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PUTTING THE PERSON IN PHOSITA: THE HUMAN'S OBVIOUS ROLE IN THE ARTIFICIAL INTELLIGENCE ERA

Abstract: Advances in artificial intelligence (AI) have enabled the technology to contribute significantly to the development of patentable inventions. These advances, which allow AI to augment inventors' problem solving capabilities, or perhaps even create inventions autonomously, have raised concerns regarding whether existing patent laws can adequately address the increasing role that AI plays in developing inventions. This tension comes to a head with patent law's obviousness doctrine, which addresses the critical question: What constitutes a patentable invention? Is human ingenuity the sole province of patent worthy invention? Should patentability be negated to the extent that AI contributes to a claimed invention? Current obviousness analysis allows patents on inventions created with AI assistance, requiring only that an invention appear nonobvious to a person of ordinary skill in the art (PHOSITA). Although agreeing with this result in theory, some commentators argue that existing doctrine fails to account for the increasing role that AI plays in the process. Under the current doctrinal paradigm, if courts and the U.S. Patent and Trademark Office fail to account for AI's role in the inventive process, this could result in too low of an obviousness standard, as they would not endow the PHOSITA with AI capabilities even when this technology is commonly used within a field. If the PHOSITA does not possess the capabilities indicative of the average skilled person in the art, then arguably patents will issue for undeserving inventions. This Note addresses these issues and argues that, despite some commentators' concerns, the current obviousness test is appropriately structured to accommodate AI's increasing role in developing inventions. Further, it challenges recent proposals intended to address perceived deficiencies in the obviousness doctrine.

INTRODUCTION

Modern advances in artificial intelligence (AI) have enabled feats once siloed to the field of science fiction writing.[1] AI machines have defeated the best humans at *Jeopardy!*, chess, and even the enormously complex game, Go.[2]

[1] *See* Ed Newton-Rex, *59 Impressive Things Artificial Intelligence Can Do Today*, BUS. INSIDER (Mar. 7, 2017), https://www.businessinsider.com/artificial-intelligence-ai-most-impressive-achievements-2017-3 [https://perma.cc/LP5Q-7BJQ] (noting that there are many modern applications of artificial intelligence (AI), including language translation, drug research, and lip-reading).

[2] David Silver et al., *A General Reinforcement Learning Algorithm That Masters Chess, Shogi, and Go Through Self-Play*, 362 SCI. 1140, 1140–44 (2018); John Markoff, *Computer Wins on 'Jeopardy!': Trivial, It's Not*, N.Y. TIMES (Feb. 16, 2011), https://www.nytimes.com/2011/02/17/science/17jeopardy-watson.html [https://perma.cc/6RH8-GJBS].

Victories that once seemed cutting-edge now appear pedestrian compared to modern AI achievements, such as self-driving cars,[3] "smart cities,"[4] and automated cancer detection tests that outperform radiologists.[5] Beyond performing calculations and parsing mounds of data, modern AI machines compose music, write news articles and poetry, paint portraits, and develop software.[6] The constant flow of new discoveries in AI technology propagates the narrative that AI

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[3] Bernard Marr, *Key Milestones of Waymo—Google's Self-Driving Cars*, FORBES (Sept. 21, 2018), https://www.forbes.com/sites/bernardmarr/2018/09/21/key-milestones-of-waymo-googles-self-driving-cars/#3238c4685369 [https://perma.cc/7WPL-8KEN]. Waymo, owned by Google's parent company, is on the cutting-edge of the race to roll out self-driving cars, with current models being tested on public roads in certain, preapproved areas. *Id.*

[4] Zaheer Allam & Zaynah A. Dhunny, *On Big Data, Artificial Intelligence and Smart Cities*, 89 CITIES 80, 88 (2019). "Smart cities" feature deeply interconnected technologies that gather data relating to energy use, transportation patterns, pollution levels, and other metrics to minimize energy waste and environmental impact, and to enable more efficient use of a city's infrastructure. James Ellsmoor, *Smart Cities: The Future of Urban Development*, FORBES (May 19, 2019), https://www.forbes.com/sites/jamesellsmoor/2019/05/19/smart-cities-the-future-of-urban-development/#574424222f90 [https://perma.cc/9XSJ-HETX]. Currently, Toyota is building a two-thousand-person smart city in which it will test self-driving cars, "robot-assisted living," and other promising technologies. Oscar Holland, *Toyota Is Building a 'Smart' City to Test AI, Robots and Self-Driving Cars*, CNN (Jan. 8, 2020), https://www.cnn.com/style/article/ces-toyota-big-smart-city/index.html [https://perma.cc/48D2-573Q]. Toyota's CEO, Akio Toyoda, predicts that "[w]ith people [and] buildings and vehicles all connected and communicating with each other through data and sensors, [Toyota] will be able to test AI technology, in both the virtual and the physical world, maximizing its potential." *Id.*

