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Key Advanced Research Initiative: A Manifesto for the New-Generation Artificial Intelligence

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Abstract

The goal here is to identify key directions for the future advanced research initiatives in Artificial Intelligence (AI) and beyond. The following areas are identified as having particular importance: (1) socially emotional, ethical, and moral AI, (2) self-developing and self-sustainable AI, and (3) human-analogous AI, inspired by the human psychology. As a result, a general concept is formulated with the intent to clarify and unify the currently popular slogans, including Artificial General Intelligence (AGI), Strong AI, Human-Level or Humanlike AI (HLAI), Brain-Inspired or Biologically Inspired Cognitive Architectures (BICA), and more. The key idea of the proposed concept is that future AI must open a new angle of view and new perspectives to humans, thereby enriching and transforming the society, helping it to solve its problems and taking the civilization to a new level. While being created by humans, for humans, and fully compatible with humans at the social level, it will not be "a human in silicon", but rather an "alien": intelligent, friendly, and welcome. Its principles will combine preprogrammed basic functions and its own natural ontogeny in a virtual social environment. Forms of implementation will range from virtual entities to wearable electronics and autonomous robots. The expected impact on the society will be immense and crucial for its survival.

Keywords: AGI, humanlike AI, strong AI, virtual evolution, machine learning, evolutionary computation, artificial creativity, anthropocentric AI

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1. Introduction

Among the exploding multitude of scientific publications, only a small part is devoted to key advanced scientific and technological initiatives that will determine the face of science and the world of tomorrow. But it is these initiatives that are of particular importance in determining future directions of science. Correct identification of possible advanced scientific initiatives could lead to radical impacts on the society in general. Driven by this idea, a virtual panel discussion was organized in the Spring of 2022 addressing the possibilities of key advanced research initiatives in the field of Artificial Intelligence (AI), including Strong AI, or Artificial General Intelligence (AGI) [1], and HLAI (Human-Level AI, Humanlike AI, Human-analogous AI). Specific focus was on two related topics: (1) human-level socio-emotional AI and (2) "alive", or self-evolving AI, including the "critical mass" of an AI embryo. This paper is the product of the collective work of the research committee represented by the authors, that was formed at the panel. The paper is organized as a sequence of questions followed by possible answers, discussions, and some conclusions, with overarching concluding remarks.

2. On becoming a world leader in AI

Can we identify promising niches in the field of AI (understood in a broad sense) that one should occupy in order to become a world leader? And if yes, then what are they?

Usually these are considered to be (1) logic and inference, (2) databases, (3) neural network algorithms and data processing. However, our society is anthropocentric. Therefore, areas of AI related to AI communication with humans are of particular interest. This includes applied areas such as the principles of creating machine-human interfaces, personal robotics and emotional robots. From a practical point of view, the smart wearable electronics market is of particular interest. These are human interaction technologies that analyze human behavior. Today the choice in research is being made in favor of large corporations that store user data. But it is also interesting to develop technologies that are useful for the humans themselves. For example, maintaining the lives of patients with various types of deficits and ensuring their communications with their loved ones. Once again, an important principle is the anthropocentricity of AI.

3. On the goals and directions for future AI

What Key Advanced Research Initiatives should be taken now in the field of AI? For example, the creation of socially emotional AI interacting with the user like a living being, and not as an automaton? Or the creation of an autonomous self-developing AI capable of understanding the context, selecting goals on its own, and growing cognitively like a human?

Here two promising points of growth can be singled out. (1) Creation of an artificial psyche as an operating system (OS) for robots. The transition from solving tasks set by someone to setting own goals. Transition to agents who formulate their own behavior and learn to behave in accordance with the notions of good and evil. This requires a psyche. It will be the OS of robots in a society where robots play a leading role in the economy. (2) Systems of collective decision-making: the same problem but applied to a group of agents. Transitioning from the model of an individual psyche to the model of a society that maximizes the benefits for its members. Algorithms that can be introduced into society to create a digital democracy will be useful for people.

Stated differently, the first task is the creation of an intelligent autonomous system of a moral agent: the concepts of "good-bad", goal setting, etc. with one clarification: the system must be recognized as a moral agent, with all the ensuing problems (interaction, semantics, etc.) [2]. The second task is the creation of social communities of artificial agents. This is the level that is inherent in natural evolution. The task is to create conditions and basic mechanisms of social interaction with all the attributes and with all the consequences of internal and external relations, internal world models, etc. Models of social behavior of robots is one of the key areas in robotics, although it has been talked about for a long time [3]. This would be a real advanced research initiative.

