ARTIFICIAL INTELLIGENCE PATENT INFRINGEMENT

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ABSTRACT

Artificial intelligence is expanding across industries for developing or delivering goods and services. Businesses and inventors have followed with seeking patent protection in artificial intelligence. The rapid rise in artificial intelligence patent filings has not been without debate of doctrinal patent law issues with inventorship and nonobviousness. A natural, next doctrinal inquiry is to determine what could be considered patent infringement of artificial intelligence. The imitation of artificial intelligence technology raises the question—how should infringement of artificial intelligence patents that are not invalidated be analyzed?

The technological distinction of "dynamic, trainable data sets" informs statutory interpretation of 35 U.S.C. § 271 for infringement of artificial intelligence patents. An examination of § 271(a) direct, § 271(b) indirect (active inducement and contributory), and § 271(c) infringement of artificial intelligence patents centers on artificial intelligence's autonomous ability to function without humans, to modify, and to evolve over time in response to new data. While the analysis of the patent infringement statute of artificial intelligence generally shows that patentees would have considerable difficulty in prevailing against would be infringers, it suggests artificial intelligence's distortions with existing patent law framework necessitates redefining "inventors" and the notion of an infringer. The dynamic nature of artificial intelligence complicates the current scope of divided infringement, resulting in addressing a liability loophole. A proposed balanced private-public, hybrid model termed the "Artificial Intelligence Identification System" (AIIS) would make artificial intelligence technology easier to identify and easier to access through labeling of artificial intelligence patents and would divert focus from patent litigation.

INTRODUCTION

Artificial intelligence is becoming ubiquitous. It more than just algorithms and analysis—it is pervading numerous industries and transforming commerce. Artificial intelligence is having tremendous economic effects akin to transformational technologies of the past, such as the steam engine, electrification, manufacturing, and information technology.[1] In parallel, artificial intelligence patenting activity in increasing at high growth rates in recent years for numerous applications and techniques,[2] is overwhelmingly occurring in the U.S.,[3] and is expected to continue with similar rapid growth rates in future years.[4]

The proliferation and advancement of artificial intelligence is disrupting numerous legal frameworks, including for patent law. While patent law's standards have been designed to adapt to new technologies,[5] artificial intelligence is creating a paradigm shift that requires us to think differently about patent law doctrines. The central reason is that with artificial intelligence, computers are routinely inventing, and in doing so, challenging the paradigm for patentability[6] and the method of innovation.[7] Inventions that otherwise would be conceived by humans are being developed by artificial intelligence,[8] which is often more than simply an assisting tool to humans in the inventing process.[9] Early patent law scholarship has addressed artificial intelligence's ability to substitute human ingenuity[10] and disrupting inventorship[11] and nonobviousness[12] doctrines.

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[1] Jason Furman and Robert Seamans, *AI and the Economy*, NBER Chapters in Innovation Policy and the Economy, Vol. 19, pages 161-191, National Bureau of Economic Research (2018).

[2] World Intellectual Property Organization, *Artificial Intelligence*, WIPO Technology Trends 2019 (2019) at 13-15.

[3] Dean Alderucci, Lee Banstetter, Eduard Hovy, *Mapping the Movement of AI into the Marketplace with Patent Data*, Carnegie Mellon University Center for Technology and Society (2018).

[4] Xavier Seuba, Christophe Geiger, and Julien Penin, *Intellectual Property and Digital Trade in the Age of Artificial Intelligence and Big Data*, International Centre for Trade and Sustainable Development: Center for International Intellectual Property Studies, Issue 5 (June 2018) at 34.

[5] Dan L. Burk & Mark A. Lemley, *Is Patent Law Technology-Specific?*, 17 BERKELEY TECH. L.J. 1155, 1156 (2002) (stating that in theory patent law standards are designed to be flexibly adapted and be unified across technologies, but that recent jurisprudence suggests increasing divergence between the rules and the application of the rules to different technology industries).

[6] Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C.L. REV. 1079 (2016).

[7] Iain Cockburn, Rebecca Henderson, and Scott Stern, *The Impact of Artificial Intelligence on Innovation: An Exploratory Analysis*, THE ECONOMICS OF ARTIFICIAL INTELLIGENCE: AN AGENDA (September 2017) at 7.

[8] World Economic Forum, *Artificial Intelligence Collides with Patent Law*, (April 2018) at 9.

[9] W. Keith Robinson, *Emerging Technologies Challenging Current Legal Paradigms*, 19 MINN. J.L.SCI. & TECH. 355, 365 (2018).

[10] Ana Ramalho, *Patentability of AI-Generated Inventions: Is a Reform of the Patent System Needed?* (February 15, 2018), available at: https://ssrn.com/abstract=3168703

[11] W. Michael Schuster, *A Cosean Analysis of Ownership of Patents for Inventions Created by Artificial Intelligence*, 75 WASH. & LEE L. REV. 1945 (2018); Robin Feldman and Nick Thieme, *Competition at the Dawn of Artificial Intelligence*, forthcoming J. OF ANTITRUST ENFORCEMENT (2018); Shlomt Yanisky Ravid and Xiaoqiong Liu, *When Artificial Intelligence Systems Produce Inventions: The 3A Era and an Alternative Model for Patent Law*, CARDOZO L. REV. (forthcoming 2018); Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C.L. REV. 1079 (2016).

[12] Liza Vertinsky, *Thinking Machines and Patent Law*, RESEARCH HANDBOOK ON THE LAW OF ARTIFICIAL INTELLIGENCE, (forthcoming 2018); Ryan Abbott, *Everything is Obvious*, 66 UCLA L. REV. 2 (2018).

However, no scholarship to date has addressed enforcement of artificial intelligence patents. At first blush, artificial intelligence patent infringement might seem preposterous. After all, patents directed to artificial intelligence, which may be based on algorithms and statistics principles, may be invalidated in district courts or in post-issuance administrative proceedings at the at the United States Patent and Trademark Office (USPTO). But a dismissive reaction ignores the potential strategic impact on the economic value of a patent and ignores posturing for potential patent licensing value. Additionally, as patent filings for artificial intelligence have increased dramatically, then patent litigation has begun to follow.[13] A recent artificial intelligence patent infringement case, *PurePredictive, Inc. v. H20.AI, Inc.*,[14] which was filed in the Northern District of California and is currently pending appeal at the Federal Circuit, may represent a sign of more of more to come. As businesses amass artificial intelligence patents[15] and as automated inventing increases,[16] it is conceivable that patentees will attempt to stop others from infringing their artificial intelligence patents.

This Article anticipates and addresses the prospect of artificial intelligence patent infringement, by analyzing: Can artificial intelligence (or some aspect of artificial intelligence) infringe patent rights? Who or what entities should be liable for actions taken by artificial intelligence that could infringe a patent? Should these questions differ in the case of artificial intelligence that infringes a patent whose inventor is a human versus the case of artificial intelligence that infringes a patent whose conception was performed by artificial intelligence? In addressing these questions, this Article grapples with the fundamental notion of who or what type of entity could be an "infringer" and explores the way the patent system can respond to protect patent owner against appropriations of their inventions by use of artificial intelligence technologies. This Article examines the U.S. patent infringement statute to examine infringement liability of patents that cover artificial intelligence technology. It concludes that artificial intelligence requires the patent system to adapt to avoid stifling innovation.

In order to tackle the first doctrinal analysis of artificial intelligence patent infringement, this Article begins by defining and describing the term "artificial intelligence."[17] Legal scholars and even experts of artificial intelligence have not adequately defined "artificial intelligence," which presents definitional challenges.[18] A deep-dive into technology of artificial intelligence

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[13] *See* World Intellectual Property Organization, *supra* note 2 at 111 (noting that, while not comprehensive, initial worldwide data reveals 1,264 artificial intelligence patent families mentioned in litigation cases, 4,231 mentioned in opposition cases, and 492 mentioned in both types of case; of these cases, 73% of the identified litigation cases involving artificial intelligence patents were filed in the U.S.).

[14] PurePredictive, Inc. v. H2O.AI, Inc., Case No. 17-cv-03049-WHO, N.D. Cal. (Aug. 29, 2017).

[15] Fujii Hidemichi and Managi Shunsuke, *Trends and Priority Shifts in Artificial Intelligence Technology Invention: A Global Patent Analysis*, Research Institute of Economy, Trade, and Industry Discussion Paper Series 17-E-066 (May 2017).

[16] Ben Hattenback and Joshua Glucoft, *Patents in an Era of Infinite Monkeys and Artificial Intelligence*, 19 STAN. TECH. L.REV. 32 (2015).

[17] *See infra* Part I.A.

