Artificial Intelligence as a Challenge for European Patent Law

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***Abstract* — Although technological developments falling under the umbrella of artificial intelligence have been developing since the 1950s, only in recent times have the unique issues associated with patenting these technologies received adequate attention. The cause for this lies in an unparalleled upswing in investment, fostering a massive expansion of technological (and business) innovations. Determining which among them qualify as inventions and meet the requirements for patent protection gives rise to inquiries that frequently necessitate a scrutiny of fundamental concepts of patent law in patent registration procedures. In this paper special emphasis is placed on European patent regulations, particularly the European Patent Convention and the practices of the European Patent Office. Assessment of the impact of artificial intelligence on existing patent law entails examination of legal concepts of the inventor and a person skilled in the art, along with the essential requirements for patentability of inventions. This analysis serves as basis for further evaluation of whether the current patent law can be adapted to the newly emerging and dynamic technological environment of artificial intelligence through interpretation, or whether it is necessary to devise a new legal framework to protect the interests of participants in the creation and use of the respective category of intellectual creations.**

Key words – artificial intelligence, law, intellectual property, patent, invention, inventor

I. INTRODUCTION

Far from the times when technological progress only aimed at enhancing or replacing human or animal muscle strength, today's digital technologies aspire to achieve the same objective but with the primary emphasis on the cognitive functions performed by the human brain. The development of artificial intelligence (AI), which began in the mid-20th century, gains particular momentum in the second decade of the 21st century due to a significant increase in two key factors: computing power and the amount of available data. The synergy between advanced algorithms, robust computational resources, and vast datasets has empowered AI systems to tackle complex problems, make sophisticated predictions, and exhibit a level of learning and adaptation previously unparalleled. Consequently, industries ranging from healthcare and finance to manufacturing and entertainment are witnessing transformative changes as AI-driven innovations reshape the landscape of human-machine interaction and decision-making processes. As we stand at the intersection of technological prowess and AI, the possibilities and implications of this dynamic era continue to unfold, offering unprecedented opportunities and prompting thoughtful considerations about the ethical, societal, and economic dimensions of the AI revolution. Against the background of disturbed socio-economic relations, the social tensions about such considerations tend to be resolved by means of legal regulation, which typically establishes the course and boundaries for subsequent advancements.

The EU legislative instrument, under the popular name of Artificial Intelligence Act, is expected to be passed any time soon since, in December 2023, the EU legislators have reached an agreement about its content. In the meantime, the reference can be made to the working text of the AU Act. The notion of "AI system" is defined therein as "a machine-based system designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments" [1].

This definition includes the AI tools most commonly used in everyday activities, such as internet search, machine translation, digital personal sustenance, object recognition in pictures and videos, human speech recognition, and generating textual, visual, audio or other content. In addition, a huge portion of AI systems belongs to the less visible application of AI in various industries where existing and new processes are automatised at the entirely new level. AI has been compared to electricity with the intention to describe the transformative power of AI over all industries [2].

The potential of AI to transform business processes in so many industries by now and consequential increase in their economic value [3] has led to a growing need for legal protection of innovative technological solutions in the field of AI. It is generally believed that the protection through intellectual property rights is important for ensuring a return on investment in research and innovation thereby incentivising the research and promoting the development of knowledge, which eventually result in overall social progress. Patents are specifically designed to protect new solutions to the problems humans face in various technology domains. As AI technology disruptively influences current technology and the economic system [4], it similarly exerts a disruptive impact on the legal system [5]. Patent law is currently undergoing pressure due to the particular features of AI-related technological solutions compared to the ones in other areas of. This is not the first,

and according to some, not even the most significant upheaval that patent law has experienced, especially when compared to the turmoil caused by advancements in biotechnology and research on the human genome and stem cells [6]. According to this view, the current patent system is sufficiently flexible to absorb the innovative segments of AI technology without compromising the fundamental functions of the patent system as a whole.

