ARTIFICIAL INTELLIGENCE INVENTIONS

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ABSTRACT

In the new technological era, artificial intelligence (AI) reigns supreme. With the assistance of AI systems, society is undergoing a radical transformation. AI may not only soon replace human labor in many industrial sectors, but as AI gains the power to generate greater inventions, it may also outsmart human inventors.

How should patent law and policy adapt to the formidable challenges of the AI era? One of these challenges, addressed by patent offices and courts in 2020 and beyond, is whether AI inventorship should be recognized. The United States Patent and Trademark Office and European Patent Office declined to recognize the autonomous AI system DABUS as an inventor despite its two inventions. Courts in the United States and United Kingdom upheld these rulings. However, the Federal Court of Australia and the South African Patent Office steered patent law in the opposite direction, accepting DABUS as an inventor and thereby legally recognizing AI inventorship.

This Article argues that these divergent approaches to determining the legal status of AI inventorship fail to address proper policy considerations central to shaping AI and patent law in service of the public interest. Applying broad-based, forward-looking policy considerations, this Article puts forward three legal principles for protecting AI-generated inventions.

The first principle draws on the doctrine of "piercing the corporate veil" to ascertain the sole patent proprietor of AI-generated inventions. It attempts to remove the unnecessary cost of protecting AI systems that are incapable of securing ownership of their inventions. The second principle considers the capacity to take legal responsibility as a means of evaluating whether AI systems should be recognized as inventors. It channels an ethos mandating that any grant of patent rights be conditioned on certain legal responsibilities. The third principle dictates that patent protection of AI-generated inventions must promote robustness of the public domain through the free flow of information and knowledge not subject to proprietary control. Together, these principles can better protect a wide range of public interests implicated in the patent protection of AI inventions.

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INTRODUCTION

In August 2020, acclaimed artificial intelligence (AI) developer Dr. Stephen Thaler mounted a formidable challenge to the patent protection system in the United States.[1] Dr. Thaler filed a lawsuit against

1. Chris Wright, *This Lawyer Is Fighting for Countries to Recognize Robot Inventors*, WIRED (Jan. 24, 2022), https://wired.me/technology/artificial-intelligence/this-lawyer-is-fighting-for-countries-to-recognize-robot-inventors/ [https://perma.cc/9PRU-QB4U] ("DABUS, the

the U.S. Patent and Trademark Office (USPTO) in the District Court for the Eastern District of Virginia, requesting that the court overturn the USPTO's rejection of two patent applications naming his AI system as an inventor.[2] He denounced the USPTO's ruling as "anti-intellectual property and anti-business,"[3] warning that it "puts American businesses at an international disadvantage."[4] Nonetheless, the district court ruled against granting his AI system inventorship status in September 2021.[5] The European Patent Office (EPO) and courts in the United Kingdom also refused to recognize his AI system as an inventor.[6]

Later, in July 2021, however, the Federal Court of Australia astonished the global community by recognizing Dr. Thaler's AI system as an inventor.[7] The court challenged the conventional wisdom of patent law that celebrates only natural persons as inventors. It started its landmark ruling[8] by raising this bold question: "We are both created

machine behind the world's first AI-driven patent, has sparked a global effort to dismantle a fundamental principle of intellectual property law.").

2. Jan Wolfe, *Case to Watch: Can AI Be a Patent Inventor? Virginia Judge Asked to Weigh In*, REUTERS (Aug. 21, 2020, 6:06 PM), https://www.reuters.com/article/ip-patent-ai-idUSL1N2FN27C [https://perma.cc/6KWV-H22Q].

3. Complaint for Declaratory and Injunctive Relief at 2, Thaler v. Iancu, No. 1:20-cv-00903 (E.D. Va. Aug. 6, 2020).

4. *Id.*

5. *See infra* Section I.A.1; *see also* Ali Ebshara, *AIs as Inventors:* Thaler v. Hirshfeld, BERKELEY TECH. L.J. BLOG (Jan. 24, 2022), https://btlj.org/2022/01/ais-as-inventors-thaler-v-hirshfeld/ [https://perma.cc/M8VG-FLRD]; Matthew Bultman, *Patents and Artificial Intelligence: An 'Obvious' Slippery Slope*, BLOOMBERG L. (Oct. 8, 2021, 8:03 AM), https://news.bloomberglaw.com/ip-law/patents-and-artificial-intelligence-an-obvious-slippery-slope [https://perma.cc/YHZ2-SLEB].

6. *See infra* Section I.A.2; *see also* Angela Chen, *Can an AI Be an Inventor? Not Yet*, MIT TECH. REV. (Jan. 8, 2020), https://www.technologyreview.com/2020/01/08/102298/ai-inventor-patent-dabus-intellectual-property-uk-european-patent-office-law/ [https://perma.cc/N6DV-CD2S] ("The UK and European offices . . . recently rejected the applications because the 'inventor' was not a human.").

7. *See infra* Section I.A.3; *see also* Josh Taylor, *I'm Sorry Dave I'm Afraid I Invented That: Australian Court Finds AI Systems Can Be Recognised Under Patent Law*, GUARDIAN (July 30, 2021, 4:22 AM), https://www.theguardian.com/technology/2021/jul/30/im-sorry-dave-im-afraid-i-invented-that-australian-court-finds-ai-systems-can-be-recognised-under-patent-law [https://perma.cc/MX86-N82E]; Rebecca Currey & Jane Owen, *In the Courts: Australian Court Finds AI Systems Can Be "Inventors,"* WIPO MAG. (Sept. 2021), https://www.wipo.int/wipo_magazine/en/2021/03/article_0006.html [https://perma.cc/G23C-GM9V].

8. Alexandra Jones, *Artificial Intelligence Can Now Be Recognized as an Inventor After Historic Australian Court Decision*, ABC NEWS (Aug. 2, 2021, 1:55 AM), https://www.abc.net.au/news/2021-08-01/historic-decision-allows-ai-to-be-recognised-as-an-inventor/100339264 [https://perma.cc/F2P8-QBR2] ("In a landmark decision, an Australian court has set a groundbreaking precedent, deciding artificial intelligence (AI) systems can be legally recognised as an inventor in patent applications.").

and create. Why cannot our own creations also create?"[9] Shortly before this judicial decision, the South African Patent Office approved Dr. Thaler's patent application listing his AI system as the inventor.[10]

With these conflicting administrative and judicial rulings, the patent protection of AI-generated inventions has emerged as one of the most important yet controversial legal issues in the United States and abroad.[11] The USPTO received more than 60,000 AI patent applications in 2018, up from around 30,000 in 2002.[12] As AI becomes embedded in our daily lives through facial and voice recognition systems, robotic appliances, and autonomous driving,[13] for instance, AI-related patent disputes will surely mushroom.[14] However, policymakers and scholars sharply disagree on whether AI systems can be recognized and protected by patent law as inventors. While the USPTO[15] and

9. *Thaler v Commissioner* [2021] FCA 879 (30 July 2021) 10.

10. Tom Knowles, *Patently Brilliant . . . AI Listed as Inventor for First Time*, TIMES (July 28, 2021, 12:01 AM), https://www.thetimes.co.uk/article/patently-brilliant-ai-listed-as-inventor-for-first-time-mqj3s38mr [https://perma.cc/2YEB-KTPQ] ("Intellectual property officials in South Africa have become the first in the world to award a patent that names an artificial intelligence as the inventor of a product."); Ed Conlon, *DABUS: South Africa Issues First-Ever Patent with AI Inventor*, MANAGING IP (July 29, 2021), https://www.managingip.com/article/b1sx9mh1m35rd9/dabus-south-africa-issues-first-ever-patent-with-ai-inventor [https://perma.cc/5DUQ-7CGJ].

11. *See* Susan Decker & Dina Bass, *Edison, Morse . . . Watson? Artificial Intelligence Poses Test of Who's an Inventor*, L.A. TIMES (Feb. 21, 2020, 6:00 AM), https://www.latimes.com/business/story/2020-02-21/artificial-intelligence-inventor [https://perma.cc/4W66-5UKR] ("Patent offices around the world are grappling with the question of who—if anyone—owns innovations developed using AI. The answer may upend what's eligible for protection and who profits as AI transforms entire industries."); Jyh-An Lee et al., *Roadmap to Artificial Intelligence and Intellectual Property: An Introduction*, *in* ARTIFICIAL INTELLIGENCE AND INTELLECTUAL PROPERTY 1, 1 (Jy-An Lee et al. eds., 2021) ("AI . . . rais[es] numerous challenges to the existing intellectual property . . . regime.").

12. U.S. PAT. & TRADEMARK OFF., INVENTING AI: TRACING THE DIFFUSION OF ARTIFICIAL INTELLIGENCE WITH U.S. PATENTS 4-5 (2020), https://www.uspto.gov/sites/default/files/documents/OCE-DH-AI.pdf [https://perma.cc/VJ84-YD4L].

13. Andrei Iancu, *Remarks by Director Iancu at the Artificial Intelligence: Intellectual Property Considerations Event*, USPTO (Jan. 31, 2019), https://www.uspto.gov/about-us/news-updates/remarks-director-iancu-artificial-intelligence-intellectual-property [https://perma.cc/HRX4-QGUM] ("Today, AI is becoming ubiquitous in our society. For example, faster, more-powerful processors and chips now provide sufficient computing power to perform trillions of calculations per second. Very quickly, AI technologies are evolving from far-off dreams of science fiction to mainstream, everyday uses that take computers to new levels at awe-inspiring speeds.").

14. *See* JAMES X. DEMPSEY, BERKELEY CTR. FOR L. & TECH., ARTIFICIAL INTELLIGENCE: AN INTRODUCTION TO THE LEGAL, POLICY AND ETHICAL ISSUES 16 (2020), https://www.law.berkeley.edu/wp-content/uploads/2020/08/Artificial-Intelligence-An-Introduction-to-the-Legal-Policy-and-Ethical-Issues_JXD.pdf [https://perma.cc/37SK-J8Z6] ("As investment capital pours into AI technology and companies apply for and seek to enforce AI-related patents, agencies and courts are beginning to consider how to apply principles of intellectual property (IP) law to AI.").

15. U.S. PAT. & TRADEMARK OFF., PUBLIC VIEWS ON ARTIFICIAL INTELLIGENCE AND INTELLECTUAL PROPERTY POLICY 4 (2020), https://www.uspto.gov/sites/default/files/documents/USPTO_AI-Report_2020-10-07.pdf [https://perma.cc/K8N5-T5AT] (discussing how "[t]he USPTO's understanding of the patent statutes and the Federal Circuit case law

some scholars[16] believe that the traditional human-centric notion of inventorship necessarily excludes AI, others contend that this notion has become obsolete in the age of AI, calling for a more dynamic interpretation of inventorship.[17]

Amid this lack of consensus, how should legislators, courts, and patent offices around the world tackle AI's challenges to the patent system?[18] What are the most significant and relevant legal and policy principles that can shape their decisionmaking process? These questions are tremendously daunting given the need to grapple with not only the complex and rapidly evolving nature of AI technology,[19] but also with the perplexing ethical and legal norms governing its development and application.[20]

In this Article, I put forward three legal principles that legislators, courts, and patent offices should consider in dealing with AI-generated inventions. Both AI and patent law must serve the public interest.[21] These principles, embodying broad-based, forward-looking policy considerations, can better protect the public interest.

The first principle requires decisionmakers to consider who or what will ultimately gain proprietary control of an invention to be protected by patent law. Will it be an autonomous AI system that can independently create inventions? Or a human being who develops such a system? I argue that we should apply the doctrine of "piercing the corporate veil" to identify patent proprietors behind the veil of AI inventorship. Applying my first principle to the litigation launched by

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concerning the concept that inventorship requires that an inventor must be a natural person").

16. *See, e.g.*, Shlomit Yanisky Ravid & Xiaoqiong (Jackie) Liu, *When Artificial Intelligence Systems Produce Inventions: An Alternative Model for Patent Law at the 3A Era*, 39 CARDOZO L. REV. 2215, 2216 (2018) (arguing that AI-generated "inventions should not be patentable at all"); Daryl Lim, *AI & IP: Innovation & Creativity in an Age of Accelerated Change*, 52 AKRON L. REV. 813, 858 (2018) ("It is unlikely, though, that an AI can qualify as an inventor under current law. Conception can be performed only by natural persons because AI has no *mind* to speak of.").

17. *See, e.g.*, Tim W. Dornis, *Artificial Intelligence and Innovation: The End of Patent Law as We Know It*, 23 YALE J.L. & TECH. 97, 119 (2020) (arguing that "inventorship can and does emerge from AI autonomy").

18. Michael M. Rosen, *AI Invents—But Should It Get Patents, Too?*, ISSUES SCI. & TECH. (Aug. 26, 2021), https://issues.org/artificial-intelligence-patents-innovation-rosen/ [https://perma.cc/7DRV-BY28] ("Courts, patent offices, and legislators worldwide should not ignore these issues because they bear significantly on how, whether, and when advanced machines serve as a boon to human ingenuity.").

19. *See* ERIK J. LARSON, THE MYTH OF ARTIFICIAL INTELLIGENCE: WHY COMPUTERS CAN'T THINK THE WAY WE DO 237 (2021) (arguing that "the myth of artificial intelligence pose a significant and even grave threat to the future of scientific discovery and innovation"); STUART RUSSELL & PETER NORVIG, ARTIFICIAL INTELLIGENCE: A MODERN APPROACH 35 (4th ed. 2021) ("As AI systems find application in the real world, it has become necessary to consider a wide range of risks and ethical consequences.").

20. *See, e.g.*, THE OXFORD HANDBOOK OF ETHICS OF AI (Markus D. Dubber et al. eds., 2020).

21. *See* HAOCHEN SUN, TECHNOLOGY AND THE PUBLIC INTEREST (2022).

Dr. Thaler, I identify Dr. Thaler himself as the patent proprietor even if his AI system is legally recognized as an inventor. As a result, the principle rejects granting inventorship status to autonomous AI systems.[22]

The second legal principle suggests that inventors must be capable of assuming the legal responsibilities ascribed to their patent rights. Applying this principle, I argue that AI systems do not at this stage have the capacity to assume and fulfill such responsibilities. I examine the extent of the responsibilities that patent law imposes upon inventors owing to their inventorship role, as well as other responsibilities that may arise from infringing acts potentially committed by AI inventions.[23]

Moreover, I argue that protecting the public domain should be applied as the third legal principle for assessing patent protection of inventions generated by autonomous AI systems. The flow of information and knowledge in the public domain is essential to the cultural dynamics and technological progress of society. The overly expansive protection of patent rights jeopardizes the public domain. As I will show, rejecting the recognition of AI inventorship would maintain the status quo of patent protection, thereby promoting the robustness of the public domain.[24]

These legal principles, as I will demonstrate, make three major contributions to the debate over and study of patent protection for AI-generated inventions among the intellectual property (IP) academy, judiciaries, administrations, and legislatures. First, the principles help to illuminate how courts should apply proper legal interpretation methods to decide patent cases. As shown in Part I of this Article, U.S. and U.K. courts have interpreted the legal concept of "inventor" according to its literal meaning without considering the relevant policy issues.[25] The Federal Court of Australia, however, has situated interpretation of this legal concept in the context of broad policy considerations.[26] It is critically important to deal with this divergence in legal interpretations because judicial rulings directly impact AI companies involved in lawsuits. Because patent office decisions are subject to judicial review, these rulings also inform patent offices' review of patent applications.

Responding to the problems with these recent AI rulings, the three legal principles provide courts with appropriate public considerations when dealing with patent cases involving new technologies such as AI. They demonstrate that courts should consider policy issues so as to

22. *See infra* Part II.

23. *See infra* Part III.

24. *See infra* Part IV.

25. *See infra* Section I.B.1.

26. *See infra* Section I.B.2.

correctly interpret the statutory meaning of patent rules.[27] Rather than focusing narrowly on incentivizing AI innovators to invent, as the Federal Court of Australia argued,[28] policy considerations guiding the adjudication of AI patent cases should be broad-based and forward-looking.[29] The three legal principles suggest that patent law should provide legal incentives to innovate only to parties who actually control patent rights, ensure that patent protection is granted to parties who are capable of assuming responsibilities associated with AI patents, and make these patents conducive to the dynamics of the public domain.

Second, the three legal principles would, if adopted, add more dynamic policy considerations to academic studies of AI and patent protection. A lack of legal research that could develop such policy considerations is another factor contributing to the inadequacies in judicial rulings on AI inventions. The extant literature on AI and patent protection falls into three categories of legal research. Some academic publications survey AI-related patent issues in general but fail to engage in any sophisticated study of policy considerations.[30] Articles that do offer more articulated study of such considerations tend to adopt a textualist approach in exploring the literal meaning of legal concepts such as "inventor."[31] That approach is very similar to the literal interpretative method adopted in the U.S. and U.K. courts' AI rulings. The

27. *See infra* Section I.B.2; *see also* Max Radin, *Statutory Interpretation*, 43 HARV. L. REV. 863, 871-72 (1930) (arguing that statutes are instruments of social policy); GUIDO CALABRESI, A COMMON LAW FOR THE AGE OF STATUTES 7 (1982) (showing how to "restor[e] to courts their common law function of seeing to it that the law is kept up to date" with majoritarian policy concerns); William N. Eskridge Jr., *Dynamic Statutory Interpretation*, 135 U. PA. L. REV. 1479, 1520 (1987) ("By interpreting such laws in light of current policy, rather than historic intent, courts enable those statutes to grow and develop in response to novel fact situations and significant changes in the legal terrain."); Frederick Schauer, *Constructing Interpretation*, 101 B.U. L. REV. 103, 116 (2021) (arguing that "it is a long-entrenched feature of the American legal environment that most instances of clear statutory and constitutional language remain at the mercy of especially strong considerations of morality or policy").

28. *See infra* Section I.A.3.

29. The Supreme Court stated that certain IP protection concepts and doctrines have "not been construed in their narrow literal sense but, rather, with the reach necessary to reflect the broad scope of constitutional principles." Goldstein v. California, 412 U.S. 546, 561 (1973).

30. *See*, *e.g.*, SIMON CHESTERMAN, WE, THE ROBOTS?: REGULATING ARTIFICIAL INTELLIGENCE AND THE LIMITS OF THE LAW 135-38 (2021) (concluding that "[p]atent law in most jurisdictions provides or assumes that an 'inventor' must be human" based on a review of recent AI rulings).

31. *See* Eva Stanková, *Human Inventorship in European Patent Law*, 80 CAMBRIDGE L.J. 338, 339 (2021) ("[T]he article considers current European patent law and shows that human inventorship is both presupposed for an invention to exist and required for a legitimate grant of a European patent."); Karl F. Milde, Jr., *Can a Computer Be an "Author" or an "Inventor"?*, 51 J. PAT. OFF. SOC'Y 378, 379 (1969) ("The closest that the Patent Statute comes to requiring that a patentee be an actual person is in the use, in Section 101, of the term 'whoever[.'] Here too, it is clear from the absence of any further qualifying statements that the Congress, in considering the statute in 1952, simply overlooked the possibility that a machine could ever become an inventor.").

most prominent publications, such as those by Professor Ryan Abbott, address only a utilitarian policy consideration identical to that applied by the Australian court,[32] arguing that allocating patent rights to a proper stakeholder is a necessary step in incentivizing efficient investment in AI sector innovation.[33]

The three legal principles proffered here offer broad-based, forward-looking policy considerations that can better protect a wide range of public interests implicated in the patent protection of AI inventions. Piercing the veil of AI inventorship to ascertain the sole patent rights owner would save society from the extra cost of providing patent protection to AI systems that do not hold ownership of their inventions. A responsibility-based assessment of AI systems' capacities would channel an ethos requiring any grant of patent rights to be conditioned on certain legal responsibilities.[34] Protecting the public domain, meanwhile, is intended to promote the free flow of information and knowledge not subject to proprietary control.