[18] Mark A. Lemley & Bryan Casey, *You Might Be a Robot*, 1, 7, 11-13, 23 (February 1, 2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3327602 (stating that there remains no consensus definition of artificial intelligence, but also suggesting that there may not be a correct definition of artificial intelligence).

provides the subtle yet important technological distinctions that inform the issues by litigants in patent infringement suits. This Article's central claim is "dynamic, trainable data sets" are the unique technological distinction of artificial intelligence that stresses the U.S. patent infringement statute. Dynamic, trainable data sets are (1) able to function without humans, (2) capable of modification and (3) evolve over time in response to conditions. Their dynamic nature is based on training process of a machine learning model.[19] As a result of the process of training of a machine learning model, both data sets and the machine learning model change into new forms yet retain their underlying characteristics. This Article focuses on dynamic, trainable data sets since they are dynamic elements of artificial intelligence patent claims, which this Article concludes the patent infringement doctrines do not sufficiently protect patent holders.

Furthermore, this Article contends that the proliferation of dynamic, trainable data sets to make predictions has fundamentally altered the digital value chain and sales activities. The artificial intelligence data value chain comprises a Developer, a Trainer, a Tester, and a Predictor.[20] Underlying artificial intelligence technology is the performance of methods that are executed through the combined actions of two or more entities, and therefore giving rise to divided infringement scenarios. As a result of this conceptualization of the artificial intelligence value chain, not only is the making of the patented method distributed among multiple entities, but also making, selling, and transmitting includes dynamic elements (of dynamic, trainable data sets). This Article prospectively argues that divided infringement will arise with more frequency in artificial intelligence patent infringement scenarios. Moreover, this Article asserts that the dynamic nature of artificial intelligence technology (with dynamic, trainable data sets) heightens the risk that separate actors divide the performance of patented methods among themselves significantly more so than other digital and software-based technologies.

Patented artificial intelligence systems and methods present difficult hurdles for patentees to enforce infringement against infringers. The dynamic nature of artificial intelligence technology alters some of the basic presumptions of the patent infringement statute. Under existing law, the distributors of dynamic, trainable data sets (or machine learning models that have been trained on an initial data set), could arguably be making, selling, or using the patented systems and methods, even though they may have no idea that their activities were being combined with another party to violate an artificial intelligence patent. Absent proof of active inducement, the distributors may not end up being liable for resulting infringement of the patented artificial intelligence systems and methods. As a result of the patent infringement statute not adequately protecting owners of artificial intelligence patents, there will be chilling effects on the advancement of artificial intelligence technology. Thus, artificial intelligence patent infringement must be analyzed in order to address effects on innovation incentives.

Since artificial intelligence presents a transformational technology that shakes our patent system, the patent system will need to adapt to avoid stifling innovation. It will be important that valid artificial intelligence patents be enforceable against infringers as the capabilities of artificial intelligence continue to expand and become pervasive. This Article's contention that artificial

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[19] *See infra* Part I.A. (defining machine learning model as a subset of artificial intelligence technology).

[20] *See infra* Part I.A.

intelligence is dynamic and interactives and the resulting tension on the patent infringement statute is presented in three parts: Part I describes artificial intelligence (with a technological explanation, representative patent claims, and a value chain framework), and suggests that the doctrinal tensions brought by artificial intelligence on inventorship and nonobviousness are also present in interpreting the patent infringement statute. Part II examines the difficulties of artificial intelligence technology on the patent infringement statute by analyzing direct and indirect (active inducement and contributory) patent infringement of artificial intelligence inventions. Part III examines the difficulties that courts will face when trying to fairly resolve cases of artificial intelligence divided infringement under the existing statutory framework, and suggests that there exists a liability loophole with respect to artificial intelligence technology.

I. CONCEPTUAL FOUNDATIONS

Businesses are increasingly identifying as utilizing some form of "artificial intelligence" in developing or delivering goods and services, even those whose business is not technological but primarily customer experience driven. Artificial intelligence technology is infiltrating virtually all business sectors and numerous functions, and has gotten popularized by its use in the Amazon Go cashier-less grocery store,[21] Google's Deep Mind's AlphaGo system's win over a world-champion Go player, IBM's Watson's win in Jeopardy!, and in numerous virtual assistants (including Apple's Siri and Amazon's Alexa).[22] As artificial intelligence technological uses have multiplied, businesses utilizing artificial intelligence technology have followed with suit with patent protection.

The rapid rise in artificial intelligence patent filings has not been without concerns and debate regarding patent eligibility,[23] enablement,[24] inventorship,[25] and nonobviousness.[26] Innovation in artificial intelligence technology is outpacing patent law, and many aspects of patent protection in this field are still open questions. As innovation occurs in artificial intelligence technology, imitation will likely follow. A natural next inquire is to determine what could potential be considered patent infringement of artificial intelligence. Companies are not only being vigilant in protecting their patent rights in artificial intelligence by seeking patents from the United States Patent & Trademark Office (USPTO), but also are considering enforcement actions concerning artificial intelligence. A dominant theme in both protection and enforcement of artificial intelligence technology concerns its unique technology aspect and interactions among various stakeholders—a starting point for a deeper analysis of artificial intelligence patent infringement.

A. *What is "Artificial Intelligence"?*

Artificial intelligence, big data, data science, machine learning, and predictive analytics have increasingly become buzz words. These words have been considered synonymous, but are distinct. One source summarizes each of these words in the phrase: Artificial intelligence is the key to unlocking the value of data science, and the combination of artificial intelligence with machine learning with big data is considered predictive analytics.[27] In order to better understand

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[21] Vishrut Shivkumar and Rishab Mehta, *Amazon Go: The Future of Retail*, INT'L. J. OF ACADEMIC RESEARCH & DEV. (Jan. 2018).

[22] Daniel Castro and Joshua New, *The Promise of Artificial Intelligence*, Center for New Data Innovation (Oct. 2016).

[23] Mizuki Hashiguchi, *The Global Artificial Intelligence Revolution Challenges Patent Eligbility Law*, 13 J.BUS. & TECH. L. 1 (2017).

[24] Alfred Früh, *Transparency in the Patent System: Artificial Intelligence and the Disclosure Requirement* (Jan. 3, 2019) available at: https://ssrn.com/abstract=3309749

[25] *See supra* note 11.

[26] *See supra* note 12.

[27] *See* Info. Comm'rs Office, Big Data, Artificial Intelligence, Machine Learning and Data Protection, *supra* note 12 at 8.

this statement, it helps to parse this sentence by understanding the technology that forms the basis of analysis in this Article.

The definition of "artificial intelligence" varies so much that it diffused the concept into meaningless buzz,[28] and the definition changed with time due to rapid technological developments.[29] However, artificial intelligence has consistently referred to imitating intelligent behavior with computer programs.[30] Artificial intelligence has been referred to as being a "black box",[31] "thinking machines",[32] and an "a learning system."[33] While the definition of artificial

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[28] Foster Provost and Tom Fawcett, *Data Science and Its Relationship to Big Data and Data-Driven Decision Making*, Big Dta (March 2013).

[29] KAY FIRTH-BUTTERFIELD & YOON CHAE, ARTIFICIAL INTELLIGENCE COLLIDES WITH PATENT LAW 5 (2018) http://www.weforum.org/whitepapers/artificial-intellingence-collides-with-patent-law (defining artificial intelligence as "a computerized system exhibiting behavior commonly thought of as requiring intelligence" or "a system capable of rationally solving complex problems or taking appropriate action to achieve its goals in real-world circumstances"); Phillipe Aghion et al., Artificial Intelligence and Economic Growth (Nat'l Bureau of Econ. Research, Working Paper No. 23928, 2017) (defining artificial intelligence as "the capability of a machine to imitate intelligent human behavior [or] an agent's ability to achieve goals in a wide range of environments."; Sean Semmler & Zeeve Rose, Comment, *Artificial Intelligence: Application Today and Implications Tomorrow*, 16 DUKE L. & TECH. REV. 85, 86 (2017–2018) (defining artificial intelligence as "the process of simulating human intelligence through machine processes"); Chris Smith et al., *The History of Artificial Intelligence*, U. WASH. 4 (Dec. 2006), http://courses.cs.washington.edu/courses/csep590/06au/projects/history-ai.pdf (defining artificial intelligence as "a system which amplified people's own knowledge and understanding"); Roger Parloff, *Why Deep Learning is Suddenly Changing Your Life*, FORTUNE, (Sept. 28, 2016, 5:00 PM), http://www.fortune.com/ai-artifical-intelligence-deep-machine-learning/ (defining *modern artificial intelligence* as "a vast range of technologies—like traditional and rules-based system—that enable computers and robots to solve problems in ways that at least superficially resemble thinking"); H.R. 4829 (available at:) (defining "artificial intelligence" as anything the can: "(A) think like humans (including cognitive architectures and neural networks); (B) act like humans (such as passing the Turning test using natural language processing, knowledge representation, automated reasoning, and learning); (C) think rationally (such as logic solvers, inference, and optimization); (D) act rationally (such as intelligent software agents and embodied robots that achieve goals via perception, planning, reasoning, learning, communicating, decision-making, and acting); or (E) automate or replicate intelligent behavior").

