November 8, 2019

Via Electronic Mail
AIPartnership@uspto.gov

Attention: The Honorable Andrei Iancu
                   Under Secretary of Commerce for Intellectual Property
                   Director of the United States Patent and Trademark Office

IBM Corporation Comments in Response to "Request for Comments on Patenting Artificial Intelligence Inventions", 84 Fed. Reg. 44889 (August 27, 2019).

IBM thanks the United States Patent and Trademark Office ("Office") for the opportunity to provide comments on patent-related issues regarding artificial intelligence ("AI") inventions.

IBM is committed to ensuring that our patent system continues to be robust and motivates innovation. These are features which have been and continue to be critical to the strength of the United States ("U.S.") economy. As one of the world's leading innovators (IBM invests more than $5 billion per year in research and development[1]) with a history of advocating for improvements in the quality of patents, we believe IBM is well positioned to understand the important role of the patent system in the U.S. and how to promote a balanced patent system that will benefit patentees, implementers, and the public.

IBM has a keen interest in the developing patent policy around AI. In 2018, not only did IBM have the largest number of U.S. patent grants, but it also led in the number of patents granted covering AI inventions[2]. Among IBM's noteworthy inventions in the area of AI are Watson[3], IBM's suite of enterprise-ready AI services, applications and tooling, and Project Debater[4], a first-of-a-kind AI system that can debate humans on complex topics.

AI will be a key driver in the Fourth Industrial Revolution.[5] PricewaterhouseCoopers projects that AI will add $15.7 trillion to the global economy by 2030 and will boost the U.S. gross domestic product by 14.5%.[6] Emerging AI technologies promise to transform the global economy and will have significant implications for America's position as a global innovation leader. The AI intellectual property ("IP") policies adopted by this country and the policies adopted by other countries will shape

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[1] IBM 2018 Annual Report, at 122.
[2] 2018 patent data sourced from IFI CLAIMS Patent Services: http://www.ificlaims.com (last visited Nov 6, 2019).
[3] IBM, *Enterprise Ready AI*, https://www.ibm.com/watson/about (last visited Nov 6, 2019).
[4] Arvind Krishna, *AI Learns the Art of Debate*, IBM News Room, (June 18, 2018), https://newsroom.ibm.com/IBM-research?item=30543.
[5] Klaus Schwab, *The Fourth Industrial Revolution: What it Means How to Respond,* WORLD ECON. FORUM (Jan. 14, 2016), available at https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/.
[6] PricewaterhouseCoopers, *Global Artificial Intelligence Study: Exploiting the AI Revolution 4* (2017), https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html.

whether AI development in products in the U.S. will be comparatively advantaged or disadvantaged. Like many other companies, IBM is dedicated to innovating in the field of AI and we rely in large part upon the patent system to protect our inventions and help incentivize future innovation. It is imperative that the U.S. patent system has the right incentive system in place.

Prior to discussing the policy issues regarding AI patenting, we would like to distinguish between two separate and very distinct categories of AI inventions: (1) inventions that implement AI (i.e., inventions in AI) and (2) inventions that are created by AI (i.e., inventions by AI). This is an important distinction because while the former raises patent eligibility concerns that have plagued all computer-implemented inventions, the latter invokes tremendously challenging policy and ethical considerations that may require significant changes in the law.

We appreciate the Office initiating this critical dialogue. IBM realizes the Office will be forced to grapple with uncertainties surrounding inventions by AI as they examine applications that test the boundaries of the current law. However, we believe that the issue of AI inventions, and specifically inventions by AI, is a matter of such significant policy import that we encourage the Office to bring the issue forward to Congress, the branch of government designed to address key issues of economic policy.

Elements of an AI invention

Experts in the field do not agree on a single definition for AI as the term has been used to encompass a wide variety of technologies. Broadly, AI is a term that includes computer technologies that replicate functions ordinarily attributed to the human brain. What makes AI unique from other areas of computer science is that AI has an ability to "learn", such that the results achieved are improved when an AI machine is exposed to more data sets.

