

Systems of Artificial Intelligence in the Educational Process*

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Abstract. The development of national standards for artificial intelligence systems and giving them international status is necessary to maintain leadership in the field of advanced technologies. The article discusses the prospects for the use of artificial intelligence in the United States and Russia, as well as the concept of the development of national programs and the creation of national standards in this area; examples of the use of elements of artificial intelligence in information educational technologies of some countries are given; substantiates the need to develop artificial intelligence standards for use in various fields, including for the education system, as well as the basic requirements for these standards and the process of their development; shows the role and tasks of government institutions in organizing the development of artificial intelligence, taking into account their interaction with scientific organizations, commercial structures, and the international community. In creating a system of artificial intelligence standards for education, it is proposed to identify nine areas to focus on, using the main tools to advance the development and implementation of effective, reliable, and trustworthy artificial intelligence technologies. Considering the level structure of information technology standards on the example of the Open Systems Interconnection model of the International Organization for Standardization, it is proposed to combine the standards of artificial intelligence systems in the educational process into a multi-level network structure. It is proposed to form the upper level of this network structure based on the structure of the Universal Description Discovery & Integration system, a tool for the location of web service descriptions. This will allow in the future to unite artificial intelligence services

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of information educational systems of universities in different countries into a single global information educational environment.

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1 Introduction

Nowadays, artificial intelligence innovations affect more and more areas and not only technical ones. This is largely due to the development of computing facilities. Performance capabilities of modern gadgets and smartphones today are many times above the processing power of the giant supercomputers of the 80-90-s of the 20th century. Modern processors allow you to create artificial neuron networks, accumulate and process a large amount of data (Big Data), use the most complex mathematical and algorithmic methods and approaches. Today there are tremendous opportunities not only for theoretical research but also for the practical implementation of artificial intelligence systems in various spheres of human activity.

Artificial intelligence technology entails a huge scope of activity, a vast field of knowledge. Since artificial intelligence is an interdisciplinary area of research, one needs knowledge in various fields, including new ones, to use it efficiently and more often as well as to participate in its development.

Artificial intelligence (AI) refers to systems of technological and software solutions that, according to modern experts, are similar or superior to the result of human intellectual activity. As a result, some experimental problems are being solved - such as based on big data -when the researchers use speech recognition systems or voice synthesis, natural language processing, computer vision, and other technologies.

2 Theory

The importance of artificial intelligence for the future of humanity is becoming more and more evident, which is reflected in the measures taken by the governments of leading countries to ensure their leadership in this direction. Making exactly this point, viz the importance of AI for the future of the US economy and national security, on February 11, 2019, the President of the United States issued Executive Order (EO 13859) stipulating federal agencies to take various steps to ensure that the country remains at the forefront in the development and use of artificial intelligence. At the same time, leadership in artificial intelligence (along with "quantum information science and strategic computing") was named the second most important R&D priority after ensuring the safety of the American people for the 2020 financial year. The American AI Initiative is guided by principles that include (in short form) [1]:

1. Moving forward to achieve technological breakthroughs.
2. Moving forward to develop appropriate technical standards.
3. Training the employees to form the needed skills to develop and use AI technologies.

4. Protecting American values, including civil and private liberties, and building up public confidence in artificial intelligence technologies.

5. Securing US technological advantage in artificial intelligence while developing an international environment that supports innovation.

In May 2019, the United States joined dozens of other countries in adopting the OECD Recommendation, the first intergovernmental standard on AI, that includes five complementary values-based principles and five recommendations to governments. The following month, the US also joined the G20 - countries that support the G20 principles, taken from the OECD recommendation. In September 2019, the US Chamber of Commerce released the Principles on Artificial Intelligence, which also support the OECD recommendation and call on US businesses to comply with international standards.

Russian leaders also attach great importance to the task of developing and applying AI. Thus, in 2019, by Decree of the President of the Russian Federation No. 490 "On the development of artificial intelligence in the Russian Federation", a national strategy for the development of artificial intelligence in Russia for the next 10 years was approved. Putin V.V., speaking on November 10, 2019, in front of scientists, developers, and representatives of high-tech business, said that it is imperative to maintain leadership in the field of artificial intelligence. The President noted that the so-called strong artificial intelligence can become the foundation and breakthrough for the entire civilization.

Thousands of specialists are working on the development and application of various artificial intelligence systems in Russia. At the AI Journey forum in 2019, the Direct Investment Fund companies - Sberbank, MTS, Yandex, Mail.ru, and Gazprom Neft - signed an agreement to create an alliance made specifically to promote the development of artificial intelligence in Russia.

It should be noted that at present more than 30 countries of the world have adopted national strategies for the development of artificial intelligence.