[30] Joost N. Kok et al., *Artificial Intelligence: Definitions, Trends, Techniques, and Cases*, *in* ARTIFICIAL INTELLIGENCE 1, 1–2 (2009). The following definitions of artificial intelligence are based on The New International Webster's Comprehensive Dictionary of the English Language, EncyclopedicEdition:

> An area of study in the field of computer science. Artificial intelligence is concerned with the development of computers able to engage in human-like thought processes such as learning, reasoning, and self-correction.
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> The concept that machines can be improved to assume some capabilities normally thought to be like human intelligence such as learning, adapting, self-correction, etc.
>
> The extension of human intelligence through the use of computers, as in times past physical power was extended through the use of mechanical tools.
>
> In a restricted sense, the study of techniques to use computers more effectively by improved programming techniques.

[31] W. Nicholson Price II, *Artificial Intelligence in Health Care: Applications and Legal Issues*, SCI. TECH. LAW, Fall 2017, at 10, 10 (defining artificial intelligence as relying on "such algorithms may be best described as *black-box*"); The Petrie-Flom Center for Health Law Policy, Biotechnology, and Bioethics at Harvard Law School, *Black-Box Medicine: Legal and Ethical Issues: A Health Policy and Bioethics Consortium* (February 8, 2019) (describing the "black-box" of artificial intelligence algorithms as opaque computational models to make decisions).

[32] Liza Vertinsky and Todd M. Rice, *Thinking About Thinking Machines: Implications of Machine Inventors for Patent Law*, B.U. J. Sci. & Tech. L. 8(2), 574, 576-77 (2002) (discussing the growing use of computers to augment human capabilities and replace human operators, as well as its effects on the invention process that cannot be easily accommodated within the current patent system).

[33] Encyclopedia of Computer Science and Technology, Vol. 11, pp. 24, Marcel Dekker (1978) (defining a learning system as "any system which uses information obtained during one interaction with its environment to improve performance during future interactions).

intelligence varies, the context and nature of its use remains consistent across applications. This Article adopts such a unifying definition of artificial intelligence as "methods and systems that automate behaviors dynamically using trainable data sets."

A subset of artificial intelligence is machine learning,[34] which is comprised of algorithms that provide new insights without being programmed to do so.[35] Machine learning is comprised of computer programs that can learn from experience and improve their performance over time.[36] Artificial intelligence technology, specifically machine learning,[37] utilizes algorithms to change their output based on experiences, and such learning can classified as being supervised learning or unsupervised learning.[38] Machine learning techniques, which can automatically design models from large amounts of observed data without relying on rule-based programming,[39] provides a technique, mechanism, or a process to achieve artificial intelligence.[40] The underlying steps of machine learning can be summarized as: (1) gathering and preparing data (to apply towards a chosen machine learning model), (2) training the data (based on a chosen machine learning model) with validation and verification, (3) evaluating, tuning, and testing the data (resulting in a trained machine learning model), and (4) making predictions with new data (using the trained machine

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[34] Juan Mateos-Garcia, *The Complex Economics of Artificial Intelligence* (Dec. 19, 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3294552 6 (stating that the artificial intelligence system combines machine learning algorithms).

[35] Carlton E. Sapp, *Preparing and Architecting for Machine Learning*, Gartner (January 17, 2017) at 1, 5 (further defining machine learning at extracting knowledge or patterns from a series of observations; describing that data is fed into a machine learning system, which uses the data to fit to algorithms to solve a problem or derive an insight).

[36] Harry Surden, *Machine Learning and Law*, 89 WASH. L. REV. 87, 89 (2014).

[37] Surden, *supra* note 3636, at 88–89 (defining machine learning techniques as algorithms that have the ability to improve in performance over time on some task, by detecting patterns in data in order to automate complex tasks and make predictions).

[38] Info. Comm'rs Office, Big Data, Artificial Intelligence, Machine Learning and Data Protection 7 (2017), http://www.ico.org.uk/media/for-organisations/documents/2013559/big-data-ai-ml-and-data-protection.pdf (defining machine learning generally as being "the set of techniques and tools that allow computers to 'think' by creating mathematical algorithms based on accumulated data" specifying that supervised learning involves algorithms based on labelled datasets, such that the algorithms are trained how to map form input to output with the provision of correct values assigned to them, and where the initial training phase creates models of the world on which predictions can be made in a subsequent prediction phrase; and specifying that unsupervised learning involves algorithms that are not trained, but are left to find regularities in input data without what to look for).

[39] ALEX SMOLA & S.V.N. VISHWANATHAN, INTRODUCTION TO MACHINE LEARNING 3–4 (2008) (describing a variety of machine learning applications, where there exists a nontrivial dependence between some observations for which a simple set of deterministic rules is not known, such as: (i) *web page ranking*, which a process of submitting a query to a search engine to find webpages relevant to the query and returning them in an order of relevance; (ii) *collaborative filtering*, where Internet bookstores utilize users' past purchase and viewing decisions information to predict future viewing and purchase habits of similar users; (iii) *speech recognition*, where an audio sequence is annotated with text or where handwriting is annotated with a sequence of strokes); and (iv) classification, where spam filtering program can identify whether an email contains relevant information or not, such as a frequent traveler email, based on the type of user); GIANLUCA BONTEMPI, HANDBOOK: STATISTICAL FOUNDATIONS OF MACHINE LEARNING 379 (June 2017) di.ulb.ac.be/map/gbonte/mod_stoch/syl.pdf.

[40] *See* Info. Comm'rs Office, Big Data, Artificial Intelligence, Machine Learning and Data Protection, *supra* note 12 at 7-8 (defining artificial intelligence as being achieved by machine learning; suggesting that machine learning is one of the mechanisms that facilitates artificial intelligence).

learning model).[41] These steps can be conducted by different entities in the data science value chain,[42] which this Article labels as: Developer, Trainer, Tester, and Predictor. The labeling of distinct data-based entities demonstrates a value chain of data-based transactions, which are analyzed through sales and offers to sell in potential patent infringement scenarios as explained in Part II of this Article.

The key facet of the data science value chain[43] are "dynamic, trainable data sets," which are a combination of initial fixed-sized data and additional actively generated data.[44] The "dynamic, trainable data sets" are applied in a machine learning model, which can comprised of any combination of algorithms, functions, code libraries, decision trees, clustering, and neural networks.[45] The machine learning module can "learn"[46] through a process where new data is fed into an algorithm, and over time, the machine learning module can make its own judgment based on previous data from similar tasks.[47] Newly fed data into "dynamic, trainable data sets" enables the predictive power of machine learning.[48] This Article makes the claim that "dynamic, trainable data sets" have the following unique characteristics that challenge the patent infringement statute: (1) able to function without humans; (2) capable of modification; and (3) evolve over time in response to conditions. Because the line between static and dynamic is increasingly being blurred with the advent and proliferation of "dynamic, trainable data sets," the patent system will need to react. This analysis is addressed in Parts II and III respectfully.

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[41] Towards Data Science, *The 7 Steps of Machine Learning* (Aug. 31, 2017) (combining some of the provided 7 described steps into a total of 4 steps, wherein the original 7 steps of machine learning are described as: gathering data as involving data that will become training data and being critical towards determining the robustness of the predictive model; data preparation as involving loading the data into a suitable place, randomizing the data, and preparing the data for use in the next step of training; choosing a machine learning model as involving a particular algorithm that is suitable for the type of data, such as one that is specific for image data, numeric data, text based data, among others; training as involving incrementally improving the model's ability to make a prediction by initializing random values, attempting to predict the output based on those values, and adjusting the values to have more correct predictions; evaluating as involving testing the model against data that has never been used for training; tuning as involving further improving the training based on testing the parameters that were implicitly assumed during the training; and finally, predicting as involving using the model to make predictions based on new data); Lasse Overlier, Intellectual Property and Machine Learning: An Exploratory Study (January 2017) (Master Thesis, Norwegian University of Science and Technology) (on file with author) at 7 (explain that the initial step of machine learning can include data collection, data preparation, and descriptive statistics).

[42] Jose Maria Cavanillas, Edward Curry, Wolfgang Wahlster, NEW HORIZONS FOR A DATA-DRIVEN ECONOMY, Springer Open (2016); ATKearney, THE DATA VALUE CHAIN (2018);

[43] *Id*.

[44] Matt Taddy, *The Technological Elements of Artificial Intelligence*, forthcoming National Bureau of Economic Research book THE ECONOMICS OF ARTIFICIAL INTELLIGENCE, University of Chicago Press (2019) at 4 (describing that artificial intelligence systems require keeping a steady stream of new and useful information flowing into learning algorithms, comprised of two classes of data: 1. fixed-sized data assets used to train the machine learning models for generic tasks, and 2. data that is actively generated by the machine learning model as it experiments and improves performance).

