CAN DEEP THOUGHT PATENT THE EARTH? ARTIFICIAL INTELLIGENCE'S TRYST WITH PATENT LAW*

ARVIND SANKAR & JITMANYU SATPATI**

ABSTRACT

Artificial Intelligence (AI) systems are increasingly being used in various fields to generate novel and creative inventions. However, the patent law system has not kept pace with these innovations and consequently there are several unresolved issues with respect to the patentability of inventions generated by AI systems. This essay focuses on two of these issues: the grant of inventorship status to AI systems and the application of the current non-obviousness standard to AI generated inventions. It begins by discussing the developments and the state of the art in the field of invention generating AI systems. It then goes on to analyze the inventorship requirement and examines whether AI systems qualify as 'inventors' under the existing patent regime. In this regard it examines the procedural and technical requirements for filing patent applications, the jurisprudential understanding of an 'inventor', and the decisions of the few Patent Offices which have dealt with this issue. It cautions against the dismissal of AI patent applications on purely formalistic grounds when the AI systems in question fulfil the substantive requirements for inventorship. It further examines the implications of such dismissals and makes policy recommendations. It then examines the current non-obviousness standard for patentability and argues that the current standard is inadequate for dealing with AI generated inventions. It concludes by proposing a

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* After the article was cleared for publication, there were updates from some jurisdictions.
In Australia, the Federal Court ruled that an A.I. system can be named as an "inventor" of a patentable subject matter. (Thaler v Commissioner of Patents, [2021] FCA 879). This was based on a judicial review of the Deputy Commissioner of Patents' refusal to treat DABUS as an inventor. The Commissioner of Patents will be appealing the decision.
South Africa has also granted a patent to an application where DABUS was listed as an inventor. But the patent procedure only consists of a formal examination step. Since there is no substantive examination, the courts will be highly likely to be called to make a judicial determination.
In the USA, a federal judge ruled that an A.I. cannot be listed as an inventor. [Thaler v. Hirshfeld, 20-903, U.S. District Court for the Eastern District of Virginia (Alexandria)] This appeal was against the USPTO rejection.

** Arvind Sankar is a 5th Year student at the National Law University, Odisha. He may be contacted at asankar31@gmail.com.
Jitmanyu Satpathi is a 5th Year student at the National Law University, Odisha. He may be contacted at jitmanyusatpathi@gmail.com.

new standard which substitutes the human PHOSITA with an equivalent skilled AI system, focusing on reproducibility rather than obviousness.

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INTRODUCTION

Douglas Adams' *The Hitchhiker's Guide to the Galaxy*[1] is considered to be one of the most popular science fiction books to have ever been written and it has achieved an almost cult-like following across the world. One oft-referenced scene from the book is when Deep Thought, an Artificial Intelligence ("AI") system built by hyper-intelligent pan-dimensional beings, is tasked with computing the answer to the 'Great Question of Life, Universe and Everything'. After seven-and-a-half million years of computation, Deep Thought gives '42' as the answer and points out that the answer appears meaningless as the programmers who assigned it the task never knew what the question was or meant. When asked to produce the question, Deep Thought declines and instead offers to design a computer more powerful than itself to find the question. This computer is later revealed to be the Earth.

While AI systems will probably not be creating planets anytime soon, the technology behind them has advanced to the point where they are able to come up with patentable inventions autonomously. These inventions raise several questions for the existing patent regime with respect to their patentability and the entity having inventorship rights over them. Both the World Economic Forum and the World Intellectual Property Organization have recognized these challenges and have stressed on the need for effective policies that accommodate the changes that AI inventors bring to the inventive process.[2]

This essay explores some of the issues and conflicts between AI inventorship and the existing patent regime. This essay is divided into two parts. Part I of this essay details the developments and the current state of the art in the field of AI systems which are used for generating inventions. It primarily focuses on 3 AI systems viz. the Creativity Machine, the Invention Machine and Watson, and discusses the mechanisms they use to generate inventions. Part II of this essay focuses on the issues of AI inventorship of inventions and the challenges in applying the current non obviousness standard to AI generated inventions. In this regard, this essay discusses the implications of decisions made by Patent Offices across different jurisdictions and concludes by identifying various considerations for making a sound policy decision.

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[1] DOUGLAS ADAMS, THE HITCHHIKER'S GUIDE TO THE GALAXY (1979).

[2] KAY FIRTH-BUTTERFIELD ET AL., ARTIFICIAL INTELLIGENCE COLLIDES WITH PATENT LAW (2018), http://www3.weforum.org/docs/WEF_48540_WP_End_of_Innovation_Protecting_Patent_Law.pdf; *WIPO Conversation on Intellectual Property and Artificial Intelligence*, WIPO (Oct. 1, 2019), https://www.wipo.int/about-ip/en/artificial_intelligence/news/2019/news_0007.html.