Issues related to morality and reasoning are of particular interest here. Reasoning is needed not in the sense of classical logic, but as an ability to reason based on morality, similar to a human. Anthropocentric robots should try to justify their decisions based on events as well as moral principles. Moreover, such robots may need to construct

the Theory of Mind for human beings and ground their decisions in what is considered good or moral within the human ethical domain.

The focus of research driven by this objective should be on how people comprehend the social environment, their participation and interaction within. The main task today is the hybridization of data-based models (lower level) and knowledge-based models (higher, symbolic level), because this social information workflow is homeomorphic to the functional hierarchy of the human brain.

From the practical standpoint, the two key objectives may stand for a true democratization and the safety of AI. For the former, we should be able to perform complex cognitive task on least resource-consuming environments, including “edge devices” not necessarily connected to corporate “clouds”. For the latter, interpretable AI models and methods [4] should emerge to address the many ethical issues and mission-critical applications, corresponding to the “system 2” type of thinking according to Daniel Kanheman [5].

4. On the criterion for a Strong AI or AGI

Can we be specific about the goal of creating "strong" AI, or AGI [1,6]? What is the exact criterion for achieving it? Is it possible in the near future? What should a minimal embryo of a new AI look like to guarantee the victory?

If we talk about goals, then they are: (1) a radical increase in the level of social productive forces due to robotization and, as a result, a radical increase in the number of individuals who are employed in the economy. That is, the population stops growing, and further we can increase the efficiency of the economy through the growth of artificial personalities who produce GDP in proportion to their number. This is where robot OS plays a central role. (2) Since such a society becomes very complex and needs to be regulated in order to avoid social catastrophes, the second task is to develop a social intelligence: algorithms of collective behavior. Here, robots and artificial agents should play the role of "lubrication" between people, since it may be difficult for people to reach a consensus. The channel of human speech interaction is relatively narrow: about two bytes per second. Artificial personalities can communicate with each other over a gigabyte channel. Accordingly, this will increase the connectivity and manageability of the society. This is not a specific task, but a mission, which can be performed indefinitely. Many intermediate goals can be found along the way: from the first OS for robots to OS at the human, or even the superhuman level.

Speaking generally, however, the term "strong AI" is hackneyed, unconstructive, and useless. The same is true about “general-purpose AI” and AGI: these are not the terms that will allow us to define the vector of development. If we talk about the utility function in terms of economic efficiency, then the recipe is the following: reduce the needs, and then the economy will be more efficient. Actually, the problem is different. When we talk about AI, we almost always use the word "robot", in one way or another. This indicates a specific subject matter. We need to get away from the task. Exaggerating, one could say that AI originated from the robot Shakey [7]. Planning, recognition, heuristics, A* algorithms, etc. were born there. Therefore, it is necessary to build on the solution of a specific problem. And then it will be clear that the solution needs “weak” AI, or “strong” AI, or interaction technologies, etc. We talk about toy problems and abstract directions, not imagining why all this is necessary.

Indeed, it is hard to distinguish between "strong" and "weak" AI. Consider the following example. Dogs have emotional intelligence: Is it “strong” or “weak”? Many people are completely crazy about it, they spend their whole lives with dogs, they are happy with them, and dogs certainly enrich their lives. It is possible to set the goal of creating such intelligence. On the other hand, we raise the question of the possibility of implementing inference mechanisms and consciousness in computer architectures, we ask whether it is possible for a computer to understand a human, but we do this while bearing in mind simple architectures, assuming that consciousness and the Theory of Mind are simple phenomena that can be reproduced in limited architectures. Maybe the near future will force us to look again at the choice of architectures, at the separation of strong and weak AI, and at the definition of intelligence in general. The criterion for achieving the goal can be, for instance, the creation of an artificial human companion at the level of a dog, enriching human life. There is no clear criterion: for example, a teddy bear that growls is sufficient for young children as an emotional partner. Then the criterion for progress will be the creation of sufficient emotional partners for more advanced ages.

Position centered on the goal has its advantages, although for a person working on applied tasks goals are clear. The overall goal of AI development is to augment human abilities. Man is the bridge for the transition from a human

to the post-human [8], and "strong" AI technologies will help us in this transition. In the future, biological and technological substrates can be expected to merge into a single being. If so, then fundamental AI research should help us to implement this transition.

