THE PRINCIPLES OF ACTION OF INTELLIGENT SYSTEMS

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Introduction

Now in the field of an artificial intelligence the concept of hybrid intelligent systems [1, 2], joining in itself different methods of representation and processing of knowledge, including, traditional paradigms of AI and models of neural networks are actively developed. A finite goal of this process (if only it is possible to speak here about a finite goal) is creation of strong AI reasoning and the trained as the human.

So an actual problem is creation of the theory of intelligent systems which would unite in itself of knowledge and the experience, accumulated in the different sciences connected to learning of intelligence and adaptive behaviour. In this paper the author has tried to formulate main principles of organization of functioning of intelligent systems which mirror the most essential aspects of simulation of reasoning and training.

1. A principle of associative restoring or a principle of training by means of creation and the subsequent fixing of associations during associative restoring.

Ability to be trained (to adapt, enlarge and adjust a knowledge base, etc.) is an integral part of any really intelligent system (those artificial "intelligent" systems which do not possess this quality, certainly, cannot apply for a rank "intelligent").

The principle of training can be formulated as follows.

The intelligent system during interaction with an environment remembers associations between different images (stimulus, signals, signs, operations, etc.) which are used during planning its behaviour by means of associative restoring of images by their fragments. At sufficient fixing associations they can turn to denotations as relations (attributive, cause and effect, case, etc.) between entities.

More detailed description of this principle as the model of associative thinking, suggested by the author, contains in [3, 4].

The principle associative restoring can be considered as a variant of formulation suggested by Pribram in [5] holographic metaphors of functioning of a brain.

2. A principle of concentration and economy of resources

The principle of concentration and economy of resources can be formulated in common as follows:

In the intelligent system (natural or artificial) there is a mechanism of selection (recognition) and activation of those information resources (neurons, neural ensembles, frames, rules, etc.) which are essential to solution of actual task by the intelligent system, and deactivation of those resources which are not essential to solution of actual task.

The principle of concentration and economy at a level of conscious thinking is inextricably related with concept of goal and purposefulness [6] and expresses in concentration of efforts (information and power resources) for reaching an goal, and also, in the system of priorities and choice of the purpose. At a level of subconscious

thinking the principle of concentration expresses, for example, in solution of the task of concentration of attention (model ART of Grossberg [7] called as the adaptive resonant theory).

This principle, apparently, is connected to the mechanism of emotions [8] in intelligent systems. It is possible to tell, that force of emotions influences a degree of concentration of resources, and character of emotions - on choice of the purpose for which reaching resources concentrate. It is possible to assume also, that emotions are connected to the previous principle, and force and "sign" of emotions (positive or negative) influences fixing of the associations connected to occurrence of positive emotions.

3. A principle of uncertainty [9]

Just as in quantum physics there is the principle of uncertainty of Geisenberg installing a relation between accuracy of definition of coordinates of an elementary particle and its energy, in the theory of intelligent systems it is possible to formulate the principle of uncertainty installing a relation between accuracy of definition (recognition) of the description of internal semantics of the object (syntax or structure of an image) and its interrelations with other objects (external or simply semantics of an image).

It can be formulated as follows:

> *The it is more precisely recognized the structure of an image, i.e. its internal semantics (is interpreted), the its interaction with other images (its external semantics) and on the contrary is less precisely recognized.*

This principle of uncertainty means, that any intelligent system cannot understand equally well syntax of images and in their semantics or, in other words, it is impossible to study simultaneously deeply structure of the object and its interrelation with other objects. Or, in other words, in that degree in which the developer of knowledge representation (or the user or the interpreter) pays the big attention to representation and recognition of details in structure of objects (concepts), it (he} is forced to ignore representation and recognition of interrelations between them. This principle works as at formalising knowledge with development of the intelligent system, and at its usage during interpretation (application) of knowledge.