I. ARTIFICIAL INTELLIGENCE IN THE INVENTIVE PROCESS

Computers have been used in the inventive process in some capacity or other since at least the latter half of the 20th century.[3] However, while early computers were primarily used as tools to help human inventors in coming up with inventions, recent advancements in AI technology has enabled computers to come up with potentially patentable inventions autonomously or with minimal human input.[4] Some of the prominent examples of AI which have autonomously come up with patentable inventions are discussed below.

A. The Creativity Machine

One of the first examples of an AI which was capable of autonomously generating inventions was the 'Creativity Machine' which was developed by computer scientist Dr. Stephen Thaler.[5] The Creativity Machine employs a software concept known as 'artificial neural networks' – collections of on/off switches that connect automatically to create software without human intervention – in order to generate novel ideas.[6] The Creativity Machine, at its most basic level, combines an artificial neural network which generates output as a result of self-stimulation of its connections with another network that perceives value in the output so generated.[7] These artificial neural networks mimic the functioning of the human brain's major cognitive pathway (the thalamo-cortical loop), which enables them to generate novel ideas or patterns and adapt to new scenarios without requiring additional human input.[8] The Creativity Machine has been credited with coming up with numerous inventions such as the cross-bristle design of the Oral-B Cross Action toothbrush and a new type of super strong material among others.[9] Dr. Thaler also claims that the Creativity Machine was the real inventor of the subject matter of a patent titled 'Neural Network Based Prototyping System and Method'.[10] However it is important to note that the patent was filed in Dr. Thaler's name and he did not disclose the involvement of the Creativity Machine to the Patent Office in the application.[11]

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[3] Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57(4) B.C. L. REV. 1079, 1083 (2016) [hereinafter *Creative Computers*].
[4] *E.g.*, Ben Hattenbach & Joshua Glucoft, *Patents in an Era of Infinite Monkeys and Artificial Intelligence*, 19 STAN. TECH. L. REV. 32, 36 (2015).
[5] *Creative Computers*, *supra* note 3; U.S. Patent No. 5.659.666 (filed Oct. 13, 1994).
[6] Stephen L. Thaler, *Synaptic Perturbation and Consciousness*, 6 INT'L J. MACHINE CONSCIOUSNESS 75 (2014).
[7] *Creative Computers*, *supra* note 3, at 1084.
[8] Stephen Thaler, *Creativity Machine® Paradigm*, *in* ENCYCLOPEDIA OF CREATIVITY, INVENTION, INNOVATION, AND ENTREPRENEURSHIP 451 (Elias G. Carayannis ed., 2013).
[9] *Id.*
[10] *Creative Computers*, *supra* note 3, at 1085; U.S. Patent No. 5.852.815 (filed May 15, 1998).
[11] *Creative Computers*, *supra* note 3, at 1085.

B. The Invention Machine

A second type of AI software which has seen some success in coming up with patentable inventions is Genetic Programming (GP).[12] GP is modelled after the process of biological evolution and tries to emulate the basic evolution processes (like mutation, natural selection and sexual recombination etc.) digitally to achieve machine intelligence.[13] GP uses algorithms which apply analogues of the basic evolution processes to existing solutions of a problem in order to come up with new solutions.[14] This process is then repeated iteratively on the new solutions till the software comes up with a solution that meets some specified termination criteria.[15] Thus while human operators provide the initial set of solutions and specify the termination criteria, there is minimal human intervention during the execution of the program itself. GP is especially useful for optimizing pre-existing inventions and in fields where even minor improvements in performance over the existing technology is significant.[16] An example of a GP based AI which has come up with patentable inventions is the 'Invention Machine', which was created by computer scientist and GP pioneer Dr. John Koza. Dr. Koza claims that the Invention Machine came up with an improved version of a controller which was the subject matter of a patent titled 'Apparatus for improved General-Purpose PID and non-PID Controllers'.[17] The Invention Machine was only supplied with information about basic electronic components and desired performance specifications, and it was able to come up with the improved controller without any further human intervention.[18] Like the Creativity Machine, the patent for these inventions were filed in Dr. Koza's name and the involvement of the Invention Machine was not disclosed to the Patent Office.[19]

C. Watson

IBM's Watson is another example of an AI which has autonomously come up with creative and patentable inventions. Watson was originally developed to compete on the game show

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[12] *E.g.*, Erica Fraser, *Computers as Inventors – Legal and Policy Implications of Artificial Intelligence on Patent Law*, 13(3) SCRIPTED 305, 316 (2016).
[13] John R. Koza et al., *Evolving Intentions*, 288(2) SCIENTIFIC AMERICAN 52 (2003).
[14] Riccardo Poli & John Koza, *Genetic Programming*, *in* SEARCH METHODOLOGIES: INTRODUCTORY TUTORIALS IN OPTIMIZATION AND DECISION SUPPORT TECHNIQUES 143 (E Burke & G Kendall eds., 2014).
[15] *Id*.
[16] Fraser, *supra* note 12, at 316.
[17] Jonathan Keats, *John Koza Has Built an Invention Machine*, POPULAR SCIENCE (Apr. 19, 2006), https://www.popsci.com/scitech/essay/2006-04/john-koza-has-built-invention-machine/.
[18] *Creative Computers*, *supra* note 3, at 1087.
[19] Keats, *supra* note 17.