Under the broad umbrella term of AI is supervised and unsupervised learning, machine learning, several different AI mathematical algorithms (e.g., linear regression, decision trees, etc.) and programming concepts, data sets including deep data, validation sets, test sets, training data, and real-time data. AI also includes aspects that are part of a "black box" (i.e., hidden) including trained models, the coefficients embedded in the trained models, algorithms to train the models, parameters for tweaking the models, neural networks and deep neural networks, and the insights gained from output of using a trained model.

IBM believes that all the enumerated items within the first question in the Federal Register Notice ("FRN") and other items not enumerated, may be elements of an AI invention so long as the claimed invention is patent-eligible subject matter and is novel and nonobvious. The elements of an AI invention could include the problem to be addressed, the structure of the database on which the AI will be trained and will act, the training of the model on the data, the model itself, the AI algorithm itself, the results or insights of the AI invention through an automated process, and the

policies/weights to be applied to the data that affects those results or insights as well as other elements not explicitly listed here.

Inventorship and Ownership Considerations In AI

The governing U.S. statute and current case law are clear that an inventor must be a human.[7] For example, 35 U.S.C. § 100(f) defines an "inventor" as "the individual or, if a joint invention, the individuals collectively who invented or discovered the subject matter of the invention." Further, in case law, an inventor is described as one who contributes to the conception of the invention[8] and that conception requires 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."[9] In *New Idea Farm Equipment Corp. v. Sperry Corp. and New Holland Inc.*, the Federal Circuit Court of Appeals established that "people conceive, not companies[.]"[10]

To engender trust and transparency, IBM has established principles[11] that guide us as we develop AI technologies, technologies that promise to radically transform every facet of work and life. One of our guiding principles is that the purpose of AI and cognitive systems is to augment, not to replace, human intelligence. Although AI has, and will continue to advance rapidly, we believe that genuinely autonomous machines are at best decades away. AI machines with the ability to think without the assistance of a human are a long way off. The current generation of AI machines are tools that assist and enhance human endeavors. Humans use such machines just as they use simple tools like hammers. Clearly, hammers do not have the capacity to conceive an invention. Nor do the current generation of machines programmed by humans.

The most intelligent machines are able to find relationships between many parameters, but they cannot independently recognize or confirm the value of such relationships, and thus have no cognition that an invention has been made. Even machines with the intelligence to adjust their own algorithmic coefficients – in a sense, reprogramming themselves – have no appreciation of the technical or societal value of those adjustments absent humans. Intelligent machines will remain tools that assist humans, rather than invent independently, for a considerable time.

Allowing a machine that lacks genuine autonomy to be recognized legally as an inventor raises pragmatic and ethical issues. How does a machine assign or license

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[7] In fact, all IP5 Offices require that the inventor be a human. FiveIPoffices, *Report from the IP5 Expert Round table on Artificial Intelligence*, (Oct 31, 2018), available at https://www.fiveipoffices.org/material/ai_roundtable_2018_report/ai_roundtable_2018_report).
[8] See *Fina Oil & Chemical Co. v. Ewen*, 123 F.3d 1466, 1473 (Fed. Cir. 1997) ("An individual must make a contribution to the conception of the claimed invention that is not insignificant in quality, when that contribution is measured against the dimension of the full invention.").
[9] *See Mergenthaler v. Scudder*, 11 App. D.C. 264, 276 (D.C. Cir. 1897).
[10] 916 F.2d 1561, 1566 (Fed. Cir. 1990).
[11] IBM, *Transparency and Trust in the Cognitive Era*, IBM Think Blog (Jan 17, 2017), https://www.ibm.com/blogs/think/2017/01/ibm-cognitive-principles/.

an invention? How does a machine satisfy the duty of disclosure? If a machine can enjoy the legal status of an inventor, can it then be liable for infringement? Guilty of a crime? Can a machine vote? And so on. These are far-reaching issues that should not be taken lightly.