Summarizing the above, we can say that the main problem is that there is no problem worthy of developing an emotional, independent, autonomous intelligence, a problem for which one can really do something. At the same time, it is said that there are no such tasks, and it is not clear why this is necessary. Suppose we make an artificial dog, but we do not know what it will bring to us. What needs do we have in connection with the development of the new AI? Does anyone see this massive global challenge?

Elon Musk recently announced that he would be making his own robot. They now embody all the technologies that they have “on autopilot” there: sensorimotor understanding of space, etc. But this is not sufficient for a robot: the robot must be able to navigate its social space, be able to reason, and so on. In addition to sensory intelligence, the robot needs a general intelligence so that he is not just a pizza delivery man but can solve a wide range of problems in the human society. This requires an artificial psyche. At the same time, possibilities are not limited to anthropomorphic robotics. For example, Google is following the path of creating a “superintelligence” that solves “supertasks”, for example, plasma stabilization in the Tokamak. There are many such promising directions.

On the one hand, global tasks can be proposed: for example, to proclaim that we are creating a robotic home assistant. In this case, a whole bunch of tasks arise with all understandable motivations, reasons, etc. We can talk about creating a robot avatar. But you can also start with a “boring” technical task, for example, the creation of a sustainable technical device operating in complex non-deterministic environments. Then it becomes clear that since the conditions are complex, you need a team of devices, and hence interface mechanisms, social models, etc. As a result, it becomes clear that in order to solve this “boring” problem of the survival of a technical device, everything that we now have or can create will be needed. This is one example of a variety of possible motivations. Specific tasks can be related to intelligence, security, defense, etc. Just as in Nature, in this example collective interactions and cognitive abilities are needed to effectively solve the problem of survival. Modern technology is capable of solving virtually all conceivable tasks individually. But when we try to claim universalism, it does not work. This is a perennial problem. Apparently, it is necessary to reformulate the problem, defining it as the problem of survival (or stable functioning) of a group of artificial agents in a complex environment, where the human society can be an element. In this case, we begin to understand, for example, the role of the mechanism of emotions as a regulatory mechanism [9,10] or the mechanisms of social interaction as one of the ways of adaptation.

Could it be that the main task of emotional AI is to fight loneliness? Here is another opinion. Global tasks are: (1) increasing the duration of high-quality human life, and (2) consequently, the colonization of space.

Unfortunately, the tasks for creating a “strong” or “general” AI are usually only discussed in general terms. The tasks that have been discussed here are as good as "stars", but in order to reach the stars, we need vehicles, and these vehicles are built on the basis of the formulation of specific scientific problems. The development of science is based on two steps. (1) We formulate the problem: it can be described mathematically, technically, or otherwise, but a clear description of the problem is very important. Therefore, one should always try to find existing gaps, for example, in neural network models or in AI methods such as planning, etc. (2) Having identified the problem, we are trying to somehow fill the gap. Chains of problems constructed in this way should gradually lead us to strong AI, if it is achievable at all.

Finally, from the biological inspiration point of view, in order to create AGI, one needs to understand and verify the principles of its operation referring to human cognitive abilities as well as to supporting them neurophysiological phenomena and either verify that all of those are actually having place in the existing state-of-the-art cognitive architectures or improve the latter to actually implement these principles on the available computational resources.

5. On changing the paradigm of software development

Can machine learning (ML), understood in a certain sense, become the new dominant paradigm to replace the traditional one: “research, development, programming”? If not, then why? If yes, then what are the limits of its possibilities and expansion? And what is needed to overcome the barriers, if any?

ML, understood in a broad sense, can replace the traditional paradigm. In this case ML becomes a dynamic multi-level cognitive architecture, including low-level elements of the suite of existing ML techniques, as well as higher-

level layers capable of operating with abstract concepts at various levels of abstraction, involving symbolic and linguistic reasoning. The limits are determined by our currently restricted ability to build such architectures as well as by the costs and availability of computational resources required to run modern foundation models [11]. What is needed is not to just to keep exploiting the state-of-the-art deep-learning models, but to look for the applicability of principles novel to the traditional ML field, such as modern developments in the field of functional systems theory, probabilistic semantic logic, probabilistic formal concept theory, and the task-driven approach [12,13].