[5] David Alayón, *BioMind, Artificial Intelligence That Defeats Doctors in Tumour Diagnosis*, MEDIUM (Aug. 8, 2018), https://medium.com/future-today/biomind-artificial-intelligence-that-defeats-doctors-in-tumour-diagnosis-5f8ec97298b2 [https://perma.cc/22HU-CCGJ]; Hanna Ziady, *Google's AI System Can Beat Doctors at Detecting Breast Cancer*, CNN (Jan. 2, 2020), https://www.cnn.com/2020/01/02/tech/google-health-breast-cancer/index.html [https://perma.cc/8HDA-QFAY]. Researchers are finding new ways to apply AI across many industries. EXPERT PANEL, FORBES TECH. COUNCIL, *13 Industries Soon to Be Revolutionized by Artificial Intelligence*, FORBES (Jan. 16, 2019), https://www.forbes.com/sites/forbestechcouncil/2019/01/16/13-industries-soon-to-be-revolutionized-by-artificial-intelligence/#5f494ca03dc1 [https://perma.cc/PBF6-CQBS]. For example, in one recent study, an AI program outperformed twenty experienced attorneys at reviewing five non-disclosure agreements for potential risks. LAWGEEX, COMPARING THE PERFORMANCE OF ARTIFICIAL INTELLIGENCE TO HUMAN LAWYERS IN THE REVIEW OF STANDARD BUSINESS CONTRACTS 2 (2018), https://images.law.com/contrib/content/uploads/documents/397/5408/lawgeex.pdf [https://perma.cc/6G67-EL6B]. On average, the attorneys scored eighty-five percent accuracy and completed the task in ninety-two minutes. *Id.* at 14. The AI program reported an accuracy rate of ninety-four percent and finished the task in twenty-six seconds. *Id.* AI also aids journalists by generating first drafts of news reports, which writers can then edit and improve. Nicole Martin, *Did a Robot Write This? How AI Is Impacting Journalism*, FORBES (Feb. 8, 2019), https://www.forbes.com/sites/nicolemartin1/2019/02/08/did-a-robot-write-this-how-ai-is-impacting-journalism/#6dacc2c47795 [https://perma.cc/63YT-T6CK]. Similarly, at least one writer has used an AI program to help write a novel. David Streitfeld, *Computer Stories: A.I. Is Beginning to Assist Novelists*, N.Y. TIMES (Oct. 18, 2018), https://www.nytimes.com/2018/10/18/technology/ai-is-beginning-to-assist-novelists.html [https://perma.cc/B4XW-9MRT]. The writer provides the AI program with the beginning of a sentence, and then the AI program suggests different phrases to complete the sentence. *Id.*

[6] Shlomit Yanisky Ravid & Xiaoqiong Liu, *When Artificial Intelligence Systems Produce Inventions: An Alternative Model for Patent Law at the 3A Era*, 39 CARDOZO L. REV. 2215, 2217, 2219 (2018).

creativity is limitless.[7] Indeed, reports indicate the technology has become so sophisticated that it is capable of creating patentable inventions.[8] These reports have caused concern among some members of the legal and technological communities who worry that the trajectory of AI inventiveness is on course to disrupt the patent system fundamentally and shake the existing patent doctrine to its core.[9] How will a patent system created in a pre-AI world react when humans are no longer the only source of inventorship?[10] Can human and AI compete within the same arena of patentability?[11] Is there a line of demarcation where human and AI creativity should no longer be judged according to the same standards?[12]

One AI machine, known as the Device for the Autonomous Bootstrapping of Unified Sentience (DABUS), has provoked controversy in patent systems around the world.[13] DABUS is the first AI machine to be named as an inventor on a patent application.[14] Although this is the first time a patent application

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[7] *See* Ryan Calo, *Artificial Intelligence Policy: A Primer and Roadmap*, 51 U.C.D. L. REV. 399, 401 (2017) (noting that modern AI technology prompts varied reactions among the public, ranging from awe at computers that are capable of beating humans at various games, to concern that AI will automate the jobs people rely on). Some prominent figures, including Elon Musk, the CEO of Tesla and SpaceX, and world-renowned physicist Stephen Hawking, have warned that AI might bring about the end of human existence as we know it. Catherine Clifford, *Hundreds of A.I. Experts Echo Elon Musk, Stephen Hawking in Call for a Ban on Killer Robots*, CNBC (Nov. 8, 2017), https://www.cnbc.com/2017/11/08/ai-experts-join-elon-musk-stephen-hawking-call-for-killer-robot-ban.html [https://perma.cc/XYM5-FTBD].

[8] *See* Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C. L. REV. 1079, 1083–86 (2016) (stating that AI machines have been creating patentworthy inventions "for at least twenty years," and some have even been awarded patents); Ben Hattenbach & Joshua Glucoft, *Patents in an Era of Infinite Monkeys and Artificial Intelligence*, 19 STAN. TECH. L. REV. 32, 34–35 (2015) (noting that AI machines are engaging in the types of activities that traditionally have required human creativity and ingenuity, such as generating inventions).

[9] *See* ROBERT PLOTKIN, THE GENIE IN THE MACHINE: HOW COMPUTER-AUTOMATED INVENTING IS REVOLUTIONIZING LAW AND BUSINESS 105–07 (2009) (asserting that current patent doctrine does not consider the role that AI plays in developing new inventions, which could allow early adopters of AI technology to obtain a large number of undeserved patents before the system adjusts); Hattenbach & Glucoft, *supra* note 8, at 32 (stating that the use of AI in inventing "is on a collision course with our patent laws"); Daniel Pitchford, *Is Protecting AI's Intellectual Property a Step Too Far?*, FORBES (Apr. 4, 2019), https://www.forbes.com/sites/danielpitchford/2019/04/04/ip-and-ai-oxymoron-or-huge-commercial-opportunity/#3c6e393ed580 [https://perma.cc/3UWZ-B5ED] (noting that intellectual property issues arise because machine learning systems can write code for themselves, possibly leading to more distance between innovation and the initial human involvement).

[10] *See infra* Part IV (arguing that patent law's obviousness doctrine is well-suited to address AI's increasing role in the inventive process).

[11] *See infra* Part IV (asserting that obviousness can accommodate both human and AI contributions to the inventive process).

[12] *See infra* Part IV (reasoning that no such line is necessary, so long as the "person having ordinary skill in the art" (PHOSITA) standard remains responsive to industry practices).

[13] Martin Coulter, *Patent Agencies Challenged to Accept AI Inventor*, FIN. TIMES (July 31, 2019), https://www.ft.com/content/9c114014-b373-11e9-bec9-fdcab53d6959 [https://perma.cc/K2UF-7GG6].