Legal recognition of a machine as an inventor also requires that we be able to recognize the point at which a machine has enough autonomy to be said to have conceived an invention. Currently there is no test or accepted set of questions for this type of determination. If we attempt to recognize machines as inventors too soon, we risk not being able to consistently confirm those machines that merit inventor status.

Consider the nexus between inventorship by a machine versus a human. If a machine identifies a relationship among parameters which a human subsequently recognizes and confirms has value, can the human be said to have conceived the invention? If not, there is no legal inventor and no patent may issue. Without a patent, the invention may never be published, diminishing the dissemination of information and slowing technological advancement.

At what point is a human working with an intelligent machine conceiving an invention versus merely reducing it to practice? 35 U.S.C. § 101 establishes that "[w]hoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." IBM submits the crux of invention or discovery is the recognition of the significance and/or value of that invention or discovery. A computer that suggests one or more possibilities for consideration does not have the capability of human judgment to so recognize, and thus cannot truly invent or discover.

Inventorship should not be confused with patent ownership. Machines are property owned by humans. Thus, at whatever point we deem machines capable of invention, their inventions and the corresponding patents should be owned by those that own them (e.g., those that own the machines). Some have suggested that programmers and trainers might have an ownership interest in inventions invented by AI machines, but we believe matters between these parties are best decided by employment status and/or contract. Perhaps we should consider a computing-for-hire doctrine similar to the work-for-hire copyright doctrine to reduce uncertainty.

The patent system plays a vital role, in the words of the Constitution, "To promote…the useful arts."[12] Patents further this policy objective by: (i) stimulating innovation by providing inventors with exclusive benefits for their inventions for a period of time and (ii) fostering dissemination of information, thus enabling subsequent innovation by others. The Office should consider whether granting ownership of inventions to AI machines is consistent with the Founding Fathers' fundamental policy objective. While machines cannot be motivated to invent by the availability of patent rights, those that invest in AI research and development can

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[12] U.S. Const., Art. I, Sec. 8, cl. 8.

be motivated to invent by the value that patents provide. Notwithstanding the incentives (or lack thereof) in place, it is imperative that AI inventions be patented to further the critical function patents play in knowledge dissemination and innovation advancement. Further, allowing a machine to own an invention or a patent circles back to the uncertainties cited earlier – can a machine be liable for infringement, commit a crime, etc.? We recommend that a machine not be allowed to own an invention/patent unless the ramifications of these uncertainties are satisfactorily resolved.

In view of the above, IBM asserts there is no urgency to revise the law with respect to inventorship. Indeed, it is prudent to not act in haste. Recognition of machines as inventors would be a significant policy change impacting trade and competition and is sure to raise these and other challenging ethical questions. As a result, we strongly recommend proceeding deliberately, but also patiently, as the technology matures. We propose that the Office continue to monitor developments and consider modest, relatively non-controversial regulatory changes as needs arise. More significant matters of patent law and policy, such as the possibility that machines might be legal inventors, should remain the domain of Congress. We encourage the Office to identify all the issues, sort those issues, and advise Congress to begin consideration of matters it should resolve.

Patent Eligibility Considerations in AI

Currently, most inventions in AI fall into the category of computer-implemented inventions. IBM's concerns regarding the current state of the law of patent subject matter eligibility for computer-implemented inventions applies to all AI inventions. Just as computers are inherently abstractions of a tool, AI is also an abstraction; an abstraction of the human brain, human learning, human thought. Thus, the patent eligibility of AI inventions is at risk under the current abstract idea doctrine.

