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I. INTRODUCTION

Artificial intelligence (AI) enables the creation of inventions that no natural person conceived, at least as conception is traditionally understood in patent law. These can be termed "AI inventions," i.e., inventions for which an AI system has contributed to the conception in a manner that, if the AI system were a person, would lead to that person being named as an inventor.

Deeming such inventions unpatentable would undermine the incentives at the core of the patent system, denying society access to the full benefits of the extraordinary potential of AI systems with respect to innovation. But naming AI systems as inventors and allowing patentability on that basis is also problematic, as it involves granting property rights to computer programs.

This Article proposes a different approach: AI inventions should be patentable, with inventorship attributed to the natural persons behind the AI under a broadened view of conception. More specifically, conception should encompass ideas formed through collaboration between a person and tools that act as extensions of their mind. The "formation" of those ideas should be attributed to the person, including when the ideas underlying the invention were first expressed by a tool used to enhance their creative capacity and subsequently conveyed to them.

Reconceptualizing conception in this manner would involve minimum disruption to existing law, as it would not require any change to the text of the Patent Act. It would promote investment in AI as a means to complement and enhance human creativity, and would avoid the many problems that would be associated with permitting non-human inventors.

The proposal described herein to rethink conception in relation to AI complements a growing body of scholarship and policy attention to the intersection of AI and patent law. Some authors have argued that AI inventions[1] do not deserve patent protection at all.[2]

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[1] The terminology used by different authors to describe what this Article calls "AI inventions" varies.

[2] *See, e.g.*, Shlomit Yanisky-Ravid & Xiaoqiong (Jackie) Liu, *When Artificial Intelligence Systems Produce Inventions: The 3A Era and an Alternative Model for Patent Law*, 39 CARDOZO L. REV. 2215, 2222 (2018) (explaining AI intelligence and writing "we argue here for abolishing patent protection of inventions by AI altogether"); Michael McLaughlin,

Others have argued that AI inventions do deserve patent protection, and that this should be accomplished by permitting AI systems to be named inventors.[3] Still others have suggested that patentability of AI inventions should be circumstance-dependent.[4] Authors have argued that there is no distinction between human and AI inventions since AI systems are programmed by humans,[5] or argued essentially the

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Computer-Generated Inventions, 101 J. PAT. & TRADEMARK OFF. SOC'Y 224, 251 (2019) (arguing in relation to computer-generated inventions that "[i]f a nexus to human inventorship is lacking, the resulting invention should enter the public domain"); Kaelyn R. Knutson, *Anything You Can Do, AI Can't Do Better: An Analysis of Conception as a Requirement for Patent Inventorship and a Rationale for Excluding AI Inventors*, 11 CYBARIS 1, 28 (2020) (writing that "any subject matter derived wholly from AI processing is unpatentable").

[3] *See, e.g.*, Russ Pearlman, *Recognizing Artificial Intelligence (AI) as Authors and Inventors Under US Intellectual Property Law*, 24 RICH. J.L. & TECH. 2, 37 (2018) (arguing that "United States intellectual property law must recognize AI systems as authors and inventors"); Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C. L. REV. 1079, 1126 (2016) (arguing that "recognizing that computers can be inventors . . . will provide certainty to businesses, fairness to research, and promote the progress of science"); Ernest Fok, *Challenging the International Trend: The Case For Artificial Intelligence Inventorship in the United States*, 19 SANTA CLARA J. INT'L L. 51, 72 (2021) (writing that the "U.S. patent system has the potential to strongly benefit from recognizing inventing-AI as inventors"); Austin G. Miller, *Can a Light Bulb Turn on in the Mind of a Computer?–A Primer to the Issue of Whether AI Computers Are Capable of Conception*, 99 U. DET. MERCY L. REV. 95, 117 (2021) (writing that as AI advances, "the argument in favor of computers as inventors will strengthen"); Mimi S. Afshar, *Artificial Intelligence and Inventorship – Does the Patent Inventor Have to be Human?*, 13 HASTINGS SCI. & TECH. L.J. 55, 71 (2022) (writing that "AI should be Recognized as a Legitimate Inventor").

[4] *See, e.g.*, Mark Lyon, Alison Watkins & Ryan Iwahashi, *When AI Creates IP: Inventorship Issues to Consider*, LAW 360 (Aug. 10, 2017) (writing "patents should generally be available for inventions conceived in whole or in part by AI technologies, but with some exceptions . . . In the case in which no human provides a material contribution to the conception of an invention, patent protection should be withheld for lack of inventorship"); Ben Kovach, *Ostrich with Its Head in the Sand: The Law, Inventorship, & Artificial Intelligence*, 19 NW. J. TECH. & INTELL. PROP. 137, 153 (2021) (arguing that, depending on the circumstances, AI systems should be named inventors, or AI inventions should be unpatentable).

[5] *See, e.g.*, Daria Kim, *'AI-Generated Inventions': Time to Get the Record Straight?*, 69 GRUR INT'L 443, 443 (2020) (arguing that "as long as computers rely on instructions defined by a human as to how solve a

opposite, i.e., that AI can surpass human ingenuity.[6] Other authors have called for redefining "inventor,"[7] considered the implications of computer-generated claims,[8] applied economic theory to determination of rights to patents on AI inventions,[9] explored the interaction between AI, creativity and inventorship,[10] considered AI in relation to patents in medicine,[11] and suggested that AI could mean the end of patent law.[12]

Questions at the AI/intellectual property interface are also spurring policy discussions. In 2019, the U.S. Patent and Trademark Office (PTO) solicited public comments on the impact of AI on patents, copyright, trademarks, trade secrets, and protection of

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problem, the separation between human and non-human (algorithmic) ingenuity is, in itself, artificial").

[6] *See, e.g.*, Erica Fraser, *Computers as Inventors – Legal and Policy Implications of Artificial Intelligence on Patent Law*, 13 SCRIPTED 305, 333 (2016) (arguing that the "patent system must recognise the implications of and be prepared to respond to a technological reality where leaps of human ingenuity are supplanted by AI").

[7] Pheh Hoon Lim & Phoebe Li, *Artificial Intelligence and Inventorship: Patently Much Ado in the Computer Program*, 17 J. INTELL. PROP. L. & PRAC. 376, 386 (2022) (arguing to "change the definition of inventor by expanding it to include humans responsible for an AI system which devises inventions").

[8] *See generally* Ben Hattenbach & Joshua Glucoft, *Patents in an Era of Infinite Monkeys and Artificial Intelligence*, 19 STAN. TECH. L. REV. 32 (2015) (considering computer-generated claims and the associated issues of patentability, inventorship, and prior art).

[9] W. Michael Schuster, *Artificial Intelligence and Patent Ownership*, 75 WASH. & LEE L. REV. 1945, 1945 (2018) (in relation to "inventions created solely by AI," using the "Coase Theorem and its corollaries to determine who should be allowed to secure these patents to maximize economic efficiency").

[10] *See generally* Christian E. Mammen & Carrie Richey, *AI and IP: Are Creativity and Inventorship Inherently Human Activities?*, 14 FIU L. REV. 275 (2020).

[11] Susan Y. Tull & Paula E. Miller, *Patenting Artificial Intelligence: Issues of Obviousness, Inventorship, and Patent Eligibility*, 1 ROBOTICS, A.I. & L. 313, 313 (2018) (writing that AI in medicine raises the "question of personhood and human contributions, affecting both inventorship (and ownership) and patentability").

[12] Tim W. Dornis, *Artificial Intelligence and Innovation: The End of Patent Law as We Know It*, 23 YALE J.L. & TECH. 97, 97 (2020) (arguing that "[w]ith the advent of artificial intelligence (AI), the end of patent law is near").

databases.[13] In 2020, the PTO published a report summarizing the comments received.[14] In response to the question "Do current patent laws and regulations regarding inventorship need to be revised to take into account inventions where an entity or entities other than a natural person contributed to the conception of an invention?,"[15] the report stated that "[t]he majority of commenters responding to this question" had the view that no revision is needed.[16]

The PTO report further stated that:

> [T]he activities by a natural person(s) that would ordinarily qualify as a contribution to the conception of an invention are unaffected by the fact that an AI system is used as a tool in the development of the invention. For example, depending on the specific facts of each case, activities such as designing the architecture of the AI system, choosing the specific data to provide to the AI system, developing the algorithm to permit the AI system to process that data, and other activities not expressly list here may be adequate to qualify as a contribution to the conception of the invention.[17]

But noting that the people behind the AI may have made a contribution to conception underscores that there is an elephant in the room: It leaves hanging in the air the unanswered question of what other entity may have contributed to conception, and how that should be recognized. Current interpretations of patent law do not sufficiently address the scenario where an AI system makes a contribution to conception that is distinguishable that made by humans. This scenario will become increasingly common with continued advances in AI.