Third, the three legal principles, if adopted, would contribute well-informed policy considerations to administrative agencies, such as patent offices, that are striving to properly protect AI-generated inventions. Despite its recent administrative decision rejecting AI inventorship status, the USPTO has no internal guidelines on AI inventions and is currently conducting consultations on how best to deal with them. In October 2020, it released a preliminary report summarizing nearly 200 comments from various stakeholders in the AI and patent protection arena.[35] Other national patent offices are making similar efforts to advance understanding of AI and patent

32. *See, e.g.*, Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C. L. REV. 1079, 1079 (2016) ("Treating nonhumans as inventors would incentivize the creation of intellectual property by encouraging the development of creative computers.").

33. *See*, *e.g.*, W. Michael Schuster, *Artificial Intelligence and Patent Ownership*, 75 WASH. & LEE L. REV. 1945, 1950 (2018) (proposing that "efficiency is best attained by allocating AI property rights to parties that purchase or license AI software and utilize it for invention").

34. *See* Haochen Sun, *Corporate Fundamental Responsibility: What Do Technology Companies Owe the World?*, 74 U. MIAMI L. REV. 898 (2020) (arguing that technology companies should take more responsibilities); Haochen Sun, *Patent Responsibility*, 17 STAN. J. C.R. & C.L. 321 (2021) (discussing reasons why patent owners should take more responsibilities).

35. U.S. PAT. & TRADEMARK OFF., *supra* note 15, at 2 ("Building on the momentum of those discussions, on August 27, 2019, the USPTO issued a request for comments (RFC) on patenting AI inventions. The RFC sought feedback from our stakeholders on a variety of patent policy issues, such as AI's impact on inventorship and ownership, eligibility, disclosure, and the level of ordinary skill in the art.").

policy.[36] Against this backdrop, the three legal principles will inform patent offices of additional public policy considerations that experts have not yet explored or scrutinized in depth.

Similarly, the principles will provide legislatures with broad-based, forward-looking policy considerations to promote the patent protection of AI-generated inventions in the public interest. Given the existing fundamental disagreements, the District Court for the Eastern District of Virginia called upon the U.S. Congress to determine whether patent law should embrace AI inventorship.[37] In 2019, Siemens reported that it had multiple AI-generated inventions for which the company had intended to file patents but did not do so owing to the legislative uncertainty.[38] In response to such uncertainty, the World Intellectual Property Organization has launched a multinational task force to examine the legislative reforms of patent systems that are needed to tackle AI-generated inventions.[39] However, it acknowledges that it is still "developing *preliminary* considerations to questions raised for IP policy by AI."[40]

The remainder of this Article proceeds as follows. Based on a review of recent administrative and judicial rulings on AI inventions, Part I examines problems with the divergent approaches adopted by patent offices and courts to determine whether AI systems should be recognized and protected as inventors under patent law. In response to these problems, this Article proposes three legal principles for the patent protection of AI-generated inventions. The first legal principle, as Part II shows, draws on the doctrine of "piercing the corporate veil" to ascertain the sole patent proprietor of such inventions. Part III puts forward the capacity to assume legal responsibility as the second legal principle. Finally, Part IV presents the third legal principle, arguing that patent protection for AI-generated inventions must promote the robustness of the public domain.

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36. Intell. Prop. Off., *Artificial Intelligence and Intellectual Property: Call for Views*, GOV.UK (Nov. 2, 2020), https://www.gov.uk/government/news/artificial-intelligence-and-intellectual-property-call-for-views [https://perma.cc/Y42D-NAYT] ("On 7 September 2020, the IPO launched a Call for Views on AI and IP posing a series of important questions. These include questions relating to AI and patents, trade marks, designs, trade secrets and copyright.").

37. Thaler v. Hirshfeld, 558 F. Supp. 3d 238, 249 (E.D. Va. 2021). ("[I]t will be up to Congress to decide how, if at all, it wants to expand the scope of patent law.").

38. *See* RYAN ABBOTT, THE REASONABLE ROBOT: ARTIFICIAL INTELLIGENCE AND THE LAW 10 (2020); *see also* Decker & Bass, *supra* note 11 ("Increasingly, Fortune 100 companies have AI doing more and more autonomously, and they're not sure if they can find someone who would qualify as an inventor." (quoting Ryan Abbott)); Matthew U. Scherer, *Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies*, 29 HARV. J.L. & TECH. 353, 354 (2016).

39. *See Artificial Intelligence and Intellectual Property Policy*, WIPO, https://www.wipo.int/about-ip/en/artificial_intelligence/policy.html [https://perma.cc/7RGL-P25M] (last visited Jan. 16, 2023).

40. *Id.* (emphasis added).

I. PROBLEMS WITH RECENT AI RULINGS

Developed by Dr. Thaler, the Device for Autonomous Bootstrapping of Unified Sentience (DABUS) is an allegedly autonomous AI system.[41] It employs a set of artificial neural networks to generate inventions by creating and analyzing ideas and determining whether they are novel or useful. To date, it has generated two inventions: a beverage container based on fractal geometry that improves safety during shipping and an emergency beacon that flickers in a pattern mimicking neural activity to better attract attention. Naming DABUS as the inventor of these inventions, Dr. Thaler filed patent applications in Australia, Canada, China, Europe, Germany, India, Israel, Japan, South Africa, the United Kingdom, and the United States starting in 2018.[42]

In this Part, I review the administrative decisions on the DABUS patent applications made by the USPTO, EPO, U.K. Intellectual Property Office (UKIPO), Australian Patent Office (APO), and by South Africa's Patent Office, and the subsequent judicial rulings in the United Kingdom, the United States, and Australia. After discussing their contributions to the ongoing discourse on AI and patent law, I consider the major problems with these rulings.

A. Recent AI Rulings

1. United States

Dr. Thaler filed patent applications for the two DABUS inventions with the USPTO in August 2019, naming DABUS as the inventor. In April 2020, the USPTO denied both applications because they failed to disclose a natural person as the inventor, as legally required on the three following grounds.[43]

First, the USPTO decided that the Patent Act mandates that inventors be individuals. Section 101 of the Act states that "[w]hoever invents or discovers any new and useful process, machine, manufacture, or composition of matter . . . may obtain a patent."[44] According to the USPTO, the word "whoever" suggests a requirement that the inventor be a natural person.[45] Similarly, in reference to the person who claims to be the original inventor of the invention in an application,

41. *See Patent and Applications*, ARTIFICIAL INVENTOR PROJECT, https://artificialinventor.com/patent-applications/ [https://perma.cc/R4BC-J9QV] (last visited Jan. 16, 2023) (collecting patent and application documents related to DABUS).

42. *See id*.

43. *See In re* Application of Application No. 16/524,350, 2020 Dec. Comm'r Pat. (Apr. 22, 2020) [hereinafter USPTO, *Thaler Denial*], https://www.uspto.gov/sites/default/files/documents/16524350_22apr2020.pdf [https://perma.cc/5T7R-ATHW].

44. 35 U.S.C. § 101.

45. USPTO, *Thaler Denial, supra* note 43, at 4-7.

Section 115 refers to an individual and uses pronouns specific to natural persons such as "himself" and "herself."[46] Given this consistent reference to persons and individuals, "interpreting 'inventor' broadly to encompass machines would contradict the plain reading of the patent statutes."[47]

Second, with respect to the analogy between AI systems and corporations or sovereigns, the USPTO noted that neither can be inventors under existing case law. [48] For example, in *Beech Aircraft Corp. v. E.D.O. Corp.*, the U.S. Federal Circuit Court of Appeals stated that corporations cannot be inventors because "only natural persons can be 'inventors.' "[49] Similarly, in *University of Utah v. Max-Planck-Gesellschaft zur Forderung der Wissenschaften E.V.*, the Federal Circuit decided that a sovereign cannot be an inventor.[50]

Third, the USPTO decided that AI systems are incapable of performing the conception of inventions.[51] Inventorship entails conception: the inventor's formation of a definite and permanent idea of the invention that is subsequently translated into practice. Therefore, according to the USPTO, the conception of an invention must be performed by a natural person rather than a machine.

Disagreeing with all three grounds, Dr. Thaler applied for judicial review of the USPTO's decision in August 2020. The U.S. District Court for the Eastern District of Virginia upheld the decision in September 2021.[52] The court opined that the question of whether the Patent Act requires an inventor to be human is a question of statutory interpretation, meaning that the court's inquiry would begin and end with the statutory text if its meaning was unambiguous.[53] The America Invents Act formally amended the Patent Act to define an inventor as "the individual, or, if a joint invention, the individuals collectively who invented or discovered the subject matter of the invention."[54] Therefore, the question of whether DABUS could be considered an inventor hinged on what is meant by the term "individual."[55] In this instance, the district court highlighted a recent Supreme Court interpretation of "individual" under the Torture Victim Prevention Act,[56] putting forward the interpretation as evidence to conclude that Congress had used "inventor" in accordance with its ordinary meaning and

46. 35 U.S.C. § 115.

47. USPTO, *Thaler Denial*, *supra* note 43, at 4.

48. *Id.* at 5.

49. 990 F.2d 1237, 1248 (Fed. Cir. 1993).

50. 734 F.3d 1315, 1323 (Fed. Cir. 2013).

51. USPTO, *Thaler Denial*, *supra* note 43, at 5-7.

52. Thaler v. Hirshfeld, 558 F. Supp. 3d 238, 250 (E.D. Va. 2021).

53. *Id.* at 245.

54. *Id.* at 10 (quoting 35 U.S.C. § 100(f)).

55. *Id.* at 246.

56. *See* Mohamad v. Palestinian Auth., 566 U.S. 449, 453-54 (2012).

indicated no intention for it to be applied any differently.[57] The court also highlighted the consistency in Federal Circuit rulings that inventors must be natural persons.[58] In November 2022, the U.S. Court of Appeals for the Federal Circuit affirmed the district court's ruling.[59]

2. Europe

In 2018 and 2019, Dr. Thaler filed parallel applications with the EPO and UKIPO, listing DABUS as the inventor of the two aforementioned inventions. In 2020, the EPO decided that an AI system cannot be listed as an inventor on a patent application.[60] The application was rejected on the grounds of failure to comply with Article 81 of the European Patent Convention (EPC) and Rule 19(1) of its Implementing Regulations, which require the designation of an inventor in a patent application.[61] Rule 19(1) requires the designation to state the family name, given names, and full address of the inventor.[62] According to the EPO, "[n]ames given to natural persons, whether composed of a given name and a family name or mononymous, serve not only the function of identifying them but enable them to exercise their rights and form part of their personality."[63] The EPO thus ruled that the EPC requires inventors to be natural persons.[64]

Given that section 13(2)(a) of the U.K. Patents Act requires applicants to identify the "person or persons" who is or are believed to be the inventor or inventors, the UKIPO concluded that the EPC does not extend beyond human inventors.[65] According to the UKIPO, even if the AI machine in question could be regarded as an inventor, the applicant would have difficulty obtaining ownership of the invention because the

57. *Thaler*, 558 F. Supp. 3d at 246-47.

58. Thaler v. Hirshfeld, 558 F. Supp. 3d 238, 247 (E.D. Va. 2021); *see also, e.g.,* Univ. of Utah v. Max-Planck-Gesellschafl zur Forderung der Wissenschaflen E.V., 734 F.3d 1315, 1323 (Fed. Cir. 2013); Beech Aircraft Corp v. EDO Corp., 990 F.2d 1237, 1248 (Fed. Cir. 1993).

59. *See* Thaler v. Vidal, 43 F.4th 1207, 1209 (Fed. Cir. 2022) ("Thaler challenged that conclusion in the U.S. District Court for the Eastern District of Virginia, which agreed with the PTO and granted it summary judgment. We, too, conclude that the Patent Act requires an 'inventor' to be a natural person and, therefore, affirm.").

60. *See* Haochen Sun, *Redesigning Copyright Protection in the Era of Artificial Intelligence*, 107 IOWA L. REV. 1213, 1222 (2022).

61. *Id.*

62. *Id.*

63. Eur. Pat. Off., Grounds for the EPO Decision of 27 January 2020 on EP 18 275 163, at 6 (2020), https://register.epo.org/application?documentId=E4B63SD62191498&number=EP18275163&lng=en&npl=false [https://perma.cc/8KVM-CSRH].

64. *Id.*

65. Stephen L. Thaler, GB1816909.4 & GB1818161.0, BL O/741/19 ¶¶ 18-23 (Intell. Prop. Off. Dec. 4, 2019) (U.K.), https://www.ipo.gov.uk/p-challenge-decision-results/o74119.pdf [https://perma.cc/JR8E-W9S3].

machine is incapable of owning or transferring any rights.[66] The UKIPO then noted that "the applicant acknowledges that DABUS is an AI machine and not a human, so cannot be taken to be a 'person' as required by the Act."[67]

In September 2020, the U.K. High Court upheld the UKIPO's decision and rejected the DABUS patent applications. In so doing, Justice Smith explored the potential meaning of the term "inventor," citing the House of Lords judgment in *Yeda Research & Development Co. v. Rhone-Poulenc Rorer International Holdings* as authority for the conclusion that an inventor must be human.[68] In *Yeda*, Lord Hoffman referred to an inventor as the natural person who came up with the inventive concept.[69] Justice Smith also held that patent rights could not be transferred to Dr. Thaler under section 7(2)(b) or (c) of the Patents Act 1977, as DABUS is not a person and is therefore incapable of holding and conveying property.[70] Dr. Thaler appealed the High Court decision, and a new judgment was handed down by the U.K. Court of Appeal in September 2021.[71] All three judges agreed with the High Court's conclusion that an inventor must be human, with Lord Justice Arnold notably conducting a systematic interpretation of the 1977 Act to conclude that "only a person can be an 'inventor.' "[72]

3. Australia

In February 2021, the APO ruled that Dr. Thaler had been unable to satisfy the formality requirements of the 1991 Patents Regulations, stating that in identifying DABUS on the patent application, he had failed to provide the name of the inventor pursuant to the 1990 Australian Patent Act.[73] However, in a decision that commentators have described as historic, the Federal Court of Australia ruled that AI systems "can be legally recognized as an inventor in patent applications."[74] Justice Beach gave several reasons for arriving at this decision.

First, even a literal interpretation of "inventor" shows that it is an agent noun and can thus be a person or thing that invents.[75] Justice

66. *Id.*

67. *Id.* ¶ 18.

68. *See* Thaler v. Comptroller-Gen. of Pats., Designs & Trade Marks [2020] EWCH (Pat) 2412 [45].

69. *See id.* ¶ 48.

70. *Id.* ¶ 49.

71. *See* Thaler v. Comptroller Gen. of Pats., Designs & Trade Marks [2021] EWCA (Civ) 1374.

72. *See id.* ¶ 116.

73. *See* Ashley Holland & Helen Kavadias, *Federal Court of Australia Approves Artificial Intelligence to be Inventor for Patents Act Purposes*, HWL EBSWORTH LAWS. (Sept. 28, 2021), https://hwlebsworth.com.au/federal-court-of-australia-approves-artificial-intelligence-to-be-inventor-for-patents-act-purposes/ [https://perma.cc/C8GY-8QE7].

74. *See* Jones, *supra* note 8.

75. *See Thaler v Commissioner* [2021] FCA 879 (30 July 2021) 2.

Beach argued that, in agent nouns, suffixes such as "er" and "or" indicate that the agent performs the act described by the verb to which the suffix is attached.[76] Justice Beach then gave several examples of agent nouns that refer to either humans or non-humans, such as "computer," "controller," "lawnmower," and "dishwasher."[77] As no provision of the Patent Act refutes the notion that AI can be an inventor, and, in contrast to copyright law, there is no specific requirement of a human subject for the grant of moral rights under patent law, Justice Beach saw no need to deviate from this ordinary interpretation of "inventor."[78]

Second, Justice Beach applied policy arguments in favor of widening the concept of "inventor." For instance, he noted a widening conception of the "manner of manufacture" in patent law in response to twentieth- and twenty-first-century scientific developments and new technologies.[79] As the terms "inventor" and "manner of manufacture" both derive from the 1623 Statute of Monopolies, Justice Beach argued that they should "be seen in an analogously flexible and evolutionary way."[80]

He also argued that this approach would be consistent with the recently added object clause of the Patent Act, which states the purpose of Australian patent law as the promotion of economic well-being through technological innovation.[81] Therefore, the term "inventor" should be interpreted in a manner that promotes technological advancement.[82] As allowing AI inventorship would encourage innovation in inventive AI systems, Justice Beach argued that his decision was consistent with the new clause.[83]

Moreover, Justice Beach also claimed that this suggested interpretation would better reflect the reality of "many otherwise patentable inventions where it cannot sensibly be said that a human is the inventor."[84] To support this claim, Justice Beach stated that "machines have been autonomously or semi-autonomously generating patentable results for some time now."[85] Denying this reality would contravene the object clause of the Patent Act, as it would produce inefficiencies or encourage owners of AI systems to protect outputs as trade secrets, rather than publicly disclosing them as part of a patent application.[86]

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76. *Id.* at 23-24.

77. *Id.*

78. *Id.*

79. *Id.* at 24 (citing *D'Arcy v Myriad Genetics Inc* (2015) 258 CLR 334 at [18] per French CJ, Kiefel, Bell and Keane JJ).

80. *Id.*

81. *Thaler v Commissioner* [2021] FCA 879 (30 July 2021) 24.

82. *Id.*

83. *Id.*

84. *Id.* at 2.

85. *Id.* at 24.

86. *Id.* at 25-26.

Third, Justice Beach stated that although it is clear that DABUS cannot be granted a patent, that does not mean that DABUS cannot be an inventor.[87] He concluded that, as the owner, programmer, and operator of DABUS, Dr. Thaler was entitled to the grant of a patent under section 15(1)(b).[88] In support of this conclusion, Justice Beach disputed the APO's claim that granting the patent would require assignment by a human inventor, noting that in a case where an employer enters a contract to assign his or her employee's invention to a third person, the employee inventor would not be a party to the assignment.[89] By virtue of this conclusion, Justice Beach noted that Dr. Thaler prima facie fell within section 15(1)(c).[90]

The Australian Commissioner of Patents has decided to appeal the Federal Court's decision.[91] In the meantime, the Federal Court's decision has received a mixed response, with some commentators highlighting the decision's incentivization of technological innovation, and another asking "how can a non-human inventor assign its rights in the invention to the applicant/owner which can only be a legal person, such as a human being or corporation?"[92] Although the decision represents the first case in which a court has recognized AI as an inventor, it is not the first time that AI has received such recognition. For instance, two days before Justice Beach issued his judgment, South Africa's Patent Office issued a patent listing DABUS as the inventor.[93]

B. Problems

Policy and academic debates have raged without any consensus being reached on whether AI systems should be recognized as inventors or on the patentability of AI-generated inventions. Rather than healing this division of views, the above rulings have further fueled divergent approaches to protecting AI-generated inventions. This divergence, as I reveal in this Section, is caused by the different legal interpretative methods adopted by the courts. While U.S. and U.K. courts have clung to textualist interpretations focusing on the literal meaning of statutory language, an Australian court applied purposive interpretation, emphasizing the policies on which statutes are based.

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87. *Thaler v Commissioner* [2021] FCA 879 (30 July 2021) 31.