The trend to promote the use of AI couldn't but influence the education process as well. What are the prospects for the use of AI in education, and what additional benefits will students receive from the use of AI in the educational process? AI helps to make the learning process more personalized, effective, and convenient for the student and teacher. Artificial intelligence helps to tailor lessons to the learner, allows teachers to spend less time on routine work, and focus on developing new curricula and more effective teaching methods.

The use of AI for educational purposes in the European Union is also gaining momentum. Thus, the administration of the Flemish region of Belgium has signed a contract with a British AI platform that uses teaching methods and solutions, neurophysiology, and data processing to personalize the learning process in schools and universities. Century Tech will be introduced in all 700 Flemish schools over the next five years. The company says this is the first time the authorities have decided to implement artificial intelligence in schools on this scale.

The goal is to replace the standard model when teachers try to convey knowledge to students of different levels, but often fail, with a fundamentally new one, in which artificial intelligence helps to adapt lessons to the characteristics of each student. This

involves identifying areas of knowledge he or she is familiar or unfamiliar with, where he or she feels confident or not, and assessing how much he or she likes certain activities. Thus the learning process becomes personalized. A more detailed description of how intelligent information and educational technologies are combined with AI elements and being applied we can see in many papers like [2-6].

3 Research Methodology

Information about the introduction of technologies related to artificial intelligence into the educational process comes from Australia, Belarus, China, and other countries. AI-based cognitive tutors represent the most successful transition in terms of student numbers to AIED work from the lab to class [7].

The results of laboratory research and testing of systems with AI elements in classrooms show that at the heart of an intelligent learning environment there should be a methodically validated model of the student, it should have its design and channels of interaction with the student [8]. Pattern recognition is used to classify situations faced by a student, for example, when solving problems [9].

AI on campus (Smart-campus) responds to any student requests that are related to study and everyday life: how to find a lecture hall, register for a chosen course, get assignments, find a free parking space or contact a professor. The University of Western Australia (UWA) already has such a smart campus. It runs on Watson, a supercomputing system built by IBM. Nevertheless, today's information technologies in the educational process should be regarded rather than systems with elements of artificial intelligence (EII) [10].

Each new technology goes through a period of intense growth in reputation and expectations, followed by a sharp drop when it inevitably falls short of expectations, followed by slow growth as the technology develops and integrates into our lives. This applies to the development and application of AI systems in education as well. If we consider a diagram developed by Gartner to analyze and predict technological innovation, then this technology is somewhere on this curve, (see Fig. 1).

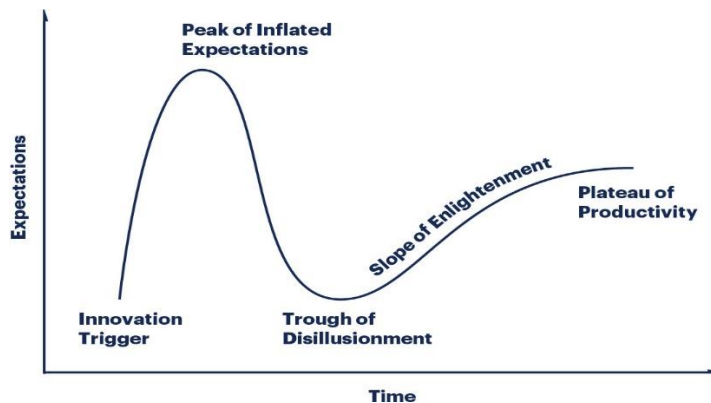


Fig. 1. Gartner diagram.

For citations of references, we prefer the use of square brackets and consecutive numbers. Citations using labels or the author/year convention are also acceptable. The following bibliography provides a sample reference list with entries for journal articles [1], an LNCS chapter [2], a book [3], proceedings without editors [4], as well as a URL [5] (Fig. 2).

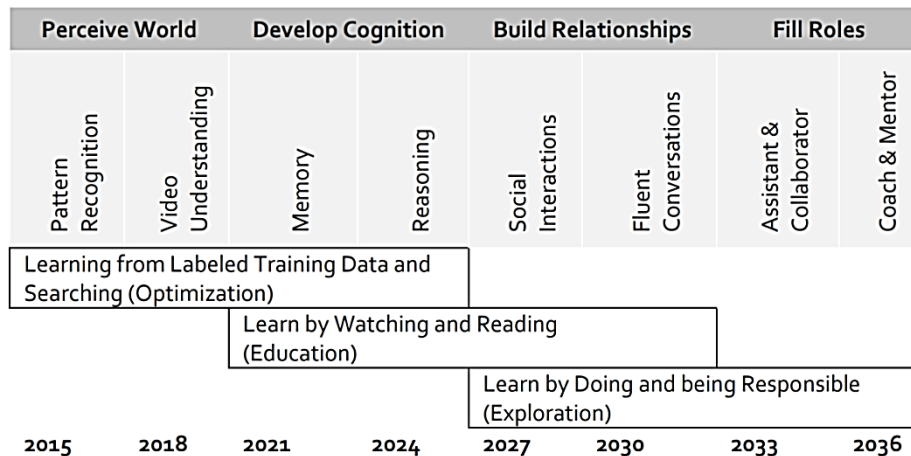


Fig. 2. Dynamics of development of systems with AI.

