PATENTING ARTIFICIAL INTELLIGENCE INVENTIONS

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With the advancements of Artificial Intelligence (AI), the U.S. patent regime is under review. In September 2019, the United States Patent and Trademark Office (USPTO) requested comments from the public on patent-related issues regarding AI inventions for purposes of encouraging the "reliability and predictability" of the patent system.[1] However, the USPTO has not yet issued guidelines on AI inventions.

At present, the attention is drawn to the USPTO's revised guidelines regarding software-related inventions issued in January 2019,[2] and subsequently updated in October 2019 with additional clarifications in response to public comments.[3] In particular, these guidelines focus on describing the subject matter, written description and enablement requirements regarding software-related inventions subject to 35 U.S.C. § 101 and 112. While these guidelines are not substantive law, they constitute guidance that the USPTO personnel are expected to follow.[4]

In this article, we will analyze the USPTO's interpretation of these requirements in the framework of AI inventions. In addition, we will analyze the nonobviousness requirement,[5] due to its relevance and implications for AI inventions. As noted, the USPTO's guidance addressing AI inventions is still pending.

Firstly, an introduction to AI, its different types and main characteristics is necessary. AI is no more (and no less) than the manifestation of the scientific method automated. Traditionally, the scientific method has followed a "process-driven approach"

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[1] *See* Notice, USPTO, Request for Comments on Patenting Artificial Intelligence Inventions, 84 FR 51522 (Sept. 30, 2019), https://www.federalregister.gov/documents/2019/09/30/2019-21190/request-for-comments-on-patenting-artificial-intelligence-inventions [https://perma.cc/2EW6-KEJ3].

[2] *See* Press Release, USPTO, U.S. Patent and trademark Office announces revised guidance for determining subject matter eligibility (Jan. 4, 2019), https://www.uspto.gov/about-us/news-updates/us-patent-and-trademark-office-announces-revised-guidance-determining-subject [hereinafter USPTO announces revised guidance] [https://perma.cc/YR42-KDYX].

[3] *See October 2019 Update: Subject Matter Eligibility*, USPTO (Oct. 17, 2019), https://www.uspto.gov/sites/default/files/documents/peg_oct_2019_update.pdf [https://perma.cc/P2CU-7VEW].

[4] Ryan N. Phelan, *Highlights of the U.S. Patent Office's Update to its 2019 Subject Matter Eligibility Guidance*, PTAB WATCH (Oct. 24, 2019), https://www.ptabwatch.com/2019/10/highlights-of-the-u-s-patent-offices-update-to-its-2019-subject-matter-eligibility-guidance/ [https://perma.cc/95E3-M5YW].

[5] *See* 35 U.S.C. § 103.

comprising several phases: formulating hypotheses, designing and running experiments, analyzing data, and deciding which experiments to run next.[6] However, in the Information Age, the high volumes of data are dramatically changing the scientific method, moving from a process-driven approach to a "data-driven approach".[7] Under this approach, the data provided to the process dictates the result of the model. Therefore, this change poses several new challenges, especially in terms of (i) handling massive and complex volumes of multi-source and multi-type data, and (ii) discerning the quality of the data. In addition, AI data analysis presents models which are non-deterministic in nature, they reflect empirical results based on data observation and provide a probability of success. Therefore, the role of humans in reviewing and applying human judgment to the AI model results is critical.

At present, there are two types of AI: Machine Learning (ML) and Deep Learning (DL). With ML techniques, engineers prepare data which is fed into learning algorithms. These algorithms apply a reflection of what they see accessing the data and generate models. On the other hand, DL is a subset of ML that is applied to what is known as neural networks. The original goal of the neural network approach was to solve problems in the way that a human brain would. The word "deep" refers to the number of layers that transform the data.[8] Even though the number of layers and connections in neural networks is several orders of magnitude less than the number of neurons and connections in a human brain, these networks can analyze high volumes of data and perform specific tasks at a level beyond that of humans (e.g., image recognition).[9]

In addition, ML and DL can learn both in a supervised or unsupervised way. Under supervised learning, the machine is trained with data that is already labelled or tagged with the correct answer. Therefore, the machine learns from labeled data and helps you to predict outcomes for new unlabeled data. Unsupervised techniques analyze directly unlabeled data to predict outcomes. This later performs today significantly worse than supervised learning. However, in the longer term, unsupervised learning is expected to become more important.