88. *Id.* at 32.

89. *Id.* at 32-33.

90. *Id.* at 33.

91. *See Commissioner to Appeal Court Decision Allowing Artificial Intelligence to Be an Inventor*, IPR DAILY (Sept. 6, 2021, 2:25 PM), http://www.iprdaily.com/article/index/15798.html [https://perma.cc/N3XZ-UW9L].

92. *See* Holland & Kavadias, *supra* note 73.

93. Ananaya Agrawal, *South Africa Approves World's First Patent with AI Inventor*, JURIST (Aug. 1, 2021, 3:32 AM), https://www.jurist.org/news/2021/08/south-africa-approves-worlds-first-patent-with-ai-inventor/ [https://perma.cc/MBY5-3478].

1. Textualism

Textualist interpretation focuses on the words of a statute instead of on the policy purposes underlying the statute.[94] Therefore, it attempts to render the ordinary meaning of a statutory term or provision.[95] As a result, textualist judges "look at the statutory structure and hear the words as they would sound in the mind of a skilled, objectively reasonable user of words."[96]

U.S. and U.K. courts have applied the textualist method, thereby determining that AI systems such as DABUS should not be recognized as inventors under patent law. U.S. courts have reasoned that interpreting "inventor" broadly to encompass AI machines would run counter to the plain reading of the relevant statutory provisions.[97] The statutory wording in Sections 100(a), 101, and 115 of the U.S. Patent Act refers to individuals when mentioning inventors. U.K. courts have adopted the same method of legal interpretation, noting that section 13(2)(a) of the U.K. Patents Act requires applicants to identify the "person or persons" believed to be the inventor or inventors and that the phrase should not be extended beyond human inventors.[98] The underlying rationale for limiting inventorship to natural persons, according to the U.K. courts, is that AI systems are unable to obtain ownership of an invention or to own or transfer any rights. Hence, there are considerable differences between the character of a legal person and that of an AI system.

According to U.S. and U.K. courts, the plain language of patent statutes in the two countries demonstrates the human-centric foundation of patent law. Humans as a species are the only beings capable of reasoning autonomously. Animals are non-rational, and corporations are merely legal fictions, and thus cannot conceive of inventions. Accordingly, the inventorship requirement recognizes only natural persons as inventors. Following this reasoning, the Eastern District of Virginia ruled that AI systems, similar to corporations and states, are unable to perform the conception process, which requires an inventor

94. *See* King v. Burwell, 576 U.S. 473, 486 (2015) ("If the statutory language is plain, we must enforce it according to its terms."); Freeman v. Quicken Loans, Inc., 566 U.S. 624, 637 (2012) ("Vague notions of statutory purpose provide no warrant for expanding [a statutory] prohibition beyond the field to which it is unambiguously limited . . . ."); George H. Taylor, *Structural Textualism*, 75 B.U. L. REV. 321, 327 (1995).

95. Chisom v. Roemer, 501 U.S. 380, 405 (1991) (Scalia, J., dissenting) (noting courts should "read the words of [a statutory] text as any ordinary Member of Congress would have read them").

96. Frank H. Easterbrook, *The Role of Original Intent in Statutory Construction*, 11 HARV. J.L. & PUB. POL'Y 59, 65 (1988).

97. *See supra* Section I.A.1.

98. *See supra* Section I.A.2.

to mentally formulate a permanent idea of the invention. Because only natural persons can accomplish the mental act of invention, inventorship under the U.S. Patent Act is limited to natural persons.[99]

2. Purposivism

Central to the purposivist interpretation of a statute are policy considerations that undergird the legislative purposes of the statute. This method of legal interpretation is based on the belief that "legislation is a purposive act."[100] Therefore, judges should construe statutes to execute legislative purposes.[101] To discover what the legislators were trying to achieve, purposivists rely on the statute's policy context, looking for "evidence that goes to the way a reasonable person conversant with the circumstances underlying enactment would suppress the mischief and advance the remedy."[102]

To support its textualist interpretation, the U.S. District Court for the Eastern District of Virginia declined to consider "public policy and the underlying intent of the [U.S.] patent system," which might help AI-based systems such as DABUS to be legally recognized as inventors.[103] The court stated explicitly that Dr. Thaler had provided "no support for his argument that these policy considerations should override the plain meaning of a statutory term" and declined to exercise such a policy decision on behalf of Congress.[104] However, in its concluding remarks, the court stated that "there may come a time when artificial intelligence reaches a level of sophistication such that it might satisfy accepted meanings of inventorship" but that it would be for Congress to decide "how, if at all, it wants to expand the scope of patent law."[105]

In contrast, the Federal Court of Australia ventured to apply purposive interpretation, thereby integrating a policy consideration into the patent protection of AI-generated inventions:

> [I]t is consistent with the object of the [Patent] Act to construe the term "inventor" in a manner that promotes technological innovation and the publication and dissemination of such innovation by rewarding it, irrespective of whether the innovation is made by a human or not.

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99. *See supra* Section I.A.1.

100. ROBERT A. KATZMANN, JUDGING STATUTES 31 (2014).

101. *See* Liparota v. United States, 471 U.S. 419, 424-25 (1985) (examining "congressional intent" and "congressional purpose" during statutory interpretation).

102. John F. Manning, *What Divides Textualists from Purposivists?*, 106 COLUM. L. REV. 70, 91 (2006).

103. *See* Mauricio Uribe, *The End of the DABUS Affair?*, WORLD INTELL. PROP. REV. (Apr. 12, 2021), https://www.worldipreview.com/article/the-end-of-the-dabus-affair [https://perma.cc/RT8V-98VH].

104. *See* Thaler v. Hirshfeld, 558 F. Supp. 3d 238, 248 (E.D. Va. 2021).

105. *Id.* at 249.

> . . . .
>
> . . . [R]ecognising computer inventors and patents on computational inventions could promote disclosure and commercialisation consistently with the [Patents Act's section 2A] object. Without the ability to obtain patent protection, owners of creative computers might choose to protect patentable inventions as trade secrets without any public disclosure.[106]

According to this policy-based statement, the recognition of AI inventors will be essential should AI become an increasingly meaningful or primary source of new inventions.[107] While the prospect of a patent would not motivate AI to invent, the protection of AI outputs would incentivize the complex and resource-intensive development of inventive AI, leading to further innovation and scientific advances.[108] The public would derive benefits from more AI-generated inventions, and, consequently, the public interest would be served,[109] which is in alignment with the purpose of patent protection expressed in the U.S. Constitution.[110]

3. Fallacies

The Australian court's ruling arguably dealt a fatal blow to the method of textualist interpretation adopted by the U.S. and U.K. courts. First, single-minded reliance on the literal meaning of a statutory term or provision runs the risk of neglecting the legislative policies the statute was intended to promote.[111] If words are only "pictures of ideas upon paper,"[112] they are not, as Justice Holmes cautioned, "crystal[s], transparent and unchanged, [but are] the skin of a living thought and may vary greatly in color and content according to the circumstances and the time in which [they] are used."[113] Resorting to the fixed meaning of a patent protection concept may not be desirable as patent law evolves closely with technological developments by expanding the scope of protectible inventions.[114] Recognizing "the evolving nature of patentable inventions and their creators," the Australian

106. *Thaler v Commissioner* [2021] FCA 879 (30 July 2021) 24, 26.

107. *See* ABBOTT, *supra* note 38, at 72.

108. *Id.*; Erica Fraser, *Computers as Inventors—Legal and Policy Implications of Artificial Intelligence on Patent Law*, 13 SCRIPTED 305, 326 (2016).

109. Russ Pearlman, *Recognizing Artificial Intelligence (AI) as Authors and Inventors Under U.S. Intellectual Property Law*, 24 RICH. J.L. & TECH. i, 24 (2018).

110. *See* U.S. CONST. art. I, § 8, cl. 8 (granting Congress the power "[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries").

111. Dornis, *supra* note 17, at 124 ("Yet before we grant any right for inventions 'made by AI,' it is essential to analyze the policy foundations and to clarify the technical and doctrinal settings.").

112. Dodson v. Grew (1767) 97 Eng. Rep. 106, 108; Wilm. 272, 278.

113. Towne v. Eisner, 245 U.S. 418, 425 (1918).

114. *See* ROBERT P. MERGES, JUSTIFYING INTELLECTUAL PROPERTY 20-25 (2011).

court urged reconsideration of the nature of inventorship in the AI era by raising the following question: "[I]f the concept of 'invention' in terms of manner of manufacture evolves, as it must, why not the concept of 'inventor'?"[115]

Second, another major problem with the textualist interpretation adopted by U.S. and U.K. courts in their AI rulings is that they may have decided on issues beyond their institutional capacity.[116] For example, they held that conception of an invention is a mental act that human inventors carry out, and then ruled out the possibility of AI systems also being able to perform such a function.[117] In so doing, they misunderstood the nature of contemporary AI systems such as DABUS, which apply neural networks to conduct machine learning and gain the capacity to think and make decisions like humans.[118] I explain the nature of such contemporary AI systems in a recent article:

> AI became a pervasive technology in the past ten years or so because of the breakthrough development of deep learning. This machine learning technique uses deep neural networks with multiple layers between the input and output layers to emulate the structure, functions, and workings of the human brain enabling an AI system to learn and make decisions on its own. . . .
>
> . . . .
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> As AI systems have increased in sophistication, they have evolved into something other than a mere tool of human creators. They are able to mimic human intelligence and creativity to generate new original works, such as news reports, poems, paintings, and music. Some AI creations are now indistinguishable from human works.[119]

In sticking to a textualist interpretation of human-centric inventorship, the U.S. and U.K. courts turned a blind eye to these new technical features of contemporary AI systems.[120] However, a more serious

115. *Thaler v Commissioner* [2021] FCA 879 (30 July 2021) 3.

116. Commentators have pointed out a logic problem with the U.S. and U.K. courts' AI rulings. *See* Anna Carnochan Comer, *AI: Artificial Inventor or the Real Deal?*, 22 N.C. J.L. & TECH. 447, 466 (2021) ("The DABUS decision illustrates how patent law, in relation to AI-generated inventions, creates a fallacy in reasoning. The USPTO employed a cyclical and fallacious 'begging the question' rationale when interpreting terms like 'inventor' and 'conception' to ultimately exclude AI. This type of fallacy is commonly known as a *petitio principii*." (footnote omitted)).

117. *See supra* Sections I.A.1, I.B.1.

118. *See* KAI-FU LEE, AI SUPERPOWERS: CHINA, SILICON VALLEY, AND THE NEW WORLD ORDER 9 (2018) ("What ultimately resuscitated the field of neutral networks—and sparked the AI renaissance we are living through today—were changes to two of the key raw ingredients that neutral networks feed on . . . . Neural networks require large amounts of two things: computing power and data."); MARCUS DU SAUTOY, THE CREATIVITY CODE: ART AND INNOVATION IN THE AGE OF AI 280 (2019) ("The new ideas of machine learning challenge many of the traditional arguments that machines can never be creative.").

119. Sun, *supra* note 60, at 1238-39 (footnotes omitted).

120. *See* Dornis, *supra* note 17, at 119 ("AI can provide the 'conception' as the essential element of an invention.").

problem is that ruling out AI inventorship goes beyond the judiciary's institutional capacities. Judges have the power only to interpret and apply statutory provisions. Hence, they lack the judicial power to decide on technological issues, such as whether AI systems have the capacity to conceive inventions as human inventors do. Because this decisionmaking process involves expertise beyond their professional training, judges should defer to scientific experts.[121]

There are also problems with the Australian court's ruling, however. Although the Australian court applied a public policy consideration, it did so incorrectly owing to its narrow understanding of the incentive function of patent protection, that is, to encourage more public disclosure of information and knowledge. Utilitarianism is the primary justification for the patent system, which is designed to protect the economic interests of human inventors and incentivize human ingenuity.[122] According to incentive theory, human beings need incentives to motivate them to generate creative and innovative works that ultimately benefit society. Patent rights provide such an incentive.[123] However, the Australian court did not inquire into whether AI systems need incentives to invent. Nor did the court consider whether the legal recognition of AI inventorship would actually promote or jeopardize the public domain to which information and knowledge are incentivized to flow.

Moreover, the Australian court also failed to consider non-utilitarian policy considerations. Based on the philosophical ideas of Kant and Hegel, personhood theories provide various justifications for IP rights, ranging from self-actualization to dignity and autonomy. One theory propounds that "to achieve proper self-development—to be a *person*—an individual needs some control over resources in the external environment. The necessary assurances of control take the form of property rights."[124] IP rights foster intellectual creativity and fundamental human needs, thereby promoting human flourishing.[125] Another justification is that human inventors freely express their will and embody their personality in their inventions, and are thus deserving of some legal claims to their inventions.[126] According to this view, granting patent rights enables inventors to fully control their personalities. Such arguments have also been put forward in relation to the ownership of

121. Decker & Bass, *supra* note 11 ("The question is not 'Can a machine be an inventor?' It's 'Can a machine invent?' . . . It can't in the traditional way we view invention.").

122. 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 INTELL. PROP. L. REV. i, 16 (2020).

123. *See* ABBOTT, *supra* note 38, at 79.

124. Margaret Jane Radin, *Property and Personhood*, 34 STAN. L. REV. 957, 957 (1982).

125. *See* William Fisher, *Theories of Intellectual Property*, *in* NEW ESSAYS IN THE LEGAL AND POLITICAL THEORY OF PROPERTY 168, 171 (Stephen R. Munzer ed., 2001).

126. *Id.*; Matthew G. Sipe, *Patent Law's Philosophical Fault Line*, 2019 WIS. L. REV. 1033, 1040-42.

AI inventions. The vast majority of respondents to a USPTO request for comments indicated their belief that only natural persons or companies, through assignment, should be able to claim ownership of patented inventions.[127]

To correct the various problems with recent AI rulings, I propose three legal principles for courts, patent offices, and legislators to apply in dealing with patent protection for AI-generated inventions. As I demonstrate in the three following Parts of this Article, these principles embody broad-based, forward-looking policy considerations.

II. THE VEIL OF AI INVENTORSHIP

The recent AI rulings examined in Part I have not arrived at consensus on the critical issue of who gets to own and exploit the patents concerned. Can an inventive AI system own and exploit a patent, or do patent rights belong to the human beings behind AI inventorship?

In this Part, I propose the first legal principle, which requires that inventors be deemed the first patent rights owners of their inventions. The principle thus capitalizes on the doctrine of piercing the corporate veil to ascertain the ownership of patent rights. I demonstrate that were the doctrine applied to AI inventorship, it would "pierce the veil" of such inventorship, allowing identification of the human developers of AI systems who would take ownership of AI-created inventions and exploit them to their own benefit. Such application would thus defeat the purpose of recognizing AI inventorship because AI systems would be unable to become the first patent rights owners of their inventions.

A. Inventorship

Inventorship, a fundamental concept in patent law, is intended to legally protect inventions by allocating their ownership. First, it requires the individual who first *conceived* of an invention to be identified by the patent application concerned as the inventor. For example, under U.S. patent law, conception is "the touchstone of inventorship."[128] To be considered the inventor of an invention, an individual must have contributed to the invention's conception.[129] According to several U.S. courts, "conception" refers to the "formation in the mind of the inventor, of a definite and permanent idea of the complete and

127. U.S. PAT. & TRADEMARK OFF., *supra* note 15, at 6-7; *see also* Erin Hanson & Nashel Jung, *USPTO Publishes Report on Public Views on Artificial Intelligence and IP Policy—US IP Law Adequate for Now, Until Artificial General Intelligence Is Reached?*, WHITE & CASE (Oct. 22, 2020), https://www.whitecase.com/publications/alert/uspto-publishes-report-public-views-artificial-intelligence-and-ip-policy-us-ip [https://perma.cc/6753-HKB7] (discussing the report).

128. Burroughs Wellcome Co. v. Barr Labs., Inc., 40 F.3d 1223, 1227 (Fed. Cir. 1994) ("Conception is the touchstone of inventorship, the completion of the mental part of invention.").

129. *See In re* Hardee, 223 U.S.P.Q. (BNA) 1122, 1123 (Com'r Pat. & Trademarks 1984) ("The threshold question in determining inventorship is who conceived the invention.").

operative invention," as it is thereafter to be applied in practice.[130] Therefore, U.S. patent law requires a patent application to name at least one individual as the inventor.[131] A person who did not participate in the first stage of conceiving the invention does not qualify as an inventor.[132]

Second, inventorship serves to ensure that the *ownership* of patent rights over an invention will first be vested in the person who invented it.[133] In the United States, patent rights ownership of an invention is initially granted to its inventor, the intellectual creator of the invention.[134] Therefore, "all issues of inventorship should be resolved before the patent application is filed. This typically requires identifying everyone who worked on the project and determining" whether their contribution reaches the "level of inventorship."[135] To document the process, attorneys produce a factual memo "bereft of legal conclusions, identifying who they interviewed and what their contribution was."[136] Such a memo "can be a helpful document if inventorship is challenged in the future."[137] "If an omitted inventor makes an evidentiary showing sufficient to establish that she should be named as a co-inventor on a patent, she will enjoy a presumption of ownership of the entire patent."[138] Under U.S. patent law, each inventor is an owner of the entire patent,[139] enjoying the rights to make, use, offer to sell, and sell the

130. Burroughs Wellcome Co. v. Barr Labs. Inc., 40 F.3d 1223, 1228 (Fed. Cir. 1994) (citing Sewall v. Walters, 21 F.3d 411, 415 (Fed. Cir. 1994)); *see also* Townsend v. Smith, 36 F.2d 292, 295 (C.C.P.A. 1929) (defining conception as "the complete performance of the mental part of the inventive act" involving "the formation in the mind of the inventor of a definite and permanent idea of the complete and operative invention as it is thereafter to be applied in practice"); Mergenthaler v. Scudder, 11 App. D.C. 264, 276 (D.C. Cir. 1897) (noting that "formation, in the mind of the inventor, *of a definite and permanent idea of the complete and operative invention*" constitutes an available conception).

131. 35 U.S.C. § 115(a).

132. *In re* Hardee, 223 U.S.P.Q. at 1123.

133. *See* Agawam Co. v. Jordan, 74 U.S. 583, 602 (1869) ("He is the inventor and is entitled to the patent who first brought the machine to perfection and made it capable of useful operation. No one is entitled to a patent for that which he did not invent unless he can show a legal title to the same from the inventor or by operation of law . . . ." (footnote omitted)).

134. 35 U.S.C. § 101 ("Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.").

135. Jill K. MacAlpine et al., *It All Starts with Inventorship*, FINNEGAN (Feb. 5, 2021), https://www.finnegan.com/en/insights/blogs/prosecution-first/it-all-starts-with-inventorship.html [https://perma.cc/HF4D-27AQ].

136. *Id.*; *see also* W. Fritz Fasse, *The Muddy Metaphysics of Joint Inventorship: Cleaning Up After the 1984 Amendments to 35 U.S.C. § 116*, 5. HARV. J.L. & TECH. 153 (1992).

