METAVERSE, AI, ANTHROPOCENTRISM OF LAW AND SUI GENERIS: AUTHORSHIP WITHOUT AN AUTHOR OR CHALLENGES AND PROSPECTS OF THE DIGITAL AGE, THE LIMITS AND POSSIBILITIES OF FUNDAMENTAL HUMAN RIGHTS

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Abstract. The rapid development of technology is changing the structure of business and production. Building an economy based on big data analysis, automation, robotization, Internet of Things, artificial intelligence, immersion technologies and blockchain sets new requirements for the qualification of specialists, significantly changes the essence of certain specialties and stimulates the emergence of new professions. The coming years opens new perspectives and allows you to develop a conceptual vision of the reality of the future, which combines the physical and virtual worlds. It is important to understand the current state of technology to build the reality of Metaverse. Today, there are Metaverse concepts. However, to predict the trends in the development of society in the Metaverse, it is necessary to analyze the current level of technological development, which is the basis for the development of the Metaverse.

Topical problems of ensuring and violating fundamental human and civil rights and freedoms in connection with the use of artificial intelligence technologies are analyzed, the impact of these technologies on human rights and freedoms is studied, specific facts of violations are analyzed, the main challenges and threats are identified, and legal methods of their protection are outlined. A comprehensive analysis of the legal regulation of legal relations related to the use of artificial intelligence (hereinafter referred to as AI) in Ukraine is carried out, the existing gaps in legal regulation are identified. The development of artificial intelligence and its impact on human rights are analyzed. life of mankind. It examines how various AI systems are used in the world today and how they can help and harm society. Artificial intelligence opens wide opportunities for both people and corporations and states in general: in particular, it is about simplifying decision-making processes, ensuring the safety of citizens and streamlining the work process.

Keywords: AI, sui generis, IoT, law, electronic jurisdiction, Metaverse, sustainable development goals, immersion technologies.

Research methods. The method of system analysis is used for a comprehensive consideration of the technologies that form the basis of the Metaverse (artificial intelligence, blockchain, immersion technologies, etc.), their interconnection, integration, impact on society and possible risks to fundamental human rights. regulations and research on the state of legislative regulation of artificial intelligence in Ukraine and the European Union, as well as the analysis of individual cases of European judicial proceedings ("Fixtures Marketing Ltd v. Oy Veikkaus Ab" and "Ryanair Ltd v PR Aviation BV C30/14") [1].

The comparative historical method is used in the analysis of historical stages of the development of technologies related to the Metaverse, which allows us to trace the logic and dynamics of the development of technologies and legal institutions related to them. The formal legal (normative) method is used to analyze legal norms, their systematization, interpretation and assessment of compliance with the provisions of these norms' human rights protection goals in the context of the use of artificial intelligence technologies and the development of the Metaverse. In particular, the possibility of formulating sui generis law in Ukrainian legislation is considered. The forecasting method is used to analyze the prospects for the development of Metaverse technologies, their integration into the educational environment, the creation of new professions, as well as to forecast possible legal, economic and social challenges associated with these technologies. the case study method (analysis of specific situations), which is used in examples of legal conflicts (the case of American women authors regarding the use of AI drawings, the painting "The Next Rembrandt", etc.). The use of the empirical method by studying the results of examples of the application of artificial intelligence and the Metaverse in various spheres of society – in particular, in medicine, education, security, transport and other fields provides a wide scientific experience.

The purpose of the study is a comprehensive analysis of the impact of digitalization, Metaverse technologies and artificial intelligence on fundamental human rights and freedoms; identification of legal challenges and threats arising in the process of implementation of these technologies; as well as substantiation of promising areas of legal regulation using sui generis mechanisms to ensure legal protection of the results of artificial intelligence activities in the modern digital society. Problems of human rights and freedoms of citizens in the context of the development of artificial intelligence, Internet of Things, Metaverse and immersion technologies has not yet been the subject of a comprehensive interdisciplinary analysis, considering the identification of gaps and shortcomings in the application of the sui generis legal regime.

Part 1. AI and Fundamental Human and Citizen Rights and Freedoms

AI poses serious challenges to people's rights and freedoms. These challenges do not indicate that new technologies, in particular artificial intelligence, are negative or that humanity needs to abandon them. To analyze the impact of artificial intelligence on human rights and freedoms, the documents widely used in Europe [2] and containing a wide range of human rights are taken as a basis, including: The Universal Declaration of Human Rights of 1948, the International Covenant on Civil and Political Rights of 1966, the International Covenant on Economic, Social and Cultural Rights of 1966 and the Charter of Fundamental Rights of the European Union [3,4 ,5]. The misuse of artificial intelligence algorithms creates many problems, such as: violation of the right to life; right to privacy; restriction of freedom of speech and thought; violation of the right to a fair trial and presumption of innocence; rights to equal opportunities and non-discrimination; rights to work, etc. [6,7]. Since artificial intelligence technologies use certain data sets, the rights of vulnerable social groups of the population are most often violated. These may include women, children, and members of ethnic, racial, or religious groups in communities [8].

Artificial intelligence technologies are actively implemented in both every day and professional life, and are also used in a variety of industries – in particular: medicine, industry, agriculture, defense, education, etc. Today, smartphones recognize the faces of their owners, autopilots drive cars, virtual assistants respond to questions, street cameras identify offenders, and surgical operations are performed using robotic systems – and this is not a complete list of examples when modern innovations make people's lives easier. As artificial intelligence technologies are increasingly used in various areas of life, analysis is relevant. Modern development of society is determined by the widespread use of digital technologies, which changes all spheres of life. One of the leading topics of the World Economic Forum (WEF) [9,10] is the impact of technology on various industries and aspects of life [11]. The current state of society increasingly defined as the era of the Fourth Industrial Revolution, which involves the use of a variety of technologies such as the Industrial Internet of Things (IIoT) [12], artificial intelligence (AI), machine learning, virtualization, data analytics, blockchain, etc. [13], to create "smart" factories and enterprises where most processes are subject to automation [14]. Leading scientists, politicians and businessmen continue to discuss the impact of technology on various spheres of public life. Particular attention is paid to the fact that many industries are switching to the latest technologies to ensure competitiveness and flexibility in rapidly developing areas, in particular cloud computing, big data processing and e-commerce [15]. There is an increase in interest in encryption, driven by new vulnerabilities in the digital age, as well as an increase in the number of companies expecting the introduction of robots and artificial intelligence [16], with both technologies gradually becoming the basis of cross-industry collaboration [17,18]. However, these issues are considered within the framework of solving the problems of personal data protection. Other aspects of the violation of human rights and freedoms are still insufficiently studied and are not a detailed subject of scientific research. The scientific novelty of this study lies in the application of a systematic approach to the assessment of potential threats and challenges to the rights and freedoms of the individual and, accordingly, the analysis of legal methods of their protection in the context of digital transformation. Due to the development of high technologies, which allow you to create completely new types of production and are based on big data processing, robotics, augmented reality, the Internet of Things and other digital innovations, the demand for highly qualified specialists is growing [19,20]. The intensive development of the Metaverse is driven by the growing need of users for deeper interaction with digital content in the

social media environment, where communication takes place through text messages, images, and videos. Among the advantages of Metaverse are: stability, which has affected the entire labor market; development of the entertainment industry, including video games; virtual travel; communication without borders, including overcoming cultural barriers. Today, there are already objects created with the help of artificial intelligence in the world, including visual compositions, architectural models, chatbots and digital avatars. Such works arouse great interest in society and are sold for a lot of money at auctions. Research in the field of development and application of artificial intelligence is an object of interdisciplinary scientific interest and is at the stage of active development.

Ukraine needs adaptation and harmonization of national legislation in this area with the legislation of the European Union. Nick Bostrom in his book "Artificial Intelligence" notes that humanity is not just on the verge of discovering the "supermind", but is also likely to face a potential threat, which is a fierce competition between humans and artificial intelligence, which is rapidly conquering all spheres of human life, which, according to the scientist, is a serious threat to fundamental human rights [21]. A person needs protection, including legal protection. As a result of the rapid spread and development of artificial intelligence technologies, scientific discussions in various fields of sciences are intensifying, ranging from philosophy, economics and law to computer science and applied computer science [22].At present, in Ukraine, the issue of legal protection of results created using AI technologies is partially regulated by the Law of Ukraine "On Copyright and Related Rights" [23] (hereinafter referred to as the Law).According to the Law, the author of a work can only be an individual who created it as a result of his own creative activity. Thus, only a person's activity is recognized as creativity, and his work is recognized as an original object of copyright. The created original work reflects the individuality of the author, has unique features of his creative style, and, accordingly, is a manifestation of the personal identity of the creator. Copyright will remain anthropocentric in its basis, while it is expedient to regulate the results of AI activities within a special legal regime – sui generis rights. This legal regime is defined by Article 33 of the Law: The right of a special kind (sui generis) to non-original objects generated by a computer program [24,25,26]. A non-original object generated by a computer program is an object that differs from existing similar objects and is formed because of the functioning of a computer program without the direct participation of an individual in the formation of this object [27]. Such wording became a compromise between the need for legal regulation of the results of AI work and the "human-centricity" of copyright [28,29]. However, this formulation raises certain questions – what exactly does the legislator mean by the concept of "generated" [30], what criteria should be used to establish that an object is "different" from similar ones, and what participation of an individual is considered "direct" [31,32]. Only practical implementation will gradually find answers to these questions; in particular, their solution will be partially carried out within the framework of judicial practice. The Law introduces the concept of "non-original objects generated by a computer program". This term also covers results created using AI technologies. Non-original objects (Fig.1):

