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Artificial Intelligence and Patents: Disclosure Requirement Issues

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ABSTRACT

Artificial Intelligence (AI) is fast becoming a part of our everyday lives that impacts the way we interact with technology and the world around us. One of the most important uses of artificial intelligence is in working the inventions. A fundamental goal of the patent system is to disclose technology so that, in the course of time, the public domain may be enriched and a systematic record of humanity's technology is available and accessible. Meanwhile, the patent system is facing substantial challenges in terms of sufficiency of disclosure due to the breakthroughs in Artificial Intelligence. It is necessary for AI and their generated results to be disclosed and explainable in order to be replicated. However, despite the breakthroughs in our daily life, a key obstacle to the use of AI-based inventions is that they often lack clarity because of their black- box nature. At the same time, some AI-inventions or AI-techniques may require additional and specific datasets in order to be disclosed. The main question here is that what information in the patent application must be revealed so that the inventor can get a monopoly right and the public can benefit from the invention?

Keywords: Artificial Intelligence; Patent; Invention; Disclosure

Introduction

Artificial Intelligence (AI) is fast becoming a part of our everyday lives that impacts the way we interact with technology and the world around us [1]. One of the most important uses of artificial intelligence is in working the inventions. Also, Artificial intelligence can create autonomously an invention. Meanwhile, the patent system is facing substantial challenges in terms of inventorship and ownership, patent eligibility, assessment of inventiveness and sufficiency of disclosure due to the breakthroughs in Artificial Intelligence. While issues such as inventorship and ownership, patent eligibility , inventive step or non-obviousness may have already been addressed [2], this paper analyzes whether disclosure requirement in patents is challenged by Artificial Intelligence.A fundamental goal of the patent system is to disclose technology so that, in the course of time, the public domain may be enriched and a systematic record of humanity's technology is available and accessible. Patent laws require that the disclosure of an invention be sufficient to enable a person skilled in the relevant art to reproduce the invention. The requirement is fundamental to patent law: a monopoly is granted for a given period of time [3] in exchange for a disclosure to the public how to make or practice the invention. If the disclosure requirement is fundamentally challenged by Artificial Intelligence, the patent system cannot fulfill its mission. Therefore, the main questions discussed in this paper are: What are the issues that AI-generated inventions (where the invention is generated by AI) and AI- inventions (where AI technique is the invention) present for the disclosure requirement in patents? What are the issues if working the invention requires the application of AI? Are the inventions disclosed, explainable and reproducible? This paper is drafted in three main chapters. In the first chapter, we have patents beginning with a general introduction to patents, then conditions of patentability and finally disclosure requirement in patents which has been discussed in detail. In the second chapter, we have discussed Artificial Intelligence in three parts: general introduction to Artificial Intelligence, explainability of Artificial Intelligence and reproducibility of Artificial Intelligence. In chapter three, we have analyzed disclosure requirement issues in Artificial Intelligence and patents under these titles: Artificial Intelligence-created inventions, Artificial Intelligence- inventions and the use of Artificial Intelligence in working inventions.

Patents

General Introduction to Patents

A patent is an exclusive right granted for the protection of an invention [4]. "Invention" means a solution to a specific problem in the field of technology. An invention may relate to a product or a process [5]. The patent provides its owner with the exclusive right to prevent others from commercially exploiting the invention for a limited period of time (generally 20 years)[6] in return for disclosing the invention to the public and is valid only in the country where you have applied for protection [4]. Patents are frequently referred to as "monopolies", but a patent does not give the right to the inventor or the owner of a patented invention to make, use or sell anything [5].Thus, the holder of a patent (the patent-holder or patentee) can prevent others from making, using, offering for sale, selling or importing the patented invention without permission, and can sue anyone who exploits the patented invention without his or her permission [4].The theory behind the system is that the financial reward flowing from the exploitation of the patent and the disclosure of the resulting inventions for public dissemination and use, would encourage innovation and raise the technical level of a nation's industry, with the obvious benefits to its trade[4]. The disclosure of the invention is thus an important consideration in any patent granting procedure [5]. Legal protection against any violation of patent rights (infringement) is not given automatically but only when the patent-holder asks for it. Hence, patent-holders need to monitor the business activities of others if they want to enforce their patent rights [4].