[14] Jared Council, *Can an AI System Be Given a Patent?*, WALL ST. J. (Oct. 11, 2019), https://www.wsj.com/articles/can-an-ai-system-be-given-a-patent-11570801500 [https://perma.cc/R3K5-

specifically names an AI machine as the inventor, reports indicate that other AI machines have played integral roles in the development of patentable inventions.[15] On August 27, 2019, soon after DABUS's patent applications were filed, the U.S. Patent and Trademark Office (USPTO) published a notice seeking input from the public regarding how patent law should approach this expanding technology.[16]

HDGW]. The AI machine is credited as the inventor on two patent applications, one involving an interlocking food and beverage container and the other involving a signal light that flashes at frequencies designed to trigger an increase in attentiveness in the human brain. *Patent Applications*, ARTIFICIAL INVENTOR, http://artificialinventor.com/patent-applications/ [https://perma.cc/8A55-QP83]. Stephen Thaler, the creator of the Device for the Autonomous Bootstrapping of Unified Sentience's (DABUS), filed patent applications before the U.S. Patent and Trademark Office (USPTO), the United Kingdom Intellectual Property Office (UKIPO), and the European Patent Office (EPO). *Id.* Thaler reports that the machine developed the inventions without human assistance. Emma Woollacott, *European Patent Office Rejects World's First AI Inventor*, FORBES (Jan. 3, 2020), https://www.forbes.com/sites/emmawoollacott/2020/01/03/european-patent-office-rejects-worlds-first-ai-inventor/?sh=7542fe085cd0 [https://perma.cc/JEW4-P3EL]. All three agencies denied the patent application based on requirements that inventors must be human beings. Decision on Petition, U.S. Pat. Application No. 16/524,350, at 3–8 (July 29, 2019) (unpublished), https://www.uspto.gov/sites/default/files/documents/16524350_22apr2020_3.pdf [https://perma.cc/X3EF-FWLJ]; James Nurton, *EPO and UKIPO Refuse AI-Invented Patent Applications*, IPWATCHDOG (Jan. 7, 2020), https://www.ipwatchdog.com/2020/01/07/epo-ukipo-refuse-ai-invented-patent-applications/id=117648/ [https://perma.cc/2R9B-4DYF]. Although DABUS's patent application failed, the USPTO and commentators recognize that questions remain surrounding inventions created using AI. *See* COKE MORGAN STEWART, U.S. PAT. & TRADEMARK OFF., ARTIFICIAL INTELLIGENCE POLICY 6 (2020), https://www.uspto.gov/sites/default/files/documents/20200507_PPAC_AI_Policy_Update.pdf [https://perma.cc/JWR3-ZJUX] (listing relevant policy questions, such as whether the use of AI in inventing should affect the PHOSITA standard); *see also, e.g.*, Jason D. Krieser & Shawn C. Helms, *USPTO: Artificial Intelligence Systems Cannot Legally Invent*, MCDERMOTT WILL & EMERY (May 8, 2020), https://www.mwe.com/insights/uspto-artificial-intelligence-systems-cannot-legally-invent/ [https://perma.cc/A69S-8J3A] (stating that the USPTO "sidestepped" difficult policy issues related to the future of AI inventing and denied DABUS's patent application based on existing law's textual requirement that inventors be natural persons).

[15] *See* PLOTKIN, *supra* note 9, at 51–61 (describing inventions that have been created using AI, such as the Oral-B Cross Action toothbrush, a new electronic controller, a specialized antenna for use in space, and others); Ralph D. Clifford, *Intellectual Property in the Era of the Creative Computer Program: Will the True Creator Please Stand Up?*, 71 TUL. L. REV. 1675, 1680 (1997) (noting that an AI machine created an "ultra-hard" substance used in construction). *But see* Daria Kim, *'AI-Generated': Time to Get the Record Straight?*, 69 GRUR INT'L 443, 445–46 (2020) ("Legal narratives of AI-generated inventions often refer to almost the same set of examples: the Oral-B toothbrush and other accomplishment of the "Creativity Machine" designed by Stephen L. Thaler, the NASA antenna, achievements in the field of genetic programming reported by John Koza and AI applications in drugs discovery and development. More recently, the project "Artificial Inventor" presented several inventions attributed to the connectionist system DABUS: a method for constructing and simulating artificial neural networks, a food container, and devices and methods for attracting enhanced attention. *None of the reviewed legal sources, however, provide a technical explanation of how the computational process was set up*." (emphasis added) (footnotes omitted)).

[16] Request for Comments on Patenting Artificial Intelligence Inventions, 84 Fed. Reg. 44,889 (Aug. 27, 2019). The USPTO received dozens of submissions from both individuals and organizations. *Notices on Artificial Intelligence*, U.S. PAT. & TRADEMARK OFF. (Mar. 18, 2020), https://www.

One issue raised in the notice was how AI inventions might implicate the "person having ordinary skill in the art" (PHOSITA) standard.[17] Similar to the "reasonable person" standard in tort law, which represents the average person for everyday negligence, the PHOSITA standard represents the average skilled worker for the scientific discipline of the invention.[18] Suppose the use of AI is commonplace within a given field of study—would this mean the PHOSITA has AI capabilities?[19] Should patent offices require applicants to disclose the use of AI?[20] Is the PHOSITA framework still effective when applied to inventions created by AI, without significant human involvement?[21]

This Note examines these and related questions as they pertain to one of the most important requirements for obtaining a patent: obviousness.[22] To receive a patent, an invention must not be obvious to a PHOSITA at the time of the patent application.[23] That is, it must be nonobvious.[24] The nonobvious requirement filters out inconsequential improvements that are undeserving of the robust rights provided by patents.[25] Whether the average skilled worker would

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uspto.gov/initiatives/artificial-intelligence/notices-artificial-intelligence [https://perma.cc/M2ED-927W].

[17] *Notices on Artificial Intelligence*, *supra* note 16.