    – do not belong to the category of works, since the work is an original intellectual creation of the author or co-authors in the field of science, literature, art, etc., expressed in an objective form;

    – are governed by sui generis law, not copyright. Formed as a result of the functioning of a computer program;

– created without the direct participation of an individual. Significant investments are made in the creation of such non-original objects, so they must be protected.
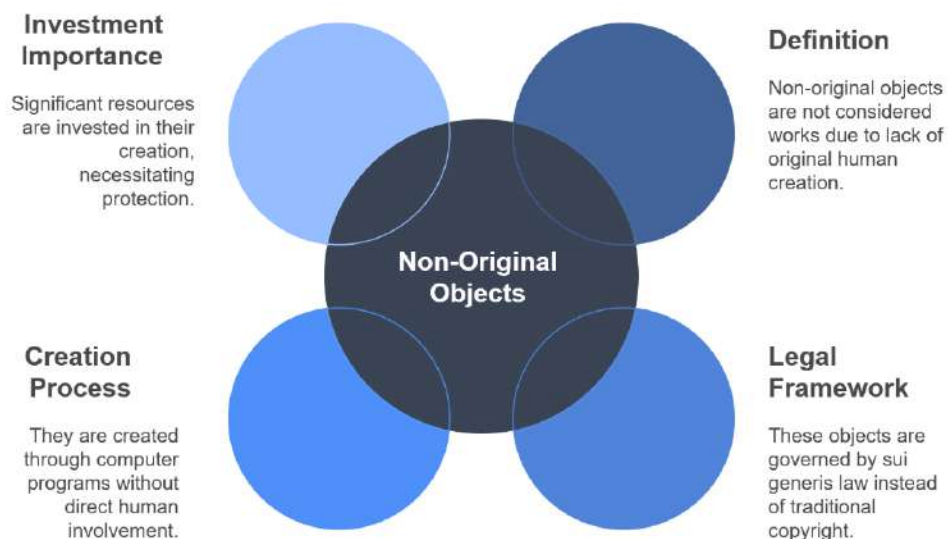
Protecting Non-Original Objects in the Digital Age

Fig.1. *Non-original objects*

Also, Article 33 of the Law regulates the legal status of subjects of the special sui generis regime – i.e. those who own property rights, regarding the occurrence of these rights, as well as the terms of their validity (Fig.2):
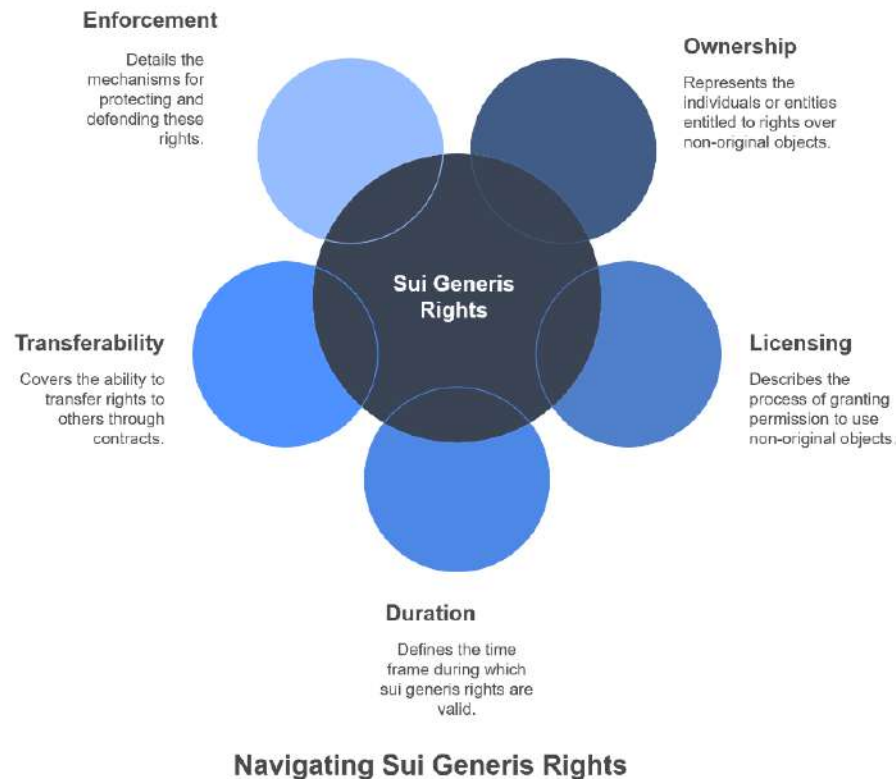
– The subjects of the sui generis right to non-original objects generated by a computer program may be persons who own property rights or who have licensing authority to a computer program – this program that works without direct human participation – the authors of the program, their heirs, persons to whom the authors or their heirs have transferred property rights to the program or lawful users of the program;

– If a non-original object is generated because of the use, for example, of copyright objects, then the above-mentioned subject will be able to exercise his sui generis rights to a non-original object only if he respects the rights of the copyright subject, whose work he used in the process of generating a non-original object. The same applies to the use of objects of related rights or another protected non-original object generated by a computer program;

– The conditions for the sui generis right to non-original objects may be determined by the contract. As a result of the formation of a non-original object, personal non-property rights do not arise;

– the scope of property rights to a non-original object is determined in accordance with the general procedure, as well as in relation to property rights to a work – according to Article 12 of the Law;

− the sui generis right arises as a result of the fact of generating an object and begins to operate from the moment of its generation;

− the validity period of the sui generis right expires after 25 years (calculated from January 1 of the year following the year in which the object was generated);

− during this period, the subject of the sui generis right has the exclusive right to grant other persons permission to use this object by any means on the basis of an agreement;

− permission to use a non-original object is granted by a license agreement;

− the sui generis right can be alienated in favor of another person (by contract);

− free use of a non-original object is allowed . If sui generis rights are violated, then a person can apply for the protection of these rights (including in court).

Enforcement
Details the mechanisms for protecting and defending these rights.

Ownership
Represents the individuals or entities entitled to rights over non-original objects.

Sui Generis Rights

Transferability
Covers the ability to transfer rights to others through contracts.

Licensing
Describes the process of granting permission to use non-original objects.

Duration
Defines the time frame during which sui generis rights are valid.

Navigating Sui Generis Rights

Fig. 2. Navigation sui generis rights

A person, using the AI program, invested in the creation of a certain object. In this case, the use of the program does not mean the direct participation of a person in the creation of the result, a person can give a request to the program, but not directly participate in the process of generating an object. By obtaining a certain result, the subject of sui generis law is endowed with certain rights – to allow or prohibit the use of this result. The law gives him these rights for a limited period, during which it is possible to return his investment and prevent the misuse of the "work". The logic of applying sui generis law to AI is that the criterion for obtaining protection is not

originality, as required by copyright, but the form of expression – the result of AI's work and investment. The sui generis right does not require an answer to the question "Who is the author?". It assumes that AI will be considered the "mind" behind the creation of the result and determine the author unnecessarily. But there are subjects of sui generis law – persons who own property rights, whose investments must be protected.

The sui generis law has its own peculiarities in calculating the terms of protection of the results created by AI. The law stipulates that the validity period of the sui generis right expires after 25 years (calculated from January 1 of the year following the year in which the object was generated). During this period, the subject of the sui generis right has the exclusive right to grant other persons permission to use this object by any means based on an agreement. It is assumed that this period is sufficient for the return on investment. The intensity of the development of AI technologies gives reason to believe that it is inappropriate to establish too long a period of legal protection of objects created with its use. Because such a monopoly can hinder innovative development. At the same time, too short a period of protection (for example, five years) will not provide effective legal protection of the results created using AI technologies. According to the legislation, today this period is 25 years. Significant investments that are made in creating the result of AI work is one of the most important factors that must be analyzed to obtain protection by sui generis law. For example, protection can be provided to developers of the AI system, who were able to confirm with relevant documents that they have made the investments necessary for AI training and implementation.

