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ROLE OF EDUCATION AND RESEARCH FOR ARTIFICIAL INTELLIGENCE DEVELOPMENT IN BULGARIA UNTIL 2030*

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This paper presents briefly the national strategic document "Concept for the Development of Artificial Intelligence (AI) in Bulgaria until 2030" with a focus on the aspects related to STEM: education, research, data processing, applications of intelligent systems in real life. The SWOT analysis given in the Concept is summarised and possible priority areas are listed. To achieve the ambitious objectives of the Concept and meet the expectations for rapid development of digitisation including AI adoption in Bulgaria, further consolidation of the national academic potential will be needed.

1. Introduction. In 2018 the European Commission (EC) announced the concept of "trustworthy AI" in which technological progress is accompanied by a legal and ethical framework to ensure the security and rights of citizens as well as measures to collect and open high-quality big data, to provide equal access to the benefits of AI technologies and to disseminate broadly information to all European citizens. Europe aims to become a world leader in the trustworthy AI by developing AI applications that follow certain ethical standards and do not cause intentional or accidental harm even when they are handled by people with minimal technical knowledge. This would increase public confidence in European AI, developed in a unique "trust ecosystem", and motivate the industry to offer products and services where reliability is a competitive advantage. Ethical norms will be an incentive for new research, scientific breakthroughs, and innovation in AI. In this way, the EU has the ambition to set global standards for AI. Ethical principles and related values that should be respected in the development, implementation, and use of AI systems were identified: the principle of respecting human autonomy, the principle of prevention of harm, the principle of fairness, and the principle of explainability. However, Europe's ambitious agenda must be realised over the next decade in competition

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with superior US and China investment plans and in an aggressive battle for markets with the products of technology giants such as Google, Amazon, Microsoft, and others which currently dominate the development of most advanced AI technologies. Achieving a scale requires a pan-European approach to AI that will prevent the fragmentation of the European Research Area and the single EU market [1]. Member States are invited by the Commission to draw up national AI strategies or programs, or to integrate this dimension into other related strategies and programs, outlining the envisaged investments and implementation measures. As a response to this invitation, in December 2020 Bulgaria adopted a national strategic document entitled "Concept for the Development of Artificial Intelligence (AI) in Bulgaria until 2030" [2]. The Concept is based on previous documents prepared by a Working group of the Bulgarian Academy of Sciences (BAS): the "Framework for a National Strategy for the Development of Artificial Intelligence in Bulgaria 2019" [3] and "Artificial Intelligence for Smart Growth – Strategy for the Development of Artificial Intelligence in Bulgaria until 2030 (preliminary vision)", 2020 [4]. These expert texts delivered by the Working group of BAS helped to put together the National Concept in a few months, after broad public discussion. Here we outline the main ideas of this Concept and present some aspects related to education and research including the current performance of the academic AI sector in Bulgaria.

At first, let us discuss the important definitions of AI. Today science fiction and entertainment industry often show AI-heroes in numerous bestsellers and successful movies where they conquer the Earth, rule, or plan to destroy mankind, or at least control human consciousness. Certainly, the implementation of such heroes is not included in the agenda of Digital Europe programme. In the thriving scientific discipline of Artificial Intelligence there is a relatively small but established group of scientists who study the hypothetical so-called *strong AI* (or Artificial General Intelligence, AGI) which will have the capacity to perform any intellectual task that a human being can. According to the AGI paradigm, the objectives of the European Commission are to develop and implement in the next decade the so-called *narrow/weak AI* which deals with software systems able to study or accomplish specific pre-defined problem solving or reasoning tasks. (The AGI enthusiasts forget that building general AI had been already planned, e.g. sixty years ago Marvin Minsky expected to create AI "within a generation", and has not been achieved yet.). In contrary to fantasy or AGI research, the definitions used in the EC documents address only practical technologies: "Artificial Intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information derived from this data and deciding the best action(s) to take to achieve the given goal. The AI systems can either use symbolic rules or learn a numeric model and can also adapt their behaviour by analysing how the environment is affected by their previous actions." [5]. The AI is a transformative technology, one of the main drivers of digital transformation and a significant factor for ensuring the competitiveness of the European economy and high quality of life. However, recent reports show that in 2021 the United States still holds a substantial overall lead in AI, China continues to reduce the gap in some important areas, and unfortunately the EU continues to fall behind. It is likely that the EU will remain behind both the United States and China, and that China might close the gap with the United States in several

years. The EU regulatory system should be more innovation-friendly, otherwise it risks losing competitiveness in key industries [6].