Progress in the development and application of AI systems goes on at an accelerating pace. Thus, according to the forecasts of the IBM Open Leader board, carried out with the involvement of research on the dynamics of many variables, by the early 2020s AI should enter the field of deeper self-learning, and by the early 2030s it should be able to help, collaborate, train and carry out mediation.

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We can say that AI is still making its first steps towards its colossal role, which it will have soon in the economy, defense, and national security, as well as education. At the same time, it is very important to understand - according to the rules or standards of which country the AI systems and programs created on their basis will function. If the standards in the field of AI will mainly take into account the national characteristics or interests of a single country, for example, the United States, then this country will become the main developer and supplier of systems and tools based on AI to all other countries and this will provide its leadership in this area.

This, in particular, is provided in the plan of the US federal government (prepared following Executive Order No. 13859), i.e. to create and develop technical standards and related tools for AI systems. This plan aims to "... ensure that technical standards ... reflect federal priorities for innovation, public confidence in systems using artificial

intelligence technologies; develop international standards to promote and protect these priorities” [11]. The Plan says that the United States should encourage the development of appropriate technical standards to provide an agreed language and framework to support the development and security of AI in different areas, including education.

4 Results and Discussion

Advances in AI development and use depend primarily on the government to play an active and focused role in developing AI standards. Its functions include:

- support, research, and development of AI;
- active participation in the development of AI standards;
- purchasing and deploying standards-based products and services;
- development and implementation of supporting policies, including laws and regulations.

The development of AI standards for education in Russia would allow it to take a leading position in the world in this area and receive considerable economic benefits.

When creating a system of AI standards for education, the following nine areas demand immediate attention: concepts and terminology, data and knowledge, human interaction, metrics, network, performance testing, and reporting methodology, security, risk management, reliability.

The Russian system of AI standards for education should take into account the "Concept for the development of the national standardization system of the Russian Federation for the period until 2020", developed by the national body of the Russian Federation for standardization - Rosstandart, approved by the Order of the Government of the Russian Federation dated September 24, 2012, No. 1762-r [12], as well as existing standards in the field of information technology application in education.

Russian AI standards should also take into account generally accepted international regulations and norms, including those related to social and ethical issues, governance, and privacy. While there is broad agreement that these issues should be taken into account in AI standards, it is unclear how this should be done and whether there is still sufficient scientific and technical basis to develop these provisions of the standards.

Standards need to be complemented by appropriate tools to advance the development and deployment of efficient, reliable, and trustworthy AI technologies. Tools that often have overlapping applications include (but are not limited to):

- datasets in standardized formats, including metadata for training, validation, and testing of artificial intelligence systems;
- tools for collecting and presenting knowledge and reasoning within AI systems;
- fully documented cases of application that provide a wide range of data and information about specific applications of AI technologies and any standards or best practice guidelines used when deciding how to deploy those applications;
- testing methods for validating and evaluating the effectiveness of AI technologies;
- metrics for quantifying and characterizing AI technologies;
- benchmarks, assessments, and descriptions of complex problems to stimulate innovation;

- test benches of AI systems;
- tools for reporting and auditing.

In the development of standards, in addition to the government, there is a need for the wide participation of scientific and commercial organizations. To help institutions make decisions about participation in the development of AI standards, their potential participation can be grouped into four categories, from least to most active: monitoring, participation, influence, and leadership.

The government should coordinate the activities of all participants in the development of AI standards to maximize efficiency and effectiveness, in particular, highlighting specific horizontal or vertical areas to prioritize the development of AI standards, determine the requirements for participation in the proposed standards activities, analyze whether the current activities are consistent with areas of standards to the needs of the education system, whether additional guidance is appropriate.

When developing AI standards for the education system, it is necessary to make maximum use of existing standards that are widely used in data transmission, medicine and can be used or developed in a new context.

A valid system of AI standards must interact with the educational information environment, the Internet, and other systems. The OSI network model (The Open Systems Interconnection model) can be considered as its possible structural prototype, (see Fig. 3). Through this model, various network devices can communicate with each other.