To the author's knowledge, this Article is the first to propose addressing the patentability of AI inventions through an expanded

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[13] U.S. PAT. & TRADEMARK OFF., PUBLIC VIEWS ON ARTIFICIAL INTELLIGENCE AND INTELLECTUAL PROPERTY, at i–ii (Oct. 2020).

[14] *See generally id.*

[15] *Id.* at 3.

[16] *Id.* at 5.

[17] *Id.* at 4.

interpretation of conception analyzed in relation to the associated technological, legal, and broader policy context. The remainder of this Article is organized as follows. Section II offers a brief primer on AI, its increasing ability to behave in ways that evoke thought and creativity, and the nature of AI inventions. Section II also explores the problems with deeming AI inventions unpatentable and with naming AI systems as inventors. Section III describes the proposal for a revised interpretation of conception and considers its implications in relation to patent policy and the current text of the Patent Act.[18] Conclusions are presented in Section IV.

II. AI AND INVENTIONS

A. *The Role of AI in Inventions*

1. AI: A Brief Primer

While "artificial intelligence" admits various definitions, it is commonly associated with the ability of a computer to learn. For instance, Brittanica's AI definition refers to computer systems "endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience."[19] AI has advanced enormously since Alan Turing in 1950 famously asked, "Can machines think?"[20] Today, AI is used by Google to improve search results,[21] by Spotify and Amazon to learn customer preferences,[22] by Lyft to match drivers with riders and perform route optimization,[23] and by credit card companies to prevent fraud.[24]

Google has demonstrated extraordinary AI advances through increasingly sophisticated AI systems in the context of games. In

[18] The Patent Act is codified at Title 35 of the United States Code.

[19] B.J. Copeland, *Artificial Intelligence*, BRITTANICA, www.britannica.com/technology/artificial-intelligence (last updated Nov. 11, 2022).

[20] Alan M. Turing, *Computing Machinery & Intelligence*, 59 MIND 433, 433 (1950).

[21] James Martin, *Inside RankBrain: What Google's New Search Algorithm Means to You*, CIO (Nov. 24, 2015).

[22] Dan Catchpole, *How Spotify and Amazon Are Using A.I. to Learn Your Preferences—And Even Read Your Mood*, FORTUNE (Nov. 9, 2021).

[23] Larry Dignan, *Uber Vs. Lyft: How the Rivals Approach Cloud, AI, and Machine Learning*, ZDNET (May 20, 2019).

[24] Mary K. Pratt, *How Visa Fights Fraud*, CSO (June 28, 2022).

2017, AlphaZero, a program created by engineers at Google's DeepMind subsidiary, was able to learn in only four hours to beat a top computer chess program.[25] AlphaZero started with no knowledge other than the rules of chess,[26] and in those hours learned how to play chess based on the experience gained from quickly playing an enormous number of games. This underscores how, in certain narrow domains, AI systems are vastly more capable than humans. There is no human who could learn the rules of chess for the first time at 10 AM and achieve competitive-level mastery by 2 PM that same day. A few years later, DeepMind unveiled MuZero, a program able to master "Go, chess, shogi and Atari without needing to be told the rules."[27]

AI is being used to identify the shapes of proteins, which in turn could lead to much faster drug development.[28] AI also underlies many recent advances in robotics, including the extraordinarily capable robot dogs built by Boston Dynamics.[29] AI can compose pop music and symphonies,[30] create art in the style of Rembrandt,[31] and write short stories.[32] In summer 2022, a piece of AI-generated art won first prize in the "digital art/digitally manipulated photography" division at the Colorado State Fair.[33] And, AI can invent.

The most well-known examples of AI inventions are those associated with DABUS, which is an acronym for "Device for the

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[25] Mike Klein, *Google's AlphaZero Destroys Stockfish In 100-Game Match*, CHESS.COM (Dec. 6, 2017).

[26] *Id*.

[27] Julian Schrittwieser et al., *MuZero: Mastering Go, chess, shogi and Atari without rules*, DEEP MIND (Dec. 23, 2020).

[28] Bryan Walsh, *Finally, an Answer to the Question: AI—What is it Good For?*, VOX (Aug. 3, 2012).

[29] *See generally* Andrew Liszewski, *Boston Dynamics' Robot Dog Spot Now Sees the World in Color, Has 5G, and Uses a Fancy New Controller*, GIZMODO (May 3, 2022).

[30] Maura Barrett & Jacob Ward, *AI Can Now Compose Pop Music and Even Symphonies. Here's How Composers Are Joining In*, NBC NEWS (May 29, 2019).

[31] Tim Brinkhof, *How to Paint Like Rembrandt, According to Artificial Intelligence*, DISCOVER (Aug. 23, 2021).

[32] Jennifer Conrad, *How GPT-3 Wrote a Movie About a Cockroach-AI Love Story*, WIRED (Aug. 5, 2023).

[33] Kevin Roose, *An A.I.-Generated Picture Won an Art Prize. Artists Aren't Happy*, N.Y. TIMES (Sept. 2, 2022).

Autonomous Bootstrapping of Unified Sentience."[34] DABUS is an AI system developed by Stephen Thaler that has purportedly created inventions that Thaler did not conceive.[35] As described in a 2019 Wall Street Journal article, Thaler designed DABUS "to ingest data about a range of subjects—including fractal geometry and flashing light patterns—and conceive ideas for products it hadn't seen before."[36] Thaler asserts that inventions due to DABUS include a new kind of flashlight and a new type of container lid, and notes that he has no background in those fields.[37] As described in Section II.B, Thaler has sought to obtain patents in multiple jurisdictions naming DABUS as the inventor, but has so far been mostly unsuccessful.[38]

DABUS is far from the only instance of inventions not fully conceived (under a traditional understanding of conception) by any one or more persons. Hattenbach & Glucoft, writing in 2015, listed a series of patents that they asserted "were conceived wholly or in part by computers."[39] In a 2022 paper, McLaughlin compiled multiple examples of AI-generated innovations, including an AI-designed airplane cabin and an AI-designed race car chassis.[40] Relatedly, some human-designed AI systems are capable of creating other, machine-designed AI systems, thereby interposing an additional step

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[34] *See, e.g.*, Blake Brittain, *U.S. Appeals Court Says Artificial Intelligence Can't Be Patent Inventor*, REUTERS (Aug. 5, 2022) (stating that DABUS "stands for 'Device for the Autonomous Bootstrapping of Unified Sentience'").

[35] *See, e.g.*, Jared Council, *Can an AI System Be Given a Patent?*, WALL ST. J. (Oct. 11, 2019) (stating with respect to two inventions that, according to a group associated with Thaler, he "didn't conceive of those two products and didn't direct the machine to invent them").

[36] *Id.*

[37] *Id.*

[38] As described *infra*, the one country to date that has granted a patent naming DABUS as the inventor is South Africa. However, South Africa does not have a substantive patent examination system.

[39] Hattenbach & Glucoft, *supra* note 8, at 44; *Acceptance of Complete Specification*, *Companies & Intellectual Property Commission*, COS & INTELL. PROP. COMM'N (June 24, 2021), *available at* www.ipwatchdog.com/wp-content/uploads/2021/07/AP7471ZA00-Notice-of-Acceptance-1.pdf.

[40] McLaughlin, *supra* note 2, at 238–39.

between humans and AI.[41] If and when those AI-designed AI systems create patentable innovations, the questions of attribution for the resulting inventions will be even more complex.

2. AI: Tool, Innovator, or Both?

Is an AI system merely a tool, or is it an innovator with the ability to generate original ideas? Or is it both—i.e., a tool capable of innovating? The answer depends on the lens used to view concepts such as the generation of ideas. It also depends on the type of AI system, as computer systems that learn span an enormous range of capabilities and behaviors.

At one end of this spectrum, consider an AI-based home thermostat that learns the times on different days of the week when the home's residents tend to leave and return. Based on that information, and on factors such as the season and the weather, it adapts its behavior to improve comfort and save energy. Such a thermostat might embody one or more inventions of its human designers, but it is not going to create any inventions on its own. It is simply acting as a tool controlled by a combination of humans—the programmers who wrote the code in the thermostat, and the home residents who enter the temperature settings and whose comings and goings the thermostat is tracking.