Part 2. Digital transformation of legislation

Unlike European countries, the legislation of Ukraine is at the stage of normalization of a new type of legal relations arising in connection with AI technologies in various areas, and needs further improvement and harmonization with the law of the European Union (EU) in in this area. Regulation of issues related to the use of artificial intelligence should be carried out in accordance with the norms of international treaties and conventions ratified by most European states. In particular, in accordance with the provisions of specialized international treaties (acts) related to the development and application of artificial intelligence, the following documents should be noted: the Council of Europe Convention on Cybercrime (2001), known as the Budapest Convention; European Ethical Charter on the Use of Artificial Intelligence in Judicial Systems and their Environment (2018); General Data Protection Regulation (GDPR), Regulation (EU) 2016/679 of April 27, 2016. Ukraine is already using the experience of leading European countries, particularly Estonia, in the field of application of artificial intelligence technologies in public administration and is gradually developing towards the creation of an electronic state – e-Ukraine. Thus, the Ministry of Digital Transformation of Ukraine has developed the Concept for the Development of Artificial Intelligence in Ukraine. Its main goal is to promote the development of AI and integrate it into economically important sectors. Particular attention is planned to be paid to the use of artificial intelligence in the field of cybersecurity and defense. It is also very important to have the right balance between artificial intelligence developed by third-party vendors and national companies. On January 28, 1981, the first international agreement in the field of personal data protection was adopted – the Council of Europe Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (known as CoE Convention No. 108, according to its serial number in the series of European Treaties) [33]. In accordance with the provisions of this Convention, the parties are obliged to take the necessary measures within the

framework of their domestic legislation to implement the principles it establishes, to ensure respect for fundamental human rights on its territory in the process of processing personal data. In July 2010, Ukraine ratified CoE Convention No. 108. Consultative Committee of the Council of Europe, established under CoE Convention No. 108, which is mandated to act in the field of protection of natural people from the risks associated with automated processing of personal data, in January 2019 adopted the "Guidelines on Artificial Intelligence and Data Protection". In this document, the Committee recognized that artificial intelligence can be an effective tool in the decision-making process, in particular to support science-based and inclusive policies, and also emphasized the need to develop and use artificial intelligence, taking into account the right to respect privacy and the proper protection of personal data. Ownership of property includes the right to own, use and dispose of it to the extent established by law. It is pertinent to recall the situation with Apple in 2016, when a software update resulted in a software update A significant number of smartphones that were serviced (repaired) in unauthorized service centers were automatically (unintentionally) blocked [34,35]. The case of Kindle electronic e-book readers is also indicative, when previously downloaded books by George Orwell disappeared from Kindle e-books without the knowledge of their owners. This happened due to the publisher's lack of intellectual property rights to these works posted on the platform [36,37,38]. In addition to the above-mentioned problems, it should also be noted that domestic scientists began to actively discuss the issue of artificial intelligence as a reality that must be separated from the already existing legal categories. The law "sui generis" (peculiar, one-of-a-kind) is a special legal regime that can be applied when the object is non-standard, goes beyond the scope of legal regulation, and is not original from the point of view of copyright. Among its advantages are flexibility, non-regulation, the ability to determine the content of regulation in accordance with existing needs, features of the AI system, and its development at a certain stage. Sui generis is a set of special provisions that differ from the general ones and protect new intellectual property objects. These provisions do not regulate copyrighted works, instead they are an option for legal regulation of objects that differ from, but are closely related to, generally accepted concepts of intellectual property. A similar approach is used to protect non-original databases. Thus, although they are not the author's own intellectual creative creation, they deserve legal protection, because significant investments have been made in them, and therefore the database can be subject to legal protection as a "database". Therefore, these objects are protected by the sui generis right. This option for the protection of the manufacturer's databases is provided for by Directive 96/9/EC "On the legal protection of databases" [39,40], which strikes a balance between the rights of the person who created the database and the rights of its legitimate users [41]. The use of the database for private and non-commercial purposes is not a violation [42]. However, the extraction and use of the contents of the database for commercial purposes can be considered a violation. contents of the database or a significant part of it [43].

The concept defines AI as an organized set of information technologies, with the use of which it is possible to perform complex complex tasks by using a system of scientific research methods and algorithms for processing information obtained or independently created during work, as well as to create and use your own knowledge bases, decision-making models, algorithms for working with information and determine ways to achieve tasks. Artificial intelligence is a software product that receives a specific request, collects and processes data, and then issues a ready-made solution. Such a decision is often perceived as the result of the work of a program that demonstrates intellectual behavior and works similarly to human
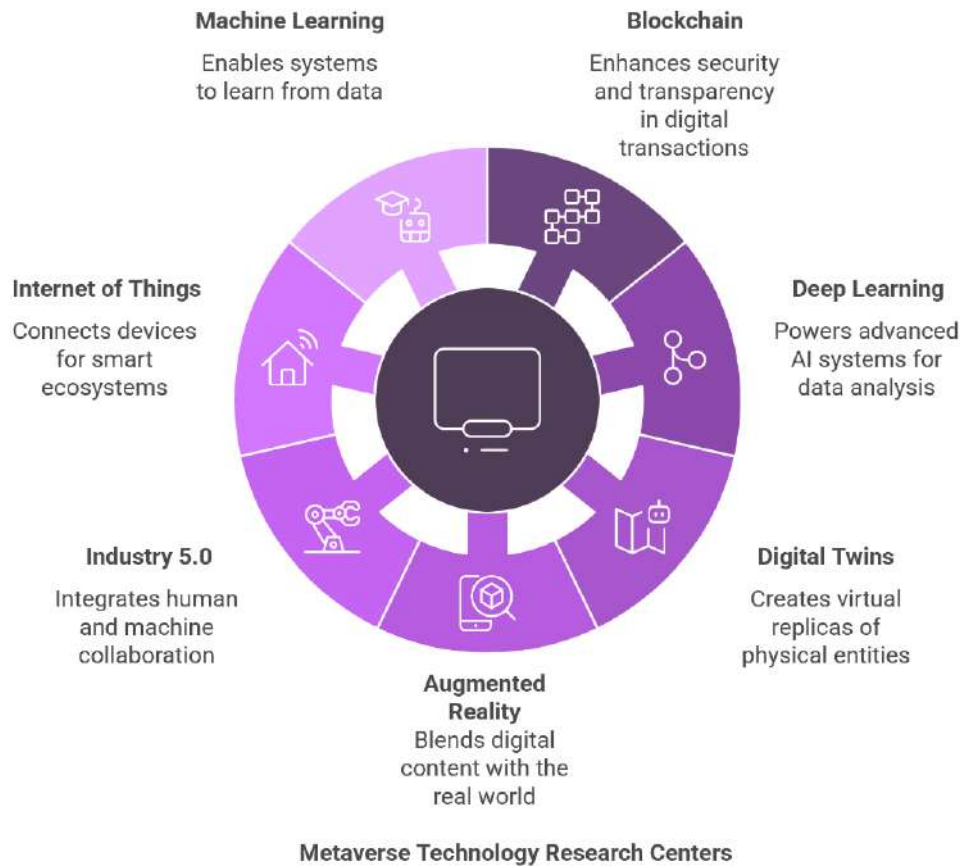
thinking. Since artificial intelligence is a software product like a computer program, the legal regulation of artificial intelligence can be applied by analogy with the regulation of a computer program [44]. At present, in Ukraine, the regulation of a computer program is equated to a literary work [45,46]. From theory, let's move on to the issues that lawyers, developers and users of programs with artificial intelligence may face in practice. At the legislative level, the question of which person should be considered the author of the work remains unregulated and open: the creator of the program or the person who gave the task to such a program [47]. However, usually, when buying and selling a program containing artificial intelligence technologies, an appropriate contract or user agreement is concluded, which regulates the issue of authorship as a result of the use of such a program [48,49]. In other words, the principle of *pacta sunt servanda* (contracts must be fulfilled) applies. Thus, the issue of copyright for objects created by artificial intelligence, although not regulated by law, is generally not problematic [50,51].

Technology has changed the life of society so much that the presence of the Internet as one of the physiological requirements has been included in the digital structure of modern needs, which includes the basic needs of digital infrastructure, social networks, career development, learning new skills and participation in the digital economy. Concept developed by the Ministry of Digital Transformation of Ukraine, provides for the development of human capital and an emphasis on the education of developers in the field of artificial intelligence, the development of entrepreneurship using artificial intelligence, the active introduction of artificial intelligence technologies in the public sector and the main industries of the country[52], and the ministry also presented the concept of "state in a smartphone" through the online platform "Diia".

An urgent issue for education is the training of specialists capable of professional self-realization in the high-tech world. During the training of a qualified specialist, technologies continue to develop and the degree of their implementation in various areas increases, the environment in which the specialist will have to work changes. which will contribute to the training of qualified specialists. The basis of the environment that meets the needs can be the Metaverse – a combination of the virtual and physical worlds.

Part 3. Metaverse Technological Foundations: Opportunities and Prospects

The current state of technology development, which is the basis for the implementation of the Metaverse concept, reflects the growth of their capabilities for the education system. Five clustering centers for the study of Metaverse technologies have been identified, one of which relates to technologies, namely: blockchain, deep learning, digital twins, extended reality, Industry 5.0, Internet things, machine learning. The use of these technologies can provide improved productivity, reduced production costs, improved product quality, reduced time required to manufacture a product, reduced energy consumption, improved occupational safety, and reduced environmental impact of production (Fig.3).

Machine Learning

Enables systems to learn from data

Blockchain

Enhances security and transparency in digital transactions

Internet of Things

Connects devices for smart ecosystems

Deep Learning

Powers advanced AI systems for data analysis

Industry 5.0

Integrates human and machine collaboration

Digital Twins

Creates virtual replicas of physical entities

Augmented Reality

Blends digital content with the real world

Metaverse Technology Research Centers

***Fig. 3.** Metaverse technology*

We are also talking about the convergence of nanotechnology, biology, computer science, and cognitive sciences as a characteristic feature of the latest technologies that open up prospects and opportunities.