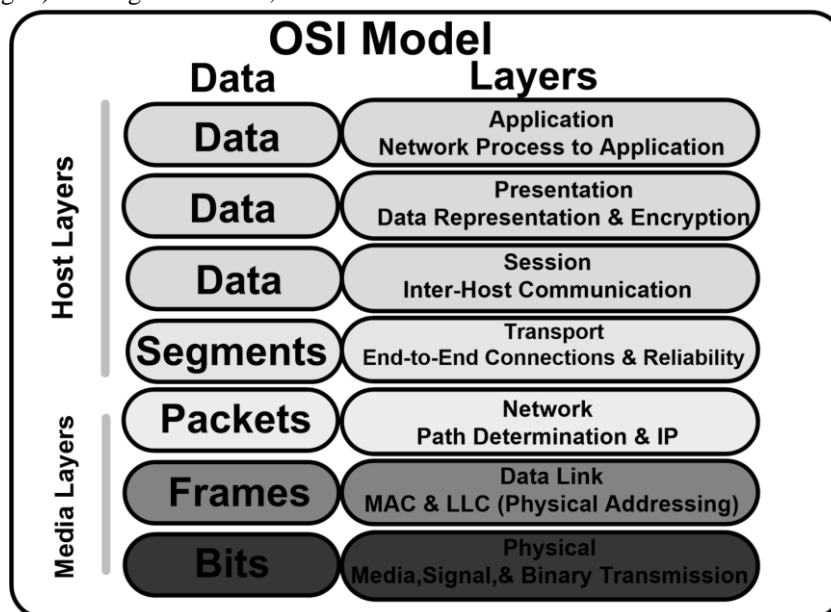


Fig. 3. Model of the interaction of open systems.

The standards of a valid AI system will also form a tiered structure, each of its parts may also include several standards. Application-level (Application), in turn, can have

levels of standards, forming structures like the system UDDI (Universal Description Discovery & Integration) [13].

Let's consider a possible interaction of valid AI systems based on UDDI, which, following the concept of the latter, may include the following components [13-14]:

- white pages designed to provide information about the service provider of the AI system: the name of the university, its address, contacts and known, as well as unique identifiers of the AI system for operational search, as well as, for example, a list of services provided (possibly in several languages);
- yellow pages that take into account the industry specification and AI categorizations based on standard taxonomy. This information will allow future users of AI to use it for comparison, as well as obtain more detailed and "voluminous" information on the required topic, as well as simplify the search for the necessary AI;
- green pages containing technical information about the services of the given AI system, its services, the organization of obtaining search and access to AI services, and information about the linked services, ie. contact the web service after it is discovered.

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Thus, the created UDDI network will be a top-up structure over the Internet (network over the network), which will make it possible to unite the system of good AI universities on a global scale. In the process of creating AI standards for the educational process, it is necessary to develop metrics and datasets to assess the relevance, reliability, and reliability of attributes of AI systems. Standards that are being developed should also minimize vulnerability to malicious attacks.

An important issue is the training of personnel to work with AI systems and their development. It is necessary to find specialists with the appropriate skills and training, as well as to provide measures to encourage participation in the development of AI standards for the education system.

Within a single country, there is a need to maintain and expand public-private partnerships to develop and use AI standards and related tools to promote robust and credible AI.

Strategic interaction with international organizations is also necessary to promote AI standards in education, to track and understand the strategy for the development of AI standards and initiatives of foreign governments and organizations.

Developing AI standards is essential to set up research requirements and approaches that help drive scientific breakthroughs in reliable and credible AI, give us confidence in AI technologies and develop confidence in the design, development, and use of AI.

5 Conclusions

Given the importance of AI to economic, educational, and national security prospects, dozens of countries have adopted national AI development programs. The process of creating, developing, and applying AI cannot be implemented without the leadership and organizing role of the government, which is responsible for developing the concept of creating, developing, and using AI, being applied to different spheres of life including the educational one. Within a single country, there is a need to maintain and expand public-private partnerships to develop and use AI standards and related tools to promote robust and credible AI.

In the process of creating AI standards for the educational process, it is necessary to develop metrics and datasets to assess the reliability and validity of the attributes of AI systems. Standards that are being developed should also minimize vulnerability to malicious attacks.

An important issue is the training of personnel to work with AI systems and their development. It is necessary to find specialists with the appropriate skills and training, as well as to provide measures to encourage participation in the development of AI standards for the education system.

Strategic interaction with international organizations is also necessary to promote AI standards in education, to track and understand the AI development strategy and initiatives of foreign governments and organizations.

Given the availability of existing information technology standards in the educational process, data transfer, and information security, newly developed AI standards should be linked to the latter in the form of a hierarchical network structure to exclude contradictions and unnecessary resource costs.

Developing AI standards is essential to set up research requirements and approaches that help drive scientific breakthroughs in reliable and credible AI, give us confidence in AI technologies and develop confidence in the design, development, and use of AI.

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