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[6] Laura Elizabeth Lansdowne, *Automating Research to Improve Reproducibility and Throughput*, TECH. NETWORKS (Jul. 5, 2019), https://www.technologynetworks.com/drug-discovery/articles/automating-research-to-improve-reproducibility-and-throughput-321482 [https://perma.cc/W2YL-3R7Q].
[7] *Id*.
[8] *See generally* STEWART COLEY, MAN VS BIG DATA: EVERYDAY DATA EXPLAINED (2017).
[9] *Id*.

Moreover, the role of humans is critical in two steps of the AI process. Firstly, reliable data requires considering data collection, storage, and preparation practices before data analysis (AI) comes into play. It also requires considering biases embedded in data sets. To date, this data quality analysis still relies in humans. Automation is just another analysis method once inputs are provided, but it shifts the role of the human from one where it's absolutely the bottleneck, to (in most of the cases) being more supervisory.[10] Secondly, since AI data analysis presents models which are non-deterministic in nature, humans have a fundamental role in reviewing and applying human judgment to the AI model results. It is humans who have to interpret the AI model results, and the interpretation will dramatically vary on a case-by-case basis. Hence, focusing on complementarity between AI and humans is key.

In analyzing the USPTO's interpretation of the patent requirements in the framework of AI inventions, we must consider that the U.S. patent law derives from a constitutional grant of authority to the Congress "to promote the process of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respecting writings and discoveries."[11] In this regard, following the AI introduction, it is clear that methods to clean, prepare and combine data with diverse formats, are essential to enhancing the accuracy of AI models in the Information Age.

Since AI is mainly implemented by software, the first legal hurdle to obtaining a patent on an AI invention is subject matter eligibility.[12] In particular, software-related inventions are at risk of being identified as an "abstract idea." One of the accompanying hypothetical examples of the revised guidelines (Example 39) addresses this issue regarding an AI-related invention.[13] The claim in Example 39 is directed to a computer-implemented method of training a neural network for facial detection, and the USPTO concludes that this claim is eligible for patent protection under Step 2A, Prong One, of the *Alice-Mayo* framework developed by the U.S. Supreme Court for evaluating eligibility because the claim is not directed to an "abstract idea."[14]

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[10] Lansdowne, *supra* note 6.

[11] *See* U.S. CONST. Art. 1, § 8, cl. 8. This clause is frequently referred to as the either the Patent Clause, the Copyright Law or the Intellectual Property Clause.

[12] *See* 35 U.S.C. § 100(f).

[13] *See Subject Matter Eligibility Examples: Abstract Ideas*, USPTO (Jan. 7, 2019), https://www.uspto.gov/sites/default/files/documents/101_examples_37to42_20190107.pdf [https://perma.cc/JRL9-5PV7].

[14] *See* Notice, USPTO, 2019 Revised Patent Subject Matter Eligibility Guidelines (Jan. 7, 2019), https://www.federalregister.gov/documents/2019/01/07/2018-28282/2019-revised-patent-subject-matter-eligibility-guidance [https://perma.cc/32B4-QQTL].

In an effort to improve "consistency and predictability," the USPTO has created the two prongs under Step 2A and three categories of abstracts ideas under Prong One: (i) mathematical concepts -mathematical concepts, formulas or calculations-, (ii) mental processes -concepts performed in the human mind-, and (iii) certain methods of organizing human activity -such as fundamental economic principles or commercial/legal interactions-. Moreover, if a claim is directed to an abstract idea, Prong Two analyzes whether the "abstract idea" is "integrated into a practical application."[15] An improvement in the functioning of a computer or other technological field is cited as an example, and requires demonstrating that an invention improves the relevant existing technology -an "improvement" in user experience or in a business process is not enough-.[16] The purpose of Prong Two is requiring the use of the abstract idea in some meaningful way "beyond generally linking it to a technological environment."[17]

Therefore, under these revised guidelines, it is clear that claims related to AI inventions must be more than just mathematical concepts, which is the critical category under Prong One, and must have some type of "practical application" under Prong Two.