This having been said, the issues related to patent protection of AI-related inventions are extremely complex. Extensive debates are ongoing in respect of at least two of out of the four fundamental prerequisites for patentability according to Article 52(1) of the European Patent Convention (EPC) [7], being (1) there must has to be an invention in the field of technology and not captured by any exception, (2) the invention must be new, (3) the invention must involve an inventive step, and (4) the invention must be industrially applicable. The questions that are raised in different stages of the patent grant procedure often require an examination of the basic concepts of patent law. For instance, whether an AI-related technological innovation qualifies for "invention" may be the first question posed in the course of substantial examination, given the exclusion of certain subject-matters from the patentability. Likewise, the question of whether an AI-system or a machine on which it runs can be inventors necessitates deep insight into the very foundations of the patent law. These are all issues of great magnitude, considering that the number of patent applications and patents in the field of AI (be it hardware, algorithms, or applied technologies) is continually growing. In the period from 2017 to 2021 alone, the average global growth rate in granted patents was 18.2% [8].

In this paper emphasis is put on European patent law, particularly the EPC and the practice of the European Patent Office (EPO). There is a noticeable increase in patent applications in the class G06N of the International Patent Classification, marked as "artificial intelligence" before the EPO. In 2020, there were 12 times more published applications than in 2014, which is significantly higher than the overall increase in the number of published patent applications in all areas of technology [9]. Against this backdrop, the following page offer insight into the elements examined by the EPO in the course of the proceedings following the patent application, including fundamental legal concepts such as "inventor" and "skilled person in the art". The disruptive impact of artificial intelligence on existing patent law is also assessed concerning the legal concepts which are part of the patentability requirements, such as "invention" and "inventive step".

II. AI AS AN INVENTION

AI may appear before the EPO in several forms: physical hardware, computer programme/algorithm or applied technology. It is the computer programme and/or the algorithm that make the key segment of an AI system because the effectiveness, efficiency and overall performance of the system heavily depend on the design, optimization, and adaptability of the underlying programme and algorithms. The algorithmic choices dictate how well the AI system can process and learn from data, make predictions or decisions, and carry out tasks across various domains, defining its capability to fulfil specific objectives and address real-world challenges.

In computer science, the notions of "computer programme" and "algorithm" are distinguished. Since long ago, algorithm was defined as system of computations that using the sequence of operations solve a given problem [10]. In machine learning, a currently flourishing branch of AI, algorithm consists of set of instructions, performed by a computer to learn from data. Computer programme, on the other hand, is said to be an implementation of the algorithm, a more concrete manifestation which may be tested as to its implementability and proper operation. In patent law, this distinction can be relevant when attempting to identify an exception from considering the claimed subject-matter as an invention, but the distinction reduces in relevance given that eventually the threshold for patentability requires the additional properties equivalent to both, the computer programmes and algorithms. According to Article 52(2) and (3) of the EPC, "mathematical methods" (subparagraph (a)) and "programs for computers" (subparagraph (c)) "as such" are expressly excluded from patent protection. Over the years, however, the EPO practice has been gradually relaxing this exclusion so that at present it does not apply to "mathematical methods" and "computer programs" that have a "technical character". An analysis of decisions by the Boards of Appeal of the EPO shows a careful approach that involves adapting the existing practice related to patenting "mathematical methods" and "computer programs" and applying it to inventions in the field of AI, at the same time not altering the exception for such inventions without a technical character [11].

A. AI-related Invention and Exclusion of Mathematical Method as Such

Prior to their application in computer science, algorithms were seen as a purely mathematical concept. In computer science, algorithms equal a step-by-step set of instructions or procedures for solving a particular problem or accomplishing a specific task. Algorithms can involve various mathematical operations, calculation and logic to achieve their objectives. However, algorithms can be expressed in various ways and are not limited to mathematical notation. For example, they can be described in natural language, flowcharts, pseudocode, or other forms. While not all mathematical methods are algorithms, algorithms often incorporate mathematical concepts and operations as part of their design to perform computations, make decisions, or process data in a systematic way.

According to Article 52(2)(a) and 52(3) of the EPC, an element of an artificial intelligence system that qualifies as a "mathematical method" "as such" is not patentable. This includes a patent claim related to an abstract mathematical method that does not specify the use of any technical means. Computer models and algorithms, e.g., neural networks, are considered mathematical methods regardless of how complex they are and whether they are trained on a specific dataset. While some of them might be eligible for patent protection in US or Japan, new general AI models and algorithms are excluded form patent-eligibility under the EPC.