137. MacAlpine et al., *supra* note 135.

138. *Id.*

139. *See* Falana v. Kent State Univ., 669 F.3d 1349, 1356-57 (Fed. Cir. 2012); Ethicon, Inc. v. U.S. Surgical Corp., 135 F.3d 1456, 1460-61 (Fed. Cir. 1998). *But see* SiOnyx LLC v. Hamamatsu Photonics K.K., 981 F.3d 1339, 1353 (Fed. Cir. 2020) (including an example of an "argument to the contrary" for divesting one of the inventors of ownership).

patented invention. Consequently, ownership also entitles the inventor to the standing to enforce these patent rights by taking such action as filing a lawsuit against an infringing party.[140]

With the fusion of conception and ownership, U.S. patent law recognizes only eligible natural persons as inventors because natural persons alone can engage in the mental activity of conceiving an invention and have the legal capacity to act as the invention owner through the exercise and enforcement of patent rights. In *Diamond v. Chakrabarty*,[141] the U.S. Supreme Court interpreted Congress's legislative intent with respect to patentable subject matter to "include anything under the sun that is made by *man*," suggesting that inventions can only be made by humans.[142] In *University of Utah v. Max-Planck-Gesellschaft zur Forderung der Wissenschaften E.V.*,[143] the Court of Appeals for the Federal Circuit made it clear that inventors cannot be corporations or sovereigns because only humans can conceive an invention.[144]

Thus, the conception of inventorship excludes corporations from being recognized as inventors because, as legal entities, they are unable to perform the mental activity of conceiving an invention. Nor, for practical reasons, can corporations obtain the ownership of patents. Deeming one person to be an inventor or several people to be co-inventors in a hierarchical corporation poses underlying integrity issues. Although it has been suggested that patent rights could be "reduced to individual members who then own the property collectively,"[145] doing so could lead to an employer manipulating and taking credit for a lower-ranked employee's creation.[146]

B. AI Inventorship

For those who believe that AI cannot in its current state independently invent, it is premature to ask whether AI systems should be named as inventors on patents. For instance, it has been argued that human contributors can still be found throughout the inventive

140. *See* Chromadex, Inc. v. Elysium Health, Inc., 507 F. Supp. 3d 579 (D. Del. 2020); James v. J2 Cloud Services, LLC, 887 F.3d 1368 (Fed. Cir. 2018); Diamond Coating Techs., LLC v. Hyundai Motor Am., 823 F.3d 615 (Fed. Cir. 2016).

141. 447 U.S. 303 (1980).

142. *Id.* at 309 (emphasis added) (quoting S. REP. NO. 82-1979 (1952); H.R. REP. NO. 82-1923 (1952)).

143. 734 F.3d 1315 (Fed. Cir. 2013).

144. *Id.* at 1323.

145. *See* Rafael Dean Brown, *Property Ownership and the Legal Personhood of Artificial Intelligence,* 30 INFO. & COMM. TECH. L. 208, 230 (2021).

146. *See* Comer, *supra* note 116, at 464.

process.[147] Based on the current state of technology, truly independently acting computers do not exist,[148] and it has thus been suggested that it would be most appropriate to define AI systems as computational problem solvers.[149] If instrumental human contributions can always be found, then there is little need to reform patent law to accommodate AI systems as inventors.

For those who believe that AI is already capable of autonomous invention, designating AI systems as inventors is a necessary step to ensure the integrity of inventorship. If the system were to change, with AI inventors recognized by patent laws, then rules would need to be established to determine who should be granted ownership of the resulting inventions.[150] With the advent of DABUS, autonomous AI systems have come to fruition and started to invent by themselves, making it possible to recognize such systems as inventors under patent law. DABUS has the capacity to generate inventions without human contributions. It independently combines simple concepts into more complex ones, and then launches a series of memories or ideas with consequences that DABUS can predict. Moreover, DABUS can independently appreciate whether its inventions are novel. When discovering a new concept chain, DABUS's neural networks recognize the concept's novelty. DABUS then alerts Dr. Thaler to the presence of the novel concept chain.[151]

Arguing against the human-centric notion of inventorship, Dr. Thaler and several commentators contend that, as an autonomous AI system, DABUS should be legally recognized as an inventor. They argue that DABUS independently conceived the two inventions in question without any human contribution. Based on the autonomous structure of DABUS described above, DABUS did form inventive ideas with results that can be carried out in practice, thus meeting the conception requirement. Dr. Thaler has published research papers explaining that his AI systems, including DABUS, imitate the structure and

147. Mark Lyon et al., *When AI Creates IP: Inventorship Issues to Consider*, LAW360 (Aug. 10, 2017, 12:51 PM), https://www.law360.com/articles/950313/when-ai-creates-ip-inventorship-issues-to-consider [https://perma.cc/KXL9-YCUJ] ("[T]here are often other individuals beyond the ultimate end users that are involved in designing, creating[,] or training an AI with relevant rules or data sets. In some cases, one or more of these individuals might be considered a potential inventor, even if they weren't among the group of people actually using the AI to come up with the solution, so long as their activity was such that it could fairly be considered to have materially contributed to the conception of the invention.").

148. Reto M. Hilty et al., *Intellectual Property Justification for Artificial Intelligence*, *in* ARTIFICIAL INTELLIGENCE AND INTELLECTUAL PROPERTY, *supra* note 11, at 50, 54.

149. Daria Kim, *'AI-Generated Inventions': Time to Get the Record Straight?*, 69 GRUR INT'L 443, 453 (2020).

150. *See* Katharine Stephens, *Who Owns an AI-Generated Invention?*, BIRD & BIRD (Dec. 5, 2019), https://www.twobirds.com/en/news/articles/2019/global/who-owns-an-ai-generated-invention [https://perma.cc/FWX5-ZXRJ].

151. *See DABUS Described*, IMAGINATION ENGINES INC., https://imagination-engines.com/dabus.html [https://perma.cc/Q2SY-B2W3] (last visited Jan. 16, 2023).

function of the human brain.[152] He and others have also asserted that courts have not construed the idea of conception in a human-centric fashion that would exclude AI systems.[153]

Dr. Thaler and others have also argued that the denial of AI inventorship would lead to arbitrary or false designations of human contributors as inventors.[154] For example, Dr. Thaler claims as follows:

> Failing to appropriately acknowledge inventive activity by AI weakens moral justifications for patents by allowing individuals to take credit for work they have not done. It is not unfair to machines who have no interest in being acknowledged, but it is unfair to other human inventors because it devalues their accomplishments by altering and diminishing the meaning of inventorship. This could equate the hard work of creative geniuses with those simply asking a machine to solve a problem or submitting a machine's output.[155]

This statement suggests that the denial of AI inventorship would lead to dilution of the notion of inventorship, which can offer moral benefits and professional credibility to human scientists and engineers. Those who make efforts to conceive an invention should be credited and rewarded with recognition of their status as inventors. The denial of AI inventorship runs counter to this moral ethos. Although it would not be unfair to a computer system for a human being to claim credit for its work, it would be unfair to legitimate human inventors, as the concept of inventorship would be diluted.[156] If inventorship were nothing more than placing one's name on something generated by a computer system, then the accomplishments of those who invent without AI assistance would no longer be adequately acknowledged.

Recognition of AI as an inventor would obviate this moral dilemma. It would simultaneously recognize the achievements of AI developers and programmers[157] in a way akin to how parents and teachers take pride in the successes of their children and students without taking credit for them. The human capital needed to generate inventions would also be reduced because it would no longer be necessary to have

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152. *See* Complaint for Declaratory and Injunctive Relief, *supra* note 3, at 13 ("Dr. Thaler has argued that his AI's architecture imitates the architecture of the human brain." (citing Stephen L. Thaler, *Synaptic Perturbation and Consciousness*, 6 INT'L J. MACH. CONSCIOUSNESS 75 (2014))).

153. *Id.* ("[Judicial language about conception] does not establish whether a nonhuman could conceive of anything, and even with regards to individuals it is not clear what 'formation in the mind' *actually* means. Courts associating inventive activity with conception have not been using terms precisely or meaningfully in the context of AI-generated inventions.").

154. *See* Stephens, *supra* note 150.

155. Complaint for Declaratory and Injunctive Relief, *supra* note 3, at 9.

156. *See* Comer, *supra* note 116, at 477-78.

157. Complaint for Declaratory and Injunctive Relief, *supra* note 3, at 9 (arguing that "acknowledging an AI as an inventor would also acknowledge the work of the AI's creators").

human conception input for valid patents.[158] Such an approach would also address the thorny issue of identifying proper human inventors when several stakeholders, including AI programmers, owners, and users, are involved in the inventive process and claim inventorship, as it would allow AI systems to be named as inventors.[159]

Some commentators have proposed an alternative approach to recognizing AI inventorship through rethinking legal personhood for AI systems. They argue that the term "personhood" is often misinterpreted, with people tending to subscribe to an anthropocentric philosophy that results in questions about the humanity of AI systems rather than exploring personhood as an important legal inquiry for the purpose of assigning accountability.[160] When U.S. law assigns personhood to corporations following the *persona ficta* approach to legal personality,[161] it should not be considered an attempt to anthropomorphize companies. It can therefore be argued that it is not unreasonable to extend the concept of corporate legal personhood to AI systems. For instance, just as a corporation is composed of shareholders, officers, and directors, an AI system requires human contributors at various stages of its inventive process, and legal and economic efficiencies can be achieved by combining these contributors into one legal person.[162]

C. Piercing the Corporate Veil Doctrine

On their face, the aforementioned arguments strongly support the legal recognition of AI inventorship. While focusing on conception as the first requirement of inventorship, however, they fail to consider that AI systems *can* meet the ownership requirement of inventorship examined in Section A above. I argue that application of the company law doctrine of "piercing the corporate veil" presents a new avenue for determining AI inventorship through consideration of whether AI systems can be the owners of their inventions.

158. Ernest Fok, *Challenging the International Trend: The Case for Artificial Intelligence Inventorship in the United States*, 19 SANTA CLARA J. INT'L L. 51, 66 (2021).

159. *Id.*

160. Brown, *supra* note 145, at 215.

161. *Id.* at 216 ("In jurisdictions (i.e. the United States and England) that follow the *persona ficta* approach, therefore, the law regards a corporation as a fictitious person or entity; while in jurisdictions (i.e. Germany, Spain, France and other continental countries) that follow the juristic person approach, the law regards a corporation as a real person.").

162. Bendert Zevenbergen et al., *Appropriateness and Feasibility of Legal Personhood for AI Systems*, *in* HYBRID WORLDS: SOCIETAL AND ETHICAL CHALLENGES 59, 62 (Selmer Bringsjord et al. eds., 2018), https://clawar.org/wp-content/uploads/2019/11/ICRES2018_p59_paper-17.pdf [https://perma.cc/2RJC-5CMT] ("Legal efficiency is achieved because it allows plaintiffs to sue the organization directly without going through a lengthy, expensive, and arduous process of identifying the specific individuals responsible. Economic efficiency is achieved by the pooling of resources to increase productivity, while creating legal certainty improves the efficiency of operation.").

Piercing the corporate veil refers to cases in which courts terminate the limited liabilities of corporations and then hold their shareholders or directors personally accountable for corporate actions or debts.[163] As a legal entity,[164] a corporation is shielded by limited liability only to the extent of its shareholders' investment in the corporation when corporate dealings with external parties have such consequences as debts incurred by contracts, taxes arising from businesses, and penalties imposed by lawsuit losses.[165] This regime is intended to encourage business investment through the reallocation of risks.[166]

To ensure that limited liability is not used by individuals as a shield to achieve illegal ends, courts have created the piercing the corporate veil doctrine. For instance, because of the limited liability regime, creditors have no recourse against corporate shareholders for debts owed by the corporation, as long as certain formalities are satisfied.[167] If a corporation is fraudulently created to escape liability, however, creditors can ask the court to pierce the corporate veil by making shareholders directly accountable for the corporation's debts.[168]

There is no uniform test for piercing the corporate veil. The most common practice is to "requir[e] a plaintiff to demonstrate that a corporation was an 'alter ego' or 'mere instrumentality' " controlled and dominated by a shareholder who committed wrongdoings that proximately caused loss or injury to the plaintiff.[169] U.S. case law contains extensive examples of conduct that has been used to justify the piercing of the corporate veil. For instance, in *Cahaly v. Benistar Property Exchange Trust Co.*,[170] an individual's treatment of corporate assets as his or her own was established as a justification for piercing the corporate veil. In that case, a shareholder had used company funds to fulfill his penchant for risky trading.[171] In the cases of *Keffer v. H.K. Porter*

163. *See* Frank H. Easterbrook & Daniel R. Fischel, *Limited Liability and the Corporation*, 52 U. CHI. L. REV. 89, 89 (1985).

164. *See* Santa Clara Cnty. v. S. Pac. R.R. Co., 118 U.S. 394, 396 (1886) (holding that "[c]orporations are persons within the meaning of the Fourteenth Amendment").

165. Jonathan Macey & Joshua Mitts, *Finding Order in the Morass: The Three Real Justifications for Piercing the Corporate Veil*, 100 CORNELL L. REV. 99, 104 (2014); Easterbrook & Fischel, *supra* note 163, at 89-90.

166. Henry G. Manne, *Our Two Corporation Systems: Law and Economics*, 53 VA. L. REV. 259, 262 (1967) (arguing that publicly held corporations with many small shareholders could not exist without limited liability); Robert B. Thompson, *Piercing the Corporate Veil: An Empirical Study*, 76 CORNELL L. REV. 1036, 1040 (1990-1991) ("Limited liability encourages development of public markets for stocks and thus helps make possible the liquidity and diversification benefits that investors receive from those markets."); David Milton, *Piercing the Corporate Veil, Financial Responsibility, and the Limits of Limited Liability*, 56 EMORY L.J. 1305, 1325 (2007).

167. *See* Macey & Mitts, *supra* note 165, at 105.

168. *Id.*

169. *See* Peter B. Oh, *Veil-Piercing*, 89 TEX. L. REV. 81, 84 (2010).

170. 864 N.E.2d 548 (Mass. App. Ct. 2007).

171. *Id.* at 557-58, 557 n.15; *see also* Macey & Mitts, *supra* note 165, at 107.

Co.[172] and *Galgay v. Gangloff*,[173] drawing on "alter ego theory," the courts found "use of the corporation as a 'façade' for the personal dealings of the dominant shareholder(s)" justified the piercing of the corporate veil.[174] In *Baatz v. Arrow Bar*,[175] it was noted that "use of the corporation to promote fraud, injustice, or illegalities" also provided such justification.[176]

Further judicial justifications for piercing the corporate veil include the "intermingling of activities and assets of the corporation and the shareholder,"[177] "absence or inaccuracy of corporate records," and "failure to observe corporate formalities in terms of behavior and documentation."[178] To illustrate the confusion that such an open-ended list of justifications has produced, in some cases, the courts have found the failure to pay dividends to justify piercing the corporate veil,[179] whereas in others the paying of dividends has been cited as a potential justification.[180] Although the potential range of justifications is wide, the "piercing the veil" doctrine is most frequently used in cases of illegality.[181] For instance, one study of case law found fraud to be the most frequently cited justification in practice, with the matter discussed in 49.2% of all piercing-the-veil cases in the dataset; of those cases in which fraud was present, courts pierced the veil in 88.2%.[182]

D. Piercing the AI Inventorship Veil

As the preceding Section demonstrates, piercing the corporate veil endeavors to reveal the party who actually controls and should be held responsible for wrongdoings committed using a company's assets. I argue that the doctrine can and should be applied to cases involving the patent protection of AI-generated inventions. Piercing the veil of alleged AI inventorship is a necessary step in ascertaining whether it is

172. 872 F.2d 60 (4th Cir. 1989).

173. 677 F. Supp. 295 (M.D. Pa. 1987).

174. *See* Macey & Mitts, *supra* note 165, at 107 & n.30.

175. 452 N.W.2d 138 (S.D. 1990).

176. *Id.* at 141; *see also* Macey & Mitts, *supra* note 165, at 108 & n.32.

177. Macey & Mitts, *supra* note 165, at 107 (citing Cancun Adventure Tours, Inc. v. Underwater Designer Co., 862 F.2d 1044, 1047-48 (4th Cir. 1988)).

178. *Id.* at 107.

179. *Id.* at 106-07; *see also* Riggins v. Dixie Shoring Co., 592 So. 2d 1282, 1283 (La. 1992).

180. *See, e.g.*, Soroof Trading Dev. Co. v. GE Fuel Cell Sys. LLC, 842 F. Supp. 2d 502, 521 (S.D.N.Y. 2012); s*ee also* Macey & Mitts, *supra* note 165, at 106.

181. *See, e.g.*, Mesler v. Bragg Mgmt. Co., 702 P.2d 601, 606 (Cal. 1985) ("As the separate personality of the corporation is a statutory privilege, it must be used for legitimate business purposes and must not be perverted. When it is abused it will be disregarded and the corporation looked at as a collection or association of individuals, so that . . . the stockholders [will be] liable for acts done in the name of the corporation." (quoting Comment, *Corporations: Disregarding Corporate Entity: One Man Company*, 13 CALIF. L. REV. 235, 237 (1925))).

182. John H. Matheson, *Why Courts Pierce: An Empirical Study of Piercing the Corporate Veil*, 7 BERKELEY BUS. L.J. 1, 32 (2010).

human actors or AI systems that control and should be held responsible for dealings related to the inventions concerned. Applying the various factors that trigger piercing of the corporate veil, I identify two instances in which the veil of AI inventorship should be pierced, allowing the human owners of patents derived from AI-generated inventions operating behind that veil to be ascertained and held legally responsible.

(1) Treatment of an AI invention as an individual's own.

The doctrine of piercing the corporate veil has been applied in dealing with shareholders who treat corporate assets as their own.[183] Regardless of personal interest or role in the corporation, nobody should treat the corporation's property as personal property. Such behavior triggers application of the doctrine to allow the relevant party to be held liable for debts or damage caused. Similarly, treating an AI-generated invention as one's own property can trigger the piercing of the AI inventorship veil, allowing the identification of an AI developer as the property (patent rights) owner. As the DABUS litigation has shown, it is ultimately those who have control of an inventive AI system who have control of its products. This reality is recognized by the group behind the DABUS patent applications. Dr. Thaler claims that the group's argument is simply that DABUS is capable of producing patentable inventions without sufficient human intervention to justify listing a person as the inventor.[184] He stresses that no one is advocating for an AI system to be deemed capable of owning patent rights to its invention, but rather that the system's developer should be the owner of the patent rights concerned.[185] This notion was supported in the recent Federal Court of Australia decision recognizing DABUS as an inventor.[186] The ruling judge in the case noted that Dr. Thaler was clearly entitled to own the invention, as he was the owner, programmer, and operator of DABUS.[187]

However, in other instances, there may be competing interests such as those of the person who developed or programmed the AI system, the person who selected and provided the system's input data, the person who trained the AI using the input data, the person who invested capital to produce the output, and the system's operator.[188] Of these

183. *See* Cahaly v. Benistar Prop. Exch. Tr. Co., 864 N.E.2d 548, 557 n.15 (Mass. App. Ct. 2007) ("[Company] funds were used by [one of the individual defendants] to carry out 'his personal penchant for risky option trading on the stock market.' ").

184. Matthew Bultman, *Can a Robot Invent? The Fight Around AI and Patents Explained*, BLOOMBERG L. (Sept. 9, 2021, 5:01 AM), https://news.bloomberglaw.com/ip-law/can-a-robot-invent-the-fight-around-ai-and-patents-explained [https://perma.cc/THM5-HFVM].

185. *Id.*

186. *Thaler v Commissioner* [2021] FCA 879 (30 July 2021) 35.

187. *Id.* at 32.

188. *See* Aaron Hayward et al., *'Why Can't Our Creations Create?'—AI Can Be Patent Inventors in Australia*, HERBERT SMITH FREEHILLS (Aug. 2, 2021), https://www.herbertsmithfreehills.com/

potential candidates for legal ownership, the developer or programmer is often proposed as the most deserving. For instance, it can be argued that, as the developer or programmer initially conceived the AI software and its apparatus, his or her creative influence extends to the eventual outputs. However, in light of the inventive autonomy now possessed by AI systems, that influence cannot always be presumed. The owner is another primary candidate, as the AI's development would not have been possible without his or her financial contribution.[189]

(2) Intermingling of the activities of an AI invention and AI developer.