The Metaverse concept describes an integrated, immersive ecosystem where the barriers between the virtual and real worlds are blurred, allowing the use of avatars and holograms to work, interact, and communicate through shared experience simulations. There are digital environments that are positioned by developers as Metaverse, in fact, they are prototypes on the basis of which AI ideas and technologies are tested. The concept of the Metaverse is created based on technologies such as blockchain and decentralized systems, in particular cryptocurrencies, including non-fungible tokens; artificial intelligence, virtual and augmented reality, machine learning; technologies that provide integration with Web 4.0. Some of the technology is currently at the stage of development or testing and is not yet ready for full-fledged integration with other technologies to implement the Metaverse concept; in particular, this applies to computing power, which is insufficient to ensure the functioning of such environments. The development of science has led to a shift from highly specialized approaches to interdisciplinarity, which, in turn, has actualized the need for integration of sciences. But not just to the geometric addition of the results, but to their synergistic effect, interpenetration. The convergence of knowledge, technology and society is the main direction of progress in the knowledge society of the XXI century, a symbiosis

of different, but firmly integrated into each other spheres of human activity, which interact to improve the life of humanity and meet its constantly changing and growing needs.

Analyzing the chronology of technology development, which is important for understanding the evolution of the Metaverse concept [53,54], researchers distinguish the following important stages: the emergence of the term "Metaverse" (1992) [55,56]; formation of the concept of "digital twins" [57,58]; introduction of blockchain technologies in the market [59,60]); as well as the distribution of NFTs (non-fungible tokens) as digital unique objects [61,62]. The next important stage in the development of the Metaverse is the development of new worlds, including gaming worlds, based on a combination of technologies. For example, the augmented reality game Pokémon Go, the online video game Fortnite, the first-ever virtual 3D platform Decentralend based on the Ethereum blockchain, which integrated the functionality NFTs. Modern technological developments are beginning to appear, including mixed reality, access to which is provided thanks to the Microsoft Mesh platform, as well as Meta products, particularly the virtual reality platform Horizon Worlds. Blockchain is a distributed storage and verification system data, which, within Metaverse, makes it possible to assign personalized digital attributes of the user, in particular cryptocurrency, NFT assets, or game resources, to his digital account for further access to Metaverse services and products. Records in the blockchain are immutable and publicly available, which allows you to ensure a high level of trust and security of data processing. The unit of accounting in the blockchain system is a token that is used to create and identify digital assets and values in a virtual environment. Tokens are classified into fungible (having equal value, for example, cryptocurrencies) and non-fungible (NFTs, unique in terms of the digital object itself and its value, allow you to obtain the right ownership of a product that exists exclusively in the digital environment). Examples of NFTs include images, animations, or videos, at the same time, this technology allows you to certify the originality of a digital asset, determine by whom and when it was created, who owns it at a given time, while the entire transaction history is stored in the public domain and has a high degree of reliability. Building a Metaverse, as an educational environment, based on blockchain technology, in turn, is able to guarantee transparency, reliability and stability of all digital interaction processes.

Important for understanding the concept of Metaverse is the concept of a digital twin model, which consists of three interrelated elements: a) physical objects that exist in real space; b) their virtual counterparts represented in digital space; c) data transmission channels that provide dynamic interaction and information exchange between physical and digital dimensions [63]. To create an ecosystem, the Metaverse must ensure the continuity of the physical world in the virtual world, so augmented reality (AR), virtual reality (VR) and mixed reality, augmented virtuality (MR) technologies play an important role in the development of this direction. Augmented reality – This technology is an information technology that allows you to add elements of virtual, simulated reality to reality (RR). This technology is used in printing, interactive cards, calendars, navigation systems (Google Street View), computer games special devices, for example, Google Glass, Ericsson, Huawei, Hololens (a Microsoft solution that is immediately integrated with the company's ecosystem), Magic Leap and others. However, in many cases, an ordinary smartphone or tablet is enough, thanks to which the technology has become widespread. The most striking example of the use of augmented reality was the computer game Pakemon Go with an audience of more than five billion users. Virtual reality is a fully simulated digital reality that simulates physical reality, including not only three-dimensional (3D) or panoramic scenes (360°), but also

visual, sound, tactile sensations and smells. A wide range of different devices are used to immerse yourself in the virtual world. These include:

− Virtual reality glasses (VR-headsets).

− Smartphones with special software that are inserted into headsets with lenses (e.g. Google Cardboard).

− Tracking systems are systems that track the position of the user's body in reality to more accurately transfer movements to the virtual environment. Previously, stationary systems in the form of cubes or external sensors were used, which were installed in the corners of the room, modern devices contain sensors in the middle of the helmet.

− Immersive systems are suits that convey tactile sensations from virtual reality.

− Gloves with haptic feedback, which are used instead of joysticks or touch controllers.

− All-in-one standalone VR VR headsets that can function independently (Oculus Quest 3, PICO 4, and others).

− "Heavy VR" (High Performance VR Systems) helmets, in which visualization takes place on an external computer with a powerful graphics card and the image is transmitted to the helmet via cable or wireless connection (Wi-Fi) (Fig.4).
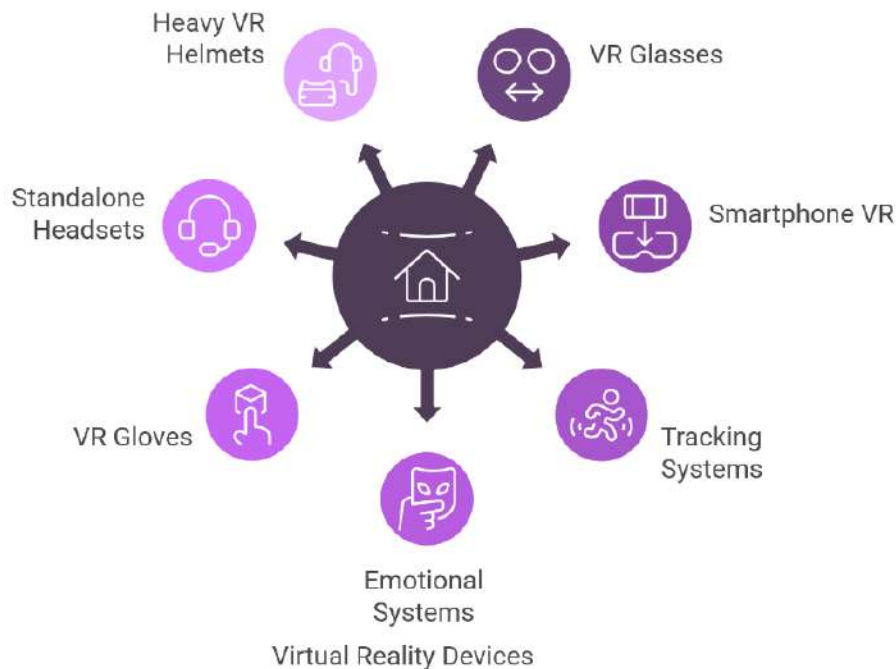
Fig. 4. Metaverse technology

Virtual reality helmets are produced by such well-known manufacturers of equipment as HTC, Lenovo, Xiaomi, Samsung, Meta. Some manufacturers are trying to create an ecosystem, for example, HP has released a helmet, laptop, manipulator and outdoor tracking. According to the researchers, "Metaverse creation technology is developing rapidly through the use of virtual reality headsets, tactile gloves, augmented reality and augmented reality (XR), which allows users to take full advantage of the feel a high level of interaction and a sense of immersion" [64,65]. To define all technologies that involve human interaction with space, information, content, the term "immersive technologies" is used, as technologies of full or partial immersion in the virtual world or any kind of mixing of real and virtual

reality. These technologies are already widely used in the educational field - from the development of textbooks using elements of augmented reality and the organization of professional training of future specialists to educational events in virtual worlds. For example, in 2020, graduation ceremonies were held at the University of California, Berkeley. It should be noted that scientific literature has already presented the experience of developing and using immersion technologies in the field of education. According to the results of the study of scientific publications devoted to the issues under study [66], it was found that among the dominant fields are computer science, medical education, training of aviation personnel (especially pilots), as well as educational programs in the field of tourism. It should be noted that immersion technologies are more often used in higher education than in school. The researchers also note the educational benefits of using simulations in the virtual world, which contributes to the knowledge and learning of cyberculture, where the visual aspect and the possibility of instantaneous changes through the action of avatars contribute to the development of short-term memory, expand the imagination, and stimulate individual and collective intellectual abilities [67]. The next technology that will become an integral part of the Metaverse is AI, which has already become a part of the life of our society and covers the automation of decision-making processes, problem solving, as well as modeling learning processes, which are traditionally considered the prerogative of human thinking.

AI is a scientific direction within which the tasks of hardware or software modeling of those types of human activity that are traditionally considered intellectual are formulated and solved. These technologies have a significant impact on the labor market and the economy, through increasing the efficiency of production, the quality of goods and services, changing the requirements for the qualifications of employees, etc. In this regard, there is a need for their regulatory regulation. In accordance with the requirements of society, a certain legislative basis for the development, implementation and legal regulation of the use of AI is gradually being formed.

AI cannot be fully identified with creativity, because creativity involves the presence of imagination, fantasy, its result is the creation of something new and original. Instead, AI operates with information arrays within the framework of embedded algorithms and models that perform tasks in accordance with the instructions received. AI has its own extensive background in the form of a database, information based on which it learns and acts. Thus, if AI "creates" a painting at the request of the user, it only follows the "instructions" and wishes and does not show an emotional advantage like: "today I choose cubism because I have no inspiration to create a painting in the style of pop art." This confirms that AI remains a tool, not a subject of creativity.