The question arises as to what would have been the outcome if the example would have been directed to the use of the neural network in facial detection, instead of to the training of such network. Although this is not specifically addressed by the USPTO, interestingly, it has been addressed by the European Patent Office (EPO) in its latest guidance for examining AI patent applications issued in November 2018.[18]

The EPO, despite adding an extra layer of scrutiny to expressions such as neural networks, establishes that the use of a neural network, for instance, "in a heart-monitoring apparatus for the purpose of identifying irregular heartbeats" and the classification of "digital images, videos, audio or speech signals based on low-level features (e.g. edges or pixel attributes for images)" have a "technical purpose or application", and would therefore be patent eligible.[19] On the contrary, sorting text documents "solely in respect of their textual

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[15] *Id.*

[16] Phelan, *supra* note 4.

[17] Robert Tarcu, *How the EPO and USPTO Guidance Will Help Shape the Examination of Artificial Intelligence Inventions*, IP WATCHDOG (Apr. 1, 2019), https://www.ipwatchdog.com/2019/04/01/epo-uspto-guidance-will-help-shape-examination-artificial-intelligence-inventions/id=107855/#.XZMEC78ZeiM.email [https://perma.cc/QVW6-ZMXF].

[18] *See Guidelines for Examination*, EUR. PAT. OFF., https://www.epo.org/law-practice/legal-texts/html/guidelines/e/g_ii_3_3_1.htm [https://perma.cc/5ECL-ZLLS].

[19] Tarcu, *supra* note 17.

content" does not serve a technical purpose, but rather a linguistic one.[20] The EPO also indicates that categorizing "abstract data records or even 'telecommunication network data records' without any indication of a technical use being made of the resulting classification is also not per se a technical purpose."[21] As such, these types of classifications would not be patent eligible.

Therefore, the conclusion that can be drawn from these guidelines is that, considering the higher level of scrutiny of the EPO, the USPTO would most probably consider that, not only the training of AI, but also the use of AI itself, would be patentable by an individual (or individuals) under the subject matter requirement as long as they are not directed to "abstract ideas" and are integrated into a "practical application" or "technical purpose." This recognition is of paramount importance for the AI industry.

Notwithstanding the foregoing, every application is analyzed on a case-by-case basis by the USPTO. Following these guidelines, it is clear that careful consideration should be given when drafting the specifications. For instance, it would be crucial to present the technical applications in detail, with real-world examples.[22]

Having analyzed the subject matter requirement, we now turn to the remaining requirements. Novelty, nonobviousness, and enablement are all determined from the perspective of a person of ordinary skill in the art. Nonobviousness is an especially relevant requirement, since it requires significant development over the prior art. The U.S. Supreme Court established the *Graham* test in *Graham v. John Deere Co. of Kansas City*,[23] under which the court must analyze (i) the state of the prior art, (ii) the differences between the prior art and the claims, (iii) the level of ordinary skill in the art, and (iv) any secondary factors to determine patentability.[24]

In this regard, for instance, using ML to interpret data and create predictions on that data in a specific use case would potentially be considered an obvious practical application of the known ML techniques for a person of ordinary skill in the art. In this regard, if we consider the claim in Example 39 directed to a computer-implemented method of training a neural network for facial detection, it should be considered that ML is particularly useful in any application based on pattern recognition. Therefore, facial recognition

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[20] *Id*.
[21] *Id*.
[22] *Id*.
[23] Graham v. John Deere Co. of Kansas City, 383 U.S. 1, 17, (1966).
[24] Thomas L. Irving, Ningling Wang, & Stacy D. Lewis, *Obviousness Developments in U.S. Patent Law*, FINNEGAN (Jul. 2009), https://www.finnegan.com/en/insights/obviousness-developments-in-u-s-patent-law.html [https://perma.cc/MD3Q-25LE].

software, or handwriting recognition, to take another example, would potentially be considered obvious applications of ML techniques.

Hence, in order to overcome nonobviousness, an AI inventor would have to develop technical improvements over previous known methodologies (e.g., this could be in the line of developing specific solutions for data cleaning, implementing a new way of making data sets compatible, enhancing computation efficiency or developing new algorithms, amongst others). This standard, which would be related with the "practical application" requirement under subject matter, would probably raise the bar for AI inventions. However, this analysis would be consistent with the purpose indicated above: enhancing accuracy of AI through patenting methods to clean, prepare and combine data, among other AI developments.

