



Inventions and Works of Authorship by Nonhumans

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Could the Creations of AI Be Entitled to IP Protection?

The development of artificially intelligent machines, or more generally artificial intelligence (AI), is poised to radically change myriad aspects of our daily lives. Not least, it has and will continue to drive time and personnel

efficiencies in finance, communications, transportation, and commerce, among other things. Countries around the world are racing to invest in the development of AI-based technologies so as to secure their continued economic growth. Public and private investments in research and development of AI-based technologies have surged in Canada and the United States. A recent Reuters article pegged the U.S. investment in AI at almost \$22 billion (USD) in 2016, while Canada reportedly funded over \$1 billion (USD) in AI research and development in 2016–2017.

As a result, the development and implementation of AI-based technologies are advancing rapidly, playing ever more prominent roles in the fields of science, engineering, and the arts. As they become essential tools in these fields, it is inevitable that the nature and role of these technologies in the

inventive and creative processes will also increase. But have we reached a stage in the evolution of AI-based technologies where the “machines” could independently create original or patentable material? The answer appears to be yes. In April 2016, “The Next Rembrandt” project unveiled a painting created by an AI algorithm that mimics the subject matter and style of the famous artist almost indistinguishably. The algorithm analyzed the features of hundreds of Rembrandt’s works, including the demographics, head positions, and lighting of the human subjects portrayed, and the resulting painting was 3D-printed to mimic the artist’s brushstrokes. There also appears to have been examples of U.S. patents issued in respect of inventions created, at least to some extent, by early AI.

How will current intellectual property (IP) regimes recognize the fruits of these



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inventive and creative processes? Should they be entitled to the same protection as inventions and works of authorship of human origin?

This article discusses the legal frameworks governing the protection of inventions and creative works in Canada and the United States, and explores whether inventions and works created by nonhumans could be protected. We conclude that such inventions and works are not expressly denied protection by the IP laws of either country; however, certain barriers to recognizing protection would have to be overcome through judicial interpretation or legislative change to embrace the creations of nonhumans, particularly with respect to nonhumans' legal status as "individuals" or "persons" and their capacity to own and transfer property.

United States Patents

In December 1998, the United States Patent and Trademark Office ("USPTO") issued a patent entitled "Neural Network Based Prototyping System and Method" (U.S. Patent No. 5,852,815) to Stephen Thaler, a computer scientist who developed an early example of AI called the "creativity machine," based on a self-stimulating artificial neural network. According to Thaler, the creativity machine invented the subject matter of this patent. Another example comes from software that uses "genetic programming," which computationally simulates the natural processes of biological evolution. Genetic programming is the core technology in John Koza's "invention machine," to which he has attributed the invention behind at least one U.S. patent, which issued in 2005 (U.S. Patent No. 6,847,851). In both of these cases, the role of computers in the creation of the inventions appears not to have been disclosed to the USPTO during prosecution of the applications.

A more recent example is IBM's "Watson" AI system, which is touted as being capable of "computational creativity" in generating and evaluating ideas by processing vast amounts of data. While it does not appear that any of Watson's "outputs" have been patented, it is possible that at least some of them could represent new, useful, and nonobvious AI-generated inventions.

Under the U.S. patent law, an "inventor" is defined as the individual who invented or discovered the subject matter of the invention. 35 U.S.C. §100. However, the U.S. Patent Act fails to define "individual." Indeed, until the development of AI-based technologies, there did not appear to be a need to do so. The USPTO's *Manual of Patent Examining Procedure* adds that an inventor is the individual who conceives the invention and reduces it to practice. Thus, a nonhuman entity must overcome two thresholds to be granted a U.S. patent: (1) the ability to perform the mental act of conception and reduction to practice, and (2) such an entity must be an "individual" (e.g., a person).

