

types and areas of *human activity* that are not part of the activities in the field of *Artificial Intelligence*. The development of the technology of *next-generation intelligent computer systems* has a pronounced interdisciplinary character. This means that all the knowledge accumulated by *human society* in various fields should be represented as part of the *Global Knowledge Base* of the Ecosystem of *next-generation intelligent computer systems* (using portals of scientific, technical, administrative and other knowledge), should be clearly stratified in the form of a hierarchical system of semantically compatible reusable *ontologies* and transformed into a hierarchical system semantically compatible *formal* components of knowledge bases of *intelligent computer systems* for various applications.

- Ensuring semantic compatibility of *next-generation intelligent computer systems* not only at the stage of their design, but also at all subsequent stages of their life cycle.
- Development of a model of collective behavior of *next-generation intelligent computer systems*, in other words, a model of decentralized collective problem solving at the level of:
 - a *multi-agent system* whose agents are *internal agents* of an *individual intelligent computer system* interacting through a common memory (through a common *knowledge base* stored in one memory);
 - a *multi-agent system* whose agents are *interoperable intelligent computer systems* interacting through a common *knowledge base* stored in the memory of a *corporate intelligent computer system* or in the memory of the coordinator of the activities of a temporary collective of *intelligent computer systems*.

Within the framework of the theory of *collective problem solving*, the following problem situations can be distinguished:

- a problem that can be solved by the *individual intelligent computer system* in which this task is initiated;
- a problem corresponding to the competence of the collective of *intelligent computer systems* within which this problem was initiated;
- a problem that goes beyond the competence of the *collective of intelligent computer systems* within which this problem was initiated. Such a problem requires the formation of a temporary team, the coordinator (but not the manager) of which becomes the *intelligent computer system* within which the specified problem was initiated. To do this, it is necessary to find those *intelligent computer systems* that together will provide the necessary competence. At the same time, note that each *interoperable*

intelligent computer system (both individual and collective) must know its competence in order to determine whether it can or cannot solve a given (arisen) task. This, in particular, is necessary for the formation of temporary collectives of *intelligent computer systems*.

- Development of the principles underlying a powerful Library of reusable and compatible components of *next-generation intelligent computer systems*, which provides full automation of the integration of these components in the assembly process of the designed systems.
- Development of methods and means of permanent expansion of the Library of reusable components of *next-generation intelligent computer systems* in various fields of *human activity*:
- Scientific and technical activity in any field should be reduced to the development of *knowledge bases* of various *intellectual portals of scientific and technical knowledge*. At the same time, the *knowledge base* of each such portal should be decomposed into fragments included in the Library of reusable components of *knowledge bases of next-generation intelligent computer systems*, which can hierarchically fit into each other. To do this, the specified components must be specified accordingly.
- Developers of any *intelligent computer system* should decompose the developed system into a set of components included in the Library of components of *next-generation intelligent computer systems* — so that the development of any similar system is reduced to the assembly of components from this Library.
- All(!) developers should take care of expanding the Library of reusable (typical) components of *next-generation intelligent computer systems*, which will significantly reduce the complexity of developing new *next-generation intelligent computer systems* within the Ecosystem of such systems. At the same time, the authorship of the components of the specified Library should be encouraged, which is the fundamental basis for the development of the knowledge market, the knowledge economy.

If we competently develop and use the Technology of *next-generation intelligent computer systems*, then the development of any new *intelligent computer system* will mainly be reduced to its automatic assembly from the components of this system specified by the developer. Some components of the *intelligent computer system* being developed may be included in the current state of the Library of Components of *next-generation intelligent computer system*, and some of them will require additional development. But at the same time, each such new component is most often the result of modification of existing components from the specified

Library and must be specified and included in this Library. Thus, the developer of an applied *intelligent computer system* should develop not only this system, but also contribute to the development of a Library of Components of *next-generation intelligent computer systems*, as a result of which the next *intelligent computer system* he is developing can be assembled without additional components being developed, but only from components of the Component Library. If all developers of applied systems act in this way, then the rate of increasing the level of automation of *human activity* will increase significantly.

III. METHODOLOGICAL PROBLEMS OF THE CURRENT STAGE OF WORK IN THE FIELD OF ARTIFICIAL INTELLIGENCE

A. Social responsibility of specialists in the field of Artificial intelligence

The current stage of development of the theory and practice of *Artificial Intelligence* exposes a whole range of problems that hinder this development [4], [5]. Further development of *Artificial Intelligence* technologies

- on the one hand, it can and quite quickly make the transition of modern society to a fundamentally new level of its evolution, providing comprehensive automation of all types and areas of *human activity* subject to automation, as well as providing the maximum possible comfort and the maximum possible disclosure of the creative potential of each person;
- on the other hand, it can quite long and quite convincingly imitate the specified progress of automation of *human activity* for an illiterate layman — any even very worthy goal can be ruined by the imitation of its achievement;
- on the third hand, can quickly enough lead *human society* to degradation and self-destruction.

As a result, at the present stage of development of *Artificial intelligence* technologies, the level of social responsibility of specialists in the field of *Artificial intelligence* is a determining factor in the development of *human society*. The danger to *human society* does not come from *intelligent computer systems*, but from the motivation of specialists who develop these systems. It is obvious that the creation of *intelligent computer systems* designed for the deliberate infliction of any damage to *human society*, and requiring the creation of appropriate intellectual means of ensuring security, is a shortcut to self-destruction.

The efforts of specialists in the field of *Artificial intelligence* should be aimed at significantly increasing the level of intelligence of *human society* as a whole, the basis of which is the complex automation of all those types and areas of *human activity* that fundamentally makes sense to automate.