It is possible that in the future, AI will acquire absolute autonomy from humans, which will allow it to carry out creative activities "for the sake of creativity itself". At the same time, we are already witnessing rapid changes in society, which require the adaptation of the current legislation to new technological realities. This also applies to the field of copyright, which is developing today not only to regulate legal relations that arise in the process of human creativity, but also in the process of the so-called "creativity" of AI.

The Concept for the Development of Artificial Intelligence in Ukraine until 2030 has been approved in Ukraine [68]. AI-based services have wide possibilities of use in the education system and have already become actively used by both students and scientists. are developed and implemented as a response to new challenges related to the transformation of approaches to acquiring knowledge, creating educational content and responding to the actual situation. The use of artificial intelligence services has certain limitations, the provision of false information, possible copyright violations, etc.

The main technologies that ensure the functioning of the Metaverse are immersion technologies (AR – augmented reality, VR – virtual reality, MR – mixed reality), interface devices, 3D modeling technologies, Internet of Things, AI, computing systems, telecommunication networks, and blockchain technologies. Considering the prospects for the development of the Metaverse As a process of in-depth combination of the virtual and real worlds, it is advisable to pay attention to biohacking and chipping technologies, which are currently at the early stages of development. Also, the development of brain-computer interfaces, which can radically change the interaction between a person and the digital environment, is of scientific and practical interest.

The chip is contained in a capsule made of biocompatible glass, is passive and must comply with the international standard ISO 11784/11785 [69]. capabilities, to help track a person's health status, such as pressure, heart rate, duration and quality of sleep, blood sugar levels, etc. The issue of cyborgization of a person, a significant extension of his life, the emergence of the phenomenon of transhumanism, as a rational worldview based on the awareness of the achievements and prospects of science, which recognizes the possibility and desirability of fundamental changes in the human condition with the help of advanced technologies in order to eliminate suffering, aging, death and significantly improve the physical, mental and psychological capabilities of a person.

AI and copyright are closely related to each other. Artificial intelligence uses people's creations to learn, and the codes and algorithms that are embedded in the AI system are the object of copyright.

– "Works" created by AI, without a clearly defined copyright, will be recognized as public domain – however, then individuals are less motivated to publish their own developments or invest in the development of AI technologies (they receive neither benefits nor recognition of authorship).

– AI will be recognized as an "electronic person" with rights and obligations, electronic legal personality, including in the field of liability for damage. This approach has become too progressive. Therefore, both at the level of the European Union and at the national levels, they refused to recognize AI as an electronic person. The argument against it was the potential blurring of the boundaries between human and non-human legal personality, which could lead to serious philosophical, legal and ethical complications in determining the nature of rights and duties in the digital age.

– The legal regulation of determining the status of "works" created by AI is carried out exclusively on a contractual basis – this would lead to legal uncertainty and litigation over many issues: for example, who can dispose of the content or who is responsible for the damage caused.

None of the considered scenarios provided an adequate level of legal protection for AI "works", as well as investments aimed at their creation. This necessitated the search for a legal solution that would guarantee certainty, stability and predictability of regulation in the field of intellectual property. One of the potential tools for such regulation is the so-called "sui generis" right, which is enshrined in the Law of Ukraine "On Copyright and Related Rights". We will turn to the consideration of this tool further, and now we will focus on the analysis of what legal protection is provided to the results of AI work in different countries of the world.

Part 4. Immersion technologies and the Metaverse

Metaverse is a modern digital ecosystem for the development of the future civilizational level of society S5/0 [70,71,72]. Depending on the level of virtuality and the degree of integration of virtual elements with the elements of the real world that the user perceives, the range of experience opportunities in the Metaverse changes significantly. The quality of the virtual

experience, the sense of presence, and the depth of immersion directly depend on the capabilities of the virtual environment and the functionality of the front-end devices. Such functionality of front-end devices includes:

− brightness – representative wealth;

− interactivity – the ability of systems to allow users to change the form and content in an indirect environment.

Researchers have developed a prototype of the Metaverse of a university campus that has a three-tier architecture that includes infrastructure, interaction, and ecology. It is possible to conduct different activities and gain different experiences in the Metaverse, such as obtaining a degree, making purchases, creating works of art, and taking care of pets.

The advantages of Metaverse are:

– accessibility – meeting social requirements through cost reduction and better access to resources without obstacles, such as quarantine restrictions and others;

– diversity – meeting society's demands for diversity without restrictions on the physical world, such as distance, language;

– equality – satisfying the desire for equality by managing one's own avatars in the Metaverse and using one's powers to create a just and sustainable society;

– humanity – ensuring humanity's desire to preserve historical values and cultural relics.

Designing, developing, and implementing Metaverse as an additional digital tool to the teaching and learning process at the university is essential.

Metaverse was developed as a model of a real university for students as part of a project to teach mathematics using new technologies. Support for students in the educational process was carried out taking into account hybrid and mobile learning models, which were considered as important elements of the modern pedagogical structure. which students could access through an integrated virtual space. There is a variety of Metaverses, which makes it possible to find the Metaverse for specific educational purposes, such as visiting virtual libraries, museums and university classrooms to participate in text-based role-playing games, simulations of archaeological sites, etc. The main drivers in the development of Metaverse are private companies. Investment growth in this industry is explained by potential opportunities Metaverse and expectations of drastic changes in various spheres of society due to the development of technology. In this regard, more and more companies and organizations are focusing on the development and implementation of their own projects within the Metaverse virtual space. There are well-known corporations such as Meta (formerly Facebook, the Metaverse project), Microsoft (Microsoft Mesh), Nvidia Corporation (Omniverse); virtual reality platforms offered by Animoca (The Sandbox Metaverse) and Decentraland (Decentraland); among game developers are Mojang (Minecraft), Machine Brick (Roblox), Epic Games (Epic Online Services, Fortnite) and others. Among the risks of Metaverse technologies are the following: in the future, people may reduce communication in the real world. Cybersecurity and information privacy concerns among society. When communicating in Metaverse, specialists have access not only to correspondence, personal data of users, but also to their voices, facial expressions and other data. Are integration: the ability to use the digital currency of one Metaverse to acquire assets in another; the movement of digital works of art, avatars and other objects between different Metaverses; the ability to participate in concerts, conferences, forums held in one Metaverse with the avatar of another Metaverse and other features. The emergence of new professions: for example, such as a neural interface developer, an AI specialist, a data protection officer, and others. It should be noted that the

development of these technologies will significantly affect the labor market, a significant part of specialists of various qualifications will lose their jobs. Questions arise regarding the development and financing of the retraining system, considering the requirements of economy 5.0.

In particular, the technologies introduced for the purpose of qualitative improvement in the daily life of a person provide for such measures as the collection of personal information about Internet users. In the future, the results of the analysis of this information are used to target individuals and groups of people in accordance with their preferences and psychological characteristics. Using Google Maps, namely the physical presence of a person at a certain point in time, is used in order to send offers on time in order to influence his choice when buying or choosing a restaurant, visiting a museum, etc. The most striking example of restrictions on freedom of movement is China, where the introduction of a system of social ratings, the mechanics of which are implemented primarily on the use of Big Data and AI, led to the fact that non-payment or late payment of alimony, taxes, various fines, committing minor offenses, etc. – all this affects the decrease in the social rating, and a combination of several of these reasons leads to blacklisting, blocking by the state of the exercise of most fundamental rights, including through the prohibition of access to banking transactions, the use of virtual money, and, as a result, people from the blacklist cannot buy transport tickets.

The Court of Justice of the European Union has given several interpretations of the provisions of the Directive, which will help us to better understand the essence of the sui generis right:

- Fixtures Marketing Ltd v. Oy Veikkaus Ab

The objective of sui generis law is to protect financial and professional investments, which are all possible resources used to search for existing materials and collect them in a database. Investments in the creation of a database may consist of involving human, financial or technical resources, but they must be substantial both quantitatively and qualitatively – intellectual effort or energy.

- Ryanair Ltd v PR Aviation BV C30/14

If the database developer allows the use of the database itself, he has the right to limit such use in the user agreement, defining the purposes and form of use. If a person has made a significant contribution (human, financial, technical) to the creation of the database, then he has a certain number of rights – to prevent the extraction and use of the contents of the database, to allow use only under certain conditions. Therefore, the sui generis right protects investments The data for training systems, infrastructure, computing power, specialists, effort, energy, time.