Conditions of Patentability [7]

An invention must meet several criteria if it is to be eligible for patent protection. These include, most significantly, that the invention must consist of patentable subject matter, the invention must be industrially applicable (useful), it must be new (novel), it must exhibit a sufficient "inventive step" (be non-obvious), and the disclosure of the invention in the patent application must meet certain standards [5].

Patentable Subject Matter

In order to be eligible for patent protection, an invention must fall within the scope of patentable subject matter. Patentable subject matter is established by statute, and is usually defined in terms of the exceptions to patentability, the general rule being that patent protection shall be available for inventions in all fields of technology (see Article 27.1 of the TRIPS Agreement) [5].

Depending on the patent law of each country, some of the following may not be patentable:

- Discoveries of materials or substances already existing in nature;
- Scientific theories or mathematical methods;
- Plants or animals (or the varieties thereof) other than micro-organisms, or essentially biological processes for the production of plants or animals (or the varieties thereof), other than microbiological processes;
- Schemes, rules or methods, such as those for doing business, performing purely mental acts or playing games;
- Methods of treatment for humans or animals, or diagnostic methods practised on humans or animals (but not products for use in such methods);
- Any invention where prevention of its commercial exploitation is necessary to protect public order, good morals or public health [4]. (see Article 27.2 and 3 of the TRIPS Agreement)

Novelty

Novelty is a fundamental requirement in any examination as to substance and is an undisputed condition of patentability. It must be emphasized, however, that novelty is not something which can be proved or established; only its absence can be proved [5]. An invention is new (or, in patent law terminology), 'novelty exists', if there is any difference between the invention and current knowledge or the 'prior art' [4]. "Prior art" is, in general, all the knowledge that existed prior to the relevant filing or priority date of a patent application, whether it existed by way of written or oral disclosure [5].

Inventive Step (Non-Obviousness)

An invention shall be considered as involving an 'inventive step' if, having regard to the state of a particular art, it is not obvious to a person skilled in that art; in other words, it must not be possible for an average expert to make the invention by mere routine work [4]. The expression "inventive step" conveys the idea that it is not enough that the claimed invention is new, that is, different from what exists in the state of the art, but that this difference must have two characteristics. Firstly, it must be "inventive", that is, the result of a creative idea, and it must be a step, that is, it must be noticeable. There must be a clearly identifiable difference between the state of the art and the claimed invention. This is why, in some jurisdictions, there is the concept of an "advance" or "progress" over the prior art. Secondly, it is required that this advance or progress be significant and essential to the invention [5].

Industrial Applicability (Utility)

An invention, in order to be patentable, must be of a kind which can be applied for practical purposes, not be purely theoretical. If the invention is intended to be a product or part of a product, it should be possible to make that product. And if the invention is intended to be a process or part of a process, it should be possible to carry that process out or "use" it (the general term) in practice [5]. Industry is meant, in its broadest sense, as anything distinct from a purely intellectual or aesthetic activity. An idea in itself cannot be patented, unless it is an invention that is considered to have an industrial applicability. The definition of 'industrial' includes agriculture [4].

Disclosure Requirement in Patents

An additional requirement of patentability is whether or not the invention is sufficiently disclosed in the application. The application must disclose the invention in a manner sufficiently clear for the invention to be carried out by a person skilled in the art. The description should set out at least one mode for carrying out the invention claimed. This should be done in terms of examples, where appropriate, and with reference to the drawings, if any [5]. In some countries (such as the United States), the description is required to disclose the best mode for carrying out the invention known to the applicant [8]. One objective of this criterion is that persons other than the inventor should be able to benefit from the inventor's disclosure, and this is most likely to happen if others are well informed with respect to the means of making or using the invention. Another objective of this requirement is to distinguish true inventions from speculative concepts of would- be inventors about future possibilities [9]. Additionally, the disclosure requirement in toto helps patent examiners determine whether an invention merits a patent and indicates that the patentee possesses enough information about the invention to indicate that he actually discovered it. And of course, it helps competitors comprehend the metes and bounds of the patent so they can avoid liability for patent infringement [10]. The disclosure requirement can be found in most patent laws [11]. The requirement is fundamental to patent law: a monopoly is granted for a given period of time [12] in exchange for a disclosure to the public how to make or practice the invention. If a patent fails to contain such information, then the bargain is violated, and the patent is unenforceable or can be revoked [13].