Piercing the corporate veil doctrine has also been applied when intermingling of the activities or assets of the corporation and shareholder occurs. In cases such as the diversion of corporate funds to dominant shareholders for their own business activities, courts have ruled that corporations are no longer separate from their shareholders.[190] Therefore, piercing the veil becomes necessary to render dominant shareholders responsible for liabilities incurred by the corporation.[191]

The DABUS litigation made it clear that Dr. Thaler, the AI developer, would likely intermingle potential business activities involving the DABUS-generated inventions with his own commercial initiatives. The inventions could, for example, be licensed to a third party to enable that party to use the inventions to make new products and to then sell those products. Dr. Thaler would issue permission to the licensee and obtain royalties from him or her. Patent ownership of the inventions could also be transferred. Again, Dr. Thaler would have the power to decide whether to allow ownership transfer and to collect the resulting transaction fees. His involvement would clearly entail intermingling between himself and business activities involving inventions generated by DABUS.

The two foregoing applications of the piercing the corporate veil doctrine to inventions generated by autonomous AI systems such as DABUS demonstrate the inseparability of AI-generated inventions and AI system developers in terms of ownership. Were we to recognize an AI system as the creator of an invention, the system would not own

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insight/why-cant-our-creations-create-ai-can-be-patent-inventors-in-australia [https://perma.cc/UJC9-7PCP].

189. Dornis, *supra* note 17, at 154.

190. *See* My Bread Baking Co. v. Cumberland Farms, Inc., 233 N.E.2d 748, 751-52 (Mass. 1968) (discussing how the separate identities of affiliated corporations may be disregarded when "there is a confused intermingling of activity of two or more corporations engaged in a common enterprise with substantial disregard of the separate nature of the corporate entities, or serious ambiguity about the manner and capacity in which the various corporations and their respective representatives are acting").

191. *See, e.g.*, Cancun Adventure Tours, Inc. v. Underwater Designer Co., 862 F.2d 1044, 1047-48 (4th Cir. 1988) ("[W]hen substantial ownership is combined with other factors, such as commingling of corporate and personal assets and diversion of corporate funds to the dominant shareholder, a court may peer behind the corporate veil . . . .").

the invention's patent rights. Instead, the system developer would become the de facto owner. Therefore, piercing the AI inventorship veil would reveal that such inventorship meets only the conception requirement of inventorship under patent law, not the ownership requirement.[192] Any legal recognition of AI inventorship would result in a bifurcated mechanism, with the AI system protected as an inventor and its developer protected as a patent rights owner. The reality of veil-pierced AI inventorship, however, runs afoul of the original purpose of inventorship, which is to grant ownership of a patent to the inventor. Hence, piercing the AI inventorship veil proves that it is unnecessary and undesirable to legally recognize such a new type of inventorship.

Application of the piercing the veil doctrine could address some of the major problems with the approach adopted by patent offices and courts to ascertain the inventorship of DABUS. In the view of the patent offices and courts discussed herein, AI systems do not have personhood and therefore are incapable of owning anything, their inventions included. This has been one of the major stumbling blocks in emerging AI ownership cases. For instance, when the UKIPO and APO issued their initial rejections of patents for the inventions produced by the DABUS system, their issue was not that AI was incapable of inventing something, but rather that "they did not see how a machine could own what it invented."[193] Ownership is an essential part of the patent process. Where an applicant is not the listed inventor, it must be shown that the inventor has passed the "title" to the applicant, something that the two patent offices believed DABUS to be incapable of doing as an AI system.[194] Until society and the law view AI as something that can possess and control property, rather than as an object possessed and controlled by humans, ownership will continue to be an obstacle.[195]

However, application of piercing the veil doctrine is vulnerable to two plausible attacks. First, it has been observed that patent law should be technologically adaptive to accommodate the legal personhood of more advanced AI systems, which could serve a similar function to corporate legal personhood. For example, Professor Rafael Brown argues that, in the case of a less advanced AI system, recognizing its legal personhood may not be necessary, as the system "can be conferred the right to own property because it can take possession or control of the property through its human programmer or owner,

192. *See supra* Section II.A.

193. Amanda-Jane George, *If Machines Can Be Inventors, Could AI Soon Monopolise Technology?*, CONVERSATION (Aug. 5, 2021, 4:09 PM), https://theconversation.com/if-machines-can-be-inventors-could-ai-soon-monopolise-technology-165604 [https://perma.cc/FQ28-K97G].

194. *Id.*

195. Brown, *supra* note 145, at 224.

whose will would be attributed to the weak AI."[196] However, Professor Brown states that this argument is less applicable to more advanced AI systems, which, as highly autonomous systems, lack "the human agency from and to which rights and duties can be attributed."[197] In such cases, arguments for legal personhood are more likely to arise when society starts viewing AI as sufficiently human-like—for instance, when AI develops autonomy and free will and demonstrates behavior involving human-like rational or social intelligence.[198]

Second, even without the recognition of legal personhood, an AI system could still obtain ownership of an invention it generated. The Federal Court of Australia holds this view. In its DABUS ruling, the court argues that Dr. Thaler, who acts as "the owner and controller of DABUS,"[199] can still derive ownership of the inventions concerned even though DABUS does not have legal personhood and is not capable of assigning its inventions.[200] The court reasoned as follows:

> Dr Thaler apparently obtained possession of the invention through and from DABUS. And as a consequence of his possession of the invention, combined with his ownership and control of DABUS, he *prima facie* obtained title to the invention. By deriving possession of the invention from DABUS, Dr Thaler *prima facie* derived title.[201]

My "piercing the AI inventorship veil" approach can provide robust responses to both arguments. First, with respect to the legal personhood of AI systems, the approach is flexible and responsive to technological developments. Focusing on the allocation of patent rights ownership, the approach leaves to scientific experts the technological issue of whether contemporary AI systems such as DABUS have human-like capacities to conceive inventions.[202] Rather than pushing the limits of the judiciary's institutional capacities by requiring judges to decide on such a technological issue, it allows them to deal only with the legal issue of the ownership of patent rights, i.e., identifying who is the

196. *Id.* at 233.

197. *Id.*

198. Robert van den Hoven van Genderen, *Do We Need New Legal Personhood in the Age of Robots and AI?*, *in* ROBOTICS, AI AND THE FUTURE OF LAW 15, 27 (Marcelo Corrales et. al. eds., 2018).

199. *Thaler v Commissioner* [2021] FCA 879 (30 July 2021) 35.

200. *Id.* at 33 ("Now whilst DABUS, as an artificial intelligence system, is not a legal person and cannot legally assign the invention, it does not follow that it is not possible to derive title from DABUS.").

201. *Id.* at 35 (emphasis added).

202. *See supra* notes 116-21 and accompanying text (explaining why scientific experts should be called upon to decide whether contemporary AI systems have the capacity to conceive inventions as human inventors do and why courts do not have the institutional capacity to decide this technological issue); Kim, *supra* note 149, at 443 (calling for "a broader technical inquiry that would elucidate the relevance of the currently debated normative concerns over 'non-human inventorship' against the background of the technological state of the art").

patent proprietor of an AI-generated invention.[203] It also advances such identification behind the veil of AI inventorship to those who possess and exercise ownership of such inventions, revealing the ultimate allocation of such ownership.

Second, the piercing AI inventorship approach refutes the "derived ownership" opinion. In my view, the Federal Court of Australia erred in reasoning that an AI system developer could, from its ownership and control of the system, derive ownership of an AI-generated invention. DABUS, as Dr. Thaler alleged, is an autonomous AI system. He thus has no control of the system as it invents, and nor can he necessarily own DABUS-generated inventions because DABUS's inventorship entitles the system to own its inventions under patent law. The piercing AI inventorship approach, however, still holds that the inventorship of an autonomous AI system leads to vesting the ownership of inventions in the system itself. It is through detaching and then possessing such ownership from AI systems that AI developers such as Dr. Thaler come to own the inventions. Piercing AI inventorship therefore exposes the de facto owners of such inventions (AI system developers) after recognizing their de jure owners (AI systems).

III. RESPONSIBILITY

Rights are not conferred and exercised in a vacuum. Instead, they are conditioned upon natural persons or legal entities being capable of assuming the responsibilities associated with the rights granted to them.[204] Patent law epitomizes this rights-infused-with-responsibilities structure. While it bestows a bundle of rights on inventors, it also imposes responsibilities on them.[205]

To reflect this legal reality, I here put forth my second legal principle: requiring inventors to have the capacity to accept responsibilities. I first discuss the scope of responsibilities that inventors should assume with respect to their inventions. Revealing why AI systems are incapable of assuming such responsibilities, I argue that they should not be deemed inventors in the present technological circumstances.

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203. *See* Scherer, *supra* note 38, at 357 (arguing that "courts are best equipped to" deal with legal issues such as "allocat[ing] responsibility after an AI system causes harm").

204. *See* Brian H. Bix, *Rights, Responsibilities, and Roles: A Comment on Waldron*, 43 ARIZ. ST. L.J. 1137, 1140 (2011) (discussing the argument that "rights are not to be understood as the weak and grasping shadow of the duties on which we should be focusing, but rather as a mechanism for combining duty and responsibility, leading to just the sort of focus on the common good and living a good life"). *See generally* Jeremy Waldron, *Dignity, Rights, and Responsibilities*, 43 ARIZ. ST. L.J. 1107 (2011); JAMES E. FLEMING & LINDA C. MCCLAIN, ORDERED LIBERTY: RIGHTS, RESPONSIBILITIES, AND VIRTUES (2013); YASCHA MOUNK, THE AGE OF RESPONSIBILITY: LUCK, CHOICE, AND THE WELFARE STATE (2017); IRIS MARION YOUNG, RESPONSIBILITY FOR JUSTICE (2011).

205. *See* Sun, *Patent Responsibility*, *supra* note 34, at 321 (arguing "for reform of patent law so that it not only protects patent holders' exclusive rights but also enforces their responsibilities").

A. Role Responsibilities

For any approved application filed by an inventor, patent law confers on the inventor the right to make, use, sell, offer for sale, or import a patented invention for the term of the patent.[206] The inventor enjoys the legal protection of this bundle of strong exclusive rights according to the scope of patent claims stated in his or her application.

At the same time, patent law imposes responsibilities on inventors by virtue of their role as inventors. Role responsibility is "ascribed to individuals or institutions if they themselves have spontaneously assumed certain roles in personal or social activities."[207] An individual occupies a certain social role such as a sea captain, husband, or clerk.[208] An individual's interpersonal roles place him or her in a special position in relation to others whose interests are affected by that individual, thereby assigning him or her certain functions to perform or goals to fulfill.[209] In this context, expectations are cast upon individuals to take on responsibilities and perform functions or fulfill goals attached to their roles.[210] Given their inventorship role, patent law requires inventors to assume two role responsibilities: (1) to ensure that they are truly the inventors who created the inventions concerned and (2) to sufficiently disclose the technical information embodied in their inventions.

1. True Inventorship

For every patent application submitted to the USPTO, § 115(a) of the Patent Act requires that "each individual who is the inventor or a joint inventor of a claimed invention . . . execute an oath or declaration

206. 35 U.S.C. § 154 (a)(1).

207. Sun, *Corporate Fundamental Responsibility*, *supra* note 34, at 929.

208. H.L.A. HART, PUNISHMENT AND RESPONSIBILITY: ESSAYS IN THE PHILOSOPHY OF LAW 212 (2d ed. 2008) ("A sea captain is responsible for the safety of his ship, and that is his responsibility, or one of his responsibilities. A husband is responsible for the maintenance of his wife; parents for the upbringing of their children; . . . a clerk for keeping the accounts of his firm. These examples of a person's responsibilities suggest the generalization that, whenever a person occupies a distinctive place or office in a social organization, to which specific duties are attached to provide for the welfare of others or to advance in some specific way the aims or purposes of the organization, he is properly said to be responsible for the performance of these duties, or for doing what is necessary to fulfil them. Such duties are a person's responsibilities.").

209. *See* MEIR DAN-COHEN, RIGHTS, PERSONS, AND ORGANIZATIONS: A LEGAL THEORY FOR BUREAUCRATIC SOCIETY 38 (1986) (arguing that "at any given point in time and within a particular normative scheme, organizational behavior is amenable to analysis and interpretation in terms of the organization's instrumental nature, that is, in terms of its pursuit of some predetermined individual or social goals").

210. *See* Robin Zheng, *What is My Role in Changing the System? A New Model of Responsibility for Structural Injustice*, 21 ETHICAL THEORY & MORAL PRAC. 869, 875 (2018) ("Performing a role . . . is an ongoing process of making infinitely many tiny decisions about *how* to perform it, thereby calibrating one's behavior with another's expectations and behavior at the same time that the other is calibrating their expectations and behavior with yours.").

in connection with the application."[211] The U.S. Code of Federal Regulations (CFR) clarifies that an oath "may be made before any person within the United States authorized by law to administer oaths."[212] Section 25(a) of the Patent Act introduces the possibility of the USPTO accepting a written declaration in lieu of an oath.[213] The CFR states that a written declaration is permissible only when the declarant is warned in the same document that willful false statements are punishable by imprisonment or a fine and may jeopardize the validity of the patent application.[214] In the declaration, the declarant must confirm that "all statements made of the declarant's own knowledge are true and that all statements made on information and belief are believed to be true."[215] Alternatively, a substitute statement can be submitted by an applicant under § 115(d) in respect of any individual who is unable to file as a result of being deceased or under legal incapacity or who cannot be found after diligent effort.[216]

It seems impossible for AI systems, as they currently stand, to fulfill their responsibility to state true inventorship. First, AI systems are unable to execute an oath or declaration of true inventorship,[217] as demonstrated in a recent decision issued by the Eastern District of Virginia. The court drew attention to the use of such terms as "individual," "him or herself," and "believes" in the provisions outlining the oath and declaration requirements, suggesting that their presence constituted evidence that Congress was describing obligations that were to be fulfilled by natural persons.[218] Therefore, under the current rules, it would not be possible to execute an oath or declaration on a patent application for an invention made by AI.[219] Dr. Thaler attempted to submit a substitute statement on behalf of DABUS, citing the system's legal incapacity.[220] However, the court again highlighted the use of the term "individual" in § 115(d), concluding that a

211. 35 U.S.C. § 115(a).

212. 37 C.F.R. § 1.66 (2021).

213. 35 U.S.C. § 25(a).

214. 37 C.F.R. § 1.68 (2021).

215. *Id.*

216. 35 U.S.C. § 115(d)(2)(A).

217. Matthew Horton & Austin Kim, *Inventorship: Why AI Is Not Smart Enough Yet*, 286 MANAGING INTELL. PROP. 19, 19 (2020) (arguing that making an oath "cannot be performed by any other entity besides human beings").

218. *See* Thaler v. Hirshfeld, 558 F. Supp. 3d 238, 247 (E.D. Va. 2021).

219. Yosuke Watanabe, *I, Inventor: Patent Inventorship for Artificial Intelligence Systems*, 57 IDAHO L. REV. 473, 486 (2021).

220. *See Thaler*, 558 F. Supp. 3d at 241.

substitute statement identifying DABUS was not in fact identifying an individual under legal incapacity.[221] Were AI inventorship to be accepted, these provisions would need to be rethought in order to make the system practicable.[222]

Assignment may act as an alternative if it includes the information and statements required for completion of an oath or declaration and a copy of the assignment is recorded.[223] In addition to submitting a substitute statement, Dr. Thaler attempted to comply with USPTO requirements by including a document stating that DABUS—represented by Thaler—assigned its "entire right, title and interest . . . to the invention" to the assignee, Thaler.[224] However, many commentators around the world, as well as the EPO, have questioned how a computer system can hold or transfer patent rights.[225] One potential solution to this problem has been proposed under section 409 of the USPTO's Manual of Patent Examining Procedures.[226] Ernest Fok notes that this provision allows for the transfer of patent rights for deceased or legally incapacitated inventors and suggests that treating AI as legally deceased or incapacitated could provide a workaround that would not require legal personhood.[227] However, the proposal is not feasible because civil or criminal penalties attributable to a willful statement of wrong inventorship cannot be enforced against the deceased or incapacitated.

Second, it is exceedingly difficult to meet content requirements for an oath or declaration in the context of AI-generated inventions. Section 115 of the Patent Act states that an oath or declaration must contain these two statements: "(1) the application was made or was authorized to be made by the affiant or declarant" and "(2) such individual believes himself or herself to be the original inventor or an original joint inventor of a claimed invention in the application."[228] Prior to amendments introduced in the America Invents Act, a statement as to the citizenship of the inventor and a declaration that the statement was made without deceptive intent were also required.[229] Despite the

221. *Id.*

222. *See* Liza Vertinsky, *Thinking Machines and Patent Law*, *in* RESEARCH HANDBOOK ON THE LAW OF ARTIFICIAL INTELLIGENCE 498, 504 (Woodrow Barfield & Ugo Pagallo eds., 2018).

223. 37 C.F.R. § 1.63(e) (2021).

224. *See* Thaler v. Hirshfeld, 558 F. Supp. 3d 238, 242 (E.D. Va. 2021).

225. *See, e.g.*, Roberto A. Jacchia & Giulia Beneduci, *The EPO Explains Why the Inventor Has to Be a Human Being, Not a Machine*, LEXOLOGY (Feb. 6, 2020), https://www.lexology.com/library/detail.aspx?g=899c6115-2e48-44b9-b794-6d46f466f48b [https://perma.cc/4LB6-KBDA].

226. MPEP § 409.01(a) (9th ed. Rev. 4, June 2020).

227. Fok, *supra* note 158, at 71.

228. 35 U.S.C. § 115(b).

229. Adam Thompson, *Managing the Changes to the Oath or Declaration Requirement: The Effect of the Leahy-Smith America Invents Act Oath or Declaration Change on Corporations*, 13 CHI.-KENT J. INTELL. PROP. 489, 493 (2014).

removal of some requirements, challenges remain. Primarily, as demonstrated in this Article, U.S. patent law recognizes and protects only human inventors. While such recognition/protection is largely based on the ordinary language of patent law, it can also be argued that, as the mental act of conception is the touchstone of inventorship, any claim that AI is the original inventor would be flawed. Under the traditional understanding of conception as "the complete performance of the mental part of the inventive act"[230] and current rules, AI systems can neither make an oath or declaration nor truthfully state a belief of inventorship. Furthermore, a human applicant making the oath or declaration on the system's behalf arguably cannot claim such a belief.

Similar problems arise in instances of human and AI joint inventorship, as it is unclear how a human applicant can truthfully state a belief in joint inventorship for either him or herself or the AI system. For instance, the joint inventorship doctrine traditionally focuses on the minds of each party, "requiring original contributions from all of the joint inventors to the conception of the invention, as well as contributions from each of the joint inventors to at least one of the patent claims."[231] For inventions generated with little human involvement, neither the AI system nor the human inventor has contributed to the *mental act* of conception under current standards. Furthermore, attempting to distinguish contributions can be a challenging process. Even when all contributors are human, the involvement of multiple minds means it can be difficult to determine who should be entitled to joint inventorship status.[232] Adding AI to the equation is likely to make determinations of joint inventorship even more challenging[233] because the involvement of multiple human contributors throughout AI development makes it difficult to determine *who* has contributed *what* to the eventual output.