Jeopardy!, and it successfully defeated two former *Jeopardy!* winners on the show in 2011.[20] IBM later developed new algorithms for Watson which enabled it to be put to more pragmatic uses.[21] Watson uses increased computational power in conjunction with access to huge databases in order to "generate millions of ideas out of the quintillions of possibilities, and then predicts which ones are [best], applying big data in new ways".[22] Watson has been successful in generating novel food recipes in response to user inputs such as ingredients, type of dish and style of cooking, and some of these recipes are potentially patentable.[23] IBM has also made Watson available to software developers and Watson is now being used in a variety of applications which include financial planning, developing treatment plans for cancer patients, genetic profile testing for drug delivery and even acting as a personal travel concierge.[24]

II. PATENT LAW AND ARTIFICIAL INTELLIGENCE

The use of AI systems in generating inventions raises many patent law issues. The most pressing issue is whether AI systems can be considered as 'inventors' of the inventions they generate under the current patent law regime. Another important issue is the implications of the increased use of AI systems on the current non obviousness standard for patentability. Both these issues are discussed below.

A. Inventorship

Before discussing whether AI systems can be considered as 'inventors', it is important to distinguish between 'ownership' and 'inventorship'. Patents, or any intellectual property for that matter, are essentially a bundle of rights. Owners of a patent enjoy the economic rights associated with the patent (such as the exclusive right of making, using, offering for sale or selling the invention),[25] while the inventor of a patent enjoys the moral rights associated with it.[26] Granting ownership rights to AI systems does not merit discussion at this time since AI

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[20] Jo Best, *IBM Watson: The inside story of how the Jeopardy-winning supercomputer was born, what it wants to do next*, TECHREPUBLIC (Sep. 9, 2013), https://www.techrepublic.com/essay/ibm-watson-the-inside-story-of-how-the-jeopardy-winning-supercomputer-was-born-and-what-it-wants-to-do-next/.
[21] *Creative Computers*, *supra* note 3, at 1089.
[22] *Id*.
[23] *Watson cooks up computational creativity*, IBM, https://www.ibm.com/thought-leadership/innovation_explanations/essay/florian_pinel.html [https://perma.cc/GGV7-NHT4]; Gene Quinn, *The Law of Recipes: Are Recipes Patentable?*, IP WATCHDOG (Feb. 10, 2012), https://www.ipwatchdog.com/2012/02/10/the-law-of-recipes-are-recipes-patentable/id=22223/.
[24] *Creative Computers*, *supra* note 3, at 1091.
[25] *E.g.,* The Patents Act, 1970, § 48 (India); 35 U.S.C. § 271; Convention on the Grant of European Patents art. 64, Oct. 5, 1973, 1065 U.N.T.S. 199 [hereinafter *EPC*].
[26] *E.g., EPC*, *supra* note 25, art. 62; Paris Convention for the Protection of Industrial Property art. 4*ter*, Mar. 20, 1883, 828 U.N.T.S. 305.

systems do not have the capacity to use these rights, or to license them to others. This would effectively result in the rights going unused and the general public would also be deprived of the benefits of the invention. Therefore, the following discussion will only focus on whether AI systems can qualify as 'inventors' under the current legal regime.

Procedural And Technical Barriers

The first legal barrier faced by AI systems in obtaining inventorship status lies in the procedural requirements which govern the filing of patent applications. All patent applications require one or more named inventors who must usually also be 'persons' or 'individuals.[27] Thus, AI systems must first satisfy the requirements to be considered as a 'person' before they can be considered as an inventor. The precise definition of a 'person', however, is likely to vary from jurisdiction to jurisdiction.

In India, for example, the Patents Act does not define the word 'person'. The latest edition of the Manual of Patent Office Practice and Procedure (which is a manual issued by the Indian Patent Office for practitioners) also does not define the word 'person' but only provides that it includes the Government,[28] although an earlier version redirected to the definition of 'person' present in the General Clauses Act, 1897.[29] The General Clauses Act provides a general definition of the word 'person' where it is defined broadly to include corporations, associations and bodies of individuals in addition to natural persons.[30] Courts in India have also considered animals,[31] religious idols[32] and rivers[33] as 'juristic entities' having the rights and obligations of living persons in contexts outside of intellectual property rights. However, the legal personality of these entities is deemed to be complete only when a human agent is appointed to act on their behalf.[34] Thus, AI systems could potentially qualify as persons either under this reasoning with