The hallmark of conception in the United States is the "formation in the mind of the inventor, of a definite and permanent idea of the complete and operative invention, as it is hereafter to be applied in practice." *Hybritech Inc. v. Monoclonal Antibodies Inc.*, 802 F.2d 1367, 1376 (Fed. Cir. 1986). The inventor must form a definite and permanent idea of the complete and operable invention to establish conception, *Bosies v. Benedict*, 27 F.3d 539, 543 (Fed. Cir. 1994), and the mental act of conception in the United States can only be performed by natural persons. *Univ. of Utah v. Max-Planck-Gesellschaft zur Forderung der Wissenschaften E.V.*, 734 F.3d 1315, 1323 (Fed. Cir. 2013). Notably, however, 35 U.S.C. §103 provides that "[p]atentability shall not be negated by the manner in which the invention was made," suggesting that the product of the inventor's "mind" takes precedence over the nature of the mental process itself. Whether the requirement for conception is fatal to a nonhuman inventor might depend on how much emphasis is placed on the location of the act (i.e., the mind), relative to the result (i.e., the definite and permanent idea); if the latter, the conception threshold may be overcome by a computer that can identify and describe an invention in sufficiently certain terms.

The uncertainty surrounding whether a nonhuman is capable of conception may encourage humans to minimize (or hide) any computer's role in the inventive process when applying for a patent, for fear that they will be denied a patent on their computer's invention. Indeed, it is intriguing

to consider whether the patents attributed to Thaler's creativity machine and Koza's invention machine would have issued had the extent of the computers' involvement in the inventive processes been known to the USPTO at the time.

One solution to this problem might be found within the notion of conception itself. Conception necessarily includes rec-

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ognition or appreciation of the invention, meaning that "an accidental and unappreciated duplication of an invention does not defeat the patent right of one who, though later in time, was the first to recognize that which constitutes the inventive subject matter." *Silvestri v. Grant*, 496 F.2d 593, 597 (C.C.P.A. 1974). In other words, given the uncertainty on whether AI would be capable of conception, there is nothing to prevent a human from appreciating and recognizing the invention embodied in a computer's output and applying for a patent on that basis.

Indeed, there is no concern with the use of AI as tools, and concomitant with the advancement of AI technology has been the increasing role of AI in the inventive process. It is interesting to consider at what point a computer crosses the line from mere tool to inventor. Further complicating matters for patent examiners is the difficulty of independently determining whether an invention is the product of human inventiveness with computer assistance or is purely computer-generated.

On the assumption that AI systems are capable of conceiving of an invention and



reducing it to practice, the critical question becomes whether a computer can be considered an “individual” so as to fall within the definition of “inventor” in 35 U.S.C. §100. The term “individual” is not defined in the statute; however, 1 U.S.C. §8 provides that “[i]n determining the meaning of any Act of Congress... the [word]... ‘individual’, [sic] shall include

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every infant member of the species homo sapiens.” Moreover, the Federal Circuit has opined that only natural persons can be “inventors.” *Beech Aircraft Corp. v. EDO Corp.*, 990 F.2d 1237, 1248 (Fed. Cir. 1993). Thus, while the word “individual” appears to expressly include only natural persons, the extent to which it may also include computers is unresolved and is sure to be the subject of future discussions as AI systems develop.

Even if an AI-generated invention were granted U.S. patent protection, who would own it? The United States patent law provides that the original applicant is presumed to be the owner of the issued patent, and the definition of “applicant” in 37 C.F.R. §1.42 refers to the inventor. As discussed above, an “inventor” must be an individual under U.S. patent law. As a result, it is unclear whether an AI applicant would be eligible to own a U.S. patent. It is possible that a human assignee of the invention would be recognized as the applicant and would own the resulting patent, but this presupposes that a computer has the legal capacity to assign property rights. Similarly, the feasibility of joint ownership is uncertain because a “joint inventor” must also be an individual per 35 U.S.C. §100.

Canadian Patents

Unlike the law in the United States, the Canadian Patent Act does not, on its face,

restrict who can be an inventor. The Canadian Patent Act provides that a patent will be granted merely to “the inventor,” without defining this term. As such, Canadian courts have formulated tests for defining an “inventor” in the context of patent litigation. The leading case on the matter is the Supreme Court of Canada’s decision in *Apotex Inc. v. Wellcome Foundation Ltd.*, 2002 SCC 77 (This decision is referred to by the name of the drug at issue, AZT). In that case, generic drug manufacturers were challenging the validity of a pharmaceutical patent on the basis, among other things, that the patent description was misleading because it failed to name certain parties who were alleged to be co-inventors. The Supreme Court of Canada inferred from the definition of “invention” in the Patent Act that “the inventor is the person or persons who conceived of the ‘new and useful’ art, process, machine, manufacture or composition of matter, or any ‘new and useful’ improvement thereto. The ultimate question must therefore be: who is responsible for the inventive concept?” Thus, an inventor in Canada must be a “person” (*i.e.*, an individual), and as in the United States, the key contribution of an inventor that opens the door to patent protection is the ability to invent.