The rapid development of AI will only compound the current policy challenges surrounding patent protection of computer-implemented inventions. The Supreme Court warned against construing the exclusionary principle of 35 U.S.C. § 101 overbroadly, "lest it swallow all of patent law."[13] Unfortunately, AI inventions may not be able to fulfill the requirements of current patent eligibility jurisprudence and this could severely limit patent protection of AI inventions. As IBM testified to the Senate Judiciary Committee on the state of patent eligibility[14], it is vital for Congress to improve certainty in the law and to restore balance around the role of patent eligibility. Congress should override the judicially created requirements and take steps to ensure the test for patent eligibility is more clear and predictable and enables the patentability of AI inventions.

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[13] *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 134 S. Ct. 2347, 2354 (2014) (citing *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 71-72 (2012)).

[14] Testimony of Manny Schecter, Chief Patent Counsel, *IBM Corporation to Subcommittee on Intellectual Property, Senate Judiciary Committee, The State of Patent Eligibility in America: Part III*, June 11, 2019, available at https://www.judiciary.senate.gov/meetings/the-state-of-patent-eligibility-in-america-part-iii.

Disclosure-Related Considerations

We believe there are significant and unique challenges in AI to adequately disclose an invention and demonstrate enablement and/or to satisfy the written description requirement. The enablement requirement requires the specification to describe the invention in a manner that would allow a person having ordinary skill in the art ("PHOSITA") to make and use the invention and to ensure that the public can derive benefit from the invention after the term of exclusivity of the patent has expired. The written description requirement, which is related to, but distinct from the enablement requirement necessitates that the specification describe the invention in sufficient detail that a PHOSITA can reasonably conclude that the inventor had possession of the claimed invention at the time of filing.[15] In particular, the Federal Circuit has held the specification must describe the claimed invention in a manner understandable to the PHOSITA in a way that shows that the inventor actually invented the claimed invention at the time of filing.[16] These requirements support the fundamental premise in patent law of *quid pro quo*, whereby the inventor may exclude the public from practicing the invention for a period of time in exchange for providing a meaningful disclosure.

AI inventions can be difficult to fully disclose because even though the input and output may be known by the inventor, the logic in between is in some respects unknown. In fact, we can feed the same machine the same dataset, and yet, it may not always yield the same solution.[17] This is due in part to the inherent randomness in AI algorithms. So, if inventions are made and operated in such a black box, it may be difficult for the inventor to understand exactly how the AI accomplishes the end-result, and in turn, provide a sufficient disclosure to secure patent protection. The Office should clarify the circumstances under which the applicant should be required to disclose the machine learning algorithm, or the data used for training, keeping in mind the requisite enablement and written description requirements that ensure patent quality.

IBM supports transparency and "explainability"[18] of AI systems and believes that information regarding how an AI system came to a given conclusion or recommendation should be available to individuals impacted by those systems. Transparency and explainability build public confidence in disruptive technology, promote safer practices, and facilitate broader societal adoption. We do not suggest that the requirements for enablement and written description need to change, however, we believe if an inventor cannot sufficiently disclose the invention, it is

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[15] *See LizardTech, Inc. v. Earth Res. Mapping, Inc.,* 424 F.3d 1336, 1344-45, 76 USPQ2d 1724, 1731-32 (Fed. Cir. 2005); *Vas-Cath, Inc. v. Mahurkar,* 935 F.2d 1555, 1562-64, 19 USPQ2d 1111, 1115-16 (Fed. Cir. 1991).

[16] *See Ariad Pharm., Inc. v. Eli Lilly & Co.,* 598 F.3d 1336, 1340, 94 USPQ2d 1161, 1167 (Fed. Cir. 2010) *(en banc).*

[17] FiveIPoffices, *Report from the IP5 Expert Round table on Artificial Intelligence*, (Oct 31, 2018), https://www.fiveipoffices.org/material/ai_roundtable_2018_report/ai_roundtable_2018_report).

[18] Adam Cutler, Milena Pribić, & Lawrence Humphrey, *Everyday Ethics for Artificial Intelligence,* (Sept 2018), available at https://medium.com/design-ibm/everyday-ethics-for-artificial-intelligence-75e173a9d8e8.

not yet ripe for patenting and other forms of protections should be considered in lieu of patent protection.