Automatic adjustment of weights in a neural network, which is learning how to process a signal, is today considered a programming method. The first problem here is that the world is complex, and the process of its description by neural networks is slow. Therefore, it is necessary to teach the neural network to break the composition of the complex world into simple components that can be studied by statistical methods, to describe their properties, and then to use these descriptions in solving specific problems. As AI advances, programming will increasingly be done by machines. The second problem here is that we have too many computers, but we program very badly, so as a rule, most computer capacities are idle at any given moment. So far, we do not know how to program them so that they would better benefit us.

There is a question of terminology here. Of course, ML is an alternative to programming, but it hardly can be called programming. We talk about programming when there is a person who first thinks through the concept of what he wants to create, and then embodies his understanding of things in the form of a code. In the case of ML, what we see in GitHub with their autopilots, etc. is still not quite programming in the usual sense of the word. This is code substitution from a large amount of statistically collected data. It may be successful, but this is not a process that a human performs: there is no design here. A parallel can be drawn with dialogue systems. Usually, such systems create a dialogue on the principle of choosing the next move (the next utterance), while a human usually thinks through several moves in advance, and not in terms of specific phrases, but rather in terms of some kind of a plan of what he wants to achieve, and then is spinning around this plan while building the dialog. And that is not the kind of thing you would see in ML, regardless of whether we are talking about big language models like GPT-3, or GPT-J, and so on. Therefore, the limitations of ML are still there, and there is still room for programming. You can also think of Charles Simonyi (1976), who dreamed of a "meta-programmer" [14] who would figure out what to do, and the rest would do his assignments. Even this idea seems closer to reality than the idea that ML will completely replace traditional programming.

Still, we can wonder about the long term: can, *in principle*, ML replace the programming of everything, including AI? This is again a question of terminology. Firstly, we have not agreed on what AI is. There is AGI, there is human-analogous intelligence, and so on. Secondly, we need to agree on adequate tests [1]. Otherwise, it sounds like talking about whether we can fly to Alpha Centauri, without knowing what it is to "fly" and what Alpha Centauri is. Speaking abstractly and philosophically however, it seems that man still can create something that will be able to solve problems at the human level, and even implement it on a non-biological basis.

6. On biological inspiration

The idea of reverse engineering the human brain recently was very popular. The problem is that the brain did not originally arise as a product of engineering. The understanding that this property gives the brain an advantage over the computer leads to the opposite question: should this principle be adopted in AI? That is, should we try to reproduce man-made AI results in a non-man-made (self-evolving) AI, in order to give them the power to evolve further on their own? If not, then why? If yes, then what could be an example scenario?

In fact, this is already done in the methods of evolutionary and genetic programming. But the cost of such an approach increases exponentially with the complexity of the tasks at hand, and if you do not have sufficient time and the ability to work with populations, then it may not be suitable for your particular needs. Not to mention the fact that allowing, e.g., a nuclear power plant safety system or the algorithm of a surgical manipulator to develop on its own sounds frightening. Still, this can be nicely used for relatively simple and non-mission-critical tasks such as ones in the field of entertainment.

One might be even tougher on this. If you look at the evolution of life, then you see that the first living cells developed according to Darwin: there were no mechanisms accelerating evolution at that time. Multicellular organisms emerged when certain mechanisms for evolution acceleration had already evolved, and, in general, only

those species were developing that were able to quickly adapt to changing conditions. Today in highly developed species, evolution by elementary random search does not occur. The notion that evolution can be carried out in a virtual environment based on genetic algorithms billions of times faster than in Nature is naive. In fact, one has to wait millions of years for virtual evolution in a computer to become possible at the same speed as in Nature, if Moore's law continues. Everything the civilization does is based on design, not on evolutionary development. This distinguishes us from the entire animal world and allows us to develop very quickly. And it is these methods that will be used in the construction of AI.

There are two additional arguments here. (1) There is a map, and there is a territory. If we are trying to build a one-to-one map of the world, then we will get another world. That is, we will not be able to shove this world into a computer. Therefore, we may not be able to accelerate evolution as we would like. (2) Evolution involves two things. The natural evolution of man has stopped, and our evolution is not to change our DNA, but to transfer knowledge. The key question is: How can we teach a machine to acquire and accumulate new knowledge on its own, to make mistakes, to model the world, and to take new initiatives? The machine must learn to ask questions, create its own picture of the world and, on this basis, accumulate new knowledge. This path can be called "biologically inspired", because this is what we humans do, and this is what we can transfer to machines in this regard.