[45] Azure Machine Learning Studio, *Machine Learning Module Descriptions*, Microsoft Docs.

[46] Surden, *supra* note 36, at 88–89 (suggesting that "learning" in machine learning is largely a metaphor and does not imply that machine learning systems are artificially replicating cognition involved with human learning).

[47] Sean Semmler and Zeeve, *supra* note 29 at 86-87.

[48] Osonde A. Osoba and Paul K. Davis, *An Artificial/Machine Learning Perspective on Social Simulation*, RAND NDRI/ISDP and ATP (2017) at 11.

In sum, artificial intelligence can be conceptualized as shown in Figures 1, 2, and 3 below. In Figure 1, the words of artificial intelligence, big data, data science, machine learning, and predictive analytics are shown to demonstrate their interrelationships and distinctions. In Figure 2, the machine learning process is shown. In Figure 3, which parallels Figure 2, shows the entities involved in the machine learning process. These diagrams inform the description of patent claims of artificial intelligence technology in Part I.B. and the analysis of patent infringement of artificial intelligence technology in Part II. of this Article.

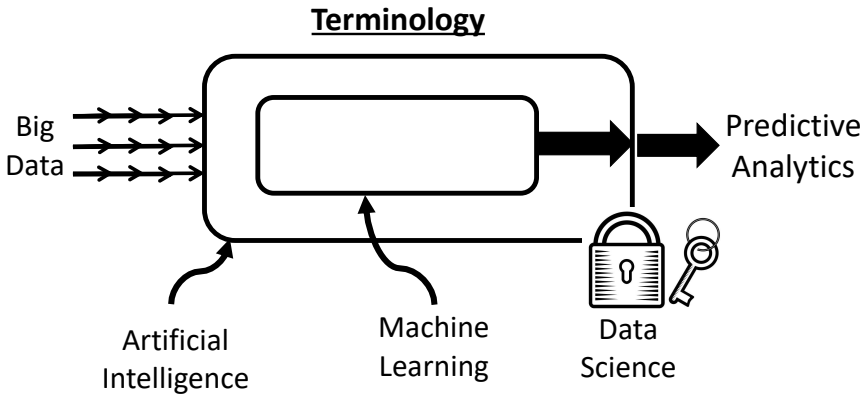

Figure 1: Conceptual representation of artificial intelligence terminology.

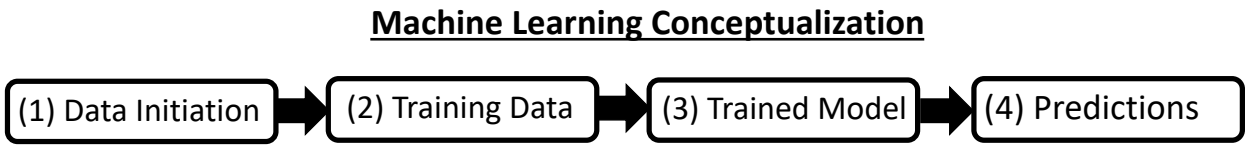

Figure 2: Conceptual representation of the machine learning process.

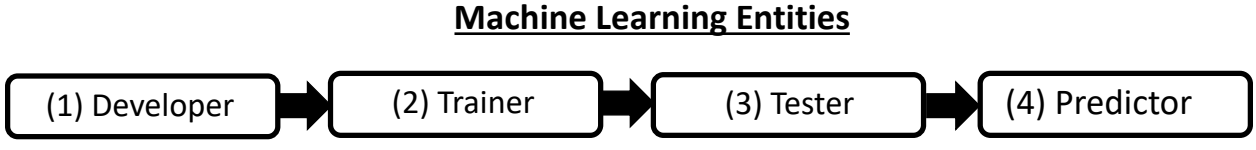

Figure 3: Conceptual representation of the machine learning entities.

B. *Artificial Intelligence Patent Claims*

Patent claims directed to artificial intelligence have tended to focus on machine learning, which inverts the programming paradigm.[49] Artificial intelligence patent claims tend to utilize functional claiming and emphasize the structural nature of machine code algorithms and the functional elements of software such as data structures.[50] Representative machine learning patent claims tend to include a method, a system, and a computer readable medium patent claim.[51] This form of patent claiming in a digital technology represents another instance of a divided infringement possibility, where separate actors can divide the performance of the patented method among themselves.[52]

There are varying opinions on patentability of artificial intelligence and machine learning technologies. However, artificial intelligence patent trend analysis demonstrates three categories of artificial intelligence patents generally and in Europe specifically: (1) algorithms, (2) platforms, and (3) applications.[53] A panel of artificial intelligence experts has presented a similar view in describing the European Patent Office's observations of artificial intelligence patenting as being classified by three types: (1) core artificial intelligence (which has largely been found to be unpatentable, especially in the U.S.), (2) trained models and machine learning (for which patentability has varied, depending on the examples and parameter ranges demonstrated), and (3) artificial intelligence as a tool that is applied to a particular field (which has a greater chance for patentability when demonstrating technical features or a technical effect).[54] Thus, depending on the nature of the artificial intelligence there could be different patent claims. However, patent trend analysis and expert feedback has suggested that many artificial intelligence patents tend to implement at least one method patent claim and at least one system patent claim.

C. *Patentability Doctrinal Concerns*

As with any new technology, there are challenges on how best to protect the intellectual property as a pioneer operating in an unexplored area. Moreover, the explosive growth in artificial intelligence technology and applications has made many to claim that existing patent protection mechanisms will not satisfy the new industry. Recent scholarship has examined the front end of

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[49] McDonnell Boehnen Hulbert & Berghoff LLP, How to Draft Patent Claims for Machine Learning Inventions (November 26, 2018) (describing that in machine learning a function is found if one gives a computer a large enough set of inputs and outputs, whereas computer programming has traditionally required a function to generate output; describing further that in machine learning, a data set is fed into an algorithm, which trains the machine learning model to "learn" a function that produces mappings between inputs and outputs).

[50] Michael D. Stein, *Patenting Inventions in Machine Learning: Part 1* (December 21, 2016); Michael D. Stein, *Patenting Inventions in Machine Learning: Part 2* (December 22, 2016).

[51] IPFolio, Patenting Algorithms: IP Case Law and Claiming Strategies (October 2017); McDonnell Boehnen Hulbert & Berghoff LLP, How to Draft Patent Claims for Machine Learning Inventions (November 26, 2018)

[52] Nathaniel Gross, *Resolving the Divided Patent Infringement Dilemma*, 50 U. MICH. J.L. REFORM 1, 3-4 (2016).

[53] Withers & Rogers LLP, Patentability of Artificial Intelligence and Machine Learning Inventions in Europe (March 22, 2018)

[54] European Patent Office, *Patenting Artificial Intelligence*, Conference Summary (May 30, 2018) at 4-6.

the intersection of patent law and artificial intelligence with analysis of patentability. Scholars have begun to confront issues with inventorship[55] and with the obviousness standard[56] for artificial intelligence technology.

First, with inventorship, the central question is—who will own the patents for inventions created solely by artificial intelligence? The doctrinal challenge is that the U.S. patent system has required human ingenuity to qualify for inventorship. At issue is how the patent system should treat inventions conceived by artificial intelligence without the assistance of humans to recognize a human inventor. The U.S. patent system requires conception, which requires "the formation in the mind of the inventor, of a definite and permanent idea of the complete and operative invention," for an invention.[57] Some may argue that artificial intelligence may solely be responsible for conception, whereas others may argue that artificial intelligence is a tool that assists humans with conception. Each of these perspectives requires reexamining the objectives of the patent system and whether granting inventorship to artificial intelligence would accelerate or negatively impact innovation.[58] Scholars have provided differing views and analysis on the inventorship issue with artificial intelligence. Professor Abbott argues that treating nonhuman artificial intelligence as inventors would incentivize the development of creative computers[59]. Professor Schuster states that "efficiency is best attained by allocating [artificial intelligence] property rights to parties that purchase or license [artificial intelligence] software and utilize it for invention" and recommends that artificial intelligence users should be entitled to obtain artificial intelligence patents to maximize economic efficiency based on the Coase Theorem.[60] Professors Ravid and Liu suggests that efforts to identify a single inventor of artificial intelligence systems are not applicable, and instead that a Multiplayer Model, which involves contributions from many players based on their indirect and insignificant involvement, should be utilized but would not meet the current threshold for inventorship.[61]

Second, with nonobviousness, the central question is—should the obviousness standard of a Person of Ordinary Skill in the Art (POSITA) be adjusted in light of artificial intelligence or is the POSITA standard adequate? The doctrinal challenge concerns whether obviousness is too lenient of a standard in light of the proliferation of artificial intelligence technology, and whether the standard should evolve to consider the use of artificial intelligence technology towards the conception of the invention. At issue is how to define a "person or ordinary skill in the art." The U.S. patent system requires a hypothetical person and not some aspect of artificial intelligence in

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[55] *See supra* note 11.