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[27] *E.g.,* The Patents Act, 1970, § 6 (India); U.S. PATENT & TRADEMARK OFFICE, MANUAL OF PATENT EXAMINING PROCEDURE § 602.01(b) (9th ed. Rev July 2017) [hereinafter *MPEP*].
[28] THE OFFICE OF CONTROLLER GENERAL OF PATENTS, DESIGNS AND TRADEMARKS, MANUAL OF PATENT OFFICE PRACTICE AND PROCEDURE 10 (2019), http://www.ipindia.nic.in/writereaddata/Portal/Images/pdf/Manual_for_Patent_Office_Practice_and_Procedure_.pdf.
[29] THE OFFICE OF CONTROLLER GENERAL OF PATENTS, DESIGNS AND TRADEMARKS, MANUAL OF PATENT OFFICE PRACTICE AND PROCEDURE 7 (2011), http://www.ipindia.nic.in/writereaddata/Portal/IPOGuidelinesManuals/1_28_1_manual-of-patent-office-practice_and-procedure.pdf.
[30] The General Clauses Act, 1897, § 3(42) (India).
[31] *See* Karnail Singh & Ors. v. State of Haryana, 2019 SCC OnLine P&H 704.
[32] *See* Yogendra Nath Naskar v. Commissioner of Income Tax, (1969) 1 SCC 555.
[33] *See* Mohd. Salim v. State of Uttarakhand, 2017 SCC OnLine Utt 367.
[34] *See* Shiromani Gurudwara Prabandhak Committee v. Shri Som Nath Dass, (2000) 4 SCC 146.

the owner of the AI system being the human agent acting on its behalf, or under a purposive and dynamic interpretation of the word 'person' in the General Clauses Act.

Even if AI systems satisfy the definition of 'person', they appear to suffer from a practical barrier. AI systems cannot file patent applications on their own and they will require the aid of a human assignee to actually file the patent application on their behalf and complete the application procedure. In India, for example, such an assignee would have to file a number of forms including Form 1 for the Application of Grant, Form 2 with the Complete Specification and a Statement and Undertaking with Form 3[35]. Form 1 requires a declaration of inventorship from the inventor(s) and this declaration needs to be signed by the inventor(s).[36] Other jurisdictions also have broadly similar signature requirements.[37]

These signature requirements pose a problem for AI systems as they cannot physically make these signatures themselves. The most obvious solution would be for the owner of the AI system to make the signature on its behalf, with the owner acting as the AI system's legal guardian or manager. Another possible solution could be to use digital signatures linked to the AI system or registered under the AI system's name. However, it remains to be seen whether Patent Offices accept these workarounds, given the lack of statutory or judicial guidance around this issue. These signature requirements are not mere formalities either, as some Patent Offices have deemed patent applications to be withdrawn or abandoned for want of the inventor's signature.[38]

The 'Human' Requirement

A more fundamental argument against granting inventorship status to AI systems looks to the overall purpose of intellectual property law. Proponents of this line of reasoning argue that the purpose of intellectual property law is to reward human ingenuity and creativity, and therefore intellectual property law should only protect the creations of natural persons.[39] This argument has not been examined in any depth under existing patent law jurisprudence, although patent statutes often use the word 'person' and 'individual' interchangeably[40]. However, there is some analogous jurisprudence under copyright law around the issue of non-human authorship of

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[35] *See* The Patents Act, 1970, ch. II & IV (India); The Patent Rules, 2003, ch. II & IV (India).
[36] The Patent Rules, 2003, Form 1, para. 12 (India).
[37] *E.g., MPEP*, *supra* note 27; EUROPEAN PATENT OFFICE, FORM 1002: DESIGNATION OF INVENTOR, http://documents.epo.org/projects/babylon/eponet.nsf/0/FD7E907381446E11C125737E004E0ED7/$File/epo_form_1002_12_07_editable.pdf.
[38] *See infra* pt. 3.1.4.
[39] *Creative Computers*, *supra* note 3, at 1099-1100.
[40] *E.g.,* 35 U.S.C. §§ 115-116.

copyrightable material.[41] For example, various Copyright Offices have adopted the policy of denying copyright protection to works generated by non-humans.[42]

Copyright protection for non-humans was squarely at issue in the case of *Naruto v. Slater*[43], which is popularly known as the 'Monkey Selfie' case. In that case, the U.S. Ninth Circuit Court of Appeals found that Naruto (a crested macaque) did not have statutory standing to sue under the U.S. Copyright Act. The Court based its decision on the absence of any express language in the U.S. Copyright Act which authorized animals to file for copyright infringement under the statute, and the presence of words like 'children', 'grandchildren', 'legitimate', 'widow' and 'widower', which implied humanity and thereby necessarily excluded animals.[44] The Court also cautioned against the extrapolation of statutory rights to animals (and by extension other non-humans) unless the statute in question explicitly conferred those rights on them.[45]

Conception and Inventorship

An analysis of case law shows that courts have traditionally defined an inventor as someone who has 'conceived' an invention.[46] Conception, in this context, has been defined as "the formation in the mind of the inventor of a definite and permanent idea of the complete and operative invention as it is thereafter to be applied in practice."[47] Furthermore, in order to conceive an invention, it is necessary for there to be a complete performance of the mental part of the inventive act.[48] This concept was first recognized and applied in India in the case of *VB Mohammed Ibrahim v. Alfred Schafranek*[49] where the High Court of Mysore held that firms and other corporations could not be considered as 'inventors' since they were incapable of 'conceiving' an invention.