Companies have already been created in the world that are managed and successfully operate with the help of self-executing smart contracts, without traditional bodies such as a CEO or board of directors. For example, DAO (Decentralized Autonomous Organizations) is one of the first companies to be created using a contract-program that regulates the acceptance of cryptocurrency used for financing and the organization's activities, as well as the conversion of accepted cryptocurrency into tokens. Therefore, instead of placing AI among the already known categories (individuals, legal entities, animals, things, and other subjects and objects), it is proposed to create a new category of "electronic persons" as more expedient. In Ukraine, a scientific discussion on the problems of regulating human interaction with AI is rapidly spreading in the context of further development and expansion of methods and means of such interaction in the global Internet. Thus, in various fields of science and practice, the phrase "Internet of Things" (IoT) acquires. What is seen as an expanding network of different objects – from industrial devices to consumer goods that can exchange information and perform their tasks while a person works, sleeps or plays sports. The rapid development of technology has already significantly changed the economy, in particular,

the frequency of high-tech production has increased, and many business processes have been digitalized. The impact of technologies such as robotics, the Internet of Things, AI, Big Data, immersion technologies, and blockchain has become especially noticeable. The natural development of these technologies is their combination to implement the Metaverse concept. Today, there is no single approach to defining the concept of "Metaverse", but it is this direction that is actively developing today and arouses significant interest among business and government representatives around the world. Immersion technologies and AI already have quite a few examples of use in education. Among the factors that complicate the use of these technologies in education, scientists note technical problems, ease of use, cost, and features of the environment itself. have already taken place in the digital economy. The lack of a full-fledged implementation of the Metaverse does not stop investors, and the very idea determines the directions of development of various industries: recreation, real estate transactions in the virtual world, purchase of goods, obtaining educational services, etc. This requires research and development of mechanisms for ensuring the protection of personal life in virtual space, legislative regulation of actions in the Metaverse, and others. Technology development, transition to the Industry 5.0 will significantly change the labor market, which sets new requirements for the education system, the definition of new professions and requirements for representatives of professions in the labor market, the possibilities of training future professionals by means of the Metaverse. With the help of robotic medical equipment, it is possible to perform extremely complex surgeries and surgeries in hard-to-reach places. However, it is fair to note that AI systems can pose a threat to human life. The world is entering a new stage, the central element of which is AI. The range of AI is quite large and can include both defensive weapons for obtaining and analyzing information about the "theater" of military operations for military intelligence, the organization of cyber defense, logistics automation, and the autonomous operation of unmanned vehicles of any base. injuries to innocent civilians. It is worth noting that AI systems pose a threat to the right to human life not only in the military plane. Undoubtedly, this threatens the most important inalienable right of every person – the right to life.

Research requires the organization of the educational process in the Metaverse that understands the principles of the functioning of the Metaverse and the technologies on which it is based, the ethical and legal aspects of using modern technologies, the advantages and disadvantages of such training, trends in the development of the digital society and the risks associated with it. Today, we can only reflect on the development of AI and the regulation of the results of its work by sui generis law. Of course, the results of AI's work should be protected, but it is necessary to proceed from the economic result and the goal of promoting innovative development.

The role that AI plays in workplace automation can pose a real threat to the right to work; first of all, it can prevent some people from accessing the labor market. It must be stated that automation has already led to job losses in certain sectors, and many predict that AI will accelerate this trend. AI gradually replaces the employee, performing certain labor functions that were previously performed by a human. Robots endowed with AI already today perform certain types of work and provide a completed product or service, for example, searching for information, processing and organizing it, navigation, etc. Although there is considerable disagreement about the extent to which the automation of workplaces will be achieved, there is no doubt that AI is still in the process of being automated. will lead to some shifts in the labor market, both by creating and destroying jobs. In general, the very possibility of making decisions using AI algorithms in

the criminal justice system raises serious concerns about the violation of the right to a fair trial. By assessing a defendant using AI systems as a person with a "high" or "low risk" of re-offending, in fact, state authorities determine the level of future guilt, which may interfere with the presumption of innocence required in a fair trial Considering.

If the results of AI work fall out of the legal field, there is a risk that the "works" will be abused. Then the authors and users of AI systems will not receive legal remuneration – and will lose motivation to work in this field and invest money in it. allows you to protect investments in the development of AI systems, promotes the development of innovations, is not a novelty (after all, there is already practice regarding databases). It can be an effective tool to:

– To satisfy and balance the interests of developers and users, because the law allows determining in the contract the conditions for the ownership of the sui generis right and the methods of granting permission to use the object.

– Change the attitude towards AI from a threat to the ability to use new technologies, in particular in creativity.

However, most issues regarding the functioning of sui generis law in practice will be resolved in courts and during public discussions – and will depend on its adaptation to the needs of society and time.

Technical sciences have made a huge breakthrough. The introduction of artificial intelligence technologies in various areas of life can qualitatively change them and increase the effectiveness of any work. Many functions performed by humans are becoming more and more automated. For example, algorithms are used to assist in sentencing and parole decisions, to predict crime hotspots, to allocate police resources; to determine credit ratings, facilitate recruitment and provide medical and legal services, among others. Undoubtedly, AI systems facilitate the collection, processing and classification of vast amounts of data. This can have serious consequences for the exercise of the right to privacy and family life, including the right to data protection. AI systems are often trained by accessing large data sets and analyzing them. even if it is derived from large data sets derived from publicly available information. Researchers have developed machine learning models that can accurately estimate a person's age, gender, occupation, and marital status from data on their cell phone location alone. They can also predict a person's future location from history and friends' location data. In order to protect human rights, this information should be treated in the same way as any other personal data. Thus, the risks associated with AI's ability to track and analyze human life are amplified by the vast amount of data that is produced today when using the internet, with the widespread use of devices, that is, people will soon be creating traces of data on almost every aspect of their lives.

AI will be used to process and analyze all this data for a variety of purposes: from micro-targeted advertising to optimizing public transport traffic and surveillance of citizens by the state. The development of the Internet and new AI technologies allows for deeper, more penetrating facial surveillance tools than ever before. Unregulated use of AI systemsthreatens to end anonymity, and fear of being tracked down can prevent people from enjoying other rights, such as the right to freedom of association, the right to freedom of movement, freedom of speech. When people feel that they are being watched or lack anonymity, they show self-censorship, refuse to express their opinions freely, etc.

In Ukraine, one of the most obvious violations in connection with the use of AI technologies is the violation of the right to privacy, in particular, access to personal data databases. The problem of protecting human rights on the Internet is further complicated by citizens' distrust of the law

enforcement system. The use of advanced AI technologies should not contradict human rights, civil liberties, and the principles of the rule of law. only the substantive aspect, but also the procedural aspect, which is based on the requirements of compliance of law-making and law enforcement practice with certain standards, such as: prohibition of retroactive effect of the law, the requirement of clarity and consistency of the law; the requirement for uniform application of the law; the application of punishment solely on the basis of the law, etc., i.e. comply with the practice of the European Court of Human Rights (ECtHR). At the same time, it is necessary to take into account the conceptual legal problem of the future. Traditional legal doctrine states that legal norms regulate social relations between people. But at the present stage, legal science in Ukraine is not ready to provide an answer about how social relations related to AI will be regulated.

The above problems allow us to say that today Ukraine exercises insufficient control over violations in the field of information leakage and other areas of interaction with AI. In our opinion, this is due to the fact that the legislation does not keep up with the development of this area. At the same time, the rapid development of technologies can negatively affect human rights. Risks to fundamental human rights are associated with the inability to predict the consequences of the use of such a new technology therefore, in order to prevent violations of fundamental human rights specified in the Convention for the Protection of Human Rights and Fundamental Freedoms, uncontrolled development and use of AI in society, state bodies entrusted with the law-making process should develop draft laws and other regulations related to human rights and freedoms related to the use of AI.

The government of the state must ensure the preparation of relevant documents and represent the interests of the state in the ECtHR during the consideration of cases of human rights violations in Ukraine in order to respect the rights and freedoms of man and citizen. AI models are designed for sorting and filtering, whether they are ranking search results or dividing people into groups. This division can violate human rights when it treats different groups of people differently. degrees exist in society, but if people try to hide it, or at least not demonstrate it explicitly, then AI systems are not capable of such behavior or making sense of the situation. Therefore, experts warn that automation and machine learning can reinforce existing biases because, unlike humans, AI may not be adapted to consciously counteract learned biases.

This is a very serious problem, as more and more enterprises are starting to use AI technologies, but they are not given enough attention. As a result, there is new evidence that AI systems can not only detect, but even reinforce social prejudices in society, for example, unfairly distribute resources or opportunities between representatives of different social groups, reproduce existing social stereotypes that may not correspond to reality in a particular situation, lead to the fact that the level of service turns out to be worse for one of the groups than for another, or humiliate some groups, giving an offensive result.

Computer scientists should work together with human rights theorists, philosophers, international lawyers, and policy experts. This will increase the likelihood that the enormous potential of artificial intelligence will benefit society without harming humans. Because a human rights-based approach provides the best opportunities to protect against the most serious risks associated with AI and allows people to take advantage of numerous opportunities.

Part 5. Methods of mathematical implementation of law and their normative and legal analysis

New digital technologies have taken a modern step, which today is intensively entering the legal part of life. This changes the regulation of social relations in the legal environment and poses new challenges to the science of law.

The application of artificial intelligence, big data analytics, the development of blockchain systems, and the whole principle of the Metaverse represent new components shaping a reality in which classical legal control lags behind the flow of rapid change among such technologies.

Classical legal doctrines developed on legal texts with case law and principles of law enforcement should be compensated by modern methods of forecasting, modeling and analyzing legal phenomena. The reason is that the use of mathematical methods in legal research is becoming an increasingly applied place for superiority. They help not only in the formalization of legal provisions but also allow you to predict the results of their application in digital gradually changing conditions.