However, if the patent claim comprises a mathematical method that involves technical means or a device (e.g., computer, vacuum cleaner, self-driving car, assembly machine, mobile phone), the subject matter of that claim has a technical character as a whole and is not excluded from patentability based on the above-cited provision of the EPC. It is important to understand that under current patent law in Europe, regardless of how advanced an AI algorithm may be, only a concrete technical character of the invention as a whole, may lead to patentability. Thus, in addition to data sets *per se* being excluded form patenting, the methods of generating or pre-processing data are likewise excluded unless there is a technical character to the invention as a whole. Furthermore, the updated Guidelines for Examination in the European Patent Office [12] clarify that a general technical purpose is not sufficient, while a specific technical purpose will meet this criterion. Thus, purpose described as managing a technical system would be insufficiently concrete, while managing a magnetic resonance machine or providing automated diagnosis based on processed physiological measurements would qualify. Therefore, in order to be patent-eligible AI inventions of mathematical nature have to be tied to specific technical application or purpose or to a technical device.

In order to meet this requirement, patent claims need to be carefully drafted. Precisely identifying the inventive contribution or defining the invention may true huge challenge. The technical purpose needs to be concretized with respect to the claimed invention. In addition, the patent claim itself must be limited to that technical purpose. AI-related inventions may not be patentable if patent claims use common expressions like "support vector machine" or "reasoning engine" or "neural network". This is because, regardless of the general meaning these expressions may imply about the presence of technical means, the terms themselves qualify as abstract mathematical methods lacking technical character. In contrast, a technical contribution is achieved, e.g., by using a neural network in a heart monitoring machine for identifying irregular heartbeats or by classifying a digital image based on pixels using an algorithm [13].

B. AI-related Invention and Exclusion of Computer Programme as Such

The exclusion from patentability of computer programs as such under Article 52(3)(c) and Article 52(3) of the EPC can be avoided if the computer program has a technical character. To achieve this, the computer program must have "further technical effect" when executed on a computer, such as through the control of a technical process or the internal functioning of the computer itself or its interfaces. Such further technical effect has to go beyond the normal physical interactions between the program and the computer. Normal physical effects of program execution, such as the flow of electrical currents in the computer, are not, by themselves, sufficient for the technical character of a computer program [14].

The analysis published by WIPO in 2019 shows that the majority of patent applications have a commercial application focus, as they relate to the AI functional application or are combined with the AI application field. One of the areas with the most patent applications related to AI was transportation, including self-driving vehicles, vessels, airplanes and drones. The other was medical science with applications such as the collection of medical data (including patient records, imaging scans and genomic information), to provide disease diagnosis and predictions, treatment planning and personalized medicine [15]. Additionally, the image and voice recognition and natural language processing have also been represented to an important extent.

In this context, the concept of "computer-implemented invention" has been developed in the past, to denote patent claims involving computers, computer networks, or other programmable devices, with at least one feature being realized through a computer program. Unlike computer programs as such, patent claims related to a computer-implemented method, computer-readable memory medium, or device cannot be excluded from patentability based on Article 52(2) and (3) of the EPC, because any method involving the use of technical means (e.g., computers) or the technical means themselves (e.g., computer or readable memory medium) has a technical character and thus constitutes an invention.

Examples of patentable AI include: a computer program for recognising, categorising, and processing images or videos collected by sensors of an autonomous vehicle to identify the surrounding environment; classification of traffic at IP network nodes using machine learning to enhance traffic management on the IP network; and the use of a robot equipped with audio sensors to collect sound data and convert it into language data using a computer program for language recognition to determine the movements and sounds of the robot. In contrast, the use of AI for predicting stock market prices or for extracting commercial keywords from textual content for identification and indexing are not considered technical [16].