[18] 2 DONALD S. CHISUM, CHISUM ON PATENTS § 5.04A[1] (Matthew Bender ed., 2011). The "reasonable person" is a conception employed in tort law to determine whether a defendant has committed negligence. Alan D. Miller & Ronen Perry, *The Reasonable Person*, 87 N.Y.U. L. REV. 323, 325 (2012). The test examines whether the defendant exercised the level of care that would be expected of a reasonable person acting under similar circumstances. *Id.* The purpose of using a standard based on this hypothetical person is that it measures the defendant's conduct based on society's expectations, rather than on how any specific, actual person would have performed under the circumstances. Richard Mullender, *The Reasonable Person, the Pursuit of Justice, and Negligence Law*, 68 MOD. L. REV. 681, 681–82 (2005).

[19] *See infra* Part IV (arguing that the PHOSITA standard should treat AI like any other tools and that, if inventors within an industry widely use AI, courts and the USPTO should expect that a PHOSITA has used it).

[20] *See infra* Part IV (explaining that requiring inventors to disclose the use of AI could confuse the obviousness analysis and could result in an inappropriately heightened PHOSITA standard with respect to inventions that are created using the aid of AI).

[21] *See infra* Part IV (positing that unless or until AI exists with human-like intelligence, the PHOSITA standard can address issues of AI inventing adequately).

[22] John F. Duffy, *Inventing Invention: A Case Study of Legal Innovation*, 86 TEX. L. REV. 1, 2 (2007) (describing obviousness as a "defining doctrine of invention" and "fundamental to the proper functioning of the patent system").

[23] Douglas L. Rogers, *Obvious Confusion Over Properties Discovered After a Patent Application*, 43 AIPLA Q.J. 489, 491–92 (2015). This definition of obviousness applies to patents governed by the Leahy-Smith America Invents Act (AIA), which Congress enacted in 2011. *Id.* at 491. For patents governed by the Patent Act of 1952, the frame of reference focuses on the time of invention rather than the filing date of the patent application. *Id.* at 492. For further explanation of the changes brought forth by the AIA and an explanation of the process for determining whether the AIA or the Patent Act of 1952 applies in a given case, see *infra* note 69 and accompanying text.

[24] Rebecca S. Eisenberg, *Pharma's Nonobvious Problem*, 12 LEWIS & CLARK L. REV. 375, 379 (2008).

[25] Great Atl. & Pac. Tea Co. v. Supermarket Equip. Corp., 340 U.S. 147, 152–53 (1950).

find something nonobvious depends on the resources available.[26] As the PHOSITA's capabilities increase, inventions must demonstrate greater ingenuity to show nonobviousness.[27]

This Note rebuts scholarship that contends that the current obviousness doctrine is ill-equipped to handle technological advances in AI.[28] Part I outlines the historical development of obviousness and the role that it plays in screening out inventions that do not deserve patents.[29] Part II describes the capabilities of contemporary and potentially forthcoming AI machines.[30] Part III discusses the implications of AI's increasing contribution to the development of inventions.[31] It also analyzes current scholarship, which surmises that the existing obviousness analysis is insufficient when it comes to AI.[32] Part IV argues that the obviousness doctrine, in its current conception, is sufficient and necessary for addressing the expanding role that AI plays in inventing.[33] It further contends that recent proposals to modify obviousness to require that patent applicants disclose the use of AI or to replace the PHOSITA altogether, could distort the obviousness standard such that it rejects certain patent-worthy inventions and awards patents to some obvious inventions.[34]

I. THE PATENT INCENTIVE AND THE OBVIOUSNESS DOCTRINE

Patents confer several rights on an inventor, including the right to exclude others from using patented technology.[35] Although this limited monopoly is

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[26] Graham v. John Deere Co., 383 U.S. 1, 19 (1966).

[27] Dystar Textilfarben GmbH v. C.H. Patrick Co., 464 F.3d 1356, 1370 (Fed. Cir. 2006) (stating that a highly skilled PHOSITA would look beyond the processes commonly known in the field and would apply related scientific disciplines to solve a problem). Such a sophisticated PHOSITA is much harder to impress than a less educated tradesperson who is skilled only in a specific task. *Id.*

[28] *See* PLOTKIN, *supra* note 9, at 105–07 (asserting that the current application of the obviousness doctrine fails to consider the role that AI plays in augmenting research, which could lead to early users of AI technology obtaining patents for inventions that should have been found to be obvious); Ryan Abbott, *Everything Is Obvious*, 66 UCLA L. REV. 2, 34 (2019) (reasoning that when AI machines become ubiquitous within a given industry, the PHOSITA will become capable of invention, thus rendering everything obvious). Whether patent protections should apply to creations produced by AI machines is a matter of current debate. *Compare* Hattenbach & Glucoft, *supra* note 8, at 50 (reasoning that granting patents to AI inventors could provide social gain by incentivizing the further development of inventive machines), *with* Pamela Samuelson, *Allocating Ownership Rights in Computer-Generated Works*, 47 U. PITT. L. REV. 1185, 1199–1200 (1986) (arguing that AI-created inventions should not receive patent protection because AI systems do not require and would not respond to the incentives that patents provide).

[29] *See infra* Part I.

[30] *See infra* Part II.

[31] *See infra* Part III.

[32] *See infra* Part III.

[33] *See infra* Part IV.A.

[34] *See infra* Part IV.B; Part IV.C.