[56] *See supra* note 12.

[57] Sewall v. Walters, 21 F.3d 411 (Fed.Cir. 1994); *See* U.S. PATENT & TRADEMARK OFFICE, MANUAL OF PATENT EXAMINING PROCEDURE § 2138.04 (9th ed. 2018).

[58] *See* Artificial Intelligence Collides with Patent Law, *supra* note 29 at 9-10.

[59] Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C.L. REV. 1079 (2016).

[60] W. Michael Schuster, *A Cosean Analysis of Ownership of Patents for Inventions Created by Artificial Intelligence*, 75 WASH. & LEE L. REV. 1945 (2018).

[61] Shlomt Yanisky Ravid and Xiaoqiong Liu, *When Artificial Intelligence Systems Produce Inventions: The 3A Era and an Alternative Model for Patent Law*, CARDOZO L. REV. (forthcoming 2018).

its comparison for nonobviousness. Some may argue that raising the nonobviousness standard too high could lessen incentives for innovation, and some may argue that keeping the standard as is would result in a flood of artificial-intelligence generated patents to the U.S. Others have suggested that patent law has been an effective system for many years of numerous technological developments, and there is no need to change the nonobviousness standard. Scholars have provided differing views and analysis on the inventorship issue with artificial intelligence. Prof. Abbott has proposed a new Inventive Machine Standard[62] that would focus on reproducibility or secondary factors to raise the bard to patentability in fields where artificial intellingence reduces the cost of invention.[63] Professor Vertinsky points out that including artificial intelligence system ("thinking machines") into the Person Having Ordinary Skill in the Art (PHOSITA) standard would leave little if anything to meet patentability since obviousness determiations would require a search of different types of artificial intelligence and access to a broader range of data.[64]

There is a disconnect with the current patent system and artificial intelligence technology. Artificial intelligence has been recognized as challenging the frontend of the patent system with inventorship and with obviousness. Similar to the discussion on patentability, the backend issues concerning infringement of artificial intelligence patents face similar challenges. Artificial intelligence disrupts patent law in cases where artificial intelligence may violate patent rights.

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[62] Ryan Abbott, *Everything is Obvious*, 66 UCLA L. REV. 2, 9, 37 (2018) (where the Inventive Machine Standard requires that a decisionmaker would need to "(1) determine the extent to which incentive machines are used in a field, (2) if the inventive machines are the standard, characterize the inventive machine(s) that best represents the average worker, and (3) determine whether the machine(s) would find an invention obvious.")

[63] *Id* at 37, 42-46.

[64] *See* Vertinsky, *supra* note 12.

II. PATENT INFRINGEMENT DOCTRINAL & STATUTORY ANALYSIS

As the role of artificial intelligence technology becomes more commonplace in products and services, artificial intelligence patentees may consider filing patent infringement actions against their competitors. The long string of contributors (either human or machine)[65] in the use of artificial intelligence technologies creates potential opportunities for asserting patent infringement in light of an unclear statutory language. Even though owners of artificial intelligence patents risk invalidation of their patents in district courts or with the United States Patent & Trademark Office's Patent Trial & Appeal Board (PTAB), disputes of patent infringement of artificial intelligence technologies are gaining attention. For example, a recent patent infringement case in a district court has centered on a dispute concerning predictive analytics.[66]

In order to prevent an influx of patent infringement suits and promote the patent system's objectives of maximizing social and economic benefits, this Article examines the doctrinal gaps in the patent infringement statute for artificial intelligence technologies. It argues that the unique attributes of artificial intelligence—autonomous ability to function without humans, to modify, and to evolve over time in response to new data—cause doctrinal uncertainties in patent infringement analysis that are not the result of purely market disruption.[67] This analysis necessitates an introduction to patent infringement and application of artificial intelligence to the patent infringement statute.

Patent rights enable an inventor to excludes other from infringing the patented invention.[68] In the U.S. patent system, one cause of action for patent infringement of a patent claim can occur when "whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent thereof."[69] Patent infringement assessment is based on first determining the meaning in each patent claim and second showing the accused infringement meets each claim term.[70] The words in the patent infringement statute and the steps in utilizing it have been applied to a variety of technologies over many years. However, artificial intelligence challenges whether to assign liability independent of human involvement, who to assign liability, and how to assess liability for

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[65] *See* Vertinsky, *supra* note 12 at 19.

[66] *See supra* note 14 (in which the plaintiff PurePredictive, Inc., which uses artificial intelligence technology to provide insight into business data through the use of predictive modeling, filed a patent infringement action against H2O.AI, which provides a machine learning platform integrated with applications and data products, alleging infringement both direct and induced infringement; H2O.AI successfully dismissed the complaint based on patent ineligibility of implementation of predictive analytics as reciting abstract ideas).

[67] Mark Lemley and Mark McKenna, *Unfair Disruption*, Notre Dame Law School Legal Studies Research Paper No. 1926, available at: http://ssrn.com/abstract=3344605 at 1, 7-8 (drawing from antitrust injury doctrine to recognize that for disruptive technologies, such as artificial intelligence, cases of infringement are sometimes challenges to market disruption; also recognizing the cases where disruptive technologies, such as artificial intelligence, are traceable to the act of infringement occur when there is interference with the law itself).

[68] United States Constitution, Art. I. § 8.

[69] 35 U.S.C. § 271(a).

[70] Markman v. Westview Instruments, 52 F.3d 967, 979 (Fed. Cir. 1995).

patent infringement. These questions are important since they inform damages for patent infringement, or possibility injunctions for the infringing activity.

The primary doctrinal challenge with artificial intelligence patent infringement is that U.S. patent laws do not acknowledge finding of patent infringement independent of human involvement.[71] The U.S. patent infringement statute is replete with references to the human without any reference non-human possibilities. U.S. patent law does not attribute cognition to machines,[72] and phrases in the Patent Act such as "whoever," "knowing," and "no patent owner" indicate human attribution.[73] Thus, artificial intelligence technology cannot be held liable for patent infringement actions. Instead, patent infringement occurring as a result of artificial intelligence technology would have to be traced back to a human.

As a result of these doctrinal challenges with respect to artificial intelligence technology, this Part II helps to makes three claims: First, it proposes that "dynamic, trainable data sets" of artificial intelligence technology requires new principles of interpretation of patent infringement to provide clarity on legal liability. Second, it suggests that patenting of artificial intelligence creates divided infringement scenarios and concludes that method and system claims are infringed under the same reasoning due to "dynamic, trainable data sets." Third, the statutory analysis presented suggests attributing patent infringement to the Developer[74] or end user Predictor[75] would cause uncertainty in the development of artificial intelligence technology, and instead a contractual indemnity solution as described in Part III would provide predictability to liability for artificial intelligence patent infringement.

These conclusions are reached through a detailed exploration of the various acts under 35 U.S.C. § 271 that constitute patent infringement. In the world of artificial intelligence technology, the theories and causes of action of patent infringement are more complex. The nuances of indirect infringement, divided infringement, and infringing uses are particularly pronounced with artificial intelligence patent infringement. The analysis proceeds with exploring each of the infringement provisions of 35 U.S.C. § 271, and concludes with analyzing the issue of divided infringement involving multiple actors.

A. *35 U.S.C. § 271(a)*

The Patent Act defines direct infringement in 35 U.S.C. § 271(a) as when another party without authorization makes, uses, offers to sell, sells any patented inventions, within the United States or imports into the United States any patented invention.[76] Section § 271(a) has been

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[71] Artificial Intelligence Collides with Patent Law, World Economic Forum White Paper (April 2018) at 11 (also suggesting a related issue concerning how liability and damages is handled for patent infringement by artificial intelligence technology)

[72] Liza Vertinsky, Thinking Machines and Patent Law, available at: https://ssrn.com/abstract=3036030 (2017) at 10.

[73] 35 U.S.C. § 271 (where § 271(a), (b), and (c) utilize "whoever"; where § 271(b) utilizes "knowing," and where § 271(d) utilizes "no patent owner").

[74] *See supra* Part I.

[75] *See supra* Part I.

[76] 35 U.S.C. § 271(a).

recognized as requiring no more than the unauthorized use of a patented invention by performing one of the enumerated activities—either making, using, offering for sale, selling, or importing the invention.

Thus, an entity that makes a patented artificial intelligence technology and goes onto to use, offer for sale, sell, or imports plainly is a direct infringer. The mere act of making a patented artificial intelligence technology is a direct infringement, and distinct from any subsequent use, sale, offer for sale, or importation. The patent infringement statute does not define "make" or "making," but it seems unlikely that artificial intelligence technology would qualify under "making," since it fails to produce something tangible. It may seem better from the patentee's perspective to proceed on a theory of "use," "offer to sale," or "sale" of the invention, particularly the patent claims directed to a machine learning model employing "dynamic, trainable data sets."