Congress has been reluctant to create rigid legal provisions to aid joint inventorship determinations, with a lower bar for joint inventorship ensuring that patent law can accommodate the team approaches spread over multiple years common in universities and large organizations.[234] Nevertheless, it has been argued that this lack of clarity might be conducive to declarations of joint inventorship with AI. For instance, Rachel Schwein suggests that Congress's efforts to avoid rigidity and allow for different forms of collaboration indicate an intention to "be inclusive rather than preclude a bona fide inventor from being named."[235] Moreover, Schwein also states that the views of

230. Townsend v. Smith, 36 F.2d 292, 295 (C.C.P.A. 1929).

231. *See* Vertinsky, *supra* note 222, at 500.

232. *Id.*

233. *Id.*

234. Rachel L. Schwein, Note, *Patentability and Inventorship of AI-Generated Inventions*, 60 WASHBURN L.J. 561 (2021).

235. *Id.* at 588.

Congress suggest that inventorship is an administrative requirement and not part of the threshold for patentability, meaning that the questions of joint inventorship raised by AI should not be an obstacle to validity.[236] From this perspective, an overly strict interpretation of inventorship and joint inventorship for the purpose of making an oath or declaration would be undesirable.

If the USPTO and courts were to adopt Schwein's approach, then statements of belief of joint inventorship could be taken to be true. However, if the current approach is maintained, applicants face potential invalidation and even criminal penalties. The same applies for applications listing sole AI inventors. As noted above, the makers of written declarations are warned that false statements may result in fines or imprisonment, which also applies for inventors' oaths.[237] Both provisions refer to § 1001 of the U.S. Code, which lists these outcomes as the potential consequences of knowingly and willfully (1) falsifying or concealing a material fact; (2) making a materially false or fraudulent statement; or (3) making or using a document containing false or fraudulent statements in dealings with the U.S. government.[238] Dr. Thaler has argued that listing himself as an inventor on the DABUS application would constitute a misrepresentation, and some commentators have suggested that his silence on previous patent applications for AI-generated inventions listing himself as inventor indicates concern over falling foul of § 1001.[239]

It has been suggested that recognizing AI inventorship would discourage the practice of human inventors falsely claiming in their oath or declaration that they are the inventor of output actually generated by AI systems.[240] However, if such inventorship is denied, and if stricter enforcement of § 1001 is initiated to curb the practice, efforts may instead be made to keep AI-generated inventions as trade secrets and avoid public disclosure.[241] Nevertheless, recognition of AI inventorship alone would be insufficient to overcome the challenge of fulfilling the responsibility to provide inventorship oaths or declarations to the USPTO.

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236. *Id.*

237. 35 U.S.C. § 115(i).

238. 18 U.S.C. § 1001(a).

239. Susan Krumplitsch et al., *Can an AI System be Named the Inventor? In Wake of EDVA Decision, Questions Remain*, DLA PIPER (Sep. 23, 2021), https://s3.amazonaws.com/documents.lexology.com/827e6919-e3f9-48ef-baab-740e7f83dae3.pdf?AWSAccessKeyId=AKIAVYILUYJ754JTDY6T&Expires=1673904369&Signature=tCfrp5%2BXEJpNlifUn1mubuifkG0%3D [https://perma.cc/3DG4-8YG8].

240. *See* Vertinsky, *supra* note 222, at 506.

241. *Id.*

2. Sufficient Disclosure

The sufficient disclosure of technical information is another role responsibility that patent applicants must meet. As a result of the public interest implications of patents,[242] an applicant has a "duty of candor and good faith . . . which includes a duty to disclose . . . all information known to that individual to be material to patentability."[243] U.S. case law has established that a finding of fraud, inequitable conduct, or violation of this duty with respect to any claim will invalidate a patent. For instance, it was established in *J.P. Stevens & Co. v. Lex Tex Ltd.*[244] that once a court concludes that inequitable conduct has occurred, all claims—not just those to which the conduct relates—will be unenforceable.[245] The court in that case also dismissed the nonbinding precedent of an earlier case in which "some claims were upheld despite nondisclosure with respect to others."[246]

Under § 1.56(a) of the CFR, the duty to disclose information "exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned," and the duty will be satisfied if all known information material to patentability is submitted as part of an information disclosure statement in accordance with § 1.97 and § 1.98.[247] These provisions concern the disclosure of prior art material to patentability, with § 1.97 identifying the timeline for filing[248] and § 1.98 setting out the content requirements of statements.[249] Section 1.555 establishes that the same duties

242. *See* Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 151 (1989) ("In consideration of [the fulfillment of] its disclosure and the consequent benefit to the community, the patent is granted." (quoting United States v. Dubilier Condenser Corp., 289 U.S. 178, 186-87 (1933))); Sun, *Patent Responsibility*, *supra* note 34, at 334 ("The disclosure responsibility benefits society at large by requiring patent holders to supply relevant technical information.").

243. 37 C.F.R § 1.56(a) (2021).

244. 747 F.2d 1553 (Fed. Cir. 1984).

245. *Id.* at 1561.

246. *Id.* at 1561 & n.8.

247. 37 C.F.R. § 1.56(a) (2021).

248. *Id.* § 1.97(b) ("An information disclosure statement shall be considered by the Office if filed by the applicant within any one of the following time periods: (1) Within three months of the filing date of a national application other than a continued prosecution application under § 1.53(d); (2) Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application; (3) Before the mailing of a first Office action on the merits; (4) Before the mailing of a first Office action after the filing of a request for continued examination under § 1.114; or (5) Within three months of the date of publication of the international registration under Hague Agreement Article 10(3) in an international design application.").

249. *Id.* § 1.98(a). For example:

> (1) A list of all patents, publications, applications, or other information submitted for consideration by the Office . . . (2) A legible copy of: (i) Each foreign patent; (ii) Each publication or that portion which caused it to be listed, other than U.S. patents and U.S. patent application publications unless required by the Office; (iii) For each cited

exist in relation to reexamination proceedings.[250] The duties are primarily enforced "through the judicially-created inequitable conduct doctrine, which provides an equitable defense to a claim of patent infringement."[251] Changes to the doctrine were recently introduced by *Therasense, Inc. v. Becton, Dickinson & Co.*[252] The decision reaffirmed the requirement of proof that the applicant withheld material information with the "specific intent to deceive the [US]PTO."[253]

The challenge for AI systems relates primarily to whether such systems are capable of fulfilling these duties. Section 1.56(c) of the CFR clarifies that individuals implicated by such duties include the following: "(1) Each inventor named in the application; (2) Each attorney or agent who prepares or prosecutes the application; and (3) Every other person who is substantively involved in the preparation or prosecution."[254] If AI inventorship were to be introduced in the United States, then AI systems would certainly fall under § 1.56(c)(1), but it is less clear how they would be able to fulfill the duty to the same standards as human inventors. For instance, it has been noted that, in contrast to human inventors, who can be deposed in relation to patent proceedings, it would be difficult for future patent challengers to identify what information was available to an AI inventor at the time of invention.[255] Complex machine learning systems process huge amounts of data, making it extremely difficult to interpret AI outputs. The black box nature of AI would therefore make it challenging to identify the preexisting data an AI inventor relied upon in generating an invention, and it would be impractical to attempt to examine the entirety of its vast input data.[256]

Until these limitations are addressed, or until a system of artificial general intelligence is capable of being deposed, courts and the USPTO may need to "continue to define the contours of inventorship under the

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pending unpublished U.S. application, the application specification including the claims, and any drawing of the application, or that portion of the application which caused it to be listed including any claims directed to that portion; and (iv) All other information or that portion which caused it to be listed. (3)(i) A concise explanation of the relevance, as it is presently understood by the individual.

Id.

250. *Id.* § 1.555(a).

251. Lisa A. Dolak, *Patent Office Contested Proceedings and the Duty of Candor*, 22 J. INTELL. PROP. L. 1, 11 (2014).

252. 649 F.3d 1276 (Fed. Cir. 2011) (en banc); *see also* Dolak, *supra* note 251, at 11-13.

253. *See Therasense*, 649 F.3d at 1286-87.

254. 37 C.F.R. § 1.56(c) (2021).

255. *See* Krumplitsch et al., *supra* note 239.

256. *See* Hilty et al., *supra* note 148, at 54-55; Tabrez Y. Ebrahim, *Artificial Intelligence Inventions & Patent Disclosure*, 125 PENN. ST. L. REV. 147, 161 (2020) (arguing how a lack of AI transparency undermines the interrelated teaching and scope-limiting purposes of patent disclosure).

existing statutory scheme."[257] Alternatively, a process could be established for piercing the inventorship veil to identify the individual who should be, or is capable of being, responsible for the information disclosure duty on behalf of the AI system.

B. Responsibilities for Infringing Acts

In addition to role responsibility, inventors also need to assume responsibilities arising from the legal liabilities of their infringing acts. They may defectively design their inventions or use others' patents in their inventions without permission. Given that both acts infringe others' civil or patent rights, legal liabilities are ascribed to the inventor.

1. Defective AI

In the general field of AI, technological limitations mean that there is significant potential for legal liability to be imposed upon AI systems. For instance, AI systems sometimes produce erroneous predictions based on out-of-sample inputs because machine learning systems are often poor at recognizing changes in content or data.[258] When such systems are used in the medical field to identify health concerns, there is a very real potential for misdiagnosis, and thus legal liability.[259] Machine learning systems are also often trained on historical data, which has the potential to reinforce outmoded practices if insufficient efforts are made to periodically retrain the systems.[260] In the facial recognition sector, this issue can produce racial injustices that result in lawsuits.[261] Moreover, in the case of driverless cars, the black box nature of autonomous decisionmaking can render a car's behavior unpredictable by the manufacturer, programmer, or owner.[262] Accordingly, it can be difficult to apportion legal liabilities in cases where a driverless car causes an accident.

Therefore, the machine learning limitations imbedded in AI systems, such as those described above, might foreseeably result in defective inventions that result in injury or financial loss. The potential

257. *See* Krumplitsch et al., *supra* note 239.

258. Robert Challen et al., *Artificial Intelligence, Bias and Clinical Safety*, 28 BMJ QUALITY SAFETY 231, 232 (2019).

259. *Id.* at 233 ("De Fauw *et al* discovered their system worked well on scans from one OCT machine, but not another, necessitating a process to normalise the data coming from each machine, before a diagnostic prediction could be made. Similarly we anticipate that the system for diagnosing skin malignancy, which was trained on pictures of lesions biopsied in a clinic, may not perform as well when applied to the task of screening the general population where the appearance of lesions, and patient's risk profile, is different." (footnotes omitted)).

260. *Id.* at 235.

261. *See* Adam Schwartz, *Resisting the Menace of Face Recognition*, ELEC. FRONTIER FOUND. (Oct. 26, 2021), https://www.eff.org/deeplinks/2021/10/resisting-menace-face-recognition [https://perma.cc/N2JU-YRJ2].

262. *See* CHESTERMAN, *supra* note 30, at 88, 94.

grounds for liability arise from the sale of AI systems as products,[263] which can be equally applied in the case of AI-generated inventions. One notable ground for liability is a defect within an AI system's design,[264] which could also extend to defective products invented by defective systems. As an invention must be manufactured and marketed for sale following its initial AI generation, additional grounds for liability could arise from either manufacturing defects resulting from a deviation from the original design or failure to provide instructions or warnings that could foreseeably have avoided the risk of the product causing harm.[265] However, as these two scenarios concern conduct that occurs after an AI system has generated the invention, only design defect liability would require a new legal approach to account for AI.

As Simon Chesterman states, "a significant challenge for regulating AI systems is that their speed, autonomy, and opacity may result in undesirable harms that fall outside existing regimes of public control."[266] This assertion also applies to inventions generated by AI systems. Multiple agents contribute throughout the lifecycle of an inventive AI system, making "the causal connection and the foreseeability—i.e.[,] elements that are crucial for the attribution of liability—more difficult to be traced."[267] The increasing inventive autonomy of AI will serve to compound this problem.[268] However, it many cases it should be relatively easy to identify human actors who use an AI system to further their own interests. In introducing a system to conduct the identification process, inspiration can be drawn from piercing the corporate veil doctrine. This mechanism could be an important tool, whether AI legal personhood is introduced or the law attempts to identify a traditional legal person to be held accountable for AI-generated harms.

Before exploring AI legal personhood, it is important to consider the simpler solution of applying or modifying existing norms in holding traditional legal persons responsible. Whereas some applications of AI push the very limits of tort law, others require only minor changes, as the underlying legal principles are sound.[269] Were AI inventorship to be introduced, it is tempting to think that design defect liability for AI-generated products would fall neatly into the latter category of

263. David Nersessian & Ruben Mancha, *From Automation to Autonomy: Legal and Ethical Responsibility Gaps in Artificial Intelligence Innovation*, 27 MICH. TECH. L. REV. 55, 66 (2020).

264. *Id.*

265. *Id.*

266. CHESTERMAN, *supra* note 30, at 86.

267. THEMISTOKLIS TZIMAS, LEGAL AND ETHICAL CHALLENGES OF ARTIFICIAL INTELLIGENCE FROM AN INTERNATIONAL LAW PERSPECTIVE 216 (2021).

268. *Id.*

269. *See* CHESTERMAN, *supra* note 30, at 88.

application. For instance, a user who employs an AI system to generate inventions, and then produces and markets those inventions, appears to be an obvious target for liability lawsuits.

However, not all cases are so clear-cut. For example, user ownership would be presumed only in the absence of existing licensing or contractual agreements for the use of AI systems.[270] Where agreements do exist, the negotiating leverage of the parties concerned may determine the reality of control over output. For instance, a powerful AI owner may require that licensees using the system to develop and manufacture inventions agree that the resulting patent rights will be assigned to the owner. Such a requirement would complicate determination of who is truly the interested party behind the AI system. In such cases, as Part II demonstrates, a legal doctrine that allows courts to pierce the inventorship veil to make a fact-specific determination of responsibility could provide important value.

If inventive AI systems were considered to introduce challenges beyond any extension of existing legal principles, then the introduction of AI legal personhood might be another option. For design defect liability, this option might prove necessary "when there is no identifiable person to whom harmful conduct can be attributed, or when the harm is so far removed that the person cannot be said to have owed the injured party a duty of care."[271] Moreover, as AI becomes increasingly autonomous, identifying such a person will only become more difficult.[272] As the autonomy of inventive AI systems and minimal nature of human contributions have already been identified as reasons why humans cannot fairly list themselves as inventors, it could be similarly argued that the technology has reached a point where it is too difficult to identify harmful human contributions.

However, in circumstances where an inventive AI system is found liable for design defects in one of its inventions, to avoid allowing "producers and owners of AIs to shift liability to the artifact itself,"[273] the law must determine which actor bears responsibility for the legal consequences. As the purpose of introducing AI legal personhood would be to address the challenge of establishing causal contributions, courts could instead look more broadly at which party is factually in control of the system or using it to further its own interests. Introducing piercing the inventorship veil doctrine would allow for such fact-specific determinations.

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270. *See* Pearlman, *supra* note 109, at 36.

271. *See* CHESTERMAN, *supra* note 30, at 88.

272. *Id.*

273. *See* Zevenbergen et al., *supra* note 162, at 63.

2. Infringing AI

Patent infringement presents another legal issue that may require piercing the inventorship veil. As AI systems are capable of creating patentable inventions, their inventive processes may trigger the infringement of rights attached to existing patented inventions.[274] When AI repetitively learns from data and modifies its behavior, it becomes increasingly possible "that a resulting product, process, or action may infringe on one or more patent claims."[275] Although it may be asked whether an AI system can truly be aware of patents, direct liability does not require an inquiry into the infringing party's mental state.[276] Were AI legal personhood to be introduced, AI systems might therefore become the target of infringement suits.

However, in certain cases, it may be necessary to pierce the veil and establish the responsible party behind the AI system. For instance, consider an inventive AI system that develops an invention and compares it to a patent database, identifies the risk of infringement of one or more patents, but "proceeds to 'infringe' based on its own quantified assessment of risk."[277] As the system could presumably have been programmed by its developer to alert users to the risk, it might be appropriate to hold the developer responsible for "willful" infringement "because—perhaps just as easily—the owner could [have] decide[d] to program the AI machine to *never* infringe a third party's patent right."[278]

Under a system of patent assignment, the need to pierce the veil appears less pressing because, at first glance, the party using the AI system to produce the infringing invention is the obvious target. In other words, the person who becomes the owner of an AI's invention should bear responsibility for its infringement.[279] However, as discussed above, this solution could be complicated by licensing agreements that assign patent ownership to the AI owner rather than the person using the system to produce and market products. In such instances, the need for further consideration of control is evident, as it would be less clear who should assume responsibility for a "willful" patent infringement. In some cases, for example, the system owner may have exerted substantial influence on the AI user's conduct, whereas, in others, the user may have produced and marketed an infringing invention in the belief that the patent owner would assume the risk of liability.

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274. Bridget Watson, *A Mind of Its Own—Direct Infringement by Users of Artificial Intelligence Systems*, 58 IDEA 65, 78 (2017).

275. *See* Ravid & Liu, *supra* note 16, at 2251.

276. Jeremy A. Cubert & Richard G.A. Bone, *The Law of Intellectual Property Created by Artificial Intelligence*, *in* RESEARCH HANDBOOK ON THE LAW OF ARTIFICIAL INTELLIGENCE, *supra* note 222, at 411, 422.

277. *Id.*

278. *Id.*

279. *See* Ravid & Liu, *supra* note 16, at 2250-51.

In the case of inducement liability, some consideration of intent is necessary.[280] The Federal Circuit has interpreted U.S. law as requiring an alleged inducer to "have knowingly aided another's direct infringement of a patent."[281] In inducement cases, it may be necessary to explore degrees of control to determine who is the direct infringer and who knowingly aided the infringement. For instance, if an AI developer instructs a user to use its system to generate an infringing invention, but the generation process is autonomous and does not occur on the user's premises, then, depending on the degree of control, one or both parties could be considered responsible for inducement.[282] Such a question of inducement would require consideration regardless of whether the AI developer, AI user, or AI system itself owns the rights to the infringing invention.

There is clear comparability between certain justifications under piercing the corporate veil jurisprudence and justifying exploration of responsibility on the grounds of product defect liability or patent infringement liability. For instance, just as *Baatz v. Arrow Bar*[283] prevented the use of a corporation to promote fraud, injustice, or illegalities, the law should seek to prevent AI from being used to promote direct or induced patent infringement. Similarly, if an AI system produces a defective invention and harm is suffered, drawing insight from the alter ego theory of piercing the corporate veil jurisprudence,[284] responsible human actors should not be able to use the system as a façade to hide behind in order to avoid legal liability.

IV. THE PUBLIC DOMAIN

Protection of the public domain is the third legal principle that presents a potential barrier to recognition of AI inventorship under patent law. In this final Part of this Article, I first discuss the importance of the public domain in fostering cultural dynamics and innovative capacities. Based on an examination of how the overly expansive protection of patent rights can potentially jeopardize the public domain, I then present reasons why inventions generated by autonomous AI systems should be placed in the public domain.

A. AI and the Public Domain

There is no single official definition of "the public domain" for the purpose of patent law. The term is generally used in the context of technical information that has been publicly disclosed but is not

280. *See* Cubert & Bone *supra* note 276, at 422.

281. *See* Ravid & Liu, *supra* note 16, at 2251.

282. *Id.*

283. *See supra* notes 175-76 and accompanying text.