[35] *See* 35 U.S.C. § 154(a)(1) ("Every patent shall . . . grant to the patentee . . . the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States or

justified as benefiting the public good by encouraging innovation,[36] patents also can impose heavy costs on society by decreasing competition, reducing access to necessary medical treatments, and impeding further innovation when patent holders refuse to license their technology to researchers.[37] Nonetheless, inventors are unlikely to invest significant time and resources into bringing new technologies to the market if they fear that they cannot recover their costs.[38] Patents enable inventors to recover their costs by preventing competitors from manufacturing the same technology within the twenty-year patent term.[39] Without patent protection, competitors could reproduce the invention, which would drive down prices before inventors can recover their costs.[40]

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importing the invention into the United States . . . ."). The term "patentee" refers to both the original recipient of the patent as well as those who later obtain ownership over the patent. *Id.* § 100(d). Patents are commonly conceptualized as property rights, except that patents only ever guarantee the right to exclude others from using the claimed invention. *See* 5 DONALD S. CHISUM, CHISUM ON PATENTS § 16.02 (Matthew Bender ed., 2011) (noting that patents only provide the right to exclude others and never "grant the affirmative right to make, use or sell" the invention); *see also* Impression Prods. v. Lexmark Int'l, Inc., 137 S. Ct. 1523, 1531 (2017) (explaining that the sale of an item, subject to a patent, extinguishes the right to exclude others from the use of that item, and thus the "patent rights yield to the common law [of property] principle against restraints on alienation"). *But see* Adam Mossoff, *Exclusion and Exclusive Use in Patent Law*, 22 HARV. J.L. & TECH. 321, 325–26 (2009) (theorizing that the characterization of patents as simply a right to exclude, rather than a wholly distinct form of property, causes doctrinal disarray within patent law).

[36] *See* Robert P. Merges, Symposium, *Of Property Rules, Coase, and Intellectual Property*, 94 COLUM. L. REV. 2655, 2661 (1994) (stating that the overarching purpose of intellectual property protection is commonly portrayed as enhancing economic productivity by addressing market failures that stifle further innovation). Patents are most often justified on utilitarian theories, which find that the costs of patents are worth the benefits of incentivizing innovation. *See* David S. Olson, *Taking the Utilitarian Basis for Patent Law Seriously: The Case for Restricting Patentable Subject Matter*, 82 TEMP. L. REV. 181, 183 n.1 (2009) (analyzing a series of patent law casebooks and finding that law students are consistently taught that the purpose of patent law is to advance innovation in line with utilitarian principles). The constitutional basis for patent law, U.S. CONST. art. 1, § 8, cl. 8, exhibits utilitarian motivations by giving 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." U.S. CONST. art. 1, § 8, cl. 8 (emphasis added).

[37] *See* Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents—Prizes Debate*, 92 TEX. L. REV. 303, 314 (2013) (noting the deadweight loss that patent monopolies cause by limiting competition); Kevin Outterson, *Pharmaceutical Arbitrage: Balancing Access and Innovation in International Prescription Drug Markets*, 5 YALE J. HEALTH POL'Y L. & ETHICS 193, 201–02 (2005) (explaining that intellectual property protections on pharmaceuticals drive up prices, thereby impeding lower-income individuals from accessing medical care); Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29, 37–38 (1991) (explaining that, in the absence of licensing agreements, patents can inhibit cumulative innovation).

[38] Olson, *supra* note 36, at 183.

[39] *Id.* at 192–93.

[40] Alan Devlin & Neel Sukhatme, *Self-Realizing Inventions and the Utilitarian Foundation of Patent Law*, 51 WM. & MARY L. REV. 897, 919–20 (2009); Olson, *supra* note 36, at 196.

The pharmaceutical industry provides a good example of this principle.[41] The average cost of developing a new drug is between two to three billion dollars.[42] Without the market exclusivity that is guaranteed by a patent, pharmaceutical developers would have little incentive to expend these costs to bring new drugs to market.[43] Patents step in to address this market failure by giving inventors an opportunity to recoup their research and development costs in exchange for a public disclosure of their new invention.[44] This is often described as a quid pro quo, through which an inventor is given a limited monopoly in exchange for developing new technology for society's benefit.[45] Patent law aims to provide only so much benefit as is necessary to incentivize innovation; anything beyond that can burden the market, resulting in more harm than good.[46]

Section A of this Part discusses the economic and social considerations guiding the obviousness doctrine.[47] Section B details the modern nonobviousness requirement that inventions must meet to qualify for patent protection.[48]

A. The Obviousness Doctrine's Role in Patent Law

Several patentability requirements exist to screen out inventions undeserving of protection.[49] To qualify for a patent, an invention must concern patentable subject matter,[50] and it must be new,[51] useful,[52] and nonobvious.[53] Of

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[41] Roberto Mazzoleni & Richard R. Nelson, *Economic Theories About the Benefits and Costs of Patents*, 32 J. ECON. ISSUES 1031, 1038 (1998).

[42] Joseph A. DiMasi et al., *Innovation in the Pharmaceutical Industry: New Estimates of R&D Costs*, 47 J. HEALTH ECON. 20, 27 (2016).

[43] *Hearing on Intellectual Property and the Price of Prescription Drugs: Balancing Innovation and Competition Before the S. Comm. on the Judiciary*, 115th Cong. 2 (2019) (written submission of David S. Olson).

[44] Olson, *supra* note 36, at 196–97.

[45] *See* Brenner v. Manson, 383 U.S. 519, 534 (1966) (describing patent rights as a quid pro quo in which the inventor is given a monopoly on the patented invention in exchange for bettering society by bringing a beneficial technology to the market). The quid pro quo analogy, however, is not without its critics. *See* Shubha Ghosh, *Patents and the Regulatory State: Rethinking the Patent Bargain Metaphor After* Eldred, 19 BERKELEY TECH. L.J. 1315, 1345–46, 1388 (2004) (discrediting the quid pro quo theory of patent law for oversimplifying market actors' behavior into a binary choice between "innovation" or "imitation" and for failing to capture patent law's many regulatory goals).

[46] Olson, *supra* note 36, at 183.

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

[48] *See infra* Part I.B.

[49] *See* Stephen Yelderman, *The Value of Accuracy in the Patent System*, 84 U. CHI. L. REV. 1217, 1224–26 (2017) (explaining that patentability requirements signal to innovators that meritorious inventions will be protected, and also serve to limit negative effects on society by denying protections to undeserving patent applications).