In AZT, the Supreme Court of Canada rooted its definition of “inventor” in the Patent Act, which requires that a patent describe the invention such that a person skilled in the relevant art is enabled to use it. While phrased slightly differently than the United States, the act of invention requires conception and reduction to a definite and practical shape, as explained in the leading Canadian case *Christiani v. Rice*, [1930] S.C.R. 443: “[I]t is not enough for a man to say that an idea floated through his brain; he must at least have reduced it to a definite and practical shape.”

While the definition of “inventor” developed by Canadian courts was clearly in contemplation of human inventors, the extent to which a court could apply it to embrace nonhuman entities is unclear. While Canadian patent law does not impose an individuality restriction, unlike U.S. patent law, it may not be more “computer friendly” than the U.S. law because it still requires conception and reduction to a definite and practical shape.

Canadian courts have considered the distinction between conception and verification as it relates to identifying inventors under Canadian law. In AZT, the co-inventor issue turned on whether certain scientists were conceivers or mere verifiers of the inventive concept claimed in the patent; if the latter, the Supreme Court of Canada reasoned that they were not co-inventors: “[I]n the steps leading from conception to patentability, the inventor(s) may utilize the services of others, who may be highly skilled, but those others will not be co-inventors unless they participated in the conception as opposed to its verification.” This approach finds support in principles enunciated in other Canadian decisions. See *May & Baker Ltd. v. Ciba Ltd.* (1948), 65 R.P.C. 255 (Ch. D.) (holding that the requisite “useful qualities” of an invention “must be the inventor’s own discovery as opposed to mere verification by him of previous predictions”).

The scientists at issue in the AZT case had developed a human cell line that could be used to conduct in vitro tests of drug compounds, and they engaged in testing a wide range of candidate molecules. Even though the scientists conducted a blind test of the compound claimed in the patent, the Supreme Court of Canada rejected the contention that the scientists were bona fide co-inventors: “[T]he patentees of an invention for testing do not, by virtue of executing tests using that invention, become co-inventors of every sound idea that is so tested.” Therefore, it is clear that the AI used to calculate or analyze data in support of the inventive process is not a co-inventor, but a tool under Canadian law. This principle does not necessarily rule out AI inventors, however, if the AI’s contribution extends to conception of the invention and its reduction to a definite and practical shape, which may raise the AI to the level of an inventor. Canadian courts have yet to explicitly consider whether an invention generated by a nonhuman is patentable, so it will be interesting to see how classical interpretations of patent law will be applied to nonhuman inventors.

Despite the lack of a statutory restriction on nonhuman inventors, the restrictions on inventor identity and the inventive process stated in the Patent Act, as inter-

preted by Canadian courts, make it unclear whether an invention derived from AI-based technologies would be granted patent protection. If such an invention were to be granted patent protection, Canadian patent law would confer ownership of the patent on the inventor or his or her assignee. It is unclear, however, whether or how AI technology would be recognized as having the legal capacity to own or assign property. Thus, the issue of ownership of patents for computer-generated inventions in Canada remains unresolved.

Copyright in the United States

Copyright law in the United States provides that copyright in a protected work vests in the “author,” without defining this term. 17 U.S.C. §201. On its face, then, and unlike U.S. patent law, there is no requirement that an author be an individual. However, the Compendium of U.S. Copyright Office Practices (the “Compendium”) states unequivocally that the U.S. Copyright Office (1) “will register an original work of authorship, provided that the work was created by a human being,” §306; (2) “will not register works produced by nature, animals, or plants,” §313.2; and (3) “will not register works produced by a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author.” §313.2. The Compendium elaborates on these rules with reference to case law principles, which echo the mental act of conception required to patent an invention. See *Trade-Mark Cases*, 100 U.S. 82, 94 (1879) (holding that the copyright law only protects “the fruits of intellectual labor” that “are founded in the creative powers of the mind.”); see also *Burrow-Giles Lithographic Co. v. Sarony*, 111 U.S. 53, 58 (1884) (Because copyright law is limited to “original intellectual conceptions of the author,” the U.S. Patent and Trademark Office will refuse to register a claim if it determines that a human being did not create the work.)