2. The Bulgarian AI ecosystem and a SWOT-analysis. The Concept draws a complex picture of progress towards the objectives of "Digital Bulgaria 2025" programme. It enumerates the Bulgarian strategic and normative documents created so far, which address the digital transformation of the economic and public sectors, upgrading them with specific measures for the development of AI in our country. Some achievements are encouraging. Bulgaria has relatively good connectivity in the context of Southeast Europe (according to the DESI index for 2019 [7]), ranking first in the EU in the number of municipalities covered by the WiFi4EU initiative to build free access to wireless internet in public places throughout Europe. Although according to the DESI index for 2019 Bulgaria ranks 28th in the EU, the increase in its overall results is visible, and its ranking is lower on the one hand due to the limited results on some of the reported indicators, and on the other hand – due to the better performance of other Member States in some dimensions of DESI. Taking into account the promising advance, in May 2020 the report SRIP 2020 [5] gives a relatively good assessment of the Bulgarian government's readiness to develop AI, ranking Bulgaria ahead of five other EU member states. The academic infrastructure that can be used to solve important tasks in the field of AI will improve dramatically in the coming years due to the funding of nine major projects under the Operational Program "Science and Education for Smart Growth" 2014-2020. Almost all Bulgarian research organisations and universities, in which research on AI is carried out and relevant curricula and doctoral programs are maintained, participate in these projects. Launched in 2017-2018, the projects are at the stage of building their scientific infrastructure, to be followed by planned research activities. In 2024, scientists from all over the country will have a new generation of scientific infrastructure. A significant increase in the expert capacity and development of fundamental and applied research in contemporary topics of ICT and AI is expected as well. The Ministry of Education and Science is actively changing curricula and policies for funding ICT-related research. Digital skills training is already starting in primary school, and computer science is a stronger focus in secondary education. The opportunities for teaching informatics in higher education, including through distance learning, are expanding. Good practice has been established to develop and update the National Roadmap for Research Infrastructure [8] and to finance major projects on important topics with social significance through National Research Programs. The Updated National Research Strategy 2017-2030 [9] identifies as a key element the linking of funding of both research organisations and individual scientists with the results of their research achievements. As a consequence of all these activities, a significant increase in the expert capacity and development of applied research can be expected.

Bulgaria has a traditionally strong sector in informatics and automation, the foundations of which as a scientific field were laid in 1962, and after 1980 even serial production of industrial robots was achieved. Despite the difficulties and losses during the transition years, today's dynamic IT sector is built on these foundations with revenues that form about 3.4% of the country's GDP [10]. A number of Bulgarian high-tech companies are very successful in the field of AI and fulfill contracts for large clients from Western Europe and the USA [11]. The growing popularity of AI technologies is creating a wave of

start-ups in the country. According to a report by SeeNews and Vangavis "AI ecosystem in Bulgaria" [11], in 2019 a total of 47 companies develop or use AI in Bulgaria. Of these, 32 are start-ups and escalators, and 15 are established Bulgarian or international companies. The sector employs over 3,000 people; AI-related jobs account for 3% of the total labour market in Bulgaria. The start-up ecosystem of companies developing or applying AI in Bulgaria is still at an early stage of its development (one-third of all companies surveyed for the report were established in the period 2016-2018) but has seen a significant boost in recent years.

In 2020 the European Commission published a study on the deployment of AI technologies across the EU, carried out by Ipsos with a total of 9640 enterprises in 30 countries [12]. It has been found that 42% of businesses in the EU currently use at least one AI technology, a quarter of them use at least two types, and 18% have plans to implement AI technology in the next two years. Three key internal barriers to the perception of AI are the difficulty of hiring new staff with the right skills (57%), the cost of deployment (52%), and the cost of adapting operational processes to new technologies (49%). A total of 380 Bulgarian companies of all sizes participated in the survey. In general, the awareness of AI among Bulgarian companies is constantly high in different sectors: 54% of the survey participants use at least one AI technology, 31% use at least two technologies, and 11% plan to use AI over the next two years. Only 36% do not use AI and do not plan to implement it at all. According to this indicator, Bulgaria is among the top three countries in the EU.