[50] 35 U.S.C. § 101. The patentable subject matter requirement stems from 35 U.S.C. § 101, which states that "[w]hoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." *Id.* The Supreme Court has interpreted this requirement as disallowing the issuance of patents on "laws of nature, natural phenomena, and abstract ideas." Diamond v. Diehr, 450 U.S. 175, 185 (1981). No matter how novel, useful, or nonobvi-

ous an invention may be, the inventor cannot lay claim to non-patentable subject matter. *See* Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 131–32 (1948) (invalidating a patent for a combination of noninhibiting bacteria strains that the inventor discovered could be used together without diminishing the effects of any one of the strains). In 1948, in *Funk Bros. Seed Co. v. Kalo Inoculant Co.*, the Supreme Court held that, although an inventor's discovery allowed farmers to use a single inoculant for multiple crops rather than "buy[ing] six different packages for six different crops," the discovery concerned a natural phenomenon and therefore could not be patented. *Id.* Scholars and courts widely cite *Funk Bros. Seed Co.* as an early application of the patentable subject matter requirement, including a recent Supreme Court decision regarding the patentability of DNA. *See* Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 569 U.S. 576, 591 (2013) (invalidating patent claims on certain DNA segments that indicate that a patient has an increased risk of breast cancer, and citing *Funk Bros. Seed Co.* to emphasize that "[g]roundbreaking, innovative, or even brilliant discovery does not by itself satisfy the [patentable subject matter] inquiry"). *But see* Shine Tu, Funk Brothers—*An Exercise in Obviousness*, 80 UMKC L. REV. 637, 637 (2012) (arguing that *Funk Bros. Seed Co.* concerns obviousness rather than patentable subject matter, and asserting that novelty and obviousness are better equipped for addressing the issue of whether patents should be granted on genes). Modern Supreme Court jurisprudence allows patents relating to non-patentable subject matter when there is a showing of separate, inventive enterprise. *Ass'n for Molecular Pathology*, 569 U.S. at 591–95 (invalidating patent claims on DNA segments but upholding claims on cDNA because cDNA is created in laboratory settings and is therefore not a natural product).

[51] 35 U.S.C. § 102. The novelty requirement disallows patents on inventions that cannot show a meaningful difference from a single example of "prior art." 1 DONALD S. CHISUM, CHISUM ON PATENTS § 3.01 (Matthew Bender ed., 2011); *see infra* note 69 and accompanying text (describing prior art). Novelty differs from obviousness in that novelty looks to singular prior art references to determine whether a claimed invention is new, whereas obviousness combines multiple prior art references to discern whether the references, evaluated together, would have rendered the claimed invention obvious to a PHOSITA. *See* KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 424–25 (2007) (invalidating a patent on an invention that combined multiple prior art references to create a novel but nonetheless obvious improvement).

[52] 35 U.S.C. § 101. Utility stems from 35 U.S.C. § 101, which courts have interpreted as requiring that an invention show some "specific" and "substantial" societal benefit in its current form. *Id.*; Brenner v. Manson, 383 U.S. 519, 534–35 (1966). Thus, "'throw-away,' 'insubstantial,' or 'nonspecific' utilities, such as the use of a complex invention as landfill, [will not] satisfy[] the utility requirement . . . ." Utility Examination Guidelines, 66 Fed. Reg. 1092, 1098 (Jan. 5, 2001). Although mechanical devices typically meet this requirement, this condition can pose a challenging obstacle for inventions concerning chemical compositions. 1 CHISUM, *supra* note 51, § 4.02; *see In re* Fisher, 421 F.3d 1365, 1373 (Fed. Cir. 2005) (invalidating a patent for lack of specific and substantial utility because the claimed chemical compounds were merely "research intermediates" for which the inventor could show no "real world benefit"). Utility also requires some showing that an invention is not "injurious to the well-being, good policy, or sound morals of society." Lowell v. Lewis, 15 F. Cas. 1018, 1019 (C.C.D. Mass. 1817) (No. 8568). This requirement, however, "has not been applied broadly in recent years." *See* Juicy Whip, Inc. v. Orange Bang, Inc., 185 F.3d 1364, 1367–68 (Fed. Cir. 1999) (upholding the utility of a patent, which was arguably deceitful, in that it displayed a colorful liquid atop a beverage dispenser, though the drink customers actually received was combined at the time of order with water and syrup concentrate hidden below the dispenser).

[53] 35 U.S.C. § 103; *see* Cameron T. Ellis, *The Four Horsemen of Patentability—An Empirical Study of Patentability Requirement Reversal Rates in the Federal Circuit*, 28 ALB. L.J. SCI. & TECH. 28, 32–37 (2018) (describing patentable subject matter, novelty, nonobviousness, and other patentability requirements, and stating that it is established doctrine that inventions must be new, useful, and nonobvious to qualify for a patent).

these requirements, obviousness is one of the most commonly litigated issues.[54] Thus, it performs a critical role in ensuring that patents are issued only for those inventions whose benefits to society outweigh the costs that patents impose.[55] The obviousness doctrine does this by screening out inventions that exhibit only minor technological advances, reserving patent protection only for those inventions that meaningfully advance the field of study.[56]

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[54] *See* John R. Allison & Mark A. Lemley, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185, 208–09 (1998) (finding that obviousness was the most commonly litigated patentability requirement). A 2014 update found that, although other issues of patentability had been raised more frequently than in the previous study, obviousness remained one of the most commonly litigated issues. John R. Allison et al., *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769, 1785 (2014); *see also* Christopher C. Kennedy, *Rethinking Obviousness*, 2015 WIS. L. REV. 665, 666–67 ("More judicial ink likely has been spilt on the topic of obviousness than on any other topic in patent law."); Giles S. Rich, *Laying the Ghost of the "Invention" Requirement*, 1 APLA Q.J. 26, 26 (1972) (describing the nonobviousness requirement as "the heart of the patent system and the justification of patent grants").

[55] Great Atl. & Pac. Tea Co. v. Supermarket Equip. Corp., 340 U.S. 147, 152–53 (1950).