Just as the error of definition of coordinates and energies of an elementary particle depends on characteristics of "spectator" (resources of measurements), the error of processing of knowledge depends on memory size of a computing resource and speed of the inference, used at interpretation. With reference to a natural brain these characteristics correspond, apparently, to possibilities of a brain on storage and recall of the images.

Depth reason of principle of Geisenberg just as a reason is higher than the formulated principle the fact of unity observable both the spectator and necessity of their consideration as uniform system is. And with reference to the intelligent system not essence important who (that) is the spectator of knowledge - the interpreter of knowledge being its part or the external spectator (the user or the developer).

Probably, this analogy between image and an elementary particle is not random. Not gift, in [5] had been formulated analogy between the hologram and image in biological memory, and process of restoring of images possesses the properties similar to properties of the process of restoring of the hologram. Now the concepts of quantum physics in an artificial intelligence [10-12] and in frameworks construction of quantum computers [13] widely develops.

Probably, one of reasons of appearance in natural intelligent systems during evolution of ability to abstraction is this principle since it limits possibilities of the system to install relationships of cause and effect, to plan, using operation only with concrete images of an external world.

At formalising a knowledge base of the intelligent system (for example, the consulting model in Expert Systems) this principle appears that if the developer of a knowledge base wants to describe as much as possible interrelations of some concept with other concepts, representation of this concept "is blurred". Its selection as independent concept (data structure) becomes problematic. It becomes a part of other concepts more and more and loses the value as the separate object with the internal structure.

The result of this principle in a knowledge engineering is appearance of various methods of structurization or scaling of knowledge, such as, the structured semantic networks, frames, onthologies, multi-agents systems.

4. A principle of unity of fuzzy reasonings and certain operations

In a basis of the reasoning in the natural intelligent systems, operating with the fuzzy or corrupted images, inexact concepts, incomplete descriptions, conditional outputs at the incomplete information, etc. always lays. Reasons of it is limitation of possibilities of sense organs, a localization of perception by them of an environment and not determined character of an environment (world), though the last factor is disputable since we judge an external world by means of the same limited sense organs let even amplified with every possible tools and instruments. On the other hand operations which are made by the intelligent system, have exact character, for example, "take an object ", "throwing of an object", "a raising of a hand", "a birth of the child", "inclusion of the defined muscle", etc.

In the elementary case at production of a conditioned reflex there is a creation of associative link between a situation and operation which is necessary for making at its occurrence. From here, the process of reasoning is reduced to recognition of a situation and associative restoring of operation appropriate to it. It seems justified to assume, that attempt to argue in terms of such "situational" thinking has led to appearance of abstract thinking, a taxonomy with classification and classical logic. In fact in essence the strict inference or solution of the task on setting precisely described mathematically is reduced to a chain of decision making by a principle "situation - operation" (here operation is meant as the operation above formulas).

More creative process of reasoning will involve thinking using images, which provides lowering risk of loss of the information on a situation (task) in decision-making process, since uses at all levels of solution of the task (before the making of decision about operation) a plenty of the tags describing an image of a situation. The greater vector of tags is used in a chain associative restoring (reasoning), the most part of a brain is involved in the process of reasoning and the more possibility of obtaining of nontrivial solutions.

A principle indicated in header of the unit, it is possible to formulate as follows:

> *In a basis of reasoning the operating with fuzzy images by means of associative restoring of images lays (see item 1), at the end of which choice of certain operation is carried out (restoring of it), with which it is possible to associate choice succeeded (the solved task), focusing of attention, start of operation as programs of operation motor neurons, etc. Thus selected operation as tag is involved in the further process of reasoning.*

Conclusion

The suggested principles, in opinion of the author, are basic for the description of operation (behaviour) of intelligent systems. All other principles and models which exists much enough and which can be formulated still much, are more private, and they can be considered as consequence formulated above.

The principles formulated in the given article are generalization of twenty years' experience of the author and experience of other investigators in the field of development of hybrid intelligent systems and can be considered as a part of the theory of intelligent systems.

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