Now consider a hypothetical AI system used to design a bicycle wheel for high-performance road racing bikes. A programmer working alone designs a new AI system and configures it to seek out and acquire vast amounts of information on existing road racing wheel models—materials, rim widths and depths,[42] number (if any[43]) of spokes, hub designs, brake styles,[44] etc. The programmer then instructs the system to design a better wheel. Suppose that after analyzing all of this data and performing millions or billions of simulations regarding different candidate designs, the AI system outputs a new design that represents an improvement over the state of

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[41] *See, e.g.*, Will Douglas Heaven, *AI is Learning How to Create Itself*, MIT TECH. REV. (May 27, 2021); Anil Ananthaswamy, *Researchers Build AI That Builds AI*, QUANTA MAG. (Jan. 25, 2022).

[42] For an explanation of bicycle wheel attributes, *see, e.g.*, Petr Minarik, *How to Choose Road Bike Wheels? (In-Depth GUIDE)*, CYCLISTS HUB (Aug. 22, 2022).

[43] Some bicycle wheels use discs instead of spokes.

[44] Some wheels have disc brakes, for which there are many different design possibilities. Others use rim brakes.

the art. Suppose further that the programmer is surprised by the output—the programmer didn't initially have the design in mind, but after seeing it, recognizes its advantages over the prior art. This is an example of an AI invention.[45]

Given the role played by AI in this example, who is the inventor? Putting aside for the moment what current patent law allows, there is an argument that the AI system is the inventor. The programmer provided a high-level goal ("design a better bicycle wheel!") to the AI system, but did not provide any guidance regarding specific design ideas or approaches. After finishing its work, the AI system conveyed the completed design to the programmer. This supports a conclusion that the AI system created the new wheel design and then communicated it to the programmer only after the design was complete.

On the one hand, there is an argument that the programmer is the inventor.[46] After all, it was the programmer who designed the AI system, configured it to acquire and analyze information relating to high-performance bicycle wheels, and directed it to design a better wheel. Under this view, the AI system, while much more sophisticated than the AI thermostat described above, is simply acting as an extension of the programmer's mind. Using its computational and learning capabilities, it does in hours or days what the programmer might have needed years or decades to do without computer assistance.

While the question of whether the programmer, the AI system, or a combination of both "created" this invention is philosophically interesting, this Article argues that patent law cannot and should not need to wrestle with it. AI systems are always tools, including when they have the capacity to produce outputs not envisioned by their designers. Thus, in terms of patent law, the inquiry should focus not on the impossible task of defining a clear

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[45] As defined in the Introduction, an AI invention is an invention for which an AI system has contributed to the conception in a manner that, if the AI system were a person, would lead to that person being named as an inventor.

[46] It is also possible to attribute an invention jointly to the programmer and AI system. However, that still involves a non-human contribution to inventorship, leading to the same options for patentability discussed in the subsequent section.

boundary between human- and AI-generated innovation, but rather on how AI inventions should be addressed by the patent system.

B. *AI Inventions: Options for Addressing Patentability*

One option for addressing AI inventions is to deem them unpatentable on the grounds that patenting them would require listing a non-human inventor in violation of the Patent Act. Second, AI inventions could be deemed patentable under a revised Patent Act allowing AI systems to be named as inventors or co-inventors. Third, patent law could be modified to include an "invention made for hire" framework, analogous to "work made for hire" in copyright. Fourth, AI inventions could be deemed patentable, with invention attributed solely to the humans behind the AI using an expanded definition of conception.[47] This Article argues for the fourth option, which does not require changing the Patent Act.

1. The Problem with Deeming AI Inventions Patent-Ineligible

The first option is to deny patentability to AI inventions. This would be bad policy, as it would disincentivize investment in developing and applying AI in the many areas where it has extraordinary potential. The list of such areas is essentially endless—drug development, cybersecurity, smart medicine, materials science, education, and so on. People will be less likely to make those investments if there is a substantial risk that the resulting inventions may be deemed unpatentable on the grounds that the contribution from AI was too substantial. This risk would arise not only at the time of patenting but also downstream—e.g., by potential licensees who view that risk as justifying a downward adjustment in the amount they are willing to pay.[48]

Denying patentability to AI inventions would also lead to endlessly complex line-drawing exercises. Initially, there would be

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[47] The framing in terms of the three specific options listed here is not intended to suggest that these are the only possible three options for handling AI inventions.

[48] When determining an acceptable price, a potential licensee will factor in the possibility that some or all of the patent claims may later be found invalid. A later finding of invalidity is always a risk when licensing a patent, but deeming AI inventions unpatentable would add a new ground for invalidity, thereby increasing the overall level of risk, and depressing the market value accordingly.

the challenge of defining "AI inventions." Subsequently, there would be disputes at the PTO,[49] and in patent litigation in federal courts and at the U.S. International Trade Commission[50] regarding what is, and is not, within the scope of that definition. Companies, investors, entrepreneurs, and researchers will be less likely to harness the extraordinary potential of AI if doing so leads to increased uncertainty regarding the patentability of any resulting inventions. Society would bear the consequences both through a reduced level of innovation and because companies would be more likely to retain innovations as trade secrets.

2. Lessons from DABUS

A second option would be to name AI systems as inventors. But patent law in the U.S. and elsewhere is generally not designed to accommodate this. This is illustrated by the challenges that have accompanied attempts to seek patents naming DABUS as the inventor.

In 2019, Thaler, the person who built DABUS, filed patent applications for two inventions with the PTO listing DABUS as the inventor.[51] The PTO declined to proceed with examination, stating that the applications were incomplete because they did not list a natural person as an inventor.[52] Thaler then filed a complaint in the Eastern District of Virginia seeking review of the PTO's actions.[53] In September 2021, the court granted the PTO's motion for summary judgment, describing "the overwhelming evidence that Congress intended to limit the definition of 'inventor' to natural persons."[54]

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[49] The validity of patent claims can be challenged in the PTO in an Inter Partes Review (IPR). *See* U.S. PAT. & TRADEMARK OFF., *Inter Partes Review*, www.uspto.gov/patents/ptab/trials/inter-partes-review (last visited Dec. 20, 2022).

[50] The U.S. International Trade Commission considers challenges to patent validity in the context of Section 337 investigations. *See About Section 337*, U.S. INT'L. TRADE COMM'N,

www.usitc.gov/intellectual_property/about_section_337.htm (last visited Dec. 20, 2022); *see also* 19 U.S.C. § 1337.

[51] *Thaler v. Vidal*, 43 F.4th 1207, 1209 (Fed. Cir. 2022).

[52] *Id*. at 1210.

[53] *Thaler v. Hirshfeld*, 558 F. Supp. 3d 238, 241 (E.D. Va. 2021), *aff'd sub nom. Thaler v. Vidal*, 43 F.4th 1207 (Fed. Cir. 2022).

[54] *Id*. at 249.

Thaler then appealed to the Federal Circuit, which in August 2022 affirmed the district court's ruling.[55] The Federal Circuit noted that while the issue of AI inventorship involved "metaphysical matters"[56] such as "the nature of invention or the rights, if any, of AI systems,"[57] its task "begins—and ends—with consideration of the applicable definition in the relevant statute."[58]

An "inventor" in the Patent Act is defined as "the individual or, if a joint invention, the individuals collectively who invented or discovered the subject matter of the invention."[59] The Federal Circuit noted that while "individual" is not defined in the Patent Act,[60] in relation to the interpretation of "individual" in a different statute, 28 U.S.C. § 1350,[61] the Supreme Court explained that "'individual' ordinarily means a human being, a person."[62] Writing that "[n]othing in the Patent Act indicates Congress intended to deviate from the default meaning,"[63] the Federal Circuit held that an "'inventor' must be a human being."[64]

Thaler has also filed patent applications listing DABUS as the inventor in multiple other jurisdictions. As of late 2022, the European

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[55] *Thaler*, 43 F.4th at 1213.

[56] *Id*. at 1209.

[57] *Id*.

[58] *Id*.

[59] 35 U.S.C. § 100(f). This statutory definition is recent, as it was added pursuant to the 2011 enactment of the America Invents Act (Pub. L. 112-29, 125 Stat. 284 (2011)). However, pre-AIA patent law also used language indicating that an inventor is a natural person. For example, pre-AIA 35 U.S.C. § 102 stated that "a person shall be entitled to a patent unless . . . he did not himself invent the subject matter sought to be patented." 35 U.S.C.A. § 102(f) (2002) (amended by Pub. L. No. 112-29, 125 Stat. 284 (2011)).

[60] *Thaler*, 43 F.4th at 1211 (stating "[t]he Patent Act does not define 'individual'").