Despite the positive developments and optimistic expectations, however, we have to take into account several negative facts. One of the main challenges for Bulgaria's progress in the development and implementation of AI technologies is the low level of digital skills at the individual and company level. According to the DESI index for 2019 [7], Bulgaria reports significantly below the average result in the dimension of human capital. The share of people with at least basic skills in the field of digital technologies amounts to about 29% of the Bulgarian population (57% on average for the EU), and only 11% of people have skills above basic (with an average for the EU of 31%). According to SRIP 2020 report [5], the level of perception of AI in Bulgarian industry is relatively good for the region (medium-low), but the report also shows the limited number of offered bachelor's and master's programs in the country, so there is much to be desired in connection with training. A change in the education system is needed throughout the cycle of formal education, vocational training, and higher education while placing greater emphasis on lifelong learning to enable people to acquire and improve adequate skills relative to the changing environment. Furthermore, there is a strong shortage of academic staff in Bulgaria because the capacity of scientific organisations to retain talented young scientists is very low. Due to the attractiveness of jobs in the IT sector or work abroad, almost all young IT professionals are turning to a career in industry, neglecting the scientific field. In recent years, the number of published scientific articles by Bulgarian authors in the field of AI has decreased significantly: 387 scientific publications for the period 2015-2018, Bulgaria being followed by six countries with smaller populations [5]. Unfortunately, these research papers are authored by scientists affiliated with a few institutions only. Another known problem of the current state of the research system and the business environment in Bulgaria is the unbalanced regional distribution of scientific organisations, universities, and successful industrial centres. The vision of

the Updated National Research Strategy 2017-2030 [8] is "gradual development of research in the regions as well, as the first step will be to support applied research through the establishment of regional research centres. In the future – during the third stage of implementation of the Strategy, planning and implementation of research and innovation complexes in less developed regions of the country are envisaged." Therefore, Bulgaria needs to address the problem of the lack of a critical mass of skilled human capital to support R&D and business innovation, especially in regional and local ecosystems.

In summary, the SWOT analysis presented in the Concept contains main findings as follows:

Strengths: Research excellence (established centers in AI and robotics, recognised researchers and internationally visible papers, good international cooperation, radical improvement of research infrastructure); Business excellence (IT sector rapidly growing, investments from leading companies, progress of startup ecosystem); State support (focus on education, improved connectivity, and digitalisation);

Weaknesses: Decreasing research capacity (reduction in the number of /aging/ scientists, insufficient funding, lagging behind other countries in scientific outputs, inability to attract talents, low success in the EU R&D programmes); ineffective links among academia and industry; modest innovation potential; low level of digital culture as a whole;

Opportunities: Chance for a complete change using the revolutionary digital transformation; available EU support and help in many respects; governmental readiness for structural changes; young Bulgarians returning from abroad;

Threats: Inability to reach a consensus on radical changes; slow progress of national R&D, market captured by foreign products; insufficient capacity to train/ retrain a critical mass of experts; inability to attract qualified staff from abroad; delay in providing big data and building products and services for the public sector.

3. Pillars of AI development aligned to the EU vision. In the EC plans, AI development is usually shaped by coordinated measures in six dimensions: (*i*) strengthening education, training, and lifelong learning to overcome the skilled staff shortages; (*ii*) building excellent research centers and reinforcing international cooperation among scientists; (*iii*) providing computational infrastructure as well as high-quality public data, accessible to all interested parties in European data spaces; (*iv*) establishing a unique "trust ecosystem" by introducing a legal and policy framework for AI; (*v*) implementing sustainable technology transfer schemes to industry, with attention to small and medium-sized enterprises to ensure equal access to AI benefits; (*vi*) supporting a dialog with the society to prepare the acceptance of a reliable and focused on human AI. Here we consider in more detail the first two dimensions.

Education and lifelong learning have a key role to play in the development and adoption of AI because they train researchers who discover new methods and invent tools, experts who implement the technologies in practice, teachers who disseminate knowledge, and specialists who are able to explain the benefits of adopting intelligent systems for widespread use. To create a critical mass of qualified staff with higher education, the most developed European countries are planning solid investments in university structures and doctoral programs in AI. For instance, Germany planned to open hundred new professorships in AI in the German universities, attracting the most talented scientists

from all over the world; France planned to increase three times the number of students in AI in three years. Some national AI strategies propose the creation of educational platforms for free distance learning courses. Finland has already created public courses on basic AI concepts[1], which are provided in all official EU languages, and plans to develop a series of courses also adapted to all official EU languages. Almost all European national strategies propose measures to integrate research and business in achieving high-quality AI education. In addition, the introduction of AI in school education programs will have a profound effect on the skills required by 2030. The programs for high-tech vocational high schools should be prepared and constantly adapted with the help of universities and research organisations. The integration along the axis "school-university-business" is essential both for the quality and current curricula in the field of AI and for filling the critical deficits of teachers and lecturers in the rare, most difficult, and most sought-after specialties – mathematics, informatics, electronics, programming, communications, robotics, embedded systems, etc. Last but not least, lifelong learning is important for people facing the societal challenges of the 21st century. The use of AI in the creation of educational content for (re-)qualification of working and unemployed can significantly accelerate the process of training. As we already said, Bulgaria needs to take care of the training of a critical mass of skilled experts in regional and local ecosystems. Further discussions and suggestions about education and training in the AI age are given in [13, 14].