The theory of suing using a patented invention is another possible cause of action, but on one that will likely be impractical with artificial intelligence. There is no definition of "use" in the patent infringement statute, but it is interpreted broadly.[77] The U.S. Supreme Court to mean "to put into service any given invention."[78] Specifically, the use of the product should incorporate some principles of the claimed invention[79] or must be put into service by controlling the system and obtaining benefit from it.[80] The *Roche Prods, Inc.* decision followed the U.S. Supreme Court's interpretation in giving the term "use" a broad definition and interpretation.[81] In *Decca*, the Federal Circuit determined that "use" of a claimed system referred putting a system as a whole into service, such that the control of a system was exercised and a beneficial use of the system was obtained.[82] However, courts have reached a different conclusion with "use" of a patented method, which requires carrying out all of the steps of the method.[83]

Thus, the theory of suing for using a patent artificial intelligence technology would depend on whether the patent claims were method or system. Nonetheless, in either case of method or system, the theory would fail for a number of reasons. One difficulty is due to the anonymity of transforming mathematical equations with artificial intelligence. This is problematic since "dynamic, trainable data sets" transform as new data is fed into the machine learning module to

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[77] NTP, Inc. v. Research in Motion, Ltd., 418 F. 3d 1282, 1316 (Fed. Cir. 2005).

[78] Bauer & Cie v. O'Donnell, 229 U.S. 1 (1913); Centillion Data Systems, LLC v. Qwest Communications Int'l, Inc., 631 F.3d 1279, 97 U.S.P.Q. 2d 1697 (Fed. Cir. 2011) (wherein Centillion accused Qwest of infringing its patent for collecting, processing, and delivering information from a service provider; Qwest had provided back office systems, front-end client applications, and software applications that a user could install onto a personal computer, and Qwest argued that did not "use" the system because it did not control the back-end processing and only provides the results; the court reasoned that Qwest never used the entire back-end processing elements because it never "used" the entire claimed system by putting into service the data processing means, and the court held that supplying of software was not the same as using the system).

[79] DONALD S. CHISUM, CHISUM ON PATENTS, § 16.02[4][c] (2001).

[80] *See* NTP, Inc. v. Research in Motion, Ltd., *supra* note 77 at 1317.

[81] Roche Prods, Inc. v. Bolar Pharm. Co., 733 F. 2d 858, 863 (Fed. Circ. 1984); NTP, Inc. v. Research in Motion, Ltd., 418 F. 3d 1282, 1316 (Fed. Cir. 2005).

[82] Decca Ltd. v. United States, 210 Ct. Cl. 546, 544, F.2d 1070, 1083 (1976); NTP, Inc. v. Research in Motion, Ltd., 418 F. 3d 1282, 1316 (Fed. Cir. 2005).

[83] Roberts Dairy Co. v. United States, 208 Ct.Cl. 830, 530 F.2d 1342, 1354 (1976).

make predictions.[84] Another difficulty is that the potential infringers would be geographically dispersed and civil procedures rules of joinder and personal jurisdiction would be problematic, or would require a significant cost and great deal of time to sue each infringer separately.

A more conceivable theory of patent infringement of artificial intelligence is the idea that sellers of machine learning models are offering for sale and selling the patented invention under 35 U.S.C. § 271(a). The patent infringement statute does not define "sell" or "offers to sell", not does it specify which infringing acts apply which to which type of patent claims. It can be assumed that Congress had intended to give "sell" its ordinary meaning, which would require transfer of title or property and the capability of being transferred. Courts have found it difficult to apply the concept of "sell" to a method patent claim comprising multiple steps.[85] Since it would be difficult for transferring the steps of a method claim in exchange for consideration and since the performance of a method would not require anything capable of being transferred, then infringement of a sale of a method claim of a machine learning model would be problematic.

However, performing some of the asserted method claims as a service for customers has not been considered selling or offering to sell.[86] And a party could be found to infringe patent claims by a sale of a system. Thus, under this analysis, method claims of artificial intelligence would be difficult as a cause of action for patent infringement under § 271(a), but service of methods or system claims from artificial intelligence could be asserted. For example, sale of a system of a trained machine learning model, device embodying that machine leaning model, and an environment where that machine learning model is applied could be infringed under § 271(a). Nonetheless, it would be impractical for a patentee of a machine learning model to sue someone who may be a buyer of either the model itself or the predicted outcomes of the model.

B. *35 U.S.C. § 271(b)*

A person or entity is liable as an indirect infringer when there is active inducement of the patent as an infringer.[87] This type of infringement refers to encouraging the unauthorized practice of another's patented invention with culpable conduct[88] and applies even when the accused infringer did not employ the patented invention for themselves.[89] In order to prove active infringement, a patentee must demonstrate: (1) direct infringement; (2) specific intent to induce a third party to infringe; and (3) an affirmative act by the inducer.[90] Artificial intelligent patent

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[84] *See supra* Part I.A.

[85] Minton v. Nat'l Ass'n of Sec. Dealers, Inc., 336 F.3d 1373, 1378 (Fed.Cir. 2003).

[86] NTP, Inc. v. Research in Motion, Ltd., 418 F. 3d 1282, 1316 (Fed. Cir. 2005).

[87] 35 U.S.C. § 271(b).

[88] *See* Global-Tech Appliances, Inc. v. SEB S.A., 131 S. Ct. 2060 (2011)

[89] *See* American Cotton-Tie Co. v. Simmons, 106 U.S. (16 Otto) 89, 1 S.Ct. 52, 27 L.Ed. 79 (1882).

[90] KIMBERLY A. MOORE, TIMOTHY R. HOLBROOK & JOHN F. MURPHY, Patent Litigation and Strategy (West 5th ed. 2018) at 445.

infringement creates unique problems for a patentee's ability to enforce its patent through active inducement.

First, the patentee would need to prove that the alleged inducement led to an act of direct infringement,[91] but this proof need not be of actual evidence. In the context of artificial intelligence, for example, the patentee would have to show by direct or circumstantial evidence that the accused inducer provided access to the machine learning model that another entity utilized for operation of new data to predict outcomes. It would be difficult to prove this kind of direct infringement of using the machine learning model because of the nature of artificial intelligence training and operation. Discovering what type of machine learning model is utilized would be nearly impossible, since it would require possession of the same "dynamic, trainable data sets" and knowledge of the model training capabilities. Under patent law, the act of direct infringement would be the implementation of the machine learning model in the operation phase to predict outcomes, and would constitute "making" of the patented module invention.[92] As such, a patentee would need to prove that the user of the machine learning model actually made predicted outcomes with the machine learning model. One would not be able to obtain such proof, not because it is costly and difficult, but because it would reverse engineering the machine learning module's operation. While the patentee's search burden could be reduced by only needing to prove direct infringement with circumstantial evidence,[93] there is uncertainty on the level of circumstantial evidence in general,[94] and for artificial intelligence technology is a new and undertheorized area.

Second, the patentee would need to prove that the alleged inducer must have had the requisite mental state of intention to induce acts of infringement.[95] While 35 U.S.C. § 271 does not expressly refer to the inducer's knowledge or purposes,[96] courts have required that the defendant intended to cause the acts that it had reason to know were infringing of a patented device or method.[97] This intent element requires actual knowledge or willful blindness,[98] or knowingly inducing the infringement. The patentee would be required to prove the underlying act of direct infringement, which the aforementioned discussion has suggested in challenging; moreover, the patentee must also prove that the inducer actively encouraged the direct infringer with knowledge of the patent.[99] This intent requirement would be challenging for patentees to sue for active inducement.

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[91] Aro Mfg. Co. v. Convertible Top Replacement Co., 365 U.S. 336, 341-42 (1961); Limelight Networks, Inc. v. Akamai Techs. Inc., 134 S. Ct. 2111, 2115 (2014).

[92] 35 U.S.C. § 271(a).

[93] Moleculon Research Corp. v. CBS, Inc., 793 F.2d 1261, 1272 (Fed. Cir. 1986).

[94] ACCO Brands, Inc. v. ABA Locks Manufacturing Co., 501 F.3d 1307, 1313 (Fed. Cir. 2007).

[95] *See* Global-Tech Appliances, *supra* note 88.

[96] 35 U.S.C. § 271(b).

[97] *See* Global-Tech Appliances, *supra* note 88.

[98] Hewlett-Packard Co. v. Bausch & Lomb Inc., 909 F.2d 1464, 1469, 15 USPQ2d 1525, 1529 (Feb.Cir. 1990).

[99] *See* Global-Tech Appliances, *supra* note 88 at 2068.