B. The global goal of Artificial Intelligence activities

Why the current stage of activity in the field of *Artificial intelligence* requires the formulation of the global goal of this activity and its permanent clarification.

The current state of *Artificial Intelligence* can be characterized as a deep methodological crisis caused by:

- the fact that scientific results in this area came out of scientific laboratories and began to have a real practical impact;
- the lack of understanding that obtaining serious scientific results in a particular field and the creation of technologies that ensure the effective practical use of these results are tasks commensurate in importance and complexity. This is especially true for *Artificial Intelligence*.

The latter circumstance leads to unjustified euphoria, the illusion of well-being and to a burgeoning eclecticism that completely ignores even the seemingly obvious laws of the general theory of systems.

Unfortunately, local implementation of the results of scientific research in the field of *Artificial intelligence*, local automation of business processes of any organization without taking into account the system organization of the entire complex of methods and automation tools of various types and areas of human activity leads to unjustified duplication of results.

If in the near future there is no awareness of the global (strategic) goal of work in the field of *Artificial Intelligence*, then activities in this area as a whole will be carried out in the style of "swan, cancer and pike". Wasting effort will not lead to a holistic, practically meaningful result. The "vectors" of specific areas of this activity, the "vectors" of our efforts will not have the same focus, which will significantly reduce the overall productivity of all these activities and the quality of the overall (total) result.

What should be the *strategic problem* (super problem) that experts in the field of *Artificial intelligence* should solve. It is obvious that such a super task is the transition of the entire complex of *human activity* to a fundamentally new level of maximum possible automation, within which *creative* activity remains a fundamentally non-automated part of human activity, in particular, research activities, teaching and educational activities, permanent increase in the level of complex automation of *human activity*. The main goal of complex automation of *human activity* is not only to automate what can be effectively automated using *Artificial Intelligence* methods, but to automate all(!) "bottlenecks" of *human activity* that determine its overall performance in various fields.

As a result, at present, *Artificial Intelligence* technologies are on the threshold of transition to a fundamentally new level of development — on the threshold of transition from solving private (local) problems to solving the global problem of complex automation of all types and areas

of *human activity*, which requires automation of solving not only private urgent and important problems, but also automation of the solution more and more high-level problems, for which the problems that are being automated now become sub-problems. In other words, when automating the solution of complex problems (supervising problems), automation focuses on the development of methods and means of interaction between the means of solving local problems (particular problems).

Shifting the focus to automation of solving not just *intellectual problems*, but to automation of solving complex problems, the sub-problems of which are a variety of intellectual problems, not only takes *Artificial Intelligence* technologies to a fundamentally new level, but will also have a significant impact on all aspects of human activity:

- research and scientific and technical work should acquire a convergent mutually enriching character;
- the basis of education should be interdisciplinarity;
- the basis of global automation of *human activity* should be a general complex formal and permanently improved theory of *human activity*, which should be based on an interdisciplinary convergent methodology aimed at overcoming the eclectic approach.

Consequently, the main goal of complex automation of various types and areas of human activity with the help of *interoperable intelligent computer systems* is to significantly increase the *level of intelligence* of human society as a whole.

Modern *human society* — is a complex distributed multi-agent *cybernetic system*, the development of which is carried out, unfortunately, in violation of many laws of Cybernetics and, in particular, in violation of the criteria that determine the level of *intelligence* of hierarchical multi-agent systems. The level of *intelligence* of such systems is determined by a number of seemingly obvious factors:

- what is the volume and *quality of knowledge* accumulated by a *multi-agent system* and available to all agents (subjects) included in this system
 - how much of this *knowledge* is sufficient to organize the management of the activities of this system;
 - to what extent is this knowledge correct (consistent) and adequate;
 - how great is the convergence, compactness and purity of this *knowledge* (the presence of information garbage, information duplication is taken into account here);
 - how well structured (systematized) is the accumulated knowledge;
- how each agent of a *multi-agent system* has access to the knowledge stored in the shared memory of the entire *multi-agent system*;

- how this *knowledge* accumulates and evolves, how a multi-agent system learns itself
 - how a *multi-agent system* learns from its own mistakes,
 - how a *multi-agent system* improves the quality of its knowledge;
- how the *multi-agent system* as a whole and each agent in particular use the *knowledge* accumulated in the shared memory to solve various *problems*.

As a result, if we consider modern *human society* from the standpoint of the theory of *multi-agent systems*, which are communities of *intelligent systems* (not only artificial, but also natural intelligent systems), it is obvious that the next stage of its evolution requires:

- automation of accumulation, analysis and permanent improvement of the ***quality of knowledge*** accumulated by mankind;
- automation of the effective use of knowledge accumulated by mankind in solving problems of various levels that require the formation of various short-term or long-term ***communities of people and intelligent computer systems***. Each such community is intended either to solve any one specific problem, or to solve some set of problems in some area;
- increasing the level of ***convergence*** of knowledge, methods, actions, as well as new technical systems being created;
- improving the level of ***interoperability*** for both intelligent computer systems and people.

C. General requirements for specialists in the field of Artificial intelligence

⇒ *epigraph**:

- The requirements for specialists in the field of *Artificial intelligence* at the new stage of development of this field are a reflection of the requirements for next-generation intelligent computer systems and related technologies
- The level of *intelligence* (including collective intelligence) of *intelligent computer system* developers cannot be lower than the level of *intelligence* of *intelligent computer systems* being created
- The level of *intelligence* of a team of agents is not always higher than the level of *intelligence* of its agents
- The development of *interoperable intelligent computer systems* can only be collective
- A collective of non-interoperable developers cannot create *interoperable intelligent computer systems*

The high level of *social responsibility* required of *specialists in the field of Artificial Intelligence* imposes on