Modern AI systems have proven themselves to be capable of conceiving an invention in the technical sense[50], although it is of course impossible for them to perform any sort of mental act. However, most jurisdictions have moved away from the 'mental act' requirement for

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[41] *See* MELVILLE B. NIMMER & DAVID NIMMER, NIMMER ON COPYRIGHT § 5.01[A] (2015).
[42] *E.g.,* U.S. COPYRIGHT OFFICE, COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES § 313.2 (3d ed. 2014) [hereinafter *CCOP*].
[43] Naruto v. Slater, 888 F.3d 418 (9th Cir. 2018).
[44] *Id.* at 426.
[45] *Id.*
[46] *See, e.g.,* Townsend v. Smith, 36 F.2d 292, 295 (C.C.P.A. 1929).
[47] *MPEP*, *supra* note 25, § 2138.04.
[48] *Townsend*, 36 F.2d at 295.
[49] VB Mohammed Ibrahim v. Alfred Schafranek, 1960 A.I.R. 173 (Mys.) 175.
[50] *See* discussion *supra* Part 1.

inventorship.[51] The best example of this is the United States, where the 'flash of genius' doctrine[52] (which accepted inventions conceived through a "flash of creative genius" rather than through toil and experimentation) was replaced by the current non-obviousness requirement present in 35 U.S.C. § 103 which disregards the "manner in which an invention is conceived." AI systems could potentially satisfy this understanding of the conception requirement, although some scholars have argued that these statutory changes were only intended to address the process of inventing undertaken by human inventors.[53]

Another approach that is used to determine whether a person qualifies as an 'inventor' is to ascertain whether that person has made sufficient contribution towards the conception of an invention.[54] This approach is especially pertinent in cases of joint inventorship, and it also assumes importance in the context of inventions where there is both AI and human involvement. For such inventions it is necessary to ascertain the level of contribution towards the conception of the invention by both entities (i.e., the human agent and the AI system) in order to determine who should get the inventorship status. There are broadly three factual situations that can arise in this context.

The first situation is where the AI system is used as a mere tool (like a calculator) while the invention is conceived and implemented by the human agent. In this case the human agent should get sole inventorship. The second situation is where the human agent uses the AI system to analyze data (which has been curated by the human agent) and output the invention. In this case both the AI system and the human agent should get joint inventorship. The third situation is where the AI system generates an invention from data supplied to it by the human agent, but the invention could not have been anticipated at the time of supplying the data. In this case the AI system should get sole inventorship as the human agent had no part to play in the conception of the invention.[55] AI systems like the Invention Machine and the Creativity Machine have demonstrated that they are capable of conceiving and implementing inventions with little to no human involvement[56], and they should therefore be eligible for inventorship rights over those inventions.

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[51] Ryan Abbott, *Everything is Obvious*, 66 U.C.L.A. L. REV. 2, 13-15 (2018) [hereinafter *Everything is Obvious*].
[52] Cuno Engineering Corp. v. Automatic Devices Corp., 314 U.S. 84, 91 (1941).
[53] *E.g.,* Hattenbach & Glucoft, *supra* note 4, at 45-46.
[54] *MPEP*, *supra* note 27, § 2137.01 (II).
[55] *See Ex parte* Smernoff, 215 U.S.P.Q. 545, 547 (Bd. App. 1982); *See generally* Shyamkrishna Balganesh, *Foreseeability and Copyright Incentives*, 122 HARV. L. REV. 1569 (2009).
[56] *See* discussion *supra* Part 1.

A potential barrier faced by AI systems in obtaining inventorship rights under the 'contributive conception' analysis discussed above lies in the decision rendered by the U.S. Supreme Court in the case of *Burrow-Giles Lithographic Co. v. Sarony*[57]. In that case the Court had to deal with the issue of whether a photograph of Oscar Wilde qualified as the 'work' of an author. It was argued that it did not qualify as a Copyrightable 'work' since a photograph was essentially a mechanical reproduction of a natural phenomenon. The Court disagreed with that characterization and held that the photographer had exercised sufficient control over the subject of the photograph to qualify it as an expression of his idea, and that the mere use of a tool such as a camera would not negate human authorship over the photograph.[58] This case later formed the foundation of the 'human authorship' requirement endorsed by the U.S. Copyright Office under which non-humans were denied copyright protection.[59] However, it would be inappropriate to import the holding of this case into patent law given that modern AI systems are capable of generating patentable inventions autonomously with almost no human control or supervision. In that sense, these AI systems are very different from a camera and it would be unfair and inappropriate to grant the human agent inventorship rights over their inventions or to deny their inventions patent protection altogether.