III. INVENTIVE STEP

An invention that is established to be new (i.e., not contained in state of the art), must also involve an inventive step to be patented, according to Article 56 of the EPC. To be precise, the invention must not be obvious to a person skilled in the art (PSA) having regard to the prior art. Obviousness assumes defining the hypothetical PSA with the relevant expertise and general knowledge to represent the reference point for assessing the inventive step. It is necessary to identify the inventive concept stated in the patent claim, as well as the differences between the prior art at the time of filing and the inventive concept. The requirement for an inventive step is intended to verify whether the transition from the prior art to the inventive concept is obvious to PSA. If it is, the invention is not patentable. Two basic legal notions have to be addressed with respect to AI-related inventions: the PSA and the prior art.

The greater part of discussions concerning the inventive step when an invention relates to AI is focused on algorithms [17]. When the inventive step consists in applying an AI system to a specific technical problem, it could be more challenging to prove that the invention involves an inventive step if the system or model is trained

on large amounts of data. This is because algorithms represent a crucial part of the ability of AI systems to solve a technical problem [18], raising the question of whether the data on which AI is trained should be part of the prior art. It has been repeated several timed throughout the paper that the AI system learns from the data (structured or unstructured) it has been trained on. The problem is particularly noticeable when dealing with data that is not publicly available but represents a unique dataset specifically created for training AI, the disclosure of which could harm the strategic comparative advantage sought by the patent applicant [19], as discussed further in the next chapter concerned with disclosure.

In light of the above, some authors advocate strengthening secondary indicia in assessing the inventive step for AI-related inventions [20], while others caution that such indicia could serve only as auxiliary criteria in situations of doubt following an objective assessment. According to the latter, the threshold of the inventive step should increase in tandem with the intensity of using AI, which makes inventions simpler [21].

The concept of PSA does not represent a person with constant properties, but is flexible and adjustable in order to be responsive to the continuous scientific and technological development. This is the reason why the criterion of expertise in the PSA continually incorporates new knowledge and skills. In a view of the technical developments in the AI field, arguments have been presented to support the hypothesis of the new PSA. Whatever the case may be the competent authorities should recalibrate the manner in which the define the person skilled in the art and possessing general knowledge possibly into the "skilled human using a machine" [22]. It has been submitted that PSA is probably subject to change as he or she is now working enhanced by the machines so that "inventive is the new skilled" [23]. This seems justified give the expected omnipresent use of AI systems, and their more and more advanced properties, which will make it considerably more difficult to show the effect of human factor in creating a new invention.

IV. Description of the Invention

Pursuant to Article 87(1)(c) of the EPC, the patent application has to contain the description of the invention and pursuant to Article 83 of the EPC, the patent application shall disclose the invention in a manner sufficiently clear and complete for it to be carried out by a PSA. In order to meet the requirements of Article 83 of the EPC, a European patent application must contain sufficient information to allow a PSA, using his or her common general knowledge, to perceive the technical teaching inherent in the claimed invention and to put it into effect accordingly.

The purpose of disclosure is the *quid pro quo* – providing insight and reproducibility of the invention in exchange for exclusive rights during a specific period of time. Not only that it facilitates the necessary examinations in the course of the proceedings for the grant of the patent, but once the disclosed information becomes part of the public domain, it contributes to the body of public knowledge. It helps avoid redundant efforts and encourages the progression of technology.

Both, the practical aspects and the multiple purpose of disclosure are questioned when it comes to the inventions associated with AI, especially the so-called fundamental models. Such models often rely on artificial deep learning neural networks, consisting of multiple hidden layers and trained on a large amount of raw data. Essentially, the model is a large set of numerical statistical weighting values representing the complex interrelationships of many input features of the training data that determine the output prediction. Although these numerical weighting values can be expressed in readable data, they are of little significance even to experts because the magnitude and sign of the numerical weightings are randomly generated during the training process. In fact, the conclusions are: the more hidden layers, the better the performance; the better the performance, the lower the explainability [24].