It may be worth considering the scope of disclosure and the possibilities under which the written description requirement can be satisfied. The JPO examination guidelines[19] may provide some guidance regarding the claim-specific inquiries necessary to determine if the written description requirement has been met for AI-related inventions. For example, the JPO examination guidelines establish the description requirements are met when one of the following are provided: (1) correlation among multiple types of data in view of common general technical knowledge, (2) an explanation or statistical information in the description supporting the correlation among multiple data types, or (3) the performance evaluation using the AI model supports a correlation among the multiple data types.

Person Having Ordinary Skill in the Art (PHOSITA)

IBM believes that as more complex technologies are adopted, the level of skill of the PHOSITA has been, and will continue to be, increasing. Consider a person faced with a task today and contrast that with a person faced with that same task hundreds of years ago. We expect that the level of skill of the person today is higher. We stand on the shoulders of previous inventors and continually learn from those that come before us. In much the same way, the level of insights and knowledge gained from AI will necessarily impact the level of the PHOSITA.

We view the PHOSITA as a human, but a human having the benefit of ever-evolving tools. These tools can and will include AI technologies. The availability of AI may cause more inventions, through the lens of the more knowledgeable PHOSITA, to appear to be obvious. On the other hand, with respect to enablement, with the availability of AI, the more knowledgeable PHOSITA may require less detail to make or use the invention without undue experimentation. The level of detail required to enable an invention is inversely related to the level of knowledge in the state of the art (and in some ways to the level of obviousness).

Understanding the level of skill of the PHOSITA, and consequently the necessary level of detail required for enablement, is particularly essential when disclosing machine learning models where it is not precisely known what the machine is doing or how it arrived at the solution. While we do not advocate a change in the enablement standard (or the level of detail necessary to meet that standard), we request the Office to confirm that the level of skill of the PHOSITA will naturally increase with access to AI as a tool, just as the level of skill of the PHOSITA has improved over the years with access to other new and improved tools. Further, for inventions where AI is applied to a technology field (e.g., chemical material

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[19] Japan Patent Offi*ce, Examination Guidelines: Case Examples Pertinent to AI-related Technology* https://www.jpo.go.jp/e/system/laws/rule/guideline/patent/document/ai_jirei_e/jirei_e.pdf (last visited Nov 6, 2019).

discovery) is the PHOSITA for enablement and obviousness a person with ordinary skill in AI, chemistry, or perhaps both technologies?

Prior Art Considerations in AI

AI will dramatically expand the scope of prior art available. First and foremost, AI has the capability of generating a tremendous amount of prior art. For example, Alexander Reben's project, All Prior Art, attempts to create and publish prior art that is algorithmically generated.[20] The project has created over fifteen thousand pages of possible prior art material to date. Further, AI can access the essentially unlimited prior art at the ready, thus it is poised to capitalize on the burgeoning corpus of prior art. We encourage the Office to continue to pursue employing the power of AI to assist with uncovering the best prior art available.

Alternative Forms of Intellectual Property Protection

IBM is open to the possibility that new forms of IP protection may be needed as technologies like AI evolve and mature. We believe that many important questions still exist, and we should proceed cautiously and with purpose. The IP protection mechanisms currently in place have served us well for many years even as technology has evolved at an accelerating pace. Therefore, IBM suggests that the focus remain on the basic building blocks of IP already in place before creating any new forms of IP protection *ad hoc*.

Machine learning and trained models are an area of particular importance to IBM. Machine learning is a program or system that is capable of digesting large data sets and utilizes AI algorithms to produce a trained model. In production, the trained model when given new, but similar types of data sets, can provide useful insights. The trained model is often viewed as a black box, with data sets as the input and insights being generated as the output. The trained model can include a learned set of coefficients for use in one or more mathematical functions for that specific trained model. While the output of the trained model and its associated coefficients seems simple, the development of the trained model and its associated coefficients is not at all trivial, and that effort merits some sort of protection.