[56] *KSR*, 550 U.S. at 427. The Supreme Court has stated that the purpose of the nonobviousness requirement is to disallow patents on inventions that inventors would have developed and provided to the public, even if they did not expect to receive a patent for their efforts. Graham v. John Deere Co., 383 U.S. 1, 11 (1966). If the USPTO provides patents only for inventions that would otherwise be unavailable to the market—because the inventors would not have felt comfortable expending the necessary research and development without the promise of a patent—then the public will experience no negative effects from the limited monopoly that patents provide. Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590, 1598 (2011). The economic burdens associated with the patent monopoly, however, would not actually occur because, if not for the patent, the technology would not exist in the first place. *Id.* This principle has come to be known as the "inducement standard" of nonobviousness, and it posits that patents should be granted only on inventions that would not have occurred but for the inducement of the patent. *Id.* at 1599–60. Although widely accepted as a guiding touchstone, this standard is regarded by many as too theoretical and unwieldy to elucidate actual doctrine. *See* Gregory Mandel, *The Non-obvious Problem: How the Indeterminate Nonobviousness Standard Produces Excessive Patent Grants*, 42 U.C. DAVIS L. REV. 57, 86–87 (2008) (reasoning that even if empirical evidence existed concerning the appropriate inducement necessary for inventions, a strictly applied inducement standard would still pose problems, such as allowing patents on trivial inventions that would not have occurred absent the inducement of a patent); *see also* Edmund W. Kitch, Graham v. John Deere Co.*: New Standards for Patents*, 1966 SUP. CT. REV. 293, 301–02 (reasoning that, because of the empirical difficulties involved in determining the necessary inducement for a given invention, the nonobviousness inquiry can only make an "awkward" attempt to accommodate the inducement standard); FED. TRADE COMM'N, TO PROMOTE INNOVATION: THE PROPER BALANCE OF COMPETITION AND PATENT LAW AND POLICY 11 (2003), https://www.ftc.gov/sites/default/files/documents/reports/promote-innovation-proper-balance-competition-and-patent-law-and-policy/innovationrpt.pdf [https://perma.cc/TVB9-V6GK] (finding the inducement standard useful "for conceptual purposes" but not sufficiently administrable "in most individual cases"). Critics reason that it is usually difficult to discern the point at which an invention would not have occurred absent the incentive provided by patents. Glynn S. Lunney, Jr., *E-Obviousness*, 7 MICH. TELECOMM. & TECH. L. REV. 363, 416 (2001). Further, there is often value in inducing earlier inventions even if they would eventually occur without the patent incentive. Abramowicz & Duffy, *supra*, at 1598. Although the inducement standard serves as an instructive principle, patent applicants are not required to show that the claimed invention would not have occurred but for the patent inducement. *See* FED. TRADE COMM'N, *supra*, at 11 (noting that the inducement standard is difficult to apply and thus "the more manageable standards of the patent statute" have arisen in its stead).

Developing a rule to determine whether a given invention represents a substantial innovation or is merely a minor improvement is a difficult task.[57] As Judge Learned Hand once lamented, the standard required for identifying inventions worthy of patenting "is as fugitive, impalpable, wayward, and vague a phantom as exits [sic] in the whole paraphernalia of legal concepts."[58] All improvements represent at least some level of advancement over prior technology.[59] Thus, courts and patent offices must compare an invention to existing technologies to determine whether the invention is *enough* of an advancement that it deserves a patent.[60] The wide range of industries and fields of study from which inventions arise further complicates the issue of obviousness.[61] In its attempt to address these issues, obviousness has undergone a number of changes.[62] Understanding its current application requires a review of the standard's historical development and the past attempts to clarify the doctrine, which have led to its current state.[63]

B. The Test for Nonobviousness: A Historical Overview

In 1851, the Supreme Court in *Hotchkiss v. Greenwood* first articulated what Congress would later enact as the nonobviousness requirement.[64] In that case, an inventor modified existing door and furniture handle designs by exchanging the wood and metal knobs with other known material, including pottery clay and porcelain knobs.[65] The Court determined that the inventor's improvement, although exhibiting the skill of an experienced worker, did not represent a significant advancement.[66] The Court held that an invention is not entitled to a patent unless it demonstrates an innovation beyond that which would be expected from an ordinary technician proficient in the industry.[67] Congress later codified the *Hotchkiss* doctrine in § 103 of the U.S. Patent Act of 1952,

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[57] Harries v. Air King Prods. Co., 183 F.2d 158, 162 (2d Cir. 1950).

[58] *Id.*

[59] *See* Hotchkiss v. Greenwood, 52 U.S. (11 How.) 248, 266–67 (1851) (describing multiple instances in which workers developed improvements over prior art that enabled cheaper production and superior products, but nonetheless failed to evidence enough of an advance to be deserving of a patent).

[60] *Id.*

[61] *See* Dan L. Burk & Mark A. Lemley, *Is Patent Law Technology-Specific?*, 17 BERKELEY TECH. L.J. 1155, 1155–56 (2002) (discussing the challenges involved in applying patent law standards across many different fields and emerging technologies).

[62] *See generally* Ryan T. Holte & Ted Sichelman, *Cycles of Obviousness*, 105 IOWA L. REV. 107, 118–30 (2019) (providing a thorough account of obviousness's historical development).

[63] *See id.* (detailing Congress's and the Supreme Court's modifications to the obviousness doctrine, which addressed various issues that arose over time).

[64] 52 U.S. (11 How.) at 267.

[65] *Id.* at 264–65.

[66] *Id.* at 267.