The need for a deeper analysis of dynamic legal processes in the digital environment has shifted the shift to mathematical models in law. Legal reality includes dynamic components of the process, which increasingly include algorithmic control, systems for autonomous decision-making, and intelligent technologies that can legally work themselves. New approaches to legal modeling are needed, and these will be approaches that will evaluate the risks of violation of fundamental human rights.

We will focus on the techniques of mathematical implementation of legal processes and digital legal regulation, as well as consider approaches to modeling algorithmic decisions in law enforcement, analytical forecasting of the impact of artificial intelligence on the legal system, ways of non-formalization of legal structures in the digital environment.

The research methodology is based on an interdisciplinary approach that combines the basics of mathematical statistics, computer science and jurisprudence. The main steps of the study are as follows.

Analysis of literature and hypothesis formation. At the first stage, an analysis of literary sources [73,74,75,76] was carried out, [1]where the use of probabilistic and Bayesian approaches in law was described. This made it possible to formulate the first hypotheses regarding the prospects of this direction.

Mathematical apparatus. To build probabilistic models, the following were used:
– Bayes' theorem
– Likelihood Ratio (LR).
– Bayes' formula is generalized taking into account a set of mutually exclusive hypotheses and combinations of evidence.
– Computer modeling. Simulation modeling of several typical court scenarios (criminal, civil, administrative) with different amounts of available evidence, varying degrees of weight of evidence and excellent quality of expert assessments have been applied.
– Statistical evaluation of accuracy. The results of the simulation were compared with real statistical data on court decisions, as well as with alternative approaches (for example, classical deterministic plausibility analysis, simple heuristic methods).

In the process of research, the following formulas were used.

Bayes' theorem

The classical formulation of Bayes' theorem for a single hypothesis and proof HE:

$$P(H \mid E) = \frac{P(E \mid H)P(H)}{P(E)} \tag{1}$$

Here is the priori probability of the hypothesis - plausibility (probability of obtaining proof provided it is true), and is the total probability of proof, which can be decomposed as:$P(H)H, P(E \mid H)EHP(E)E$

$$P(E) = P(E \mid H)P(H) + P(E \mid \neg H)P(\neg H)$$

Plausibility factor

During legal analysis, the plausibility factor is often used:

$$LR = \frac{P(E \mid H)}{P(E \mid \neg H)}, \tag{2}$$

which allows you to shift the emphasis from absolute probabilities to relative probabilities. If 1, then the proof is much more probable under the condition of truth than in the case of its falsity, and thus "supports" the hypothesis $LR \gg EHH$.

Generalized Bayes formula for hypotheses n

In the case when there are mutually exclusive hypotheses, and we receive evidence, the probability of each hypothesis is calculated as:$nH_1, H_2, \ldots, H_n E$

$$P(H_i \mid E) = \frac{P(E \mid H_i)P(H_i)}{\sum_{k=1}^{n} [P(E \mid H_k)P(H_k)]}. \tag{3}$$

Such an extended model is useful when evaluating several alternative scenarios of events in litigation.

Table 1: Sampling and Study Parameters

Thus, in the section "Methods" it is determined how the research is carried out: the mathematical apparatus, the modeling procedure and methods for assessing accuracy are described. In the next section, quantitative results of the application of these methods in various legal cases will be given.

Table 1. Research parameters and their description

Parameter	Denomination	Comment
Number of hypotheses	n	In criminal cases, it can be "guilty / not guilty" (2 hypotheses), in civil cases there are several options for decisions.
A priori probabilities	$P(H_i)$	They are set by an expert or derived from statistics (for example, the typical ratio of acquittals and convictions).
Probability of proof	$P(E \mid H_i)$	It can be calculated on the basis of expertise, preliminary research, empirical data, etc.
Amount of evidence available	m	Affects the complexity of the model, since with more evidence, multiple a priori updates are applied.
Noise Model	ϵ	Takes into account the presence of distorted, erroneous or deliberately falsified evidence.
Plausibility factor	LR	It is calculated according to the formula (2) for each proof, which allows you to estimate the weight of each proof.

We present detailed results of the application of Bayesian models to the evaluation of evidence in criminal and civil proceedings, as well as general results on legal risk in rule-making.

Criminal Justice
The main experiments concerned situations where it was necessary to determine the probability of guilt of the defendant on the basis of a limited set of evidence. A value (neutral position) was chosen as the initial a priori probability, and for test scenarios, probabilities of obtaining testimony were used, provided that the hypothesis is true and false (for example, $P(H) = 0.5 E P(E \mid H) = 0.9, P(E \mid \neg H) = 0.2$).
Table 2 presents approximate results for five criminal scenarios that differ in the quality of available evidence.
The results demonstrate how significantly the choice of a priori and plausibility parameters affects the posteriori probability of guilt. This indicates the need for clear methodological approaches to determining and $P(H), P(E \mid H) P(E \mid \neg H)$.
Applied Interpretation: – Scenario 1 (Very Informative Proof): 0.818 means that strong evidence significantly increases the likelihood of guilt. – Scenario 4 (medium level of information, higher a priori of guilt): even with relatively strong evidence, the updated probability of 0.692 remains less than, so there is no "absolute certainty" yet. $P(H \mid E) = 70\%$

Table 2. Results of updating the probability of guilt after taking into account the evidence E

Scenario	$P(H)$	$P(E \mid H)$	$P(E \mid \neg H)$	$P(H \mid E)$
1	0.50	0.90	0.20	0.818
2	0.50	0.80	0.30	0.727
3	0.40	0.70	0.20	0.700
4	0.60	0.85	0.45	0.692
5	0.50	0.95	0.40	0.760

Civil Proceedings

In civil disputes (for example, regarding damages), the Bayesian approach was used to assess the probability of occurrence of a certain event (causal relationship between the actions of the defendant and the damages), taking into account a number of circumstantial evidence. It was found that:

1. The Bayesian method makes it possible to combine several heterogeneous sources of information (testimonies, examinations, statistics, etc.) into a single model.

2. The likelihood factor allows you to quantify the "strength" of each piece of evidence and reduces subjectivity in their total assessment.

3. In a number of cases, the results obtained using the Bayesian model were consistent with the court's decisions already rendered, indicating the potential effectiveness of the method as a tool for supporting decision-making.

Rule-making and analysis of legal risks

In lawmaking, it is often necessary to assess how new norms or changes in legislation can affect social relations. Here, Bayesian risk analysis allows:

1. Assess the likelihood of conflict situations or legal conflicts. Quantitatively measure the influence of each factor (economic, social, cultural) on the probability of successful implementation of the norm.

2. To simulate various scenarios of interaction of legal norms with the existing environment.

For clarity, Figure 5 shows a conditional diagram of the dependence of the updated probability of success of a legal norm (assessed by an expert group) on three different factors (F1, F2, F3).

This diagram indicates that an increase in the strength of one or more positive factors (F1, F2, F3) significantly increases the chance of successful implementation of the norm, but in case of simultaneous action of negative factors or insufficient level of preparation (insufficient information, erroneous statistics, etc.), the probability of success can be sharply reduced.

Visualization of model parameters:

These visualizations demonstrate mathematical modeling of legal processes using a probabilistic approach. Using Bayesian analysis, it is possible to assess the impact of evidence on the likelihood of guilt of the defendant, investigate the relationship between the quantity and quality of evidence, and analyze risks in lawmaking (Fig.5-7).

1. Graph of updating the probability of guilt

X-axis: Probability coefficient (LR) – shows how much the evidence supports the hypothesis.

Y-axis: A posteriori probability of guilt after taking into account the evidence.

Curves: Reflect the change in probability depending on different a priori assumptions.

2. Heatmap of the impact of quantity and quality of evidence

X-axis: The amount of evidence in the case.

Y-axis: The quality of the evidence (the probability of its reliability).

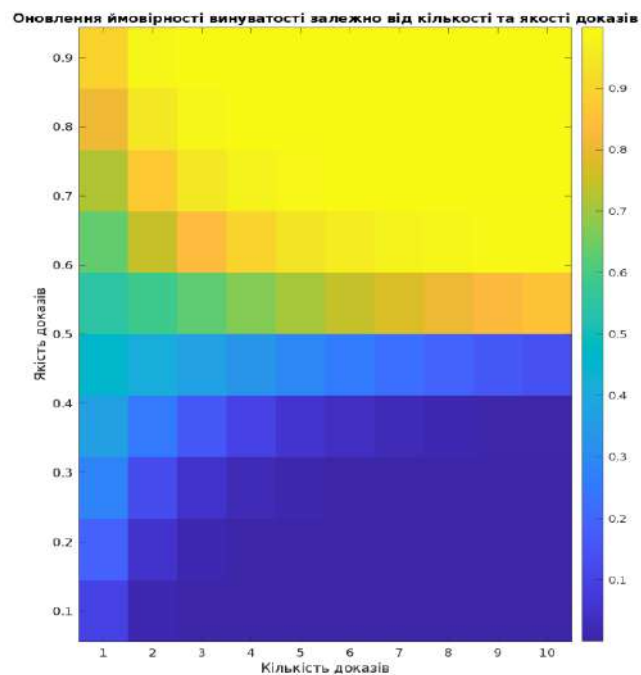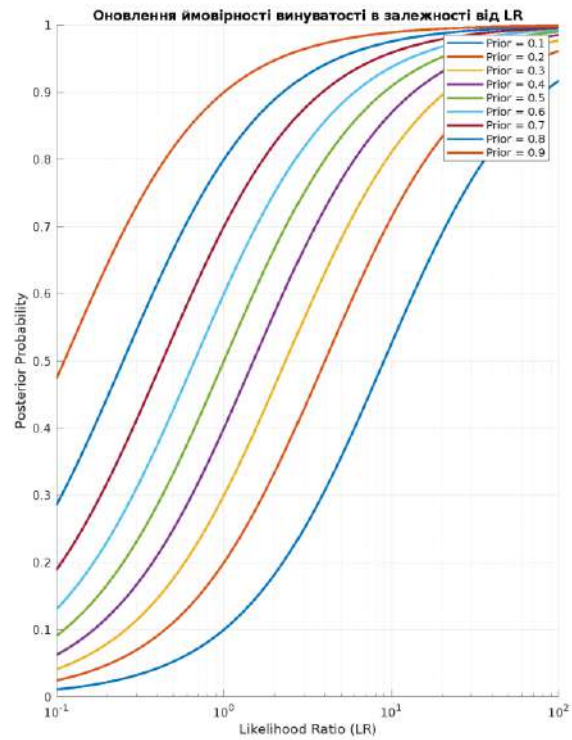Color: Displays the updated probability of culpability (warmer colors, higher probability).