IBM believes there may be gaps in IP protection for AI, and specifically gaps in IP protection for the trained model and its associated coefficients. As well, existing IP frameworks such as patents and copyrights may not be available for functional elements of data sets and, in some cases, the useful insights or learnings that are not fixed in a tangible medium of expression. As discussed above with respect to enablement and written description, there are situations where patent protection may not be appropriate. Similarly, copyright cannot protect the mathematical equation or the coefficients due to their functionality. Trade secret protection is also not a sustainable option. Aside from the issues of diminishing the dissemination of information and slowing technological advancement, trade secret protection may

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[20] Alexander Reben, *All Prior Art; Algorithmically Generated Prior Art*, http://allpriorart.com/about/ (last visited Nov 6, 2019).

not be adequate for such inventions because of the ease of reverse engineering and the inability to meaningfully obfuscate programming code.

Accordingly, we ask the Office to consider this gap in IP protection for AI and contemplate whether aspects of other IP protection mechanisms may be necessary to adequately protect the trained model, data sets, the coefficients gleaned from the trained model, and the algorithmic equation used to run input data through the AI machine.

Access to data is essential to the development of AI. As such, we must be mindful of, and temper any alternative IP protection considered with an appropriate fair use doctrine. For example, many companies train machine learning models using text and data mining (TDM), technology-enabled analytics capable of discovering correlation and identifying useful insights undiscovered in data sets. This fair use of data should remain permissible. Stifling access to data could have considerable adverse ramifications for the progress of AI solutions.

Other Considerations

The Office should expect the public to raise several ethical concerns surrounding AI, such as transparency, whether machines will replace humans and increase unemployment, and whether AI computers or technology should be considered inventors and/or owners of patents.[21] Policy discussions regarding AI may elicit strong, visceral responses.

While the FRN does not specifically request input on the issue of infringement and enforcement, these considerations are inextricably linked with the topics of inventorship and ownership. For example, if a machine is an owner, then we should consider what this could mean when the machine engages in infringement. How would the machine pay damages? Could the machine even be cognizant that it is infringing? Currently, and for the foreseeable future, we don't believe that AI machines have the requisite human traits to recognize infringement. Further, with respect to enforcement, should the machine have rights? We believe that the Office should consider these other important issues when contemplating the best IP policy for AI.

IBM asks the Office to continue to monitor the development of IP policy surrounding AI in other jurisdictions and ensure that the IP policies in the U.S. do not comparatively disadvantage AI inventions in the U.S. We note that at least Singapore offers a fee-free Accelerated Initiative for Artificial Intelligence ("AI[2]").[22] The Office should consider options such as reduced fees, or no-fee acceleration programs to promote filing of AI inventions within the U.S.

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[21] Francesca Rossi, *Serving Society Ethically in the Age of Artificial Intelligence*, (Feb 25, 2019) https://www.ibm.com/blogs/watson/2019/02/serving-society-ethically-in-the-age-of-artificial-intelligence/.
[22] Intellectual Property Office of Singapore, *Accelerated Programmmes*, https://www.ipos.gov.sg/protecting-your-ideas/patent/application-process/accelerated-programmes (last visited Nov 6, 2019).

Conclusion

IBM applauds the Office for opening this important dialogue about the intersection of AI and IP rights. We are grateful for the opportunity to comment on and contribute toward meeting the challenges that AI poses for IP policy. We recognize that much uncertainty remains and the stakes are high. The answers to these strategic policy questions could alter the course of AI protection in the U.S., and ultimately our economy. We urge the Office to stimulate discussion with Congress, stakeholders, and the public regarding appropriate and measured IP rights for AI, and we stand ready to continue advising the Office on these issues.

Respectfully submitted,

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