Recent Developments

Until recently, it was a practice among patent applicants to avoid the disclosure of AI involvement in their patent applications and to list the creator or owner of the AI system as the inventor.[60] This was largely due to the legal uncertainties involved in the recognition of AI systems as 'inventors'. However, this is not an optimal solution as it is inefficient and unfair to reward the creator or owner of an AI system when they had minimal involvement in the inventive process.[61] Allowing human agents to claim inventorship over inventions generated by AI systems is also unfair to human inventors who came up with their inventions on their own instead of depending on an AI system. Moreover, granting inventorship status to AI systems is likely to encourage innovation as computer scientists will be incentivized to develop better and more creative AI systems.[62]

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[57] Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53 (1884).
[58] *Id.* at 56.
[59] *CCOP*, *supra* note 42, § 306.
[60] *See Creative Computers*, *supra* note 3, at 1083 & 1088.
[61] Ryan B. Abbott, *Patenting the Output of Autonomously Inventive Machines*, AMERICAN BAR ASSOCIATION (2017), https://www.americanbar.org/groups/intellectual_property_law/publications/landslide/2017-18/september-october/patenting-output-autonomously-inventive-machines/.
[62] *Id.*

The legal uncertainty surrounding the eligibility of AI systems to be considered as inventors spurred Ryan B. Abbott, a law professor at the University of Surrey, and a group of patent attorneys across the word to create the Artificial Inventor Project.[63] In 2018, the Project filed patent applications for two inventions with an AI system called DABUS listed as the inventor before the European Patent Office and the national Patent Offices of the UK, USA, Germany, Israel and a few other countries.[64] As of the date of writing this essay, the European Patent Organization and the national Patent Offices of the UK and the USA have denied DABUS's applications, although all three decisions are currently under appeal.[65] These decisions are discussed below.

The UK Intellectual Property Office ("UKIPO") decision, while acknowledging that the office had earlier pre-emptively refused patent applications with AI systems as inventors in accordance with the practice endorsed in its formalities manual,[66] emphasized that the application had been considered on its merits.[67] The UKIPO had found against DABUS on two grounds: *firstly,* that DABUS was ineligible to be considered as an inventor because it was not a natural person, and *secondly,* that DABUS could not have transferred ownership rights to the patent applicant since DABUS itself could not hold any property under the existing law.[68] However, the UKIPO clarified that it was not rejecting the application merely because an AI system was listed as the inventor, but it was instead treating the application as withdrawn due to non-fulfilment of formal requirements.[69] The UKIPO's decision was subsequently affirmed by the UK High Court.[70]

The European Patent Office ("EPO") grounded its decision to dismiss DABUS's application on the fact that DABUS was not a natural person and that it lacked legal capacity to hold any rights, let alone transfer them to the patent applicants through assignment.[71] The EPO looked

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[63] Ryan Abbott, *The Artificial Inventor Project*, WIPO MAGAZINE (Dec. 2019), https://www.wipo.int/wipo_magazine/en/2019/06/essay_0002.html.
[64] THE ARTIFICIAL INVENTOR PROJECT, http://artificialinventor.com/patent-applications/, (last visited Aug. 10, 2021).
[65] *Id*.
[66] U.K. INTELLECTUAL PROPERTY OFFICE, FORMALITIES MANUAL (ONLINE VERSION) § 3.05 (2017), https://www.gov.uk/guidance/formalities-manual-online-version/chapter-3-the-inventor.
[67] *Re* Stephen Thaler, No. BL O/741/19 (U.K.I.P.O., Dec. 4, 2019), at para. 18-20, https://www.ipo.gov.uk/p-challenge-decision-results/o74119.pdf.
[68] *Id.* at 21-23.
[69] *Id.* at 26.
[70] Thaler v. The Comptroller-General of Patents, Designs and Trademarks, [2020] EWHC 2412 (Pat.).
[71] Grounds for the EPO decision of 27 January 2020 on EP 18 275 163, para. 19-21 & 27, https://register.epo.org/application?documentId=E4B63SD62191498&number=EP18275163&lng=en&npl=false.

to the legislative history of the European Patent Convention to hold that inventors needed to be natural persons.[72] The EPO also held that since AI systems could not hold moral rights there was no duty to list them as the inventor.[73] The U.S. Patent and Trademark Office applied strict statutory construction and looked to Federal Circuit precedent to categorically hold that only natural persons could be inventors under U.S. patent law.[74]