One of the main factors for Europe's intellectual and commercial leadership is the excellence in fundamental and applied research in AI, ICT, robotics, autonomous systems, and other related fields, which create and test reliable AI technologies. In 2018, the European researchers published most scientific articles in the field of AI (over 27% of the global scientific production in Scopus [15]), but the EU share of the world's AI papers would decrease if the United Kingdom portion is excluded. The European research groups work mainly in relatively small scientific units spread out across many countries. To overcome the fragmentation, the EC proposed strong financial support to unify the research community through enhanced international cooperation and targeted funding, talent retention mechanisms in Europe, and the implementation of sustainable technology transfer schemes to industry. Another recommendation is to establish a Strategic Roadmap for AI Research in the EU, outlining major research challenges and the specialised and interdisciplinary scientific problems. The map should be regularly updated and guide research in the EU to achieve reliable AI, helping to harmonise member states' research programs [16].

The largest increase in the number of published articles is observed in the following AI subfields: machine learning, including deep learning; natural language and speech processing; machine vision; AI in cyberphysical systems and robotics (US $ 7.7 billion was invested in self-driving vehicle research in the world in 2019 [15]); cognitive systems. Other research areas of strategic importance are: development of AI-algorithms for chips embedded in Internet of Things devices; creating a hybrid AI with capacity for inference and learning as the core of systems capable of explaining; development of algorithms for learning facts from small data sets, etc. The capacity of AI systems to draw inferences over big data is expected to increase significantly in the coming decades, this area is

[1] `https://www.elementsofai.com/`

viewed as one of the key AI challenges [17]. Developments in AI will lead to the emergence of a new generation of technologies. The AI is already beginning to be used for software development, which allows the automatic synthesis of program code.

4. Proposals of the Bulgarian AI Concept. The main goal of the Concept is to focus the efforts on the development and implementation of AI by creating research, expert, business, and management capacity. The Concept suggests measures and instruments enabling the achievement of the following vision: in 2030, Bulgaria is a country with a high-tech, efficient and sustainable ecosystem for research, technology transfer, development of its original products and services, and implementation of world-class solutions in the field of AI, big data, and robotics. Here we list only a few of the proposals presented in the Concept.

Adapting education systems and raising the skills of the workforce: increasing pupils' competencies in the field of ethical issues related to the use of information technology and their rights in the digital world in which they live; expanding and intensifying the training of specialists with higher education in the field of AI; creating conditions and motivation for a sharp increase in the number of trained doctoral students in the field of AI in doctoral programmes, as close as possible to those established in Western Europe and the United States; supporting interdisciplinary training and doctoral programmes; including training about the impact of AI on society as well as about the standards for building reliable AI; implementing lifelong learning programmes for expansion or change of qualification in vocational training and continuing education.

Development of research capacity for scientific excellence: creating a Bulgarian Research Programme for comprehensible, people-oriented AI and robotics, as a union of scientific organisations and universities that have original developments in the field, including Centers among the nine established under the Operational Program "Science and Education for Smart Growth" 2014-2020. The consortium will implement an ambitious research plan on scientific topics with strong Bulgarian capacity (neural networks, machine learning, hybrid AI, natural language processing, processing of knowledge and data appearing in the information space as huge public arrays – knowledge graphs and linked open data, etc.), as well as the generation of explanations for decisions made by AI. Applied research in the field of modern intelligent robotics should be aimed at creating research prototypes in specific niches, using AI and Internet of Things technologies, given the expected widespread introduction of 5G communication. The Programme will provide a research environment for the training of young scientists and specialised personnel in intelligent components in mechatronics and robotics. This consortium will enable to share experience and achievements of Bulgarian teams that are involved in pan-European networks in AI, robotics and digitalisation.