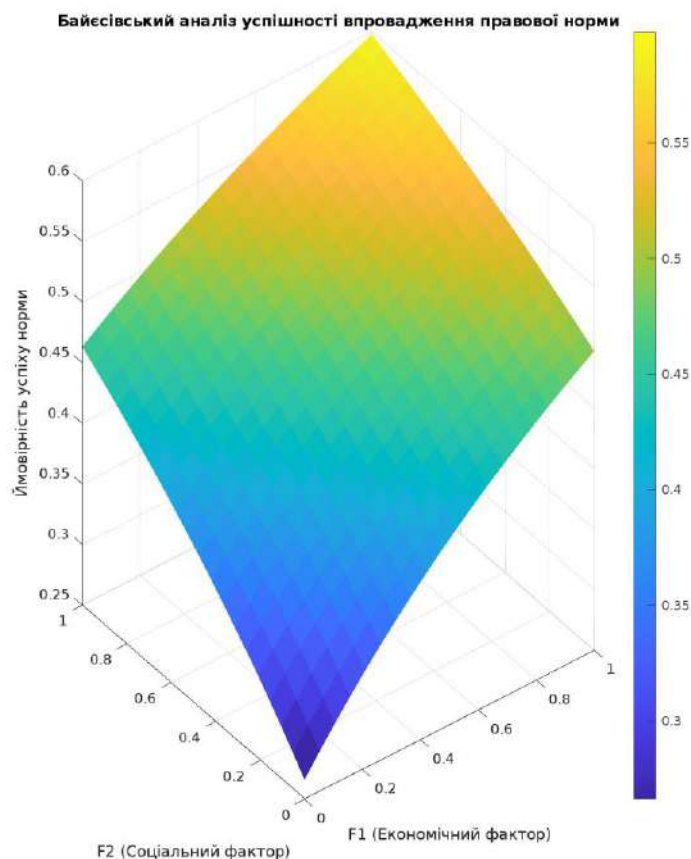3. 3D graph of legal risk analysis

X-axis: Economic factor(F1).

Y-axis: Social factor (F2).

Z-axis: Probability of success in the implementation of a legal norm.
Surface: Shows how different factors interact and affect the overall result.

Fig. 7. *LN*

The first visualization shows how the posteriori probability of the defendant's guilt changes depending on the likelihood coefficient, which allows you to quantify the impact of the evidence. The second demonstrates how the increase in the amount of evidence and its quality changes the certainty of guilt using a color map. The third model analyzes legal risks in rulemaking, showing how economic, social and cultural factors affect the likelihood of successful implementation of a new norm. Together, these methods provide a deeper analytical approach to decision-making in the legal field.

Part 6. Implementation of Ukraine's Sustainable Development Goals through Digital Transformation

Digital transformation today is one of the most important factors in achieving the Sustainable Development Goals of Ukraine, covering economic, social and environmental aspects of society. The modern legal framework and the proposed mathematical model are aimed at ensuring the protection of human rights, economic sustainability and environmental security, thereby creating conditions for comprehensive sustainable development in the digital age.

The National Strategy "Strategy for the Recovery, Sustainable Development and Digital Transformation of Small and Medium-Sized Enterprises in Ukraine until 2027 and Approval of

the Operational Action Plan for its Implementation in 2024-2027" [77,78] emphasizes the importance of integrating digital innovations into economic activities to increase competitiveness, attract investment and stimulate sustainable development. It provides for the creation of legal conditions for the introduction of technologies, in particular artificial intelligence, in key areas of economic activity, which is critically important for economic recovery and increasing social cohesion of Ukrainian society.

The sui generis legal mechanism applied to protect AI-generated works is key to stimulating economic activity and innovation.

The social dimension of sustainable development involves ensuring human rights in the context of active digitalization of society. As stated in the article, legal regulation of the introduction of artificial intelligence, in particular, the protection of privacy, non-discrimination, and ensuring the right to a fair trial, is becoming an important aspect. The metaverse also plays a significant role in enhancing social inclusion, creating new opportunities for education, distance learning, and social support. However, the growing role of virtual spaces requires careful legal support in order to avoid human rights violations and social risks, such as digital inequality and data manipulation.

Table 3. Comparison of research and aspects of the article's
solutions and sustainable development

Investigated	Link to sustainability	Decision
Sui generis rights for AI works	Promotes economic innovation and investment	Protecting Intellectual Property for Growth
Regulation of AI for Human Rights	Provides social inclusion and protection of rights	Privacy and Non-Discrimination Control
Metaverse in Education and Social	Supports access to education and social services	Virtual platforms for isolated groups
Risks of digitalization (privacy, discrimination)	Needs legal balance for social sustainability	Regulation to mitigate risks
The environmental impact of digital technologies	Potential to reduce emissions, but at a cost	Virtual meetings vs data power consumption

Digitalization has the potential to significantly reduce the negative impact of human activities on the environment. In particular, virtual communications and remote work reduce the need to move, respectively, reduce greenhouse gas emissions. At the same time, digital infrastructure, especially data centers, requires significant energy costs. Therefore, an important area of legal regulation is the creation of conditions for energy efficiency and the development of technologies that minimize the use of environmental costs, providing a balance between technological progress and environmental safety.

Achieving the Sustainable Development Goals is possible through solving the following tasks, focusing on:

– The impact of AI on fundamental human rights, including privacy, freedom of speech, the right to a fair trial, and non-discrimination.

– Legal gaps in the regulation of AI in Ukraine compared to European standards, referring to international documents, in particular the Universal Declaration of Human Rights and the Charter of Fundamental Rights of the European Union.

– The concepts of sui generis rights for the protection of AI-generated works without direct human participation, which is regulated by the Law of Ukraine "On Copyright and Related Rights". These rights provide legal protection for investments made in the creation of such objects over a period of 25 years, while helping to maintain a balance between stimulating innovation and legal certainty.

– Metaverse as an integrated ecosystem of virtual and real worlds, creating new opportunities in the field of education, entertainment, and social interaction, while creating a number of risks, namely data privacy violations and a decrease in the level of direct interpersonal interaction.

– Methodological approach, which includes system and comparative analysis, historical approach, formal-legal methods, forecasting, case analysis, empirical research and mathematical modeling (for example, Bayesian probability) to evaluate legal processes.

– On the main challenges and risks, such as violations of the right to privacy, algorithmic discrimination, job substitution, and potential abuse in criminal justice systems.

– Prospects and recommendations, in particular, the need to form an adaptive legal framework for the protection of human rights while promoting innovation, as well as the potential of AI and Metaverse technologies in the fields of education, health and safety.

Conclusions

The latest digital technologies, including AI, blockchain, and virtual environments, are rapidly being integrated into the legal field. This is changing approaches to the regulation of social relations in the legal environment, giving rise to new challenges for both legal science and law enforcement practice in the context of the digital transformation of society. The use of AI, big data analytics, the development of blockchain systems, and the entire principle of the Metaverse represent new components, forming a reality in which classical legal control lags behind the flow of rapid changes among such technologies. Classical legal doctrines developed on legal texts with judicial practice and principles of law enforcement should be compensated by modern methods of forecasting, modeling and analysis of legal phenomena. The use of mathematical methods in legal research is becoming increasingly applied. They contribute not only to the formalization of legislative provisions, but also to predict the results of their application in the context of dynamic digital transformation.

The need for a deeper analysis of dynamic legal processes in the digital environment has actualized the transition to the use of mathematical modeling in legal research. The modern legal reality integrates the dynamic components of the process, which increasingly include elements of algorithmic control, autonomous systems for decision-making, and AI that are able to function within the legislative field with minimal or no human intervention.

Therefore, there is a need for new approaches to legal modeling, such that allow assessing the risks of violation of fundamental human rights in the field of law enforcement, carrying out analytical forecasting of the impact of AI on the legal system, as well as determining the directions of non-formalized development of legal structures in the digital environment.

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