Such AI system can be repeatedly reprogrammed which changes its code and properties to achieve a specific result. This is considered an essential advantage of such model. Because of the described nature of such model, it has is been labelled as "black box". A problem is particularly evident when it is necessary to provide a sufficiently detailed description in the patent application. Therefore, alternative solutions are proposed, such as storing inventions in the field of AI similar to the storage of specific inventions in biotechnology [25]. It is possible that new regulations emphasising explainability and transparency will contribute to solving the "black box" problem. However, it seems likely that explainability for these other purposes (e.g., transparency for the users) may not necessarily be sufficient for describing inventions in patent law [26].

Another layer of the problem with description of the invention is posed by the data on which the AI algorithm has been trained. Unlike with the hidden layers, the data is known to the applicant, however, there may be reasons why the data should remain undisclosed. For instance, the data processed in the course of training the AI model may be subject to the business secret, statutory data protection rules or another type of legal limitation. Disclosing such data in the patent application would violate legal duties or obligations. Hypothetically speaking, if the training dataset disclosure would be mandatory in the patent application, this might have a chilling effect on the potential applicants. Instead of applying for a patent, they might opt for trade secrets, which in turn would affect the purpose of disclosure.

V. AI as an Inventor

The analysis of the disruptive impact of AI on patent law cannot bypass the question of the AI system as an inventor. Due to the circumstances that inventions may arise through the use of AI systems, some of which work with high level of autonomy, discussion has been stirred as to whether an AI system should be recognised as the inventor, either independently or alongside the human

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utilising it. There is also a discussion about whether the owner of the machine or AI system can be considered the inventor, considering the fundamental principles of patent law.

The Legal Board of Appeal of the EPO addressed this issue in response to Stephen Thaler's request to register his AI system, called DEBUS, as the inventor. Thaler claimed that the system independently generated the invention, while he, as the owner of the machine, acquired the right to file a patent application as the legal successor. The provision with primary relevance in this context is Article 81 of the EPC, which stipulates that the inventor must be identified in the patent application, even if the applicant is not the inventor, requiring a statement regarding the origin of the patent rights.

The right of the inventor to be named as such in the patent application and patent is considered a moral right [27], inherently applicable only to the human inventor in relation to his or her intellectual creation embodied in the invention. The assertion that only a natural person can be an inventor arises from linguistic, historical and teleological interpretations of the cited provision [28]. The purpose of Article 81 is confirmed to protect the inventor's right, enable him or her to pursue compensation claims under national law, and identify the legal basis for the right to apply, which according to the Legal Board of Appeal are purposes that are entirely meaningless if applied to a machine [29]. This seems in line with the reasoning of the European Court of Justice, which stated that patents have a "special object", consisting *inter alia* in granting the patent holder exclusive rights to exploit the invention in terms of manufacturing and first placing an industrial product on the market, either directly or through licenses to third parties, as well as the right to oppose any infringement, all aimed at ensuring compensation for the creative effort of the inventor [30].

The outcomes of the proceedings Thaler instigated in the US [31], UK [32] and Australia [33] were consistent with the one in Europe, supported by the reasoning that only a human can be considered an inventor. Thus, for the time being a uniform international standard remains that an inventor can only be a human being, a requirement unaffected by the existing autonomy in the operation of artificial intelligence systems. This is also consistent with the purpose of the patent system, part of the larger group of intellectual property rights, which recognises, rewards and incentivises human intellectual creations to the benefit of the society as a whole. From the technical standpoint, regardless of the autonomous nature of AI techniques, "as long as a human conceives the overall computational process and specifies instructions as to how it should be carried out, computers are tools assisting human inventors" [34]. Therefore, it is still a good patent law that there can be multiple inventors, but all of them must be natural persons – humans [35].

Current discussions also tackle questions about recognizing a "user" of an AI system, including programmer, developer and implementer, as an inventor. This would be in line with the aforementioned assumption that only a human can be an inventor, but would necessitate evaluating the achieved intellectual advancement by a particular person as to whether that person was one of those who devised, made or originated the invention, the criteria depending on a particular national law applicable [36]. This is not decided by the EPO in the proceedings for the grant of the patent [37], but before the competent national court of the EPC Contracting States with the legal effect recognised also under the EPC [38].