Europe Approach

Article 83 of the European Patent Convention states: "The European patent application shall disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art." Insufficient disclosure is a ground for opposition under Article 100 of the EPC: "Opposition may only be filed on the grounds that: b) the European patent does not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art;" and a ground for revocation under Article 138(1) of the EPC: "a European patent may be revoked with effect for a Contracting State only on the grounds that: (b) the European patent does not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art;" Article 14(3) of the UK Patents Act 1977 stipulates: "The specification of an application shall disclose the invention in a manner which is clear enough and complete enough for the invention to be performed by a person skilled in the art." Insufficiency is also a ground for revocation under Section 72 of the UK Patents Act. Also, according to Article L612-5 of the French Intellectual Property Code: The patent application must disclose the invention in a manner sufficiently clear and complete for it to be performed by a person skilled in the art.

Us Approach

35 U.S. Code § 112.Specification(a) and 35 U.S.C. 112 (pre-AIA) Specification stipulate: "The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention."

The Contract Theory of Patents

Patents are sometimes considered as a contract between the inventor and society [14]. The inventor is interested in benefiting (personally) from his invention. Society is interested in encouraging innovation so that better products can be made and better production methods can be used for the benefit of all; protecting new innovative companies so that they can compete with large established companies, in order to maintain a competitive economy; learning the details of new inventions so that other engineers and scientists can further improve them; promoting technology transfer (i.e. from universities to industry). So both parties are interested in a contract that grants protection to innovators (thereby also increasing the motivation to innovate) in exchange for disclosure of the invention. This social contract is institutionalized in the form of patent law [14]. Two distinct theories of patents, the "reward theory" and the "contract theory," are customarily adopted by the courts to justify the patent system. The reward theory maintains that the function of the patent system is to remunerate successful innovators so as to encourage R&D effort. In contrast, the contract theory holds that the function of the patent system is to promote the diffusion of innovative knowledge. Assuming that in the absence of patent protection innovators would rely on trade secrecy, it views patents as a contract between innovators and society whereby a property right is granted in exchange for disclosure [15].

Artificial Intelligence

General Introduction to Artificial Intelligence

Artificial Intelligence (AI), broadly (and somewhat circularly) defined, is concerned with intelligent behavior in artifacts. Intelligent behavior, in turn, involves perception, reasoning, learning, communicating and acting in complex environments [16]. Therefore, learning, problem- solving and decision-making are three common characteristics of human and artificial intelligence [17]. Artificial intelligence refers to a class of computer programs designed to solve problems requiring inferential reasoning, decision-making based on incomplete or uncertain information, classification, optimization, and perception. AI programs encompass a broad range of computer programs that exhibit varying degrees of autonomy, intelligence, and dynamic ability to solve problems [18]. On the most inflexible end of the spectrum are AI that make decisions based on preprogrammed rules from which

they make inferences or evaluate options. On the most flexible end are modern AI programs that are based on machine-learning algorithms that can learn from data [18]. For this sort of AI, there are no pre-programmed rules about how to solve the problem at hand, but rather only rules about how to learn from data [18].This paper is concerned with this second type of AI that learns from data and solves problems dynamically.AI has as one of its long-term goals the development of machines that can do these things as well as humans can, or possibly even better. Another goal of AI is to understand this kind of behavior whether it occurs in machines or in humans or other animals. Thus, AI has both engineering and scientific goals [16].

The term "artificial intelligence" was coined by an American computer scientist John McCarthy as the title of a 1956 Dartmouth conference [16]. AI is often described based on its problem space, such as logical reasoning, knowledge representation, planning and navigation, natural language processing (NLP) and perception, or based on its often-overlapping subfields, including machine learning (ML), deep learning, artificial neural networks, expert systems and robotics. AI is also often categorized based on its intelligence level, such as artificial general intelligence (AGI), which is a notional form of AI that exhibits a level of intelligence comparable to that of the human mind, and narrow AI, which is the form of AI seen today that focuses on solving specific tasks [19]. AI's technological breakthroughs dramatically accelerated in the last two decades. The impressive technological progress of the last decade in particular has led to AI's ability to perform activities which used to be typically and exclusively human, as well as to develop certain autonomous and cognitive features – e.g. the ability to learn from experience and take quasi-independent decisions [19]. Artificial intelligence (AI) is increasingly driving important developments in technology and business, from autonomous vehicles to medical diagnosis to advanced manufacturing [20]. As AI moves from the theoretical realm to the global marketplace, its growth is fueled by a profusion of digitized data and rapidly advancing computational processing power, with potentially revolutionary effect: detecting patterns among billions of seemingly unrelated data points, AI can improve weather forecasting, boost crop yields, enhance detection of cancer, predict an epidemic and improve industrial productivity [20]. According to Mr. Francis Gurry, WIPO Director General, "Artificial intelligence is a new digital frontier that will have a profound impact on the world, transforming the way we live and work" [20].