Finally, we will address the enablement and written description requirements. Firstly, under the written description requirement, the guidelines indicate that sufficient information must be provided in order to show that the inventor had possession of the invention that achieves the claimed result.[25] In *Genentech, Inc. v. Novo Nordisk A/S*,[26] the U.S. Court of Appeals for the Federal Circuit established that the specification shall disclose "specific starting material [and] the conditions under which a process can be carried out." In the case of AI, this would represent the challenge to be solved and the technique or structure used (the starting material) and the training method used (the conditions to carry out the process).[27] Accordingly, the specification shall describe (i) the challenge or problem addressed, (ii) the type of AI suitable to address the challenge or problem, (iii) the algorithms or neural networks used, and (iv) the required training data. If more than one technique is suitable, the range of options shall be described. For example, if labeled training data is available, supervised learning will be best suited.[28]

Secondly, to satisfy the enablement requirement, the guidance notes that "the specification must teach those skilled in the art how to make and use the full scope of the claimed invention without undue experimentation."[29] The guidance refers to eight factors established *in re Wands*[30] in determining whether experimentation is "undue.". These factor are the following: "(1) the quantity of experimentation

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[25] *See* USPTO announces revised guidance, *supra* note 2.
[26] Genentech, Inc. v. Novo Nordisk A/S, 108 F.3d 1361, 1366 (Fed. Cir. 1997).
[27] Mathew Fagan & Martin Miller, *Approaching AI Inventions Under New USPTO Guidance,* LAW360 (Apr. 9, 2019, 1:38 P.M.) *https://www.law360.com/articles/1147595/approaching-ai-inventions-under-new-uspto-guidance?copied=1* [https://perma.cc/29QL-UX4E].
[28] *Id*.
[29] *Id*.
[30] In re Wands, 858 F.2d 731, 737 (Fed. Cir. 1988).

necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims." Regarding the third factor, examples of specific techniques and algorithms or neural networks used may be provided in order to comply with the enablement requirement, in addition to considering the remaining factors.[31]

Moreover, in *Vasudevan Software, Inc. v. MicroStrategy, Inc.*,[32] the Federal Court established that "[a] claim is sufficiently enabled even if 'a considerable amount of experimentation' is necessary, so long as the experimentation 'is merely routine, or if the specification in question provides a reasonable amount of guidance with respect to the direction in which the experimentation should proceed.'"

An AI inventor will arguably face some challenges to accomplish these two requirements. AI is unpredictable. Two trainings of a model with the same training data and the same ML or DL architecture might lead to slightly different performance. Obviously, if the training data changes, the results will change dramatically. Without written description of each process step taken in ML or DL and how the machine arrives at the final result, patentees may be forced to claim the input process for training the AI (under the requirements established for subject matter and nonobviousness above), rather than the AI itself. The undue experimentation requirement under enablement is also especially challenging, since AI is a scientific method of experimentation. However, *Vasudevan* still allows some experimentation by the third party.

In addition, the important role that training datasets play in the performance of the technology might raise questions as to the extent of disclosure in a patent application. The availability of such a dataset with a view to verify the claimed invention by third parties may not be desirable by the inventor. Hence, these requirements also raise the bar for AI inventions. The question is therefore whether these standards are desirable not only for the inventor, but also for the general public. To answer this question, a consideration of the Intellectual Property Clause and the remaining intellectual property protections is required, since a balance between the different interests and innovations protected under the different regimes is necessary.

To conclude, considering (i) that AI is the manifestation of the scientific method automated, (ii) the importance of data in the Information Age, and (iii) the relevance of human judgement in data

[31] Fagan & Miller, *supra* note 27.
[32] Vasudevan Software, Inc. v. MicroStrategy, Inc., 782 F.3d 671 (Fed. Cir. 2015).

quality reliability and analyzing AI model results, promoting innovation through the development of specific solutions for data cleaning, implementing new ways of making data sets compatible, enhancing computation efficiency or developing new algorithms that are nonobvious applications for a person of ordinary skill in the art, amongst other AI technical improvements, is essential to enhancing the accuracy of AI models in the Information Age and is an objective compatible with the Constitutional objective of patent law. However, regarding the written description and enablement requirements, the standard may have to be softened to embrace the particular nature of AI and to emphasize the relevance of applying human judgment to data quality reliability and the AI model results.