[61] "Individual" in 28 U.S.C. § 1350 is found the "Statutory Notes" portion of this statute. *See* Shawn G. Nevers & Julie Graves Krishnaswami, *The Shadow Code: Statutory Notes in the* United States Code, 112 L. LIBRARY J. 213, 216 (2020) (explaining that "Statutory notes . . . are law"); *see also id.* at Figure 1.

[62] *Thaler*, 43 F.4th at 1211 (quoting *Mohamad v. Palestinian Auth*., 566 U.S. 449, 454 (2012) (citing 7 OXFORD ENGLISH DICTIONARY 880 (2d ed. 1989)).

[63] *Thaler*, 43 F.4th at 1211.

[64] *Id*. at 1212 ("Our holding today that an 'inventor' must be a human being is supported by our own precedent.")

Patent Office,[65] the U.K. Court of Appeal,[66] the Full Federal Court of Australia,[67] and the German Federal Patent Court[68] have each concluded that patent applications must list a human inventor. In a post regarding the German court's decision, Nurton noted that while the court ruled that DABUS could not be listed as inventor, it identified a potential path forward that would "enable[] a human to be named as the deemed inventor while also recognizing the creative contribution of the AI."[69]

South Africa has been an exception. In June 2021, the Companies and Intellectual Properties Commission (CIPC) issued a formal notice of acceptance of a patent application submitted by Thaler in which the inventor name was listed as "DABUS, The

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[65] *See* Case J 0008/20, In re Thaler, BDS. APP. EUR. PAT. OFF. (Dec. 21, 2021), www.epo.org/law-practice/case-law-appeals/pdf/j200008eu1.pdf; *see also AI Cannot Be Named As Inventor On Patent Applications: Written Decision Now Available*, EUR. PAT. OFF. (July 6, 2022), www.epo.org/news-events/news/2022/20220706.html (stating "under the European Patent Convention (EPC) an inventor designated in a patent application must be a human being") (parentheses in original).

[66] *See Thaler v. Comptroller Gen. of Pats. Trade Marks & Designs*, [2021] EWCA Civ 1374, *available at* www.bailii.org/ew/cases/EWCA/Civ/2021/1374.pdf; *see also* Greig Shuter, *UK Court Of Appeal Says AI Is Not an Inventor & Is Split on Allowing Applications For AI Inventions*, JD SUPRA (Sept. 22, 2021).

[67] *See Commissioner of Patents v Thaler* (2022) 401 ALR 551 (Austl.), *available at* www.jade.io/article/912670; *see also* Peter Divitcos, Dave Hu, Sudhanshu Ayyagari & Joy Atacador, *Dr Thaler Seeks Special Leave to Appeal to the High Court from the Full Federal Court of Australia Decision Which Held That an Artificial Intelligence Machine Cannot Be Named an Inventor on a Patent Application*, DENTONS (May 18, 2022). In November 2022, the Australian High Court refused Thaler's application for special leave to appeal the decision of the Full Federal Court of Australia. *See* Claire Gregg & David Webber, *High Court Powers Down DABUS Patent Prospects in Australia*, DAVIES COLLISON CAVE (Nov. 15, 2022).

[68] *See* Bundespatentgericht [BPatG] [Federal Patent Court] Nov. 11, 2021, 11 W (pat) 5/21 (Ger.), *available at* www.juris.bundespatentgericht.de/cgi-bin/rechtsprechung/document.py?Gericht=bpatg&Art=en&Datum=2021-11-11&nr=42859&pos=0&anz=5&Blank=1.pdf; *see also* Martin Ahr & Josephine Caneilles, *Only Human Beings Can Be Inventors: German Federal Patent Court Agrees With International Trend*, LEXOLOGY (June 27, 2022).

[69] James Nurton, *German Decision Could Provide an Answer to AI Inventorship*, IPWATCHDOG (Apr. 20, 2022).

invention was autonomously generated by an artificial intelligence."[70] The patent was formally granted several weeks later through its publication in South Africa's Patent Journal.[71] However, in contrast with the U.S. and European jurisdictions discussed above, in South Africa "a patent application in [sic] is examined for compliance with the formal requirements only." [72] There is no substantive examination to evaluate the patentability of the purported invention described in the application. Rather, as Naidoo and Mammen have explained, provided that the "application forms and fees [are] in order with the specification documents attached . . . the patent will summarily be granted by the CIPC."[73]

3. The Problem with Naming AI Systems as Inventors

One possible response to the unsuccessful attempts to name DABUS as an inventor is to argue that the law in the United States should be changed to explicitly allow recognition of AI-systems as inventors. To put it mildly, this would be difficult. As the Federal Circuit made clear in its 2022 opinion regarding the DABUS patent applications, the current text of the Patent Act precludes non-human inventorship.[74] Thus, the challenge for advocates of allowing AI systems to be named inventors of U.S. patents is not re-interpreting existing law but rather of convincing Congress to change the law.

Legislative practicalities aside, there are also profound policy concerns associated with granting rights to computer programs. However sophisticated today's AI systems or those of the near future might be, it is difficult to sustain an argument that they should be granted property rights. And even if that argument were somehow surmounted, how, as a practical matter, would they exercise those rights, and how would disputes over the extent of those rights be

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[70] *Acceptance of Complete Specification*, *supra* note 39.

[71] *DABUS Gets Its First Patent in South Africa Under Formalities Examination*, IPWATCHDOG (July 29, 2021).

[72] *Patent Filing in South Africa*, INT'L INTELL. PROP. LAW ASS'N (June 29, 2021), www.iipla.org/ip-knowledge/south-africa/patent-filing-in-south-africa/.

[73] Meshandren Naidoo & Christian E. Mammen, *Guest Post: DABUS Gains Traction: South Africa Becomes First Country to Recognize AI-Invented Patent*, PATENTLY-O (Aug. 4, 2021).

[74] *See Thaler*, 43 F.4th at 1213 (holding that "an 'inventor' must be a human being").

settled? For instance, disputes over inventorship often involve inventor depositions,[75] something that clearly won't be possible in any foreseeable time frame if the inventor is a computer. And, at the time of filing for a patent application, how would an AI system provide the required oath or declaration attesting to its status as an inventor?[76]

Another argument that might be made in favor of changing the law to permit AI systems to be inventors is to look to copyright, where U.S. copyright law recognizes non-human authors through "work made for hire." Since non-humans can be authors, then why, the argument might go, can't an analogous framework be applied to allow AI systems to be inventors? The answer is that the analogy is not nearly as close as it might initially seem.

U.S. copyright law defines a "work made for hire" to include "a work prepared by an employee within the scope of his or her employment,"[77] and provides that "[i]n the case of a work made for hire, the employer or other person for whom the work was prepared is considered the author."[78] Thus, for a work made for hire, an employer (or other entity that commissioned the work) is the author and—unless and until an assignment of copyright to another party is made—the owner of the associated copyright.

Patents are handled differently. As the Supreme Court wrote in 2011, "[s]ince 1790, patent law has operated on the premise that rights in an invention belong to the inventor."[79] The Court further explained that a "patent is property"[80] and that an inventor's interest is

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[75] *See*, *e.g.*, *Kolcraft Enterprises, Inc. v. Graco Children's Products, Inc.*, 927 F.3d 1320 (Fed. Cir. 2019).

[76] *See* 35 U.S.C. § 115(a), stating that "[e]xcept as otherwise provided in this section, each individual who is the inventor or a joint inventor of a claimed invention in an application for patent shall execute an oath or declaration in connection with the application." The exceptions identified in 35 U.S.C. § 115(d)(2) under which an oath or declaration is not required are if the inventor is deceased, legally incapacitated, or cannot be found. Under those circumstances a "substitute statement" is permitted.

[77] 17 U.S.C. § 101. Work done within the scope of employment is one of two categories of work made for hire. The other is for certain categories of "specially ordered or commissioned" works. *Id.*; *see also Cmty. for Creative Non-Violence v. Reid*, 490 U.S. 730, 737 (1989).

[78] 17 U.S.C. § 201(b).

[79] *Bd. Trs. Leland Stanford Junior Univ. v. Roche Molecular Sys., Inc.*, 563 U.S. 776, 780 (2011).

[80] *Id*. at 786 (quoting *United States v. Dubilier Condenser Corp.*, 289 U.S. 178, 187 (1933)).