Building a reliable Bulgarian infrastructure for AI development: integrating the newly built hardware infrastructure for high performance computing, data storage and processing, mechatronics and robotics; organising groups of experts in priority areas for the accumulation of large data sets (e.g. in health and agriculture) to help define formats, structures and annotation schemes, standardisation approaches and interoperability of significant subsets of data, to be added as a public resource to the national Open Data Portal and the European Data Spaces; providing access to methods and tools that make datasets comparable and useful at the international level, using common data

formats and combining different datasets in the public space; providing freely accessible arrays of high-quality data for machine learning in the construction of prototype AI applications, planning activities for clearing, calibration, annotation and tagging of data, construction of knowledge graphs, ensuring compatibility with related open data repositories and others; encouraging the sharing of non-personal data through the development of scenarios and software environments for ethical, secure and lawful exchange; providing open access (open programming interfaces) enabling the creation of AI-based innovative solutions and services.

The Concept suggest to organise an Interdepartmental Working Group including representatives of all stakeholders, to map the status of sectors important for the development and implementation of AI (regulations, assessment of the national and regional innovation capacity in ICT, industry 4.0, etc.) and to develop an Action Plan in the short, medium and long term until 2030. This Action Plan or Roadmap should define the specific measures, deadlines, responsible institutions, expected results and success indicators, sources of the necessary financial resources as well as the reporting schedule.

Regarding national priorities for the thematic areas of AI implementation, the Concept emphasizes the importance to set such areas given Bulgaria's limited resources. A fundamental proposal for the country is to focus on technological specialisation in the field of the data economy, as Bulgaria would find it difficult to achieve strong industrial specialisation due to the lack of a critical mass of leading industrial companies in the AI sector. It is the EC policy to make the EU a world leader in data-driven economics. An example of a useful service that would be very valuable for AI applications is the integration of private (company) data with publicly available ontologies and very large databases of open data, to prepare a data resource for further analysis.

The Concept lists branches and thematic areas in which it is important to conduct research and create both innovative prototypes and real applications, implemented in practice. One priority sector is the **software industry** due to its growing contribution to the national GDP and attractive job offers that ensure the retention of highly intelligent and qualified personnel. Creating **AI applications for educational purposes** is important because of the rapid expansion of e-learning. This includes multimedia learning materials, personalisation, tools for automatic assessment, and others. Embedding **AI in public services** is an EC focus because this will demonstrate the benefits of AI technologies to the society as a whole, convincingly. Another promising area is **smart agriculture**. Bulgaria has already the necessary conditions for the development and implementation of relatively large-scale applications of AI in plant and animal husbandry – high degree of connectivity, cloud structures for data exchange and storage, accessible public data, qualified developers and specialists for the maintenance of complex cyber-physical systems. Last but not least, **healthcare and medicine**, as well as **ecology and the environment**, are priority areas of the EU Digital Europe programme and the European Green Deal. It is expected AI will contribute to radical improvements in medical treatment and prevention, and AI-based tools will provide better environmental monitoring solutions and management of processes related to climate change.

5. Recent activities. Bulgaria is actively involved in the initiatives of the Research Data Alliance (RDA)[2]. At the end of 2019, RDA-BG[3] – the Bulgarian national node of RDA, was officially established at Sofia University (SU), Faculty of Mathematics and Informatics (FMI), to act as a long-term central contact point between RDA and data scientists, data practitioners, funding organisations, research agencies, and other relevant stakeholders in Bulgaria. The activities of RDA-BG are directed to achieving the main RDA goal: "building the social and technical infrastructure to enable open sharing and re-use of data". The events organised by RDA-BG in 2020 were focused on Data Management, Open Science, Open Data, Open Access, the European Open Science Cloud, and the Bulgarian Open Science Cloud, with participants from SU, the University of Barcelona, the Institute of Information and Communication Technologies of BAS, the Institute of Mathematics and Informatics of BAS, the software company Ontotext and program officers from the Ministry of Education and Science and the National Centre for Information and Documentation.

Answering to an invitation of Helsinki University, in early 2021 SU-FMI and Ontotext made official commitments in connection with the spread of the "Elements of AI"[2] course in Bulgaria. This course is a free online training resource created by the University of Helsinki and the technology firm Reaktor during the Finnish Presidency of the Council of the EU. It is viewed as one of the top 100 mass open online courses (MOOC) and is ranked first among the world MOOC courses in the field of computer science. The course is freely available in all official EU languages thanks to the translations provided by the European Commission. It aims to teach as many people as possible (as stated in [18], 1% of the EU citizens by 2021), especially those who and what it is no experts in mathematics, computer science, and information technologies, what AI is and is not, how it can be applied in real life and what are or will be the consequences of implementing AI technologies for individuals, companies, and society. After taking the course, its participants are expected to "understand some of the major implications of AI; think critically about AI news and claims; define and discuss what AI is; explain the methods that make AI possible" [19]. Sofia University was invited as an academic partner to review the course content in Bulgarian, to take care of the academic training and consultations, and to actively support the course in Bulgaria, and Ontotext – as a promotional partner for the Bulgarian version of the course. Through the FMI, SU will offer the course to a broad audience: university students and lecturers, high school students and teachers, journalists, lawyers, psychologists, sociologists, etc. This Finish initiative seems to be a promising approach to ensure the maximal effect of education and training in a relatively short period of time.