7. On possibilities of the virtual evolution

In the future (perhaps in the near future), AI should become a full-fledged partner, friend and assistant to humans. To do this, AI needs the proper interface tools, but not only. Intelligent agents of a new generation are needed that will be able to understand the context of what is happening and the inner world of a human with whom they interact (including human emotions), will have common sense, general world knowledge and a system of values, a Theory of Mind and episodic memory, will speak natural language, will be capable of abstract and meta-reasoning, imagination and dreaming, goal setting, creativity, and more. Such an agent will have its own personality, its own experiences and mental reality world, autobiographical memory of its development, and so on. All of this could result from evolution in a virtual environment, happening billions of times faster than evolution in the physical world. Or not?

Today we observe only one result of evolution, and it does not allow us to fully understand how evolution actually works. If we run another evolution in a virtual environment, despite all the technical difficulties, and get a similar result, then this will help us to understand the mechanisms involved. Of course, having two outcomes of evolution is better than having one. But is it feasible?

Eventually, in some distant future, there is no obstacles for AI to become an equal partner to humans and to outperform them in certain areas. What can prevent it from happening sooner or later? But the question is, is it necessary? How many among living humans are ready to have a personal agent with feelings and an inner world, while being able to turn off its power or erase its memory, if they do not like something in its speeches? And what if we give this agent individual rights and criminalize the violence against such agents? Is humanity ready for the explosion of electronic personalities requiring electrical power and memory upgrades to survive? Probably not. Therefore, in the short term, AI systems should still provide effective and cheap, but dumb and controllable systems, for example, such as an exoskeleton. However, that might be a matter of legal regulations and not technological limits. Although in the long term, when the Sun shuts down eventually, only AI systems will be able to carry post-human civilization into outer space. But that time has yet to come.

Theoretically, we can make evolution billions of times faster in the virtual world or even in the physical one, but only that part of evolution that is associated with the transfer and accumulation of information. And an interesting question is whether it is worth evolving such abilities as goal setting, creativity, etc. — or would it be better to implement them through programming? So far, it seems that some things are better to program and then build an evolutionary process on them. This applies, for example, to feelings of fear and goal setting. Fear is the engine of evolution, because it forces the mind to predict the future, and therefore requires the ability to model reality and plan actions. And goal setting is the other side of the coin: having the ability to predict the future, an agent with a goal setting ability can set goals for itself that go beyond the limits, ensuring its own security. These two things could be cornerstones in the evolution of virtual assistants.

It is certainly possible to replace the programming paradigm with a training paradigm; however, replacing human creativity and analytic abilities will not be easy. We do not yet know the brain well enough for this purpose. Another question is: why should we copy abilities like emotions or creativity from humans? Are humans perfect in general? It may be reasonable to draw a line: what AI can do, and where it should stop, if we need to avoid a certain danger.

On the other hand, the reason to allow AI to do everything is just because we can do it. We create new things, for the most part, not because we raise the question of limitations, but because we want to overcome those limitations. Is it OK to create virtual individuals with legal rights? Maybe this is the way to change all of humanity for the better, because we have a lot of problems with the rights of ordinary citizens, and if this explosion forces us to rethink individual rights in general, then such an approach may be necessary. The most valuable quality of future AI assistants is that they will make us look at the world differently. Since we are unable to build an exact copy of ourselves, we will inevitably create assistants who will see the world through different eyes and will have their own evolution. This means that we will get something like “aliens”, who will have a different perspective on everything, and this will be a divinely important contribution to the development of our civilization. The ability to see problems from different angles is what allows us to solve these problems. And we do not know how to solve many problems at all.

Of course, it will not be a human, it will be a completely different creature: with a different chemistry, lifecycle, physical and mental limits, senses, feelings, and long-term goals. Living tissue is not needed if civilization will move into space. And since “the stars are not for humans” [15], strong AI will still be needed in the long run, but we are not ready for this yet.

8. Concluding remarks

We live in exceptional times. On the scale of the life of the Universe, human civilization is like a beautiful flower that blooms only once and blooms only for one moment. This is really a wonderful phenomenon, despite all the abominations associated with man. How this blossom will end depends on us. The human civilization approaches its singularity. No doubt, in the near future we will see more historical events than anyone has seen during entire history of life. And we hope that among them will be huge positive events too: comparable to the first manned flight into space and even bigger. If it happens, then definitely AI will be the key to it.

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