Building on the assumption that human inventorship is the crucial and that the process for granting the patent before the EPO does not directly deals with this issue, it has been submitted that interpretation of an invention and inventive step should take into account the "human inventorship aspects into account, i.e., whether the subject matter owes its existence to a human creative intervention and intellectual activity of inventive quality" [39]. In that sense, patent application would have to contain disclosure of the role of an AI system in producing the invention, as part of the description of the technical problem and solution.

VI. Concluding Remarks

The development of AI, particularly complex systems like deep neural networks, sharply cuts into the fabric of patent law, leading to a constant reassessment of existing principles and provisions and their interpretation. Patent law provisions, including the EPC, were not written with computer programs, let alone AI systems, in mind. While the law is generally resistant to change by its very nature, some stakeholders call for a shift in the focus of interests and a redistribution of resources and benefits. This raises the question of the possible redefinition of power dynamics associated with various spheres of life and the actions of individuals, groups and commercial entities. It requires reflection on the role of patents in today's society, especially in the light of AI technology. The described situation is likely to result in a reduction of legal uncertainty and weaker predictability of legal solutions for all stakeholders for some time before the rules are settled.

It is essential, therefore, to clearly outline the contours of the patent-eligibility of AI-related inventions as soon as possible because many commercial entities rely on the advantages that patent protection offers them. This is true regardless of whether they need it for through an entire period of protection due to the rapid development of technological solutions in this field. The previously analysed requirement of technical character, which is necessary for a "mathematical method" or "computer program" at the core of AI systems to be patentable, is not considered justified in part of the professional community. Therefore, opinions are strongly divided on whether patentability should be expanded to algorithms of AI "as such" [40].

Furthermore, courts and other competent authorities would need to standardise criteria once again, defining a person with the appropriate expertise (both general and specific), what constitutes an "invention" and related issue of what information needs to be disclosed and how. This is necessary to accommodate the new circumstances and meet the need for adjustments of existing regulations by means of their creative interpretation, rather than to recognise an AI system as an inventor which would be a

considerably more radical and controversial change within the framework of patent law.

However, the dynamic technological environment in which increasingly advanced AI develops will still require some fundamental changes in the patent law system. These changes should consider the characteristics of new technologies to protect the interest of the human whose intelligence devised them and the interests of those who invested in them, while simultaneously serving the interests of the entire society that should also have access to and enjoy the benefits of technological advancements. Whether it will be necessary to create a new legal framework to protect the interests of participants in the process of making and use of inventions related to AI in the future will primarily depend on the properties of these inventions and their differences from those known today. It will also depend on a potential shift in societal values towards sustainability that goes beyond purely economic considerations.

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[32] UK Supreme Court, *Thaler v Comptroller-General of Patents, Designs and Trade Marks*, [2023] UKSC 49, 20.12.2023.

[33] High Court of Australia, *Thaler v Commissioner of Patents* [2022] HCATrans 199, 11.11.2022.

[34] See also J. Drexl et al., *Artificial Intelligence and Intellectual Property Law: Position Statement of the Max Planck Institute for Innovation and Competition of 9 April 2021 on the Current Debate*, MPI for Innovation and Competition Research Paper No. 21-10, https://www.ip.mpg.de/fileadmin/ipmpg/content/stellungnahmen/MPI_PositionPaper__SSRN_21-10.pdf, p. 24.

[35] EPO, *Patenting Artificial Intelligence, Conference summary*, 30 May 2018, EPO Munich, p. 8.

[36] Eva Stanková, "Human inventorship in European patent law", *Cambridge Law Journal*, vol. 80, no. 2, 2021, pp. 1-28, especially p. 9.

[37] Article 60(3) of the EPC states: "In proceedings before the European Patent Office, the applicant shall be deemed to be entitled to exercise the right to a European patent."

[38] See Protocol on Jurisdiction and the Recognition of Decisions in Respect of the Right to the Grant of a European Patent (Protocol on Recognition), of 5 October 1973.

[39] Eva Stanková, "Human inventorship…", p. 26.

[40] EPO, *Patenting Artificial Intelligence…*, p. 6. See also J. Drexl et al., *Artificial Intelligence…*, pp. 17-18.