Unlike a typical manufacturing technology case of active inducement, where a supplier seller of a product provides instructions or offers training promoting an infringing use, in artificial intelligence technology the machine learning module is becoming common-place[100] and parties in the artificial intelligence value chain have little knowledge of about the applicability of patent protection of such modules. Even if the accused inducer copies a machine learning module that is patented, patentees of artificial intelligence technology would need to proactively and rigorously police activities to have viable causes of action. This is a difficult task in a world of transmitted data flows and difficult to identify and track machine learning based improvements to data sources. For example, photos (and their underlying representative imaging data) can improve instantaneously based on embedded machine learning modules, and a patentee owner of the machine learning module would need to prove that an inducer Owner actively encouraged the direct infringer with knowledge of the machine learning module patent.

Third, the inducement requires that the accused inducer actively induced the infringement.[101] The Supreme Court has held that term "active" in actively induced means taking affirmative steps to bring about the desired result and the term "induced" in actively induced means by persuasion or by influence. Thus, it seems that the inducer would need to transfer the machine learning module with the specific intent that it operated. However, there is a lack of clarity around what action is required for specific intent to be met. For example, once the machine learning module is trained, then must the inducer take the affirmative step of transferring the module and urge it to be utilized by the Operator? Although libraries of machine learning modules can be shared, they are trained based on underlying trainable data sets, and the machine learning modules would not be applicable to all new sets of data.

Due to these practical technological limitations, patentees of artificial intelligence technologies would have considerable difficulty in using active inducement of patent infringement under 35 U.S.C. § 271(b) to stop or prevent transfers of machine learning modules. If patentees consider artificial intelligence patent infringement actions, then it would be unlikely under 35 U.S.C. § 271(b), but under some other cause of action.

C. *35 U.S.C. § 271(c)*

One option for pursuing the operator of machine learning modules is under a theory of contributory infringement. This form of indirect infringement under 35 U.S.C. § 271(c) is considered a narrowly focused provision.[102] Since the U.S. Supreme Court has taken a restrictive view of the meaning of "components," it is unlikely that this theory of patent infringement in artificial intelligence will be successful. Thus, parties utilizing artificial intelligence technology can avoid some liability with machine learning modules not constituting "components" under the

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[100] Michael Borella, How to Draft Patent Claims for Machine Learning Inventions, McDonnell Boehnen Hulbert & Berghoff LLP: PatentDocs (November 25, 2018), https://www.patentdocs.org/2018/11/how-to-draft-patent-claims-for-machine-learning-inventions.html

[101] *See* MOORE, HOLBROOK & MURPHY, *supra* note 90 at 444-445.

[102]

patent infringement statute. A review of statute and relevant case law guides in arriving at this determination.

Contributory infringement arose from initial cases concerning situations where a party sold a specially manufactured component that a customer intended to employ in the practice of a patented invention. The developed common law concerning such situation was codified into 35 U.S.C. § 271(c). Specifically, section 35 U.S.C. § 271(c) renders liability for contributory infringement when: (i) someone offers to sell, sells, or imports in the United States; (2) a component of a patented machine, manufacture, combination or composition, or a material or apparatus for use in practicing a patented process, constituting a material part of infringement of such a patent; (iii) knowing the component to be especially adapted for use in an infringement of a patent with no substantial non-infringing uses; and (iv) resulting in an act of direct infringement.

Whereas 35 U.S.C. § 271(b) requires an intent to cause infringement through active inducement,[103] 35 U.S.C. § 271(c) has no such requirement.[104] Instead, 35 U.S.C. § 271(c), which requires knowledge of the patent and also knowledge that the component is especially adapted for the patent,[105] is for situations where the only legitimate use of a sold component is an infringing one. Thus, the scienter requirement for 35 U.S.C. § 271(c) requires proof that "an alleged contributory infringer knew that the combination for which his component was especially designed was both patented and infringed."[106] However the statute was not clear as to what would be considered a "component." Thus, based on the lack of language in 35 U.S.C. § 271(c) and in 35 U.S.C. § 271(f) indicating the scope of "components," the courts were left to determine the proper coverage.

The earliest cases address the scope of "components" over infringement of a patent concerned mechanical devices.[107] The controversy over whether "components" for patent infringement has considered and broadly included chemical compounds[108] and considered aspects of software. In *Microsoft Corp. v. AT&T Corp*, AT&T sued Microsoft for infringing an AT&T patent by selling products containing speech signal compression and decompression software.[109]

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[103] 35 U.S.C. § 271(b).

[104] 35 U.S.C. § 271(c).

[105] *See* Aro Mfg. Co. v. Convertible Top Replacement Co., *supra* note 91 at 488.

[106] *See* Aro Mfg. Co. v. Convertible Top Replacement Co., *supra* note 91.

[107] *See* T.D. Williamson, Inc. v. Laymon, 723 F. Supp. 587 (N.D. Okla. 1989); Smith Int'l, Inc. v. Hughes Tool Co., No. CV 72-1231, 1986 WL 4795, at *1 (C.D. Cal. Mar. 12, 1986), 839 F. 2d 663 (Fed. Circ. 1988); Bristol-Myers Squibb Co. v. Rhone-Poulenc Rorer, Inc. No. 95 CIV 8833 2001 WL 1263299, at 3* (S.D.N.Y. Oct. 19, 2001).

[108] W.R. Grace & Co.-Conn. v. Interact, Inc., 60 F. Supp. 2d at 319.

[109] See Microsoft Corp. v. AT&T Corp, 550 U.S. 437 (2007) (wherein the AT&T patent covered an apparatus for digitally encoding and compressing recorded speech and Microsoft's operating system included software code which, when installed into a computer, enabled the computer to process speech within the scope of the patented apparatus; AT&T contended that software in the abstract could be considered a component of the patented invention, whereas Microsoft contended that only a physical copy of the software could be viewed as a component; Microsoft reasoned that if software is only a component when it is a physical copy, then the master copies that it sent abroad would not be considered components, because it had sent its software from the United States to a foreign manufacturer and that software was never copied abroad, but only copies of the disks were used for installation onto computers made and sold abroad).

The court held that software was not a "component" amenable to combination with a computer, until and unless it is expressed on a computer readable medium, and determined that Microsoft did not infringe since it did not supply any software copies that were actually installed on the computer abroad.[110] Thus, one perspective of the *Microsoft* case is that there is a distinction between abstract instructions and physical combinable aspects of software. Based on the *Microsoft* case, which concerned 35 U.S.C. § 271(f)'s language of a "component of a patented invention,"[111] a "component" under 35 U.S.C. § 271(c) would have an even narrower meaning under since it applies in a more narrow fashion to "a component of a patented machine, manufacture, combination, or composition."[112] Thus, under 35 U.S.C. § 271(c), a "component" would exclude abstract instructions. While ambiguities may arise with substantial non-infringing uses, artificial intelligence technology, patentees of artificial intelligence technologies would have considerable difficulty in arguing contributory patent infringement under 35 U.S.C. § 271(c) since machine learning models would not be considered components under narrow interpretation.

[110] See Microsoft Corp. v. AT&T Corp, *supra* note 109 at 449 (wherein the court reasoned that software in the abstract was information and detailed instructions comparable to a blueprint, schematic, template, or prototype, but that software itself was not combinable into a device).

[111] 35 U.S.C. § 271(f).

[112] 35 U.S.C. § 271(c).

III. IMPLICATIONS FOR LIABILITY LOOPHOLE WITH ARTIFICIAL INTELLIGENCE

Artificial intelligence technology presents an example of multi-actor patent claims.[113] Thus, in the case of artificial intelligence patent infringement, courts must determine whether the acts of one or more actors can be attributed to a single entity, such that the single entity is responsible for the infringement. This is termed "divided infringement" and it occurs when the actions of multiple entities are combined to perform every step of a claimed method, but no single party acting alone has completed the entire patented method.[114]

These divided infringement scenarios create a loophole in artificial intelligence technology since innocent parties may be unaware that their actions contributed to patent infringement. Some of the parties in the artificial intelligence value chain (of Developer, Trainer, Tester, and Predictor)[115] need to work in concert to complete the performance of machine learning. In order to obtain the benefit of predicted outcomes, the process of machine learning requires each of developing data, training the data, testing the data resulting in a trained model, and making predictions with new data.[116] Thus, since machine learning requires access to a "dynamic, trainable data set" as a data source and since other parties a need to work in concert, then no single party can perform all of the steps alone. The need for some connection between the parties in machine learning presents problems for patent holders of artificial intelligence method patents.

This Article asserts that artificial intelligence technology creates a patent litigation liability loophole. Based on context of artificial intelligence in practice, multi-actor patent claims are due to its multi-party value chain and accompanying multi-party actions to create predictions based on artificial intelligence technology. Clever claim-drafting by patent prosecution will not avoid the multiple actor scenarios since artificial intelligence necessitates that parties divide the performance of machine learning. These assertions are explained through an analysis of patent claims on inventive methods and assessment of divided infringement artificial intelligence scenarios via the *Akami* court decisions. Such an analysis demonstrates that some parties would be liable event though their innocent activities were combined with those of another party to violate another party's patent right.