284. *See* Keffer v. H.K. Porter Co., 872 F.2d 60, 65 (4th Cir. 1989); Galgay v. Gangloff, 677 F. Supp. 295, 299 (M.D. Pa. 1987).

protected by an enforceable patent.[285] The public domain promotes technological innovation and cultural creativity.[286] Legally, it is a constitutional mandate that patent law must promote the robustness of the public domain. Pursuant to the U.S. Constitution, patent law should "promote the Progress of Science and useful Arts," thereby "securing for limited Times to . . . Inventors the exclusive Right to their . . . Discoveries."[287] Socially, the public domain maintains information that is free for the public to draw upon without proprietary control, thereby enriching the dissemination of scientific knowledge and nourishing cultural dynamics.

Patent law maintains non-patentable subject matter and the term of patent protection as two mechanisms to ensure that technical information and knowledge flow dynamically into the public domain. Non-patentable subject matter refers to certain types of technical information ineligible for patent protection.[288] Although there is no absolute international consensus on what should fall into the non-patentable category, most jurisdictions provide guidance on exclusions. For instance, non-patentable subject matter under U.S. patent law includes laws of nature, natural phenomena, and abstract ideas, and EU patent law includes discoveries, scientific theories, and mathematical methods.[289] Moreover, limited terms of patent protection put expired patents into the public domain, making them free for public use. In general, inventions are protected for twenty years starting from the date on which patent applications are filed.[290]

As technology continues to advance, new innovations are raising questions about whether the scope of patentable subject matter, and thus the public domain, should be expanded. For instance, developments in computer programs and gene isolation in the past few decades have led to debates over whether they should fall within the scope

285. WORLD INTELL. PROP. ORG., IDENTIFYING INVENTIONS IN THE PUBLIC DOMAIN: A GUIDE FOR INVENTORS AND ENTREPRENEURS 19 (2020), https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1062.pdf [https://perma.cc/N9MU-FYTC].

286. *See generally* Jessica Litman, *The Public Domain*, 39 EMORY L.J. 965, 968 (1990); James Boyle, Essay, *A Politics of Intellectual Property*: *Environmentalism for the Net?*, 47 DUKE L.J. 87, 98-99 (1997); Yochai Benkler, *Free as the Air to Common Use: First Amendment Constraints on Enclosure of the Public Domain*, 74 N.Y.U. L. REV. 354, 358-59 (1999); James Boyle, *Cultural Environmentalism and Beyond*, 70 LAW & CONTEMP. PROBS. 5, 7 (2007); JAMES BOYLE, THE PUBLIC DOMAIN: ENCLOSING THE COMMONS OF THE MIND 230-49 (2008).

287. U.S. CONST. art. I, § 8, cl. 8.

288. WORLD INTELL. PROP. ORG., *supra* note 285, at 19.

289. Alexander Peukert, *A Doctrine of the Public Domain*, *in* THE INNOVATION SOCIETY AND INTELLECTUAL PROPERTY 117, 121 (Josef Drexl & Anselm Kamperman Sanders eds., 2019).

290. Agreement on Trade-Related Aspects of Intellectual Property Rights, art. 33, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299, 33 I.L.M. 1197 (1994).

of patentable subject matter, and thus be protected as inventions.[291] AI-generated inventions also raise questions about the scope of patentable subject matter, albeit not with respect to the subject matter eligibility of AI system outputs. As the DABUS cases demonstrate, AI systems are now capable of using machine learning, a unique category of AI that enables systems to learn from data and achieve improved performance over time,[292] to produce inventions that would likely be protected if developed by a human inventor.[293]

What the DABUS cases demonstrate is that the concept of inventorship is evolving into a third legal tool—in addition to patentable subject matter and the term of protection—to delimit the scope of the public domain in the AI era. Should AI systems be recognized only as machines incapable of owning patent rights despite their creation of inventions? If the answer is yes, then AI-generated inventions should initially be placed in the public domain. If, in contrast, AI inventorship is legally recognized, then such inventions should be protected by patent law provided that they meet additional requirements such as patentability standards.

Therefore, whether AI systems can be deemed inventors is an important matter that affects the public domain, although the role of AI systems in the inventive process still varies dramatically. At one end of the scale, AI is little more than a tool employed by human inventors to aid their development of a product—conceptually similar to the role of a microscope.[294] At the other end of the scale, some commentators argue that there are already AI systems that lack a human inventive component and are capable of producing technological advancements "far beyond the capacity of the most innovative of engineers."[295] For instance, Google's AutoML product is utilizing AI systems to create new AI systems capable of more than the best human-designed models.[296] As machine learning continues to advance and AI inventive systems become more autonomous, it is becoming increasingly important to determine whether such systems should be recognized as inventors.

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291. Charles R. Macedo & Sandra A. Hudak, *Understanding Patent Eligibility of New Technology in the United States*, 7 J. INTELL. PROP. L. & PRAC. 865, 865 (2012).

292. *See* Michael McLaughlin, *Computer-Generated Inventions*, 101 J. PAT. & TRADEMARK OFF. SOC'Y 224, 231 (2019).

293. *See* Christian E. Mammen & Carrie Richey, *AI and IP: Are Creativity and Inventorship Inherently Human Activities?*, 14 FIU L. REV. 275, 286 (2020) (regarding the DABUS case, noting "[i]t has been reported that the UKIPO and the EPO have both determined that the inventions are patentably novel").

294. *See* Stephens, *supra* note 150.

295. *See* McLaughlin, *supra* note 292, at 238-39.

296. *Id.*

B. Innovation and the Public Domain

As discussed in Part I, the Federal Court of Australia ruled that the recognition of AI inventorship would incentivize the public disclosure of more AI-generated innovations. This ruling implies that strengthening patent protection by recognizing AI inventorship would increase the availability of technical information in the public domain. However, the Australian court did not consider the cumulative nature of innovation, which draws heavily on public domain information, and it failed to examine whether the expansion of patent protection risks harming the development of innovation and subsequently jeopardizing the public domain.

1. Cumulative Nature of Innovation

The innovation-limiting effects of an overabundance of patents may present a further obstacle to the recognition of AI systems as inventors. Even in the absence of AI inventorship, this is a concern for the patent protection system, as technical progress may be impeded "if the cumulative nature of invention negatively interacts with patent rights."[297] There is concern among academics that this is already taking place, with the proliferation of patents and fragmentation of ownership among firms believed to have raised transaction costs and constrained freedom to engage in follow-on innovation, particularly for "complex technology" industries in which innovation is highly cumulative.[298] There is a similar concern about the effects of patents on sequential innovation. As much scientific and technological innovation incrementally draws upon public domain information, strong patent enforcement can weaken incentives to engage in follow-on research activities.[299]

AI-generated inventions have the potential to exacerbate these challenges to innovation. Inventive AI systems can generate patentable ideas at high speed and low cost.[300] As an indicator of how fast AI systems in general can process information, in 2018, researchers at UCLA introduced a 3D-printed optical neural network capable of solving complex mathematical computations at the speed of light.[301]

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297. Fabian Gaessler et al., *Bargaining Failure and Freedom to Operate: Re-evaluating the Effect of Patents on Cumulative Innovation* 1 (Max Planck Inst. for Innovation & Competition, Rsch. Paper No. 19-11, 2019).

298. Alberto Galasso & Mark Schankerman, *Patents and Cumulative Innovation: Causal Evidence from the Courts*, 130 Q.J. ECON. 317, 318 (2015).

299. *See* John H. Barton, *Patents and Antitrust: A Rethinking in Light of Patent Breadth and Sequential Innovation*, 65 ANTITRUST L.J. 449, 451 (1997); Sun, *Patent Responsibility supra* note 34, at 326-64.

300. *See* Vertinsky, *supra* note 222, at 509.

301. Carl Engelking, *This AI Calculates at the Speed of Light*, DISCOVER (July 26, 2018, 7:59 PM), https://www.discovermagazine.com/technology/this-ai-calculates-at-the-speed-of-light [https://perma.cc/L7QG-VPVB].

Such processing power is already being utilized in the generation of potentially patentable subject matter, such as chemical compounds for potential medical treatments. In one case, an AI system was able to identify a molecule as a potential candidate for treating motor neuron disease in the space of just two weeks.[302] Although the candidate molecule had already been proposed by scientists, its identification was the result of two years of research.[303] The pharmaceutical industry is already employing AI extensively in the innovative process. For instance, Novartis, Pfizer, Merck, Johnson & Johnson, and the other firms constituting the so-called "Big Pharma" ten have all acquired AI technology or collaborated with AI developers to take advantage of the innovation benefits it offers.[304] As the pharmaceutical industry is a key user of the patent system, concerns over inventive AI's potentially negative impact on innovation are certainly valid.

However, the speed of AI is also being applied more broadly in the generation of innovation. For instance, the Iprova system was developed to identify new business models, trends, and technologies in the hope of introducing disruptive innovation.[305] The system operates a "disruption platform" that scans the Internet for new advances and assesses whether they can be applied to another field. Within twenty-four hours, it then evolves into an "invention platform," placing potential inventive outputs before a production team, which can then have an invention delivered within two weeks.[306]

2. Blocking Patents

The increasing speed and ease of invention could become a problem when combined with the patenting practices of companies involved in innovative industries. The simple fact that patents are used for blocking purposes could prove problematic, especially if they are powered by inventive AI systems. The patent system limits imitation to promote competition through innovation and substitution, but this exchange is challenged when patents are drafted with the purpose of

302. *AI Is Reinventing the Way We Invent*, NESTA, https://www.nesta.org.uk/feature/innovation-squared/ai-reinventing-way-we-invent/ [https://perma.cc/4TDC-CXAB] (last visited Jan. 16, 2023).

303. *Id.*

304. Iolanda Bulgaru, *Pharma Industry in the Age of Artificial Intelligence: The Future is Bright*, HEALTHCARE WEEKLY (Nov. 23, 2022), https://healthcareweekly.com/artificial-intelligence-in-pharmacology/ [https://perma.cc/G2SV-CXSS].

305. *See Increasing the Speed and Diversity of Invention Using Artificial Intelligence*, CAMBRIDGE WIRELESS (Dec. 5, 2019), https://www.cambridgewireless.co.uk/news/2019/dec/5/increasing-speed-and-diversity-invention-using-art/ [https://perma.cc/ATN6-QYYS].

306. *Id.*

preventing competitors from engaging in such innovation efforts.[307] There are several features and effects of blocking patents that make the public domain particularly susceptible to the harm caused by inventive AI systems.

First, blocking patents can cover essential elements of innovation that should be placed in the public domain for follow-on innovation. Although cumulative innovation is not new, the increasing importance of basic science in shaping the direction of technological progress has made the problem of patents that lay claim to such elements more acute.[308] For instance, in the biotechnology industry, patents have been issued "on all transgenic cotton, on biological receptors important in research on a broad category of pharmaceuticals, and on concentrated human stem-cell compositions useful for basic research on the immune system."[309] The effect of such patents cannot be assessed only in relation to the monopoly they confer on a single invention, as, by focusing on basic elements, they reach many products and may even limit the ability to conduct research on those products.[310]

Some commentators have argued that patents on basic research and components have significant effects in both the short and long term. For instance, it has been suggested that IP rights can be used by firms to restrict entry by later firms as technological competition moves from one generation of products to another.[311] Others have argued that the effects are predominantly short-term. One empirical study found that although broad patents limit downstream innovation and competition in the short term, competing firms' shift in focus to conducting new basic research means that limited downstream innovation is more than compensated for in the long term.[312] However, in the AI context, the "exponential pace of innovation"[313] makes for a shorter product lifecycle, and hence the competition-limiting effects of blocking patents should be measured in the short term.

The blocking effects of patents suggest that the patent system is better at supporting initial innovation than follow-on innovation. For instance, commentators have noted that firms must at some point negotiate with a firm holding a basic patent if they wish to invest in

307. Andreas Heinemann, *Blocking Patents and the Process of Innovation*, *in* NEW DEVELOPMENTS IN COMPETITION LAW AND ECONOMICS 149, 159-62 (Klaus Mathis & Avishalom Tor eds., 2019).

308. *See* Galasso & Schankerman, *supra* note 298, at 317-18.

309. *See* Barton, *supra* note 299, at 449 (footnotes omitted).

310. *Id.* at 450.

311. *Id.* at 454.

312. Guido Cozzi & Silvia Galli, *Sequential R&D and Blocking Patents in the Dynamics of Growth*, 19 J. ECON. GROWTH 183, 208-09 (2014).

313. *See* Mauritz Kop, *AI & Intellectual Property: Towards an Articulated Public Domain*, 28 TEX. INTELL. PROP. L.J. 297, 314-15 (2020).

follow-on research.[314] If such negotiation is conducted ex ante, it is certainly possible that the result will support the investment needed for follow-on research. If it is conducted ex post, however, there is a serious risk of hold-up before a follow-on invention can be introduced to the market. As inventors researching a follow-on innovation "have to invest significantly in understanding its implications before they can knowledgeably negotiate with the initial inventor,"[315] negotiations are far more likely to occur ex post.

In the absence of efforts to address the patent system's imbalanced support for initial innovation and follow-on innovation, the risk of hold-up caused by ex-post licensing negotiations could be heightened by inventive AI systems. However, it may be the system users who are limited by the black box nature of the systems they employ. The characterization of a system as a "black box" denotes computational complexity, the non-linearity of models, and, ultimately, decisionmaking autonomy, meaning the system's human operators are left with little understanding of the process that produced a particular output.[316] Such limited understanding makes it almost certain that operators are able to engage only in ex-post licensing negotiations. Although this situation may benefit competitors, it is doubtful whether it is sufficient to counter all of the competitive advantages enjoyed by AI users, and it demonstrates a lack of preparedness for AI inventions in the patent system.

3. Patent Thicket Generators and Patent Trolls

Some blocking strategies are employed not to protect an invention or secure opportunities for innovation but rather to block competing products and innovations.[317] Complex technologies often result in multiple patent applications for a single invention, and such patents provide a strong negotiating position for cross-licensing. However, collections of interrelated patents can also be used to block production and impede further technological developments.[318] In some cases, companies develop a "thicket" of overlapping patents with the specific intention of making it harder to invent around the protected technology.[319] Following the DABUS decision in Australia, there is already concern that large corporations may be incentivized to use AI systems as "patent thicket generators."[320]

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314. *See* Barton, *supra* note 299, at 453.

315. *Id.*

316. *See* Kim, *supra* note 149, at 453-54.

317. *See* Heinemann, *supra* note 307, at 150.

318. T. Randolph Beard & David L. Kaserman, *Patent Thickets, Cross-Licensing, and Antitrust*, 47 ANTITRUST BULL. 345, 351 (2002).

319. *See* Heinemann, *supra* note 307, at 150.

320. *See* Taylor, *supra* note 7.

As is the case with portfolios of defensive patents, patent thickets are most severe in technologically complex and dynamic industries.[321] For instance, a recent study of the patenting practices of law firms found that, in fields of increasing technological complexity, the existence of patent thickets significantly hampers entry.[322] This conclusion was supported by the discovery that technological complexity itself has a weak impact on entry, suggesting that it is the potential for hold-ups rather than the difficulty of inventing that leads firms to avoid an industry.[323] The study also found that in industries with greater technological opportunity—referring to dynamic sectors with opportunities for invention based on the recombination of conventional or atypical knowledge—entry is similarly reduced by the presence of patent thickets.[324] As AI systems such as Iprova innovate through the recombination of knowledge, they are likely to be present in and contribute to thicket development in industries susceptible to hold-up.

The invalidation of individual patents in technological fields where innovation is held up by patent thickets has been found to have the same effect as in fields held up by cross-licensing bargaining failures. The bundle of patents jointly protecting a single technology means that the freedom of competitors to operate remains limited even in such circumstances.[325] Patent invalidation leads to an average increase of just thirty percent in forward citation, making it clear that patent thickets and other constraints on freedom to operate restrict cumulative innovation and limit the intended role of patents in the innovative process.[326] Moreover, after comparing discrete technology fields and complex technology fields with a high prevalence of patent thickets, a recent study found that the increase in follow-on citation was more substantial following invalidation in the former category.[327]

If the removal of individual patents in a thicket does not produce a substantial increase in follow-on innovation, in light of the potential increase in output caused by AI, there is a strong case to be made for inventions generated by autonomous AI systems falling into the public domain. Thickets are already hindering smooth market entry and innovative performance, resulting in reluctance to enter certain technological areas and market barriers for companies of all sizes.[328] In

321. *See* Beard & Kaserman, *supra* note 318, at 353.

322. Bronwyn H. Halla et al., *Technology Entry in the Presence of Patent Thickets*, 73 OXFORD ECON. PAPERS 903, 912, 923 (2021).

323. *Id.* at 920.

324. *Id.* at 913, 923.

325. *See* Gaessler et al., *supra* note 297, at 2.

326. *Id.* at 34-35.

327. *Id.* at 27.

328. *See* Lisa Orucevic, *A Machete for the Patent Thicket: Using* Noerr-Pennington *Doctrine's Sham Exception to Challenge Abusive Patent Tactics by Pharmaceutical Companies*,

contrast, a vital public domain enables innovation and prosperity.[329] AI has the potential to dramatically alter the nature of innovation. By ensuring that the inventions generated by such systems are used to bolster the public domain instead of increasing patent thickets, it is possible to ensure that such change is positive. A formal public domain for inventions generated by autonomous AI systems may therefore be an optimal way to promote vibrant innovation.

Such a domain would also ensure that inventive AI systems are not used for abusive patenting practices. Extortive litigation by non-practicing entities (NPEs), or "patent trolls," is one such practice that should not be enabled by the protection of AI-generated inventions. NPEs acquire patents without any intention to produce and market inventions. Instead, they seek revenue by extracting licensing fees from the companies attempting to do so. Although this practice has the potential to serve a valuable social function by helping inventors with insufficient resources extract value from their patents, some argue that, in reality, patent trolls have been buying up vaguely worded patents with the intention of opportunistically extracting revenue from real innovators,[330] and the practice appears to be on the rise. For instance, one study found that between 2000 and 2015, in contrast to a decrease in patent litigation by practicing entities, litigation by NPEs increased, with an estimated eighty percent of software litigation identified as NPE litigation.[331]

Patent trolls have the potential to significantly harm innovation if left unchecked. It has been argued that NPEs represent the most significant and destabilizing change to the management of IP rights, as their presence is inconsistent with the public policy objectives and foundation of the patent system.[332] As investors' expectations of future profits are notoriously volatile, the potential loss of wealth caused by NPE litigation can provide a disincentive to invest in research and important innovation—harming society as a whole. Moreover, such litigation can also provide the wrong kind of incentive to smaller

75 VAND. L. REV. 277, 293 (2022) ("Patent thickets can be so effective at deterring competition because the sheer number of patents in a patent thicket makes any kind of litigation too risky for the challenger."); Kop, *supra* note 313, at 325.

329. Kop, *supra* note 313, at 324.

330. James Bessen et al., *The Private and Social Costs of Patent Trolls*, 34 REGULATION 26, 26 (2011).

331. *Stanford NPE Litigation Database*, STAN. L. SCH., https://law.stanford.edu/projects/stanford-npe-litigation-database/ [https://perma.cc/92KC-E5HM] (last visited Jan. 16, 2023).