The Compendium was published with an updated human authorship requirement in 2014, in response to the so-called “monkey selfie.” David Slater, a British photographer, asserted copyright in self-photographs of a monkey taken with his camera. The animal rights organization

PETA launched a copyright infringement action against David Slater on behalf of the monkey in September 2015. The lawsuit was dismissed by the district court in January 2016, on the basis that the monkey was not an “author” under U.S. copyright law, and any argument to the contrary ought to be made to Congress and the president. PETA appealed to the U.S. Court of Appeals for the Ninth Circuit, which filed its decision on April 23, 2018. The Ninth Circuit affirmed the district court’s dismissal of the lawsuit and held that the monkey lacked statutory standing to sue under the Copyright Act.

Taken together, the explicit restrictions on nonhuman authors imposed by the Compendium and the monkey selfie decision make it unlikely that works of authorship by nonhumans would be eligible for copyright protection in the United States. As is the case with patents, however, there appears to be little to stop a human from claiming authorship of a work that was created by a nonhuman, particularly when such a work lacks the hallmarks of nonhuman origin (e.g., unlike the monkey selfie).

Despite the fact that U.S. copyright law does not embrace nonhuman authors, it appears that a computer-generated work of authorship could be eligible for copyright protection as a work made for hire. In this regard, 17 U.S.C. §201 provides that “the employer or other person for whom the work was prepared is considered the author.” Such an arrangement would appear to only be available, however, if the exception to copyright protection for machine-generated works in the Compendium is overcome by “creative input or intervention” from a human. The extent of human intervention in an AI system that would be required to meet this threshold is uncertain.

Copyright in Canada

Limitations on the identity of authors under Canadian copyright law are similarly restrictive of nonhumans, but they are stated in less explicit terms. The Copyright Act provides:

[C]opyright shall subsist in Canada... in every original... work if... the author was, at the date of the making of the work, a citizen or subject of, or a person ordinarily resident in, a [a Berne Con-

vention country, a Universal Copyright Convention country or a World Trade Organization member].

Computers are not citizens, subjects, or persons, so any works attributable to nonhuman entities would be unlikely to secure copyright protection in Canada, subject to any future grant of such status to computers.

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If a computer-generated work were granted copyright protection, who would own it? The Copyright Act confers ownership of copyright on the author. As noted previously, it is unclear whether a computer has the legal capacity to own property. Alternatively, similar to U.S. law, Canadian copyright law confers ownership of works made in the course of employment to the employer. Importantly, however, this concept is narrower in Canada because, unlike the U.S. concept of works made for hire, it only applies in an employment context. Given that computers currently lack the legal capacity to enter contracts, it is unclear whether a computer could be considered an employee. As a result, the ownership of copyright in computer-generated works remains uncertain under Canadian law.

Interestingly, neither U.S. nor Canadian copyright statutes define “authors” as individuals or persons, unlike inventors. Rather, they restrict protection for works

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of authorship to humans, implicitly accepting that a work of authorship might be by a nonhuman author.

Conclusion

As AI-based technologies become more ubiquitous as well as gain in capability, it is likely that they will play an ever greater role in the development of IP. Once we have reached the point where AI-based technologies can meet the requirements of conception and reduction to practice (although some would argue that they already have), it is unclear how current IP legal frameworks in the United States and Canada will deal with and adapt to the reality of inventions and works of authorship created by nonhumans. Applied conservatively, the law in both countries appears to argue against patent and copyright protection for inventions and works of authorship created by nonhumans. Current laws also create some uncertainty with respect to the extent to which computers can be involved in the inventive process as tools without usurping a human's inventor status. However, there are already toeholds in the laws of both countries upon which arguments could be crafted in favor of the expansion of the scope of IP protection to embrace non-human creations.

Even if computer-generated inventions and works of authorship were granted protection, it is unclear how ownership of the IP rights subsisting in such patents and copyrights would be resolved, given that computers currently lack the legal capacity to own property. Consider that another type of nonhuman entity, namely the corporation, already enjoys legal personality, so the eventual grant of similar rights to computers would not be without precedent.

Inventors and authors would be well-advised to seek guidance on how to best leverage technological advancement to improve the efficiency and efficacy of their creative processes, while navigating the law's restrictions on inventions and works of authorship by nonhumans so as to maintain their IP entitlements. IP attorneys should keep abreast of new developments in the law so that they can provide such guidance to their clients. 