Courts have struggled to equitably resolve divided infringement lawsuits, and artificial intelligence patent infringement will present similar issues. There are liability loopholes that would-be infringers of patented artificial intelligence technology can circumvent by intentionally dividing the performance of a patented method among multiple parties working together. As a result of the liability gap, this Article proposes that an artificial intelligence process claim should only be infringed if it has no substantial non-infringing use other than to effectively draw upon the value of the trained machine learning model for predicting outcomes. Moreover, it proposes private-public, hybrid model termed the "Artificial Intelligence Identification System" (AIIS).[117]

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[113] *See supra* Part I.A.

[114] Nathaniel Grow, *Resolving the Divided Infringement Dilemma*, 50 U. MICH. J.L. REFORM 1, 2 (2016).

[115] *See supra* Part I.A.

[116] *See supra* note 41.

[117] *See infra* Part IV.

IV. RESOLVING THE DIVIDED ARTIFICIAL INTELLIGENCE LIABILITY LOOPHOLE

Artificial intelligence is challenging the patent system more than any technology has done so before. Historically, a high level of patent activity in a particular sector has been followed by a patent war, resulting in numerous, high-value patent litigations. Artificial intelligence, which has experienced a recent high and growing patenting activity will be no different. Similar to the high patenting activity that triggered patent wars in semiconductor, Internet, and smartphone technologies, artificial intelligence technology patenting will trigger patent wars to prevent threats from patent trolls and respond to competitors in their industry. Regulatory and judicial challenges await, and it is the policymakers turn to do something about it.

In anticipation of artificial intelligence patent wars and with artificial intelligence technology having the potential to transform numerous industries, there can be either private-ordering mechanism or public-ordering mechanisms. Private-ordering mechanisms would be set by Standard Setting Organizations that would establish market confidence by setting a baseline platform to prohibit patent grants on the same technologies. However, private-ordering mechanisms often result in industry players promoting their own interests. Public-ordering mechanisms would be legislative reforms could provide a new way to defend against patent assertions in a faster and more efficient manner. However, public-ordering mechanisms typically take many years in the making and many years to implement.

A variety of artificial intelligence regulation proposals have been suggested by scholars and policymakers concerning artificial intelligence technology applications, including for regulation of autonomous vehicles, crimes, and personalized medicine. However, there has been a dearth of regulatory solutions specific to patenting of artificial intelligence technologies and specific to patent infringement of artificial intelligence patents. One conceivable proposal would be to make available to the public all possible "dynamic, trainable data sets" that could possibly be trained up by machine learning models. Another conceivable proposal would be to develop a uniform, consensus "dynamic, trainable data sets" that would be made available to the public all for future trainings by machine learning models. A problem with the first possibility of making accessible all data sets is that it is a static solution, since new "dynamic, trainable data sets" will continue to be available. A problem with the first possibility of attempting to arrive at uniform, consensus "dynamic, trainable data sets" would be that there would always be disagreements on who and what features should go within such a uniform data set and there would always be inherent biases in such a data set. Thus, there are short-comings to such proposals.

In order to the balance the tradeoffs of private-ordering and public-ordering mechanism and to avoid a patent war of artificial intelligence technologies, this Article proposes a balanced private-public, hybrid model termed the "Artificial Intelligence Identification System" (AIIS). This system involves collaboration from both the private sector (including the public, inventors, attorneys, and industry) and the public sector (including the government in general and the USPTO specifically). The AIIS calls for identification of artificial intelligence patents where "dynamic, trainable data sets" are utilized, and is comprised of two identification mechanisms: (1) utilizing artificial intelligence technology itself to serve as a threshold search tool to identify patent applications utilizing "dynamic, trainable data sets" and (2) proactive, identification by patent

applicants of patent applications implementing "dynamic, trainable data sets" in the field of invention of the patent application.

The first identification mechanism, which would have a public-ordering motivation, would require the USPTO to implement artificial intelligence technology. While it may be somewhat ironic that artificial intelligence technology is being utilized to regulate artificial intelligence patenting, the capability . Similar to the Japanese Patent Office's artificial intelligence capabilities, this first aspect of AIIS would serve as an initial screening tool. The USPTO could utilizing classification and tagging technology enabled by artificial intelligence to label patent applications implementing "dynamic, trainable data sets." Consensus can be achieved through a consensus protocol that filters unnecessary labels and determines the prominent labels. The second identification mechanism is similar to another USPTO identification mechanism of patents applications that are generated through federally-funded research grants at universities that require an identification of that patent application. In this second identification mechanism, the patent applicant can provide its own label for its own patent application. This second identification mechanism of AIIS would incentivize artificial intelligence inventors to share their knowledge through the patent system and enable another inventor to spend its resources on further technological advancements in artificial intelligence development.

These labels will not have any legal implications and patent rights, but would serve as metadata that provides educational information and searchability of the labels. This balanced private-public, hybrid, AIIS model would promote education, efficiency, and transparent access to artificial intelligence patents. The policy goal of the AIIS proposal is to alleviate the potential artificial intelligence patent wars that are to come and to avoid the liability loopholes of divided infringement from artificial intelligence patents. Despite the uncertainty surrounding inventorship and nonobviousness in patenting artificial intelligence technology, uncertainty surrounding theories of patent infringement among the performance of multi-actor artificial intelligence methods necessitates an immediate and simple-to-enact proposal in hopes of mitigating a patent war of artificial intelligence patents.

Rather than pursue a long-winded and cumbersome legislative reform, a quicker solution and one that would promote advancement of artificial intelligence technology is a better approach. AIIS can enable artificial intelligence researchers, inventors, patentees, and industry players to gain knowledge from labeling of artificial intelligence patents, and in doing so, incentivize sharing of knowledge of artificial intelligence technology. Rather than have private sector parties elucidate the scope of coverage of existing artificial intelligence patents and potential assert those patents in patent infringement suits, a proposal to make artificial intelligence technology easier to identify and easier to access through labeling of artificial intelligence patents would divert focus from patent litigation. Instead, AIIS-driven labeling would promote access, education, and transparency.

There may be challenges and dismissive reactions raised to the AIIS proposal, including redundancy and labeling abuse. First, some may argue that AIIS-driven labeling would serve a redundant effort that is already covered by the USPTO's existing classification and system for patent examination. The existing USPTO classification system identifies patents according to the field of technology that it covers. Moreover, the existing USPTO intake system assigns patent

applications to a particular patent examiner in an art unit of a technology center according to the field of technology that it covers. However, the existing mechanisms have a time delay effects since they take a time period from receipt of the patent application until classification and assignment for patent examination. Additionally, the existing mechanisms may be overwhelming and require an undue search burden. Instead, AIIS would have proactive and immediate measures without a time delay and would quicken the search of artificial intelligence patents. Second, some may argue that AIIS-driven labeling would run into labeling abuse. Users of AIIS may label patents as being artificial intelligence patents when they are not. This can be prevented with technological solutions that detect erroneous identification and incentives that reward high-accuracy labeling. For example, public recognition of users that provide high-accuracy labeling in submitted patent applications could serve an incentive. Furthermore, these criticisms could be thwarted by through engagement with standard setting organizations and the USPTO to create a robust tagging system. The standard setting organizations could assist in AIIS labeling by collaborating in self-reporting by industry players. The USPTO could assist in AIIS labeling by integrating its classification and intake-assignment system with the AIIS itself. In sum, the proposed private-public, hybrid AIIS can be an accessible, educational, robust, scalable, and transparent system that will lower the risk of a patent infringement war that has typically followed high patenting in a disruptive technology, such as artificial intelligence.

V. CONCLUSION

Artificial intelligence technology is disruptive and has potential to impact a number of applications and industries. While the term "artificial intelligence" has varying definitions and itself is unclear, the underlying technological principles include gathering and preparing data, training and testing "dynamic, trainable data sets" to make predictions. There has been a rapid raise in patenting of artificial intelligence technology despite doctrinal issues with inventorship and nonobviousness. Similar to the high patenting activity that triggered patent wars in other disruptive technologies, artificial intelligence technology patenting will trigger patent wars. A doctrinal assessment of 35 U.S.C. § 271 (a), (b), and (c) demonstrates little likelihood to success in such patent infringement lawsuits. However, a liability loophole results from multi-actor, divided infringement scenarios. As a result, a mechanism is needed to close the liability loophole and prevent patent wars of artificial intelligence technologies. The proposed "Artificial Intelligence Identification System" (AIIS) would make artificial intelligence technology easier to identify and easier to access through labeling of artificial intelligence patents and lessen the focus on patent litigation.