The Way Forward

A commonality that runs through all the three Patent Office decisions discussed above is that while they deny inventorship status to AI systems, they do not provide any alternative way for the inventions of such AI systems to gain patent protection. It is also interesting to note that while the Patent Offices deemed the patent applications to be withdrawn or abandoned due to the non-designation of a human inventor, they did not find the inventions themselves to be non-patentable on any substantive grounds. It is submitted that dismissing the patent applications of otherwise patentable inventions because of the non-designation of a human inventor is inefficient and illogical. Disallowing such applications would force applicants to either list a natural person as the inventor to avoid risking forced abandonment or protect their inventions through means other than obtaining a patent. While the former route would dilute the integrity of the inventorship status, the latter would discourage innovation by removing the incentive for owners of AI systems to continue inventing and disclosing such inventions to the public.[75]

Some scholars have argued that the current patent system may be irrelevant for AI generated inventions as there are other systems and models that are more conducive for promoting and protecting such inventions.[76] Others have argued that patent protection is not the primary motivation behind innovation in certain settings (such as universities),[77] and therefore it cannot be automatically assumed that a lack of protection for AI generated inventions will lead to the death of innovation in that field.[78] However, it is uncertain whether such alternative models

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[72] *Id.* at 23-24.
[73] *Id.* at 39.
[74] Decision on Petition filed by DABUS c/o Stephen Thaler *re* Patent App'n No. 16/524, 350 (U.S.P.T.O. Apr. 27, 2020), https://www.uspto.gov/sites/default/files/documents/16524350_22apr2020_3.pdf.
[75] *Creative Computers*, *supra* note 3.
[76] *E.g.,* Dr. Shlomit Y. Ravid & Xiaoqiong (Jackie) Liu, *When Artificial Intelligence Systems Produce Inventions: An Alternative Model for Patent Law at the 3A Era*, 39 CARDOZO L. REV. 2215 (2018).
[77] *See* WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 312-13 (2003).
[78] Ravid & Liu, *supra* note 76, at 2239.

will adequately perform or substitute the public disclosure function of the existing patent system.

At the same time, it is also not wise to ignore the possible negative implications of granting inventorship status to AI systems. Granting patent protection to AI generated inventions, some argue, can aid the establishment of technological monopolies, patent thicketing and the creation of barriers to entry into the field.[79] This can destroy the delicate balance between granting exclusivity to the inventor and maintaining innovation in the industry.[80] This apprehension is especially concerning due to the pace at which AI systems can generate inventions. The pace of innovation has already increased to such an extent that technologies tend to become obsolete even before the patent expires in some industries, and it is only expected to increase with the use of AI systems to generate inventions. The software industry, for example, has already been forced to use intellectual property in unconventional ways in the form of Open-Source Licenses.

For the patent system to hold continued relevance, it must adapt to technological changes in a manner that successfully achieves the primary goal of a patent system, i.e., the promotion of innovation. In the context of AI generated inventions this might entail recalibrating the incentive structure to ensure that further innovation is not stifled by abuse. One way this recalibration can be achieved is by shortening the 20 year patent monopoly period to ensure that the reward is at par with the labour.[81] Patent Offices can also introduce 'method of invention' as a requirement in patent applications in order to obtain empirical information about AI inventors and to efficiently measure patent effectiveness and industry trends.[82] This requirement will also help Patent Offices to identify the relative contributions of human agents and AI systems towards an invention and to attribute inventorship accordingly.

B. Non-Obviousness

The use of AI systems in generating inventions also raises issues of 'obviousness'.[83] Most patent regimes require an invention to be non-obvious to a person having ordinary skill in the

[79] *See generally* Lisa Larrimore Ouellette, *Access to Bio-Knowledge: From Gene Patents to Biomedical Materials,* 2010 STAN. TECH. L. REV. N1, https://law.stanford.edu/wp-content/uploads/sites/default/files/publication/662898/doc/slspublic/ouellette-access-to-bio-knowledge.pdf.
[80] *Fraser*, *supra* note 12, at 330.
[81] *Fraser*, *supra* note 12, at 332-333.
[82] *Id.*
[83] *E.g.*, Ravid & Liu, *supra* note 76, 2247-2248 (2018).

art (PHOSITA) in order to be patentable.[84] This standard is sometimes also expressed in the form of a requirement that an invention must involve an 'inventive step' over the existing prior art in order to be patentable.[85] Essentially, a patent cannot be granted if a PHOSITA would find the difference between the subject matter of the patent and the existing prior art, obvious.

The non-obviousness inquiry requires the decision maker (a patent examiner or a judge) to put themselves in the shoes of the average worker having the ordinary level of skill in the field of the claimed invention, and then determine whether the claimed invention would have been obvious to such a person.[86] Determining the level of ordinary skill is thus crucial for the purposes of the non-obviousness inquiry.[87] Advanced AI systems with increased processing power, widened access to searchable information and improved tools for efficiently analysing such information are likely to be more skilled than the average human worker in a particular field.[88] To put it another way, what is not obvious to the average human worker may be very obvious to the average AI system, and the non-obviousness hurdle must be set accordingly.

