daily/25707/908213/

"That was Staunton's theory, and the computer bore him out. In cases where planes or trains crash, the vehicles are running at 61 percent capacity, as regards passenger loads. In cases where they don't, the vehicles are running at 76 per cent capacity. That's a difference of 15 percent over a large computer run, and that sort of across-the-board deviation is significant. Staunton points out that, statistically speaking, a 3 percent deviation would be food for thought, and he's right. It's an anomaly the size of Texas. Staunton's deduction was that people know which planes and trains are going to crash… that they are unconsciously predicting the future."
Stephen King, "The Stand" (1990)

internal state and behavior at attempt of an external observation. This property is intrinsic for both unstable classical systems (close to chaos), and quantum coherent systems.
4) The system should be strongly protected from an external thermal noise (decoherence).
5) The system should support the classical unstable or quantum coherent state and be protected from the external thermal noise not so much passively as actively. I.e. it should not be some hard armour or low temperatures. Rather it should be some active metabolic process. The system should be in a stationary dynamic balance, instead of thermodynamic equilibrium. So the vertical wall of water in a waterfall is supported by its constant inflow from the outside.
6) The main purpose of such system should be its "survival".

To use similar systems, we need not to know in details their internal states and algorithms of operation which they will establish at interaction with around world. Moreover, trying to make it, we will strongly risk to break their normal operation. We should attend only that the purposes, which they pursue for "survival», are coincided with the solution of problems which are necessary for us.

We see that physics becomes necessary for creation of such cybernetic AI systems. Whether are there now prototypes of such systems? Many features of the abovementioned systems are inherent to the quantum computers [19-20, 24] or to their classical analogues - to the classical unstable computers [14] and to the molecular computers [16]. Besides, there is a lot of literature where the synergetic systems modeling specified above property of living systems are constructed «on a paper». In quantum field it is [21-23, 30-32], and for classical unstable systems [15].

Here appear two problems.
1) Which from above-mentioned objects will be appropriate in the best way for creation of the AI systems?
2) What purposes, necessary for "survival" of these systems, we need to put? Indeed, these purposes must be coincided with solution of our problems.

The solution of both these problems is not algorithmizable, creative process. It makes again artificial intellect to be closer to Art, than to Science. Really, usually we cannot even know how such systems are arranged inside. We can only define their restrictions only. It is necessary to direct these systems to solve problems useful for us. We often are not capable even to understand and accurately to formulate our own purposes and problems. Without all this knowledge the Science is powerless. So creation of such systems more likely will be related to writing music or drawing pictures. Only "brushes" and "canvas" will be given to us by the Science.

Whether can the AI systems solve the two abovementioned problems instead of us? For the first problem such chances exist, but the second one cannot be solved without us in principle. Indeed, none can know better than us that we want. But, both these problems are interconnected. Therefore people always will have intellectual job. It is true also for the case that our «clever assistants» will be very powerful.

Conclusion

Perspective of an artificial intellect (AI) future is considered. It is shown, that AI development in the future will be closer to art, than a science. Complex dissipative systems which behavior cannot be understood completely in principle will be a basis of AI. Nevertheless, this not complete understanding will not be a barrier for their practical use. But a human person inevitably will conserve his important role. Completely to exclude him from the process it is impossible.

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