Two large National Research Programs in Smart Crop Production and Smart Livestock Farming will start in March 2021, funded for 3 years by the Ministry of Education and Science. Embedding of AI technologies in agriculture activities will allow the creation of complex infrastructures that integrate the virtual and physical world and provide support such as remote process control; effective use and monitoring of quality of resources; monitoring and controlling the growth of agricultural crops; analysis of sensory data and publicly available satellite images; use of automation and robots in various processes

[2] https://www.rd-alliance.org/

[3] https://rda.bg/

including automating unattractive activities in livestock farming; application of digital methods for diagnostics, forecasting, and management of the production. Several research prototypes after assessment will serve as reference infrastructures to be adapted and further developed for different regions of Bulgaria. This will support the formation of a consolidated agricultural policy, taking advantage of AI applications in crop production and livestock farming, and will facilitate the digitisation of agriculture. It will be possible to build plans about the education of professional staff in smart agriculture.

6. Conclusion. The conclusions from the work carried out on the development of the Concept, as well as from the analysis of subsequent proposals, can be grouped in the following statements.

6.1. Research. The Concept proves the need for intensive research in integrated academic and business teams through active international cooperation with leading partners. Measures to achieve both this goal and thematic focuses are proposed. There is an explicit emphasis on academic entrepreneurship and commercialisation of innovations in partnership with business.

6.2. Educational. The Concept recognises that the AI-education relationship is a two-way link. On the one hand, AI contributes to the modernisation of education and training. On the other hand, building and using reliable and effective AI is impossible without a deep understanding of its nature and impact starting from school. The Concept envisages concentrated efforts both for the mass basic training in the field of AI and for a specialised one in vocational secondary and higher education.

6.3. Business oriented. The AI-business relationship will develop more and more intensively. One of the most important tasks of the Concept was to set priorities. For a country such as Bulgaria, this is especially important due to its relatively limited resources. The priority areas are settled – both consumers of AI with a particularly large impact on society, and creating specific new AI technologies for which the country has the experience, results achieved, and potential.

6.4. Ethical and legal. The Concept takes into account and fits into the leading and distinctive feature of "reliable AI" of the European vision. It provides for the unconditionally necessary technological progress to be inextricably linked to the creation of a legal and ethical framework to ensure the security and rights of citizens, as well as equal access to the benefits of AI technology.

6.5. Political. The analyses have shown that any achievement of serious results in the development and application of AI in any of the above areas would require a well-planned and regulated cooperation within the EU. The conditions and mechanisms for its functioning have been worked out, repeatedly and continuously proven in action. The clear fixation of Bulgaria's commitments as resources and contributions, a step towards which is the Concept, together with also clearly defined reciprocal obligations of EU partners, should lead to the expected positive results.

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РОЛЯ НА ОБРАЗОВАНИЕТО И НАУКАТА ЗА РАЗВИТИЕ НА ИЗКУСТВЕНИЯ ИНТЕЛЕКТ В БЪЛГАРИЯ ДО 2030

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Тази статия представя накратко националния стратегически документ „Концепция за развитието на изкуствения интелект (ИИ) в България до 2030 г.“, като се фокусира върху аспектите, свързани с природните науки, технологиите, инженерството и математиката (STEM): образование, научни изследвания, обработка на данните и приложения на интелигентните системи в практиката. Представен е анализ на българската екосистема по ИИ – силни и слаби страни, възможности и предизвикателства, и са изброени възможни приоритетни области за развитие на ИИ. За да се постигнат амбициозните цели на Концепцията и да се отговори на очакванията за бързо възприемане на цифровизацията, включително въвеждане и използване на ИИ, ще бъде необходима максимална консолидация на националния академичен потенциал.

Ключови думи: изкуствен интелект, надежден изкуствен интелект, стратегия за развитие, образование и научни изследвания, консолидация на академичния потенциал.