[67] *Id.*

officially establishing the nonobviousness standard for all patent applications.[68] Congress reaffirmed the test in § 103 of the Leahy-Smith America Invents Act (AIA), enacted in 2011 and set out below:

> A patent for a claimed invention may not be obtained . . . if the differences between the claimed invention and the *prior art* are such that the claimed invention as a whole would have been *obvious* . . . to a *person having ordinary skill in the art* to which the claimed invention pertains. Patentability shall not be negated by the *manner in which the invention was made*.[69]

Section 103 does not detail how to determine the relevant "prior art," define the "person having ordinary skill in the art," nor how to decide if the invention would have been "obvious."[70] In 1966, in *Graham v. John Deere Co.*, the Supreme Court interpreted § 103 and laid out the modern nonobviousness test.[71] The Court held that nonobviousness is a question of law based on several findings of fact, including: (1) "the scope and content of the prior art"; (2) the dissimilarities between the invention and the prior art; (3) the standard of ordinary skill in the pertinent art; and (4) "secondary considerations," such as whether the invention enjoys market success, addresses lingering but unre-

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[68] Patent Act of 1952, ch. 950, § 100, 66 Stat. 792, 797 (codified as amended in scattered sections of 35 U.S.C.); Graham v. John Deere Co., 383 U.S. 1, 17 (1966).

[69] 35 U.S.C. § 103 (emphasis added). The AIA sought to synchronize the U.S. patent system with the rest of the world by transitioning from the 1952 Act's "first-to-invent" system to a largely "first-to-file" system. Robert P. Merges, *Priority and Novelty Under the AIA*, 27 BERKELEY TECH. L.J. 1023, 1046 (2012). The old first-to-invent system allowed inventors to "swear[] behind" an otherwise invalidating prior art reference. Dennis D. Crouch, *Is Novelty Obsolete? Chronicling the Irrelevance of the Invention Date in U.S. Patent Law*, 16 MICH. TELECOMM. & TECH. L. REV. 53, 67 (2009). Thus, inventors who filed patent applications for inventions that already had been disclosed in the prior art could still obtain a patent by showing that they already had conceived of the invention at the time of the prior art disclosure. *Id.* at 68. Assuming the inventor exercised reasonable diligence in reducing the invention to practice, the prior art disclosure would not disqualify the patent—hence the term "first-to-invent." *Id.* at 67–68. The AIA eliminated the first-to-invent system by making the effective filing date, rather than the date of invention, the critical date for determining whether the prior art had invalidated the patent. 35 U.S.C. § 102(a)(1), (2). The AIA also affected what constitutes "prior art." *Id.* Under the 1952 Act, prior art consisted of "patent[s]" and "printed publications" existing anywhere in the world, and any instance in which the invention was "in public use or on sale" within the United States. 35 U.S.C. § 102(a)(1), (2) (1952). The AIA removed the geographic restrictions for prior use and sale; thus, for patent applications with an effective filing date on or after March 16, 2013—the date on which the AIA took effect—any prior patents, printed publications, uses, and sales qualify as prior art. *See* 35 U.S.C. § 102(a)(1), (2) (2018) (providing no geographic qualifications for what constitutes prior art). For patents operating under the 1952 Act, prior art consists of references existing at the time of the invention. 35 U.S.C. § 102 (1952). The AIA, on the other hand, considers prior art to be those references existing at the time of the effective filing date. 35 U.S.C. § 102 (2018).

[70] *See* 35 U.S.C. § 103 (mentioning the terms: "prior art," "person having ordinary skill in the art," and "obviousness," but not defining them).

[71] 383 U.S. at 17–18.

solved issues, or succeeds where others have failed.[72] Based on these four factual findings, a legal determination is made whether a PHOSITA would find the invention obvious.[73] The following Subsections further explore this test.[74]

1. Scope and Content of the Prior Art: The Analogous Requirement

Because courts evaluate obviousness based on an invention's improvement over preexisting technology, the first step is to identify all relevant prior art.[75] Prior art refers to all information, knowledge, technologies, or products available to the public prior to a patent's effective filing date.[76] Typically, the more prior art an invention is evaluated against, the more likely a court applying the PHOSITA standard will find it obvious.[77] Although § 103 does not ex-

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[72] *Id.* Secondary considerations are meant to serve as objective indicators of an invention's ingenuity. Jonathan J. Darrow, *Secondary Considerations: A Structured Framework for Patent Analysis*, 74 ALB. L. REV. 47, 49 (2010). In *Graham*, the Supreme Court provided several examples of secondary considerations, including "commercial success, long felt but unsolved needs, [and] failure of others . . . ." 383 U.S. at 17. The commercial success of an invention tends to demonstrate its ingenuity because, all other things equal, consumers likely would not seek out products possessing the claimed invention if those products were not superior to other designs. Darrow, *supra*, at 49–50. Likewise, an invention addressing long-felt needs or succeeding where past attempts have failed tends to show that it is not obvious because, if it were, those past attempts likely would have succeeded. *Id.* at 49. Although, in 1966, the *Graham* Court held that secondary considerations "*might* be utilized to give light to the circumstances," the Federal Circuit has since held that secondary considerations *must* be considered. 383 U.S. at 17 (emphasis added); *see* Transocean Offshore Deepwater Drilling, Inc. v. Maersk Contractors USA, Inc., 617 F.3d 1296, 1305 (Fed. Cir. 2010) (holding that secondary considerations must be evaluated in an obviousness determination, and stating that the lower court erred by failing to do so), *rev'd*, 699 F.3d 1340 (Fed. Cir. 2012); *see also* U.S. PAT. & TRADEMARK OFF., MANUAL OF PATENT EXAMINING PROCEDURE § 2141 (9th ed. Rev. Oct. 2019) [hereinafter MPEP] (requiring USPTO examiners to consider the secondary characteristics provided in patent applications). Courts have looked to additional secondary considerations, such as: (1) the willingness of competitors to obtain licenses from the patent holder; (2) the praise from professionals within the field advanced by the invention; and (3) infringers' imitations of the patent. 2 CHISUM, *supra* note 18, § 5.05[3–5]. When applying these factors, courts look to whether a nexus exists between the secondary factor and the ingenuity of the invention. Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1574 (Fed. Cir. 1996). For example, a showing that