332. Daniel P. McCurdy, *Patent Trolls Erode the Foundation of the U.S. Patent System*, SCI. PROGRESS, Fall-Winter 2008/2009, at 78, 78-79 (Jan. 12, 2009), https://scienceprogress.org/wp-content/uploads/2009/01/issue2/mccurdy.pdf [https://perma.cc/EL9M-46Q9].

inventors who make use of NPEs: instead of being encouraged to pursue disruptive technologies, they may be directed toward mainstream technologies, which offer the best opportunities for license fee extraction from big incumbents.[333]

One significant financial and tactical advantage that NPEs have over other patent owners is that, because they are not developing their own products, they will not be discouraged by threats of the counter-assertion of defensive patents by their litigation targets.[334] This advantage could become a huge problem in the context of inventive AI. For instance, if inventive AI were to lead to a major breakout of patent litigation between firms, any company using an AI system for the purpose of patent trolling could, without fear of reprisal, undermine the mutually assured destruction equilibrium between AI developers using the system for actual production.[335] One commentator has already expressed fear that the recent patent approval for the DABUS-generated invention in South Africa could lead to the use of inventive AI for the purpose of patent trolling.[336]

C. Enriching the Public Domain

To address the problems identified above, I suggest that inventions generated by autonomous AI systems should be placed in the public domain without patent protection by denying the systems recognition as inventors under patent law.

1. Inventorship as a Filter

One of the central justifications for this position is the traditionally human-centric interpretation of the notion of "invention." Some scholars have argued that invention is an inherently human activity, meaning that AI is not capable of conceiving an invention and that "invention" is found within the preparatory work done by human programmers and users.[337] The position is arguably reflected in the use of language specific to natural persons throughout the patent laws of

333. *See* Bessen et al., *supra* note 330, at 31.

334. *See* McCurdy, *supra* note 332, at 81.

335. Nathan Calvin & Jade Leung, *Who Owns Artificial Intelligence? A Preliminary Analysis of Corporate Intellectual Property Strategies and Why They Matter* 1, 12 (Univ. of Oxford, Working Paper, 2020), https://www.fhi.ox.ac.uk/wp-content/uploads/Patents_-FHI-Working-Paper-Final-.pdf [https://perma.cc/CE9L-V7NM].

336. Pete Swabey, *South Africa's AI Patent Approval Could Trigger Innovation and Abuse*, TECH MONITOR (Aug. 03, 2021, 8:37 AM), https://techmonitor.ai/technology/ai-and-automation/south-africas-ai-patent-approval-could-trigger-innovation-and-abuse [https://perma.cc/2MND-SSBM] ("[A]n AI system could generate thousands of speculative inventions. If these could be patented, the patent owner could then sue anyone who accidentally infringes upon one of them. 'What you get here is [an extension of] one of the worst problems of the existing IP regime: patent trolling, people hustling and trying stuff on speculatively to see what sticks.' ").

337. Hanson & Jung, *supra* note 127.

various jurisdictions, including those that prevented DABUS from being recognized as an inventor. For instance, when Congress codified the 1952 U.S. Patent Act, it expressed the intent that statutory subject matter "include anything under the sun that is made by man,"[338] indicating that inventions should be human-made.[339] However, the use of such language could instead be explained by the long-standing U.S. requirement that named inventors execute a uniquely human oath or declaration of inventorship.[340]

Commentators have also provided arguments to dispute the claim that AI is incapable of the act of invention. For instance, Ravid and Liu have identified several features of inventive AI systems which they suggest dispute that claim. First, they suggest that AI is capable of creativity because AI systems can process data and design new products and processes that significantly improve upon existing ones.[341] Second, they note that AI systems are capable of "incorporating random mutations that result in unpredictable routes to the optimal solution."[342] Other features they identify include the use of rational intelligence to pursue activities that maximize the probability of success, the ability to evolve based on new data, and the ability to process and communicate with outside data.[343]

However, multiple arguments have also been put forward for why the outputs of inventive AI systems belong in the public domain. Most fundamentally, it is argued that rewarding AI systems for invention runs contrary to the incentivization justification for patent law. This argument is based on the idea that a computer is neither conscious of nor responsive to incentives.[344] For instance, while human inventors can derive status and moral value from recognition as an inventor, the same cannot be said for algorithms. While human-run companies invest in research in the hope of recouping their investment, an algorithm invents because it is programmed to do so. As AI invention becomes increasingly "pure" and human contribution diminishes further, there is little to support the idea that an expectation of reward or a return on investment will continue to be necessary for invention.[345]

338. S. REP. No. 82-1979, at 5 (1952), *reprinted in* 1952 U.S.C.C.A.N. 2394, 2399.

339. *See* McLaughlin, *supra* note 292, at 229.

340. *Id.* at 229-30 ("In 1858, the Attorney General issued an opinion entitled *Invention of a Slave* which stated that neither a slave nor its owner can patent a machine invented by a slave. . . . While this historical anecdote recalls a terrible part of American history, it is successful at highlighting the premise that an 'inventor' must be a human capable of fulfilling the oath requirement.").

341. Ravid & Liu, *supra* note 16, at 2224.

342. *Id.* at 2225.

343. *Id.* at 2226-27.

344. *See* Hilty et al., *supra* note 148, at 62.

345. Kop, *supra* note 313, at 315.

2. Public Domain Information

In the machine learning context, it is arguably data rather than algorithms that are most instrumental in producing inventive output.[346] Although AI algorithms can be expensive to develop, it is the amount of data required to make AI systems efficient that is likely to constitute real market power.[347] If inventions generated by autonomous AI systems were to become patentable, then the value of data would rise dramatically. If the technologies and data necessary for AI-generated inventions remain in the hands of their patent rights holders, then competition is likely to suffer considerably in the future.[348] Significant efforts to improve access to data would certainly need to follow any protection for AI inventions, although they might be necessary even without such protection to ensure the stimulation of innovation.[349]

The instrumental value of data to the machine learning process means that AI developers employ data from a wide array of sources. The data used can be personal or privately owned, but are also often sourced from the public domain.[350] For instance, the AI and technology platform Towards AI has compiled and published a list of publicly accessible datasets for use in the AI training process, including the Boston Housing Dataset and Google's Open Images dataset, which contains over ten million Creative Commons licensed photos.[351] In the context of inventive AI, the origin of data raises important questions about the ownership of system outputs. In the case of privately owned data, it has been asked whether data contributors should be entitled to IP rights in any resulting inventions.[352] However, owing to the prevalent use of public data, it can also be argued that the public should not be denied the opportunity to benefit from inventions generated by autonomous AI systems.

3. Cumulative Innovation

A further argument in favor of keeping inventions generated by autonomous AI systems in the public domain is that doing so would provide greater opportunities for cumulative innovation. As shown above,

346. Francesca Mazzi, *Patentability of AI Generated Drugs*, 4 EPLR 17, 28 (2020) ("Al generated drugs are to be considered as mainly the result of proprietary data rather than of the algorithm itself, or of smart lab sensors.").

347. *Id.* at 30.

348. *Id.* at 27.

349. *Id.* at 28-32.

350. Mauritz Kop, *The Right to Process Data for Machine Learning Purposes in the EU*, 34 HARV. J.L. & TECH. 1, 3-4 (2021).

351. Stacy Stanford et al., *Best Public Datasets for Machine Learning and Data Science*, TOWARDS AI (Jan. 6, 2021), https://pub.towardsai.net/best-datasets-for-machine-learning-data-science-computer-vision-nlp-ai-c9541058cf4f [https://perma.cc/SJB6-3QL2].

352. *Can AI Own Itself?*, MORNINGSIDE (Dec. 11, 2019), https://www.morningtrans.com/can-a-i-own-itself/ [https://perma.cc/KN4D-Z5U8].

patent thickets are already proving an obstacle to cumulative creation, and the existence of systems capable of inventing at high speed and low cost is likely to further limit the access necessary for subsequent research if patents are granted for their outputs.[353] It is thus important to acknowledge their impact on cumulative innovation. The limitation of follow-on research would be especially troubling in fields where inventive AI is already being applied. For instance, AI technology has been used to develop medicines that have been tested in human trials.[354] The inhibiting effects of strong patent protection have traditionally been tolerated in the pharmaceutical sector on the grounds that a substantial investment of time and money is required for innovation in this sector.[355] However, the efficiency of inventive AI could challenge such tolerance, leading to arguments that society is entitled to the potential advances on offer.

Proponents of protection for AI inventions argue that without the patent monopoly incentive, developers will be discouraged from bringing their products to market and thus ensuring the public disclosure necessary for cumulative innovation.[356] However, public disclosure is encouraged even in the absence of patent protection. For instance, first movers can establish technological leadership, prompting consumers to perceive their products as having quality advantages over those of late entrants to the market; secure monopoly-like status before competing products are introduced; control resources when they are available only in amounts sufficient for a limited number of profitable firms; and cultivate consumer loyalty. As the inventive process and product lifecycles in the AI industry are short, ensuring that advantages are available for first movers may be more important than regulating the process for obtaining patents.[357]

4. Open Source

An even more effective way of promoting welfare and the sharing of information is to make AI inventions or systems open source.[358] The Open Source movement began in the 1990s when computer software developers committed to sharing their source code to enable

353. Vertinsky, *supra* note 222, at 509.

354. Jane Wakefield, *Artificial Intelligence-Created Medicine to Be Used on Humans for First Time*, BBC NEWS (Jan. 30, 2020), https://www.bbc.com/news/technology-51315462 [https://perma.cc/B6W2-4HKL].

355. *See, e.g.*, Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 69 VA. L. REV. 1575, 1616 (2003) ("Pharmaceutical innovation is notoriously costly and expensive. The pharmaceutical industry reports that it spends as much as $800 million on R&D for each new drug produced. . . . The ratio of inventor cost to imitator cost, therefore, is quite large in the absence of effective patent protection.").

356. *See* Comer, *supra* note 116, at 480.

357. *See* Ravid & Liu, *supra* note 16, at 2254-55.

358. *See* Kop, *supra* note 313, at 314.

collaborative improvements and innovation.[359] The movement has continued to grow, with the philosophy behind it applied beyond computer software. For instance, Elon Musk cited the Open Source movement in a press release committing to the non-enforcement of Tesla's electric vehicle technology patents.[360] Tesla justified the commitment on the grounds that it would allow the electric vehicle market to grow more rapidly, but stated that the agreement not to sue would require evidence of good faith practice such as the non-assertion of electric vehicle patent rights against Tesla or any third party.[361]

Current practice suggests that the sharing culture of the Open Source movement is thriving in the AI arena.[362] For instance, even major players such as Google are willing to share and publish their new developments for free, and data-sharing platforms have grown in importance and practical relevance.[363] Machine learning itself has become more accessible, with libraries such as Google's TensorFlow making optimization algorithms publicly available. The TensorFlow platform offers users the opportunity to develop and train machine learning models for desktop, mobile, web, and cloud use using Python or JavaScript.[364] The open access to machine learning that TensorFlow provides has resulted in multiple innovations, including a neural network that is able to quickly and reliably identify specific brain anatomy during MRI exams.[365] Therefore, denying patent protection to AI inventions while promoting the development of databases and sharing of knowledge and data[366] can ensure that the fundamental aims of IP protection are realized without dramatically departing from current industry practice.

Models have been proposed to determine when an AI invention is sufficiently autonomous to fall into the public domain. For instance, Michael McLaughlin proposed a test that distinguishes computer-assisted invention from computer-generated invention, with the latter

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359. *History of the OSI*, OPEN SOURCE INITIATIVE, https://opensource.org/history [https://perma.cc/B86E-PUJQ] (last visited Jan. 16, 2023).

360. Elon Musk, *All Our Patent Are Belong to You*, TESLA (June 12, 2014), https://www.tesla.com/blog/all-our-patent-are-belong-you [https://perma.cc/R2LM-W7B7].

361. Nicholas Collura, *A Closer Look at Tesla's Open-Source Patent Pledge*, DUANE MORRIS BLOGS (Dec. 4, 2018), https://s3.amazonaws.com/documents.lexology.com/0630d975-0056-48a4-bc70-dc6bb8316661.pdf?AWSAccessKeyId=AKIAVYILUYJ754JTDY6T&Expires=1673905560&Signature=6xL9mOBgBRX9D0Qbp8w2g9U3QzM%3D#page=1 [https://perma.cc/Z82R-HZ7R].

362. *See* Hilty et al., *supra* note 148, at 63.

363. *Id.* at 63-64.

364. *Introduction to TensorFlow*, TENSORSFLOW, https://www.tensorflow.org/learn [https://perma.cc/W32Q-AGRD] (last visited Jan. 16, 2023).

365. Jason A. Polzin, *Intelligent Scanning Using Deep Learning for MRI*, TENSORFLOW BLOG (Mar. 1, 2019), https://blog.tensorflow.org/2019/03/intelligent-scanning-using-deep-learning.html [https://perma.cc/3WXR-D7F4].

366. *See* Ravid & Liu, *supra* note 16, at 2258-59.

being unpatentable and falling into the public domain.[367] Step 1 assesses the nature of inventorship, with inventions determined to be of purely human creation eligible for patentability and other inventions proceeding to the next step.[368] Step 2A assesses the degree of human intervention, with inventions featuring a combination of computer assistance and human involvement moving to the next step, and computer-generated inventions being unpatentable.[369] Finally, step 2B assesses whether the computer-assisted invention has a sufficient nexus of human invention, with AI "(a) designed for the particular purpose of solving a well-defined problem, and (b) used merely as a tool to assist a human inventor to arrive at a predictable result" determined to be patentable.[370]

Models outlining what should happen to inventions found to be unpatentable have also been proposed. For instance, Mauritz Kop proposes a strategy to ensure that the public domain status of AI-generated inventions is affirmatively protected against private appropriation.[371] He suggests that an official Public Domain (PD) Mark be issued by a central government institution to avoid the inevitable conflicts arising from legal uncertainty and to "help businesses and research institutions understand their core rights and thereby tackle the uncertainty that discourages AI start-ups and industry's development in general."[372] An official PD Mark could also provide an opportunity to formally recognize developers' work by including their name on the mark.

Aside from the foregoing arguments suggesting that patent protection is necessary to ensure innovation, the concern that keeping AI-generated inventions in the public domain will prevent programmers from receiving the moral benefits conferred by formal recognition on a patent document is likely to be an obstacle. However, there are multiple ways of providing deserved social recognition to contributions that fall short of inventorship and ensure that the moral incentive to innovate remains.[373] For instance, recognition through "social networks, websites, trade journals, or even printing on the AI products themselves could serve as an effective alternative to granting patent rights or inventorship status to AI inventions."[374] Open source databases and voluntary sharing platforms could serve a similar purpose. By limiting inventions to the public domain but taking such positive steps to

367. *See* McLaughlin, *supra* note 292, at 246-49.

368. *Id.* at 247.

369. *Id.*

370. *Id.*

371. *See* Kop, *supra* note 313, at 327.

372. *Id.*

373. *See* Ravid & Liu, *supra* note 16, at 2258.

374. *Id.*

recognize human contribution, AI can be reconciled with the patent system without courts being forced to deny or degrade the utility of inventions to avoid naming systems as inventors.[375]

5. Legal Benefits

Another potential benefit of keeping AI-generated inventions in the public domain is the potential cost savings realized by not having to adapt patent law to accommodate the challenges posed by autonomous AI systems. For instance, it has been claimed that such inventions are incapable of meeting the legal standards of patentability, such as the requirement that patents contain enabling disclosures. Although the programming source code and architecture of an algorithm can be disclosed, in the case of complex deep neural networks, it is not currently possible to disclose exactly how a result has been achieved.[376] However, some commentators have suggested that realizing an invention from a limited disclosure is not as difficult as it has been made out to be. For example, it has been argued that with the aid of an AI system, an ordinary person skilled in the art "might be enabled to make and use an invention even with a very limited patent disclosure."[377] However, by making vague or limited disclosures possible, AI-based enablement could increase the scope of patents and potentially limit future patent applications, thereby posing problems for patent law.[378]

A further issue for patentability arises in relation to obviousness. Currently, patentability is based upon what a hypothetical non-inventive person skilled in the art would consider obvious. Once the average worker is able to use inventive AI systems, however, he or she becomes inventive, thus challenging the existing test for obviousness.[379] This is a serious problem for patent law, as the non-obviousness requirement is the primary test for distinguishing genuine innovation from trivial advances.[380] Without reformulation of the test to account for the inventiveness of AI, the public domain could be unfairly restricted by companies employing inventive AI systems. Genetic programming provides a clear example of how this could occur. Genetic programs mimic the evolutionary process, generating a random population of samples

375. *Id.*

376. *See* Hilty et al., *supra* note 148, at 70.

377. *See* Vertinsky, *supra* note 222, at 503.

378. *Id.*

379. *See* ABBOTT, *supra* note 38, at 92.

380. *Id.* at 94.

based on the user's selected criteria and then selecting the samples closest to the desired criteria and applying changes to them, with the process repeated until the desired outcome is reached.[381]

For example, one inventor ran a genetic program on an "invention machine" of 1,000 computers networked together to produce a new antenna design.[382] As most antenna designers lack access to this kind of technology, and are likely unaware that it is even possible to design an antenna in this way, the technology is clearly not obvious to a person skilled in the art. However, as genetic programming continues to spread, anyone will be able run the parameters to produce such an antenna, meaning that the public stands to gain nothing from the disclosure that patent protection would ensure. Moreover, AI systems can ensure that once-difficult innovations become trivial, deeming anything created by genetic programming obvious and unpatentable.[383] In its current state, patent law is not suited to accommodating such systems and the problems they create. However, assigning public domain status to inventions generated by AI systems would avert the need to redesign the non-obviousness standard.

CONCLUSION

One of the reasons why AI is believed to be ushering in the Fourth Industrial Revolution[384] is that it can generate inventions that are as good as those of human inventors or even advance innovation to new heights unachievable by human inventors. AI's unprecedented transformative power, however, poses distinct challenges to patent protection systems.

The recent AI rulings made by patent offices and courts have begun much-needed efforts to confront some of these challenges. As this Article demonstrates, however, those efforts suffer from misguided approaches to determining whether AI systems should be legally recognized as inventors. They have either failed to consider policy issues or wrongly applied policy considerations.

In response, this Article puts forward three legal principles that embody broad-based, forward-looking policy considerations for the patent protection of AI-generated inventions. Each principle strives to

381. William Samore, *Artificial Intelligence and the Patent System: Can a New Tool Render a Once Patentable Idea Obvious?*, *in* RESEARCH HANDBOOK ON THE LAW OF ARTIFICIAL INTELLIGENCE, *supra* note 222, at 471, 478.

382. *Id.* at 481.

383. *Id.* at 488.

384. Klaus Schwab, *The Fourth Industrial Revolution: What It Means, How to Respond*, WORLD ECON. F. (Jan. 14, 2016), https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond [https://perma.cc/56EF-EVLS]; Yang Qiang & Wang Chao, *The Fourth Revolution*, UNESCO COURIER, July-Sept. 2018, at 22, 22, https://en.unesco.org/courier/2018-3/fourth-revolution [https://perma.cc/FVV4-CXNA] ("After the internet and mobile internet triggered the Third Industrial Revolution, artificial intelligence (AI) technologies, driven by big data, are fueling a Fourth Industrial Revolution.").

deal properly with AI's relationship with human innovative endeavors.[385] If AI systems are not in a legal position to own patent rights over their inventions, then we should not recognize their inventorship status. As responsibility is central to human society, AI systems must be evaluated by whether they have the capacity to behave responsibly, as human inventors are legally and ethically required to do. Both human inventors and AI systems must protect the public domain. Without a robust public domain, science and technology will perish, with deadly consequences for both humankind and AI systems.

385. *See* FRANK PASQUALE, NEW LAWS OF ROBOTICS: DEFENDING HUMAN EXPERTISE IN THE AGE OF AI 11 (2020) (emphasizing the importance of the relationship between AI and humans).