Explainability of Artificial Intelligence

Explainability is one of the main barriers AI is facing nowadays in regards to its practical implementation [21]. The inability to explain or to fully understand the reasons by which state- of- the-art Machine Learning (ML) algorithms perform as well as they do, is a problem that find its roots in two different causes:

1) "The gap between the research community and business sectors"; and

2) "Knowledge", in that "science and society are far from being concerned just by performance"[21], but they also want to understand how AI and ML (computer programs that learn from data) models work towards producing outputs that trigger decisions. Given an audience, an explainable Artificial Intelligence is one that produces details or reasons to make its functioning clear or easy to understand [21]. It contrasts with the concept of the "black box" in machine learning where even their designers cannot explain why the AI arrived at a specific decision [22]. From data entry (input) to obtaining a result (output), the process remains more or less opaque. In the world of research in artificial intelligence, this gray area is called the "black box"[23]. Generally, the Black Box Problem can be defined as an inability to fully understand an AI's decision-making process and the inability to predict the AI's decisions or outputs [18]. One possible reason AI may be a black box to humans is that it relies on machine-learning algorithms that internalize data in ways that are not easily audited or understood by humans [18].

We provide here two illustrative examples. First, a lack of transparency may arise from the complexity of the algorithm's structure, such as with a deep neural network, which consists of thousands of artificial neurons working together in a diffuse way to solve a problem. This reason for AI being a black box is referred to as "complexity." Second, the lack of transparency may arise because the AI is using a machine-learning algorithm that relies on geometric relationships that humans cannot visualize, such as with support vector machines. This reason for AI being a black box is referred to as" dimensionality"[18]. An algorithm is a set of precise rules describing a computation process that, when executed, proceeds from an input, goes through a finite number of well-defined steps, and eventually produces an output [24]. Algorithms, particularly machine learning (ML) algorithms, are increasingly important to individuals' lives, but have caused a range of concerns revolving mainly around unfairness, discrimination and opacity. Transparency in the form of a "right to an explanation" has emerged as a compellingly attractive remedy since it intuitively promises to open the algorithmic "black box" to promote challenge, redress, and hopefully heightened accountability [25]. Each type of ML technique has different level regarding explanation ability and transparency of knowledge. For example, Neural Networks and Support Vector Machines (SVM) have poor explainability, but Decision Trees, Naïve Bayes and Rule-learners are very transparent [26]. Although machine learning's black-box features distinctively implicate notions of reasoned transparency, legal demands for reason-giving can be satisfied by explaining an algorithm's purpose, design, and basic functioning. Furthermore, new technical advances will only make machine-learning algorithms increasingly more explainable. Algorithmic governance can meet both legal and public demands for transparency while still enhancing accuracy, efficiency, and even potentially legitimacy in government [27].

Reproducibility of Artificial Intelligence

Reproducibility is the ability to be recreated or copied [28]. In machine learning, reproducibility is being able to recreate a machine learning workflow to reach the same conclusions as the original work. An algorithm from new research without the reproducibility aspects can be difficult to investigate and implement. With our increasing dependency on ML and AI systems for decision making, integrating a model not fully understood can have unintended consequences [29]. Hence, the inability to reproduce results affects the trustworthiness of science [30]. Costs and budget constraints are another area impacted by reproducibility. Without the details on hardware, computational power, training data and more nuanced aspects like hyperparameters tuning, adopting new algorithms can run into huge costs and considerable research effort, only to lead into inconclusive results [29]. The large number of artifacts, algorithm settings, code versions, system parameters, datasets, etc. that contribute to generate a single prediction can make reproducibility challenging. To make AI truly reproducible, a precise lineage and provenance must be maintained for every prediction [31].

Disclosure Requirement Issues in Artificial Intelligence and Patents

Artificial Intelligence-Created Inventions

A computer-generated invention occurs when a software conceives novel subject matter independent of human intervention [32]. Computer-generated inventions lack a human inventive component and may, therefore, spawn a technological advancement far beyond the capacity of the most innovative of engineers [32]. One example of a computer-generated invention can be seen in Google's AutoML, an automated approach to the making of machine learning models. This project utilizes AI to create more sophisticated AIs; AIs that are "more efficient and powerful than the best human-designed systems [32]. Another example is Dr. Thaler's Creativity Machine's Patent named "Neural Network Based Prototyping System and Method." Dr. Thaler is listed as the patent's inventor, but he states that the Creativity Machine invented the patent's subject matter (the "Creativity Machine's Patent") [33]. The Creativity Machine's Patent application was filed on May 15, 1998, and granted on December 22, 1998. (U.S. Patent No. 5,852,815) Considering the above-mentioned, patenting Artificial Intelligence-created Inventions may be an issue regarding inventorship [34] but does not call disclosure requirement into question.

Artificial Intelligence-Inventions

AI- invention is that kind of invention where AI technique is the invention. One example is Artificial intelligence system for genetic analysis which was granted on April 8, 2014 (U.S. Patent No. 8,693,751). This invention provides a complete artificial intelligence system for the acquisition and analysis of nucleic acid array hybridization information. This system reads data from a nucleic acid microarray, analyzes test results, evaluates patient risk for various ailments, and recommends methods of treatment [35]. As the use of AI in medicine becomes ever more prevalent, the patent system must answer increasingly difficult questions regarding the protection afforded these technologies. Perhaps the most significant question is that of subject matter eligibility [36]. Therefore, patenting an AI technique may have uncertainties in terms of subject matter eligibility, but raises no issues regarding the disclosure requirement.

Use of Artificial Intelligence in Working Inventions

When working the invention requires the application of AI or an AI technique, several situations can be occurred. The first one is that the AI technique is not disclosed in the patent application, for instance, claims are often not supported by the description and are unclear. This is a big problem for the person skilled in the art. "To satisfy enablement, a patent's specification must disclose the invention in sufficient detail to enable a person of ordinary skill in the art to make it without undue experimentation" [36]. It is up to the person skilled in the art to overcome this problem by their own knowledge (where the invention is not exactly disclosed) or using the AI. But using the AI to disclose an invention will call the disclosure requirement into question, because the person having ordinary skill in the art has been able to work an invention not exactly disclosed. The second situation is that AI-invention can be reproduced but how it works is unexplainable. "Unexplainability is impossibility of providing an explanation for certain decisions made by an intelligent system which is both 100% accurate and comprehensible" [37]. "Users want and frequently need to understand how decisions impacting them are made. Similarly it is important to understand how an intelligent system functions for safety and security reasons" [37]. In the example mentioned previously, Artificial intelligence system for genetic analysis, even the inventor or developer does not know how it operates, therefore, this is an issue for explainability, not for disclosure requirement, because as we have seen above in the section of disclosure requirement, patent law does not require the inventor to explain the inner workings of an AI. The third situation occurs where AI-invention cannot be reproduced. "If other researchers cannot replicate the research findings, the original study will draw doubters and critics. Although reproducibility is an essential part of science, many sub-fields such as machine learning are now experiencing a reproducibility crisis" [38]. According to patent law, the inventor must disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art [39]. If the invention cannot be reproduced, thus it is not sufficiently disclosed.

Conclusion

Patent law requires that a patent application be disclosed sufficiently and clearly for the invention to be carried out by a person skilled in the art. It is necessary for AI and their generated results to be disclosed and explainable in order to be replicated. However,

despite the breakthroughs in our daily life, a key obstacle to the use of AI-based inventions is that they often lack clarity because of their black-box nature. At the same time, some AI-inventions or AI- techniques may require additional and specific datasets in order to be disclosed. In this case, because of the value of this information, some individuals and companies may not want to disclose their secret information and consequently, the invention cannot be disclosed and reproduced. In some cases, as we have seen in this paper, a person having ordinary skill in the art may resort to the AI in order to disclose an invention. This means that the invention is not sufficiently disclosed and using the AI by a person skilled in the art to disclose an invention is a deficit for disclosure requirement and can call the contract theory of patents into question, because a monopoly right is granted to the inventor in return for disclosing the invention. The main question here is that what information in the patent application must be revealed so that the inventor can get a monopoly right and the public can benefit from the invention? In other words, what is the standard for full disclosure of AI Inventions? There must be a balance between the inventor rights on one hand and the public rights on the other hand. It seems that in order to achieve this purpose, legal and technical tasks are necessary.

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