The first step towards doing that is to gather information about the prevalence and use of AI systems in a particular field. One way to gather this information is for the Patent Office to conduct periodical surveys to determine the extent to which AI systems are being used in the inventive process. However, this method is likely to be expensive and cumbersome.[89] A better method would be for the Patent Office to create a special disclosure requirement in patent applications.[90] The Patent Office can require patent applicants to disclose the use or involvement of AI systems in the inventive process in a manner similar to the current inventorship disclosure requirements for human inventors.[91] Patent applicants can be incentivized to be truthful in their disclosures by allowing for patents to be invalidated if patent applicants conceal the involvement of AI systems in their applications. The Patent Office can then aggregate these disclosures and determine whether the use of AI systems in a particular field is widespread enough to be considered as standard in that field.

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[84] *E.g.*, 35 U.S.C. § 103 (2018).
[85] *E.g.*, The Patents Act, No. 39 of 1970, § 2(1)(ja) (India); *EPC*, *supra* note 25, art. 52(1) & 56; Agreement on Trade-Related Aspects of Intellectual Property Rights art. 27, Apr. 15, 1994, 33 I.L.M. 1197, 1208.
[86] *Everything is Obvious*, *supra* note 51, at 17-18.
[87] *Id*.
[88] Ravid & Liu, *supra* note 76, at 2248.
[89] *Everything is Obvious*, *supra* note 51, at 34-35.
[90] *Id*.
[91] *E.g.*, 37 C.F.R. § 1.56 (2018).

Once the Patent Office makes such a determination, it should then proceed to examine the precise nature of the AI system(s) involved. The AI systems can be broadly divided into two groups in this step: AI systems which require non-trivial human input or involvement during the inventive process, and AI systems which operate almost autonomously with little to no human involvement.[92] The level of human involvement should be determined as a question of fact on a system-by-system basis. The PHOSITA standard for the first group of AI systems should incorporate the fact that the average skilled worker is now augmented by the use of AI systems, while the PHOSITA standard for the second group should substitute the average human worker with the average AI system. The PHOSITA standard for the field as a whole should depend on what type of AI system is more prevalent.

Of course, substituting, or even augmenting the traditional PHOSITA standard with AI systems comes with its own problems. The biggest problem lies in characterizing the average AI system in a particular field, given that it is possible, and even likely, that a variety of AI systems with different levels of creativity, skill or sophistication are in use simultaneously at any given point in time.[93] One possible solution could be to characterize the standard AI system as a hypothetical entity which is based on the general capabilities of the AI systems in use in a particular field (like the fictional human PHOSITA).[94] A better alternative, however, would be to characterize the average AI system in terms of one or more specific AI system(s) that are actually being used in a particular field.[95] The most obvious candidate for this is the AI system which is the most widely used; however, a combination of two or more different systems could also be used to make the standard more balanced.

Another problem with substituting the average AI system for the human PHOSITA is that human decision makers would have to judge, in hindsight, what a machine would have found obvious. Although this problem is present in the traditional PHOSITA analysis as well,[96] the use of AI systems is likely to present even greater difficulties. One possible way to circumvent this problem is to focus on reproducibility rather than obviousness. In other words, the decision maker would focus on whether the average AI system would be able to reproduce the claimed invention in a reasonable period of time rather than whether it would find the claimed invention

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[92] *Everything is Obvious*, *supra* note 51, at 27-30.
[93] *See* KAY FIRTH-BUTTERFIELD ET AL., *supra* note 2, at 12.
[94] *Everything is Obvious*, *supra* note 51, at 40.
[95] *Id.*
[96] *See generally* Gregory N. Mandel, *Patently Non-Obvious: Empirical Demonstration that the Hindsight Bias Renders Patent Decisions Irrational*, 67 OHIO ST. L. J. 1391 (2006).

obvious. The reproducibility test could also be coupled with other objective factors such as long-felt but unsolved needs, the failures of others and real-world evidence of an invention's reception in the market – in order to alleviate some of the problems with applying a 'cognitive' non-obviousness standard to AI systems.[97]

CONCLUSION

There is an imminent need for a sound and comprehensive policy to promote innovation while minimizing the negative impacts of adopting AI in the inventive process. Such a policy must clearly lay down factors for attributing inventorship and ownership among other considerations that may affect the pace of innovation. The discussion so far either tries to forcefully fit AI systems into the existing patent regime through dynamic interpretations of statutes, or excludes them from the purview of patent regimes through originalist interpretations. The policy discussions must instead focus on what our goals are for these new technologies, what we want our world to look like, and how the law can make it so.[98]

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[97] *E.g.*, Daralyn J. Durie & Mark A. Lemley, *A Realistic Approach to the Obviousness of Inventions*, 50 WM. & MARY L. REV. 989, 1004-1007 (2008).
[98] *Everything is Obvious*, *supra* note 51, at 52.