"assignable in law by an instrument in writing."[81] Employers typically require that new employees sign a contract under which they agree to assign the rights to any inventions they make in the context of their employment to the employer.[82] As O'Connor explains, a "tripartite scheme of default common law rules, often mistakenly referred to in toto as 'shop rights,' governs how and when employees must assign or license their inventions to their employers."[83]

Allowing AI systems to be inventors would not be analogous to allowing corporations to be authors. Most fundamentally, corporate "personhood" is well established in American law, and corporations have rights that are in many (though of course not all[84]) ways analogous to those of individuals. Corporations can acquire, own, and transfer rights to property (including intellectual property), enter into contracts, pursue legal remedies and defend against legal claims filed against them, and so on.[85] An AI system is a computer program that can do none of these things.

Put another way, rights are of little utility if the entity holding those rights is a collection of software lacking the power or capacity to exercise them. Giving AI systems property rights would provide a short-term solution regarding AI inventions, but it would generate a whole new set of challenges regarding the exercise of those rights.

4. "Invention Made for Hire": Employers as Inventors?

A third option is to revise the Patent Act so that, by analogy with work made for hire in copyright law, employers are deemed

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[81] *Id*. at 785 (quoting 35 U.S.C. § 261).

[82] Whether these contracts signed at the start of employment are themselves assignments or whether they are promises to execute future assignments is a complex question. *See, e.g.*, Fred Carbone, *Employee Inventors and Patent Ownership: Whose Rights Are They Anyway?*, AM. BAR ASS'N. (Mar. 31, 2021); *see also* Richard Kurz & Kiersten Fowler, *"Shall Be the Property" Is Insufficient in a Contract to Automatically Assign IP Rights*, AM. BAR ASS'N. (Aug. 16, 2022).

[83] Sean M. O'Connor, *Hired to Invent vs. Work Made For Hire: Resolving the Inconsistency Among Rights of Corporate Personhood, Authorship, and Inventorship*, 35 SEATTLE U.L. REV. 1227, 1240 (2012) (emphasis and quotation in original); *see also id*. at 1240 n.84, regarding *United States v. Dubilier Condenser Corp*., 289 U.S. 178 (1933).

[84] For example, corporations cannot cast ballots in political elections.

[85] For a discussion of the history and current status of corporate personhood, *see* O'Connor, *supra* note 83, at 1229–33.

inventors on AI inventions produced by their employees. This approach would offer some advantages, including vesting inventorship rights with entities (e.g., corporations and universities) well equipped to exercise them. It would also obviate the need to disentangle ambiguities regarding which of the multiple people in a corporate or university research lab who may have contributed to creating an AI system that produces an invention should be named as inventors.

But it also raises new challenges. For instance, would a new "invention made for hire" law apply only to AI inventions? If so, how would "AI inventions" be defined, and who would decide which inventions are in this category? This approach would also create an incentive for employees working with AI not to categorize the resulting inventions as attributable to AI, as doing so would mean they wouldn't be named as inventors.

Alternatively, would "inventions made for hire" apply to all categories of inventions created through employees in the course of their work, regardless of whether AI was involved? Making that sweeping a change to patent law just to address AI inventions would seem to be a case of the tail wagging the dog, and would almost certainly create unforeseen downstream consequences. Another shortcoming with handling inventorship of AI inventions through a new "inventions made for hire" law is that it would not address the many situations in which inventors are not employees. And, the process of creating an invention made for hire category would create an incentive for corporations to lobby for maximalist policies, such as longer term lengths for patents with corporate inventors.[86]

Finally, recognition under U.S. patent law of corporations as inventors would have implications internationally, given the human inventorship requirement in other jurisdictions. The upshot is that whether or not to create an invention made for hire framework is a worthy policy question, but it should be addressed with full consideration of its implications, and not only because it would simplify inventorship questions in the case of AI inventions in corporate and university environments.

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[86] There is already a precedent in copyright, where the duration of protection of a work depends on whether it is a work made for hire. *See* 17 U.S.C. § 302.

5. Attributing Conception of AI Inventions to Persons

The fourth—and this Article argues, best—option for addressing AI inventions is to expand the interpretation of conception such that a person who uses an AI system as an extension of their mind is deemed to have conceived inventions created by that system. This approach recognizes that AI systems, regardless of their sophistication, are at the end of the day tools designed and applied in ways that can enhance human creative capacity. It also reflects the view that, while innovation in the future will often involve collaborations between humans and AI systems, there is no legal or moral imperative to pursue any sort of parity in how humans and AI systems are treated under the law relating to inventorship.

III. RECONCEPTUALIZING CONCEPTION

A. *Conception: A Broadened Interpretation*

1. A Century-old Definition

As the Federal Circuit explained in a 2013 decision, "[t]he definition of conception in patent law has remained essentially unchanged for more than a century."[87] That definition was originally penned by Robinson in the 1890 treatise The Law of Patents for Useful Inventions.[88] In a section titled "'Conception' Defined," Robinson wrote that conception is "the formation, in the mind of the inventor, of a definite and permanent idea of the complete and operative invention, as it is hereafter to be applied in practice."[89] This definition has been quoted in numerous court rulings, including by the Court of Customs and Patent Appeals (the precursor to the Federal

[87] *Dawson v. Dawson*, 710 F.3d 1347, 1352 (Fed. Cir. 2013).

[88] WILLIAM C. ROBINSON, 1 THE LAW OF PATENTS FOR USEFUL INVENTIONS 532 (§ 376) (1890), *available at* www.babel.hathitrust.org/cgi/pt?id=uc1.b3124815&view=1up&seq=9.

[89] *Id*. This text is part of a longer quotation that also includes "[t]he conception of the invention consists in the complete performance of the mental part of the inventive act."

Circuit[90]) in 1929,[91] 1968,[92] and 1978,[93] and by the Federal Circuit in 1986,[94] 1994,[95] and at least six times since 2013.[96]

Modern courts look to a nineteenth century legal treatise for the definition of conception because the Patent Act, which is codified at Title 35 of the United States Code, does not define it. The statutory definition of "invention" sheds no insight on this issue either, as the definition is circular, stating that "[t]he term 'invention' means invention or discovery."[97] In fact, the words "conceive[d]" or "conception" appear in only one section in the Patent Act,[98] in definitions specific to a chapter addressing inventions arising from work done with federal assistance.[99] Thus, in seeking to interpret conception more broadly, there is no need to tackle the task of asking Congress to alter a statutorily-defined term. And it is not even necessary to propose modifying or replacing the text of Robinson's

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[90] *See, e.g.*, *U.S. Court of Appeals for the Federal Circuit*, LIBR. CONG. RSCH. GUIDES, www.guides.loc.gov/papers-of-federal-judges/appeals-federal (last visited Dec. 20, 2022) (explaining that "Under Article III of the Constitution, on October 1, 1982, the court formally known as the United States Court of Customs and Patent Appeals, became the United States Court of Appeals for the Federal Circuit").

[91] *Townsend v. Smith*, 17 C.C.P.A. 647, 651 (C.C.P.A. 1929).

[92] *Fredkin v. Irasek*, 397 F.2d 342, 348 (C.C.P.A. 1968).

[93] *Gunter v. Stream*, 573 F.2d 77, 80 (C.C.P.A. 1978).

[94] *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1376 (Fed. Cir. 1986).

[95] *Burroughs Wellcome Co. v. Barr Labs., Inc.*, 40 F.3d 1223, 1228 (Fed. Cir. 1994).

[96] *See, e.g.*, *Dawson*, 710 F.3d at 1352; *Univ. Utah v. Max-Planck-Gesellschaft zur Forderung der Wissenschaften E.V.*, 734 F.3d 1315, 1323 (Fed. Cir. 2013); *Allergan, Inc. v. Apotex Inc.*, 754 F.3d 952, 967 (Fed. Cir. 2014); *REG Synthetic Fuels, LLC v. Neste Oil Oyj*, 841 F.3d 954, 962 (Fed. Cir. 2016); *Univ. S. Fla., Bd. of Trs. v. United States*, 146 Fed. Cl. 274, 282 (2019); *Bio-Rad Labs., Inc. v. ITC*, 996 F.3d 1302, 1318 (Fed. Cir. 2021).

[97] 35 U.S.C. § 100.

[98] There are also several instances in 35 U.S.C. where "conceive[d]" or "conception" appear in editorial notes regarding previous statutory language that was removed via amendments; e.g., in the editorial notes for pre-America Invents Act (AIA) 35 U.S.C. § 102(g)—which addressed conception and reduction to practice in relation to determining priority dates. The PTO regulations in Title 37 of the Code of Federal Regulations are similarly silent on the definition of conception.

[99] *See* 35 U.S.C. § 201(e), (g).

1890 definition. All that is needed is to interpret it through a broader lens.

2. A Broader Interpretation of Conception

As noted above, Robinson wrote that conception is "the formation in the mind of the inventor, of a definite and permanent idea of the complete and operative invention, as it is hereafter to be applied in practice."[100] Consider again the hypothetical presented earlier, in which a programmer builds an AI system to design a better bicycle wheel. The AI system comes up with a design and conveys it to the programmer. Once that occurs, the programmer has in their mind "a definite and permanent idea of the complete and operative invention."

But was the idea formed in the programmer's mind? For the purposes of patent law, the answer should be yes. Recall that the programmer was initially surprised upon seeing the design. While this might initially seem to support an argument that the idea was formed elsewhere, the text of Robinson's definition refers not to formation in the abstract, but rather to "formation in the mind." No matter how sophisticated an AI system might be, it does not have a mind in the human sense in which to form ideas. The programmer is the first person to hold the invention in mind, and that occurs as a direct consequence of information obtained from the output of a tool (the AI system) used as extension of the programmer's mind.

Attributing conception to the person who forms "a definite and permanent idea of the complete and operative invention" in their mind poses no conflict with situations in which the assisting entity is a person instead of an AI system. For instance, consider a manager who tells an employee to design a better bicycle wheel. If the employee, working alone and without receiving any design ideas from the manager, comes up with a new wheel design, the employee will be the sole inventor. The fact that the employee's innovation would not have occurred if the manager had not provided the task assignment and the resources enabling the employee to perform it does not make the manager a co-inventor.

It might be argued that this is inconsistent. After all, if an employee who is instructed to design a bicycle wheel and does so is named an inventor, why shouldn't an AI system that is instructed to design a bicycle wheel and does so also be named an inventor? One

[100] ROBINSON, *supra* note 88, at 532.

answer lies in the requirement in Robinson's conception definition that formation occur in the human mind. In that sense, the differential treatment of the employee and the AI system is fully consistent with the definition.

There is an additional answer as well that is tied to the incentives at the heart of the patent system. An employee who designs a better bicycle wheel is rewarded with inventorship and the associated rights. The employee will likely be obligated to assign those rights to an employer, but companies (or at least, well-run companies) reward employees who come up with potentially valuable inventions. None of these incentives apply to an AI system, which will do its work without regard to whether and how the results of that work are recognized and utilized more broadly.

3. Potential Support from 35 U.S.C. § 103

35 U.S.C. § 103 states that "Patentability shall not be negated by the manner in which the invention was made."[101] On its face, this text could be read to support a view that AI inventions should not be unpatentable on the grounds that AI was used to make them. Whether it should be interpreted in that manner depends in part on the weight accorded to legislative history. Accompanying this statute, a "Reviser's Note" in the "Legislative History" section of the 1952 U.S. Code states that with regard to patentability that "it is immaterial whether [an invention] resulted from long toil and experimentation or from a flash of genius."[102] That same text is still present today in the notes to 35 U.S.C. § 103.[103]

"Flash of genius" refers to a question that was much litigated in the mid-20th century: whether a patentable invention had to reflect

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[101] 35 U.S.C. § 103. This text, using "negatived" instead of "negated," was introduced by the Patent Act of 1952. *See* 35 U.S.C. § 103 (1952).

[102] 35 U.S.C. § 103 (Reviser's Note) (1952), *available at* www.tile.loc.gov/storage-services/service/ll/uscode/uscode1952-00403/uscode1952-004035010/uscode1952-004035010.pdf

[103] 35 U.S.C. § 103 (Historical and Revision Notes); *see also* Nevers & Krishnaswami, *supra* note 61, at 215–16 (explaining that "Historical and Revision Notes" in the United States Code are editorial notes added by the Office of the Law Revision Counsel (OLRC) and that, "[w]hile useful research tools, editorial notes are not law").

a "flash of genius" on the part of the inventor.[104] The writer of the 1952 legislative notes was referring to this issue and its resolution in the negative through the language in 35 U.S.C. § 103, i.e., patentability does not require a flash of genius. Noting this history, Hattenbach and Glucoft write that "a deeper analysis of Section 103 suggests that it was not actually intended to permit computer-generated inventions to be patented."[105] This is an accurate assertion, as legislators certainly did not have AI inventions affirmatively in mind when drafting the language of the Patent Act of 1952. That said, the statutory text in question wasn't added with any particular hostility to AI inventions.

Furthermore, under a strictly textualist interpretation, what matters is the words in the statute and not the motivations or intent of the legislators who wrote them. Under a textualist approach, 35 U.S.C. § 103 does indeed support the patentability of AI inventions. The words of the statute state that the "the manner in which the invention was made" does not negatively impact patentability. Under that logic, the extent to which an invention was "made" by AI should not have any consequence on patentability.

4. AI Inventions and Explainability

AI systems can sometimes be opaque, including to the human designers who created them. By definition, an AI system learns, meaning that it can perform computations not originally envisioned by its designers. Observations of AI behavior often produce little information regarding the underlying methods being employed. Consider a driverless car that uses an AI-based route planning algorithm to determine which streets to use when navigating to a destination. It is easy to observe the path the car follows, but typically impossible to ascertain from observation alone what specific algorithms were used in determining that path.

An explainable AI system is one that "explains how specific outcomes were generated in a way that can be understood by a

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[104] *See, e.g.,* Frank D. Prager, *Standards of Patentable Invention from 1474 to 1952*, 20 CHI. L. REV. 69, 81–88, 93–95 (1952).

[105] Hattenbach & Glucoft, *supra* note 8 (citing 35 U.S.C. § 103 (Historical and Revision Notes)).

human."[106] While it may not be necessary to look under the proverbial and literal hood to know why a driverless car took a particular route,[107] in many contexts, explainability is crucially important. If an AI system is used to evaluate applications for home loans, it is not sufficient to only consider the output. To ensure that the system is not biased, it is also necessary to understand how it makes decisions regarding which applicants should be given or denied a loan.

An interesting question is therefore whether AI systems used to generate inventions need to be explainable. The answer is no. While an explanation regarding how an AI system arrived at an invention might be nice to have, it should have no bearing on patentability of the resulting invention. To be patentable, an invention must be "new and useful."[108] To obtain a patent, the inventor—which under the approach advocated in this Article would be the person who is using the AI system as an extension of their mind—must file an application that includes a specification "contain[ing] a written description of the invention, and of the manner and process of making and using it."[109]

But, as Seymore writes, it is a "bedrock principle of patent law that an inventor need not understand how or why an invention works. The patent statute simply requires that the inventor explain how to make and use the invention."[110] And since, as the Federal Circuit has written, there is no requirement for an inventor to "set forth, or even know, how or why the invention works,"[111] there is

[106] *Explainable Artificial Intelligence (XAI)*, TECHOPEDIA (last updated July 22, 2022), www.techopedia.com/definition/33240/explainable-artificial-intelligence-xai.

[107] This example is not intended to suggest that explainability has no role in driverless cars. If there is an accident attributable to the driverless car, it is extremely important to understand why the AI system controlling the car acted in the manner causing the accident.

[108] 35 U.S.C. § 101.

[109] *Id.* at § 112.

[110] Sean B. Seymore, *Patenting the Unexplained*, 96 WASH. U.L. REV. 707, 707 (2019).

[111] *Newman v. Quigg*, 877 F.2d 1575, 1581 (Fed. Cir. 1989) ("[I]t is not a requirement of patentability that an inventor correctly set forth, or even know, how or why the invention works."); *see also Fromson v. Advance Offset Plate, Inc.*, 720 F.2d 1565, 1570 (Fed. Cir. 1983) ("[I]t is axiomatic that an inventor need not comprehend the scientific principles on which the practical effectiveness of his invention rests.").

certainly no requirement for an inventor to explain the process used to conceive an invention.

In short, provided that the written description requirement is met, patentability of AI inventions does not require that the AI algorithm used to create the invention be explainable. That said, there will often be advantages to explainable AI in relation to inventions. A programmer who uses an explainable AI system to assist with inventions will be better positioned to understand and therefore make improvements to that system. Explainable AI can also help improve innovation opportunities by giving people a better understanding of the processes under study. For instance, explainable AI can improve drug discovery, where "the underlying mathematical models often remain elusive to interpretation by the human mind."[112]

5. What about Reduction to Practice?

This Article focuses primarily on conception. AI can also be used for reduction to practice.[113] This implicates the role of reduction to practice in invention more generally—something which remains both unsettled and evolving. As Lemley explains in a 2016 article, "[c]ourts and scholars have long struggled with the question of whether invention is primarily a mental act or instead primarily an act of building it—what patent law calls 'reducing an invention to practice.'"[114]

The case law on reduction to practice is complex. The Supreme Court wrote in 1998 in Pfaff v. Wells Electronics that "[t]he primary meaning of the word 'invention' in the Patent Act unquestionably refers to the inventor's conception rather than to a physical embodiment of that idea. The statute does not contain any express requirement that an invention must be reduced to practice

[112] José Jiménez-Luna, Francesca Grisoni & Gisbert Schneider, *Drug Discovery with Explainable Artificial Intelligence*, 2 NATURE MACH. INTEL. 573, 573 (Oct. 2020).

[113] Reduction to practice as discussed herein refers to "actual" reduction to practice, as opposed to "constructive" reduction to practice, which is the filing of a patent application meeting the requirements of Chapter 11 of 35 U.S.C. (i.e., §§ 111–23). *See In re Lundak*, 773 F.2d 1216, 1223 (Fed. Cir. 1985) (holding that "constructive" reduction to practice is satisfied upon filing an enabling patent application); *see generally* U.S. PAT. & TRADEMARK OFF., MANUAL OF PATENT EXAMINING PROCEDURE § 2138 (9th ed., rev. 10.2019, 2020) [hereinafter "MPEP"].

[114] Mark Lemley, *Ready for Patenting*, 96 B.U. L. REV. 1171, 1171 (2016).

before it can be patented."[115] While this underscores that an inventor can obtain a patent without reducing an invention it to practice, there are also instances where conception only occurs through reduction to practice.

As the Federal Circuit explained in 1991, "[i]n some instances, an inventor is unable to establish a conception until he has reduced the invention to practice through a successful experiment. This situation results in a simultaneous conception and reduction to practice."[116] AI may turn out to make simultaneous conception and reduction to practice more common, because it permits rapid simulation and modeling of implementations[117] that can identify refinements to conception. In other words, an AI system can use simulation software to quickly and inexpensively model and improve upon the design of an invention without the need to physically build it. This sort of AI-driven feedback loop between conception and (simulated) reduction to practice could help mitigate what Cotropia has asserted are the disadvantages of a patent system that incentivizes early filing, i.e., prior to reduction to practice.[118]

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[115] *Pfaff v. Wells Electronics, Inc.*, 525 U.S. 55, 60 (1998).

[116] *Amgen, Inc. v. Chugai Pharm. Co.*, 927 F.2d 1200, 1206 (Fed. Cir. 1991) (citing DONALD CHISUM, CHISUM ON PATENTS § 10.04[5] (3d ed. 1990)); *see also Smith v. Bousquet*, 11 F.2d 157, 159 (C.C.P.A. 1940) ("In the experimental sciences of chemistry and biology this element of unpredictability frequently prevents a conception separated from actual experiment and test. Here the work of conception and reduction to practice goes forward in such a way that no date can be fixed as subsequent to conception but prior to reduction to practice . . . at no time before the successful experiment can it be said that a conception of the invention exists in the inventor's mind. Until that instant it is mere speculation or possibly a probable deduction from facts already known; but the conception does not reach a definite and final form until the completion of acts which likewise satisfy the requirements of a reduction to practice.").

[117] There is also an interesting question of the extent to which, and the circumstances under which, a computer simulation used to implement an invention qualifies as reduction to practice.

[118] *See generally* Christopher A. Cotropia, *The Folly of Early Filing in Patent Law*, 61 HASTINGS L.J. 65 (2009). Cotropia asserts that a system that incentives early filing leads to "too many patent applications, too many patents, underdevelopment of patented technology, increased assertion of patent rights, and fuzzy patent boundaries." *Id*. With the AIA, the incentives favoring early filing are even stronger today than they were in 2009 when Cotropia's article was published.

Another wrinkle is that the Federal Circuit has indicated that a person can become a joint inventor having contributed only to reduction to practice and not to conception, writing in Pannu v. Iolab Corp. in 1998 (several months before the Supreme Court issued Pfaff v. Wells Electronics) that a joint inventor must "contribute in some significant manner to the conception or reduction to practice of the invention."[119] The Federal Circuit has included this language in multiple decisions since 1998,[120] including as recently as 2022.[121]

In a post citing Pannu, Crouch wrote that reduction to practice "gets short shrift in the patent system, but the law is clear that a joint inventor's contribution may be at that post-conception stage."[122] With respect to AI, this can help reduce the need to examine the extent to which the contribution of an AI system is better characterized as relating to conception or reduction to practice. An analogous approach to that proposed herein for conception can be applied: If an AI system contributes to reduction to practice in a manner that, had the AI been a person, would have led that person to be named as a joint inventor, the joint inventor should be the person who was using the AI system as an extension of their mind in reducing the invention to practice.

An additional factor impacting the role of reduction to practice is that 35 U.S.C. § 102 (and 103) changed in 2013 pursuant to the America Invents Act.[123] For patents issuing from patent applications with an effective filing date prior to March 16, 2013;[124] that is, under pre-AIA 35 U.S.C. § 102, prevailing in a priority

[119] *Pannu v. Iolab Corp.*, 155 F.3d 1344, 1351 (Fed. Cir. 1998) (emphasis added).

[120] *See, e.g., Shum v. Intel Corp.*, 633 F.3d 1067, 1083 (Fed. Cir. 2010); *In re Verhoef*, 888 F.3d 1362, 1366 (Fed. Cir. 2018); *Duncan Parking Techs., Inc. v. IPS Grp., Inc.*, 914 F.3d 1347, 1357 (Fed. Cir. 2019); *Ethicon LLC v. Intuitive Surgical, Inc.*, 847 F. App'x 901, 908 (Fed. Cir. 2021). All four of these decisions addressed patents subject to pre-AIA 35 U.S.C. § 102.

[121] *Google LLC v. IPA Techs. Inc.*, 34 F.4th 1081, 1085 (Fed. Cir. 2022). This decision addressed a patent subject to pre-AIA 35 U.S.C. § 102.

[122] Dennis Crouch, *Conception for Joint Inventors*, PATENTLY-O (July 28, 2021).

[123] Pub. L. 112-29, 125 Stat. 284 (2011).

[124] The AIA was signed into law in September 2011, and the associated changes to 35 U.S.C. §§ 102 and 103 were effective for patent applications with an effective filing date on or after March 16, 2013. *See also* 35 U.S.C. § 100(i)(1) (defining "effective filing date"). In some circumstances determining whether pre-AIA or post-AIA law applies can be complex. *See, e.g.*, MPEP, *supra* note 113, at § 2152.01.

dispute can require showing not only conception but also "reasonable diligence" in relation to reduction to practice.[125] The AIA removed the portion of § 102 (section (g)) containing that language, so that particular inquiry will become less common in litigation as more and more pre-AIA patents expire and enter the public domain. However, the text in 35 U.S.C. § 116 regarding joint inventions was left unchanged by the AIA.[126] This suggests that the Pannu holding regarding joint inventorship is no less relevant post-AIA, and that reduction to practice will therefore continue to be a subject of inquiry in that context.

6. The Case for Minimum Change

Broadening the interpretation of conception, in addition to providing policy advantages over the other alternatives for addressing AI inventions, is also the easiest path forward. Throughout the history of the United States, there have only been five major rewrites of the U.S. patent code, in 1790, 1793, 1836, 1870, and 1952.[127] The AIA, while representing a major change with respect to the determination of priority dates, still left in place the overall framework created by the 1952 Act. The language in patent statutes can persist for decades. Today's 35 U.S.C. § 101 begins "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof . . ."—phrasing

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[125] 35 U.S.C. § 102(g) (2006) (amended by Pub. L. No. 112-29, 125 Stat. 284 (2011)).

[126] Joint inventions are addressed in the first paragraph of 35 U.S.C. § 116 (the first paragraph is designated 116(a)). The only change made by the AIA to that paragraph was in the form of a technical amendment adding a title and the section designation "(a)" to that section. *See* § 20(a), 125 Stat. at 333.

[127] *See, e.g.*, Sam F. Halabi, *Constitutional Avoidance and the Federal Common Law of Patent Subject Matter Eligibility*, 22 NEV. L.J. 211, 217 (2021) (discussing the "legislative history of the Patent Acts of 1790, 1793, 1836, 1870, and 1952"). The 1790 Act wasn't technically a "rewrite;" rather it was the first time Congress had broadly legislated regarding patent law. *See generally* PAT. OFF., U.S. DEP'T COM., THE STORY OF THE AMERICAN PATENT SYSTEM, 1790–1952 (2d. ed. 1953), *available at*

www.babel.hathitrust.org/cgi/pt?id=uiug.30112068061420&view=1up&seq=5&skin=2021.

that differs substantively only in the substitution of "process" for "art" from the corresponding language in the 1870 Act.[128]

If Congress were to commit to undertaking a major redesign of the U.S. patent system, it would certainly be appropriate to engage with the policy arguments for and against the idea of drafting statutes allowing AI systems to be named inventors.[129] But there is almost certainly not going to be any such redesign in the foreseeable future. As noted earlier, the Patent Act defines inventors as "individuals,"[130]—which the Federal Circuit has ruled must be natural persons[131]—and it is difficult to envision a realistic near-term scenario under which that definition would be changed to explicitly encompass computer systems as inventors.

The proposal described herein for a broadened interpretation of conception can be adopted without changing statutory text, regulations, or the text of the 1890 definition of conception that courts still rely on today. And, it doesn't require reversing any Supreme Court or Federal Circuit precedent.

B. *Exploring the Downsides*

A broader interpretation of conception has the advantages of ensuring that AI inventions are patentable, and of avoiding the cascade of problems that would result if AI systems are granted property rights. But it has disadvantages as well.

1. Line Drawing Challenges

This Article proposes that conception should encompass ideas formed through collaboration between a person and tools that act as extensions of their mind. This requires determining whose mind an AI system is acting as an extension of. This question does not arise in the hypothetical presented earlier involving the programmer who works alone to build an AI system that outputs a better bicycle design. But few AI systems are designed and built in this manner. Far more often, collaboration among multiple (and sometimes many) programmers is

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[128] *Compare* 35 U.S.C. § 101 *with* Patent Act of 1870, ch. 230, §24, 16 Stat. 198 (1870).

[129] Any argument in favor of AI inventorship would need to engage with the many challenges that would accompany giving property rights to AI systems.

[130] *See, e.g.*, 35 U.S.C. § 100(f), (g) (referring to inventors using "individual[s]").

[131] *Thaler*, 43 F.4th at 1207.

involved. This collaboration can occur in parallel if there is a team of people all working together simultaneously, and it can occur serially, as successive groups of software engineers employed at a company work to update an AI system that existed before they joined the company and will continue to be developed after they leave.

An additional factor is that the programmers actually writing the code aren't the only people with a hand in building an AI system. There can also be people who never write a line of code for a system but who nonetheless have a highly influential role in the creative and substantive aspects of its design. A former programmer who is now a manager might provide the vision and high-level architecture for an AI system, and then task a group of programmers with the task of writing the code to implement it.

Given this complexity, the "whose mind is it an extension of?" question should be answered by considering a person's 1) degree of proximity to and 2) degree of creative input involved in engaging with an AI system. This is best illustrated through an example. Consider an AI system used to explore protein folding, which is of direct relevance to drug development. Suppose that the AI system was developed by a company that sold or licensed it to a pharmaceutical company. The AI system offers its users an extremely high degree of flexibility in how they can configure it to solve a wide variety of protein folding problems.

A researcher at the pharmaceutical company has an idea for a new drug, and based on that idea configures the AI system to explore a particular search space. Using a tool that allows a potentially infinite number of searches (that would take an essentially infinite time for a computer to perform), the researcher has insight on how to narrow the search space so it can be explored in reasonable time. Even that narrowed search space would be too large to meaningfully examine without AI, but thanks to AI, the search can be performed in a way that efficiently identifies results directly relevant to new drugs. If the result of that search proves crucial in identifying a new drug, the researcher, who is highly proximate to the AI system and who

provided substantial creative input to focus its actions,[132] should be named the inventor. The people who originally developed the AI system while employed by the licensor would not be inventors.

Proximity alone, however, is not necessarily sufficient to confer inventorship. Suppose that the pharmaceutical company researcher makes the same intellectual contribution described above, but instead of directly using the AI system, gives a junior colleague highly specific instructions on how to configure the AI system. Suppose further that the junior colleague follows those instructions, adding no new creative input. In this variation, the researcher would still be the inventor of the resulting drug. The junior colleague, despite being more proximate to the AI system, would not be an inventor.

There is an endless set of potential variations on the ways people have a hand in designing, programming, training, using, and evaluating the outputs of an AI system. There can be scenarios where the contribution of any one person to that process is limited to one specific stage of the process—e.g., programming alone, but not training the system or observing its outputs; or observing the outputs alone, but not programming or training the system that produced those outputs. While identifying inventorship for AI inventions that result from team collaborations can be messy, inventorship in a non-AI context can also be messy in relation to collaborative work, as evidenced by the many court cases involving joint inventorship disputes. Put another way, determining inventorship has always involved the challenge of distinguishing those persons who are inventors from those who have provided important support to make the invention possible, but are nonetheless not inventors. That challenge is still present, though in different form, when inventors utilize AI.

2. Third-party AI Systems and the Limited Power of Contract Law

In the hypothetical above, the inventor of the drug discovered through AI assistance was an employee of the pharmaceutical

[132] Of course, disputes could arise regarding whether someone has provided "substantial" creative input in relation to an AI invention. However, the need to navigate criteria that admit conflicting interpretations is common in patent law. *See*, *e.g.*, "substantial noninfringing use" in 35 U.S.C. § 271(c) in relation to evaluating liability for contributory infringement.

company that was a licensee of the AI. But there may also be scenarios where employees or contractors of the licensor are sufficiently proximate to, and provide sufficient creative input to, an AI system such that they would be considered inventors.

Suppose that as part of supporting the licensed product, an employee of the licensor provides highly specific, detailed recommendations across multiple weeks to the researcher at the pharmaceutical company. Suppose that as a result, the insight on how to narrow the protein folding search space so it can be explored in reasonable time is due in equal parts to the researcher at the pharmaceutical company and to the employee of the licensor. In that case, under the approach proposed in the previous section, both the researcher and the employee of the licensor should be inventors. But the pharmaceutical company is clearly not going to license the AI system in the first place if doing so creates a risk that employees of the licensor will be named inventors on any resulting patents.

And, this isn't a problem that contract law can cleanly solve. Contract law can require that inventors transfer ownership of their inventions to different party—most commonly, an employer or other entity for which the inventor is performing work. But contract law can't be used to contract away inventorship. As a partial solution, the pharmaceutical company might require the licensor to warrant that, in the event that any employees of the licensor are deemed inventors of patents arising from the pharmaceutical company's use of the AI system, they will need to assign those inventions to the pharmaceutical company. But that is a messy approach for several reasons.

First, it leaves the pharmaceutical company with a reduced degree of control over inventions it is investing to develop. Second, it would require the licensor to require its own employees to commit to that category of future assignment, which is distinct from the traditional assignment that commits employees to transfer patent rights to their own employer. Third, the law is still developing regarding the conditions under which a contractual agreement to assign future inventions is itself an assignment or whether it is a promise to assign in the future.[133] If it is the latter, then it could be difficult for the pharmaceutical company to obtain that assignment, particularly if the person in question made their inventive contribution

[133] *See, e.g.*, Carbone, *supra* note 82; Kurz & Fowler, *supra* note 82.

at a different (i.e., licensor) company, where they may or may not still be employed. The best way to address these concerns is for companies using AI systems for invention to be highly attentive to the source of creative input and control regarding the use of those systems, ensuring that it is limited to employees or others who the company would be comfortable being named as inventors.

IV. CONCLUSION

Interest regarding the role of computers in creating intellectual property is not new. Over 35 years ago, in a paper addressing copyright, Samuelson asked "can a computer be an author?"[134] Advances in AI in the intervening decades render it vital to engage with the law and policy questions raised by computer-generated IP, including patents.

Because AI systems possess intelligence, an attribute that patent law has historically considered only in relation to humans, complexities are inevitable when AI systems produce inventions. A key motivating premise of this Article is that inventions that would be patentable if they were not created using artificial intelligence (AI) should not become unpatentable by virtue of the use of AI in their creation. This Article has also argued against naming AI systems as inventors, due to the problems associated with granting property rights to computers.

This Article has proposed a solution based on broadening the definition of conception, thereby enabling humans to be the named inventors of inventions arising from the AI systems they use as extensions of their minds. This proposal requires no change to the text of the Patent Act. Rather, it requires viewing Robinson's 1890 definition of conception through a broadened lens. Persons who use tools, including AI, as extensions of their mind, should be deemed to have conceived inventions generated through the use of those tools. This avoids the many problems that would arise if AI systems are deemed inventors and thus holders of the associated property rights. It also preserves the incentives that underlie the patent system, which confers inventors with a time-limited set of exclusive rights in exchange for disclosures of their inventions.

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[134] Pam Samuelson, *Rights in Computer-Generated Works*, 47 U. PITT. L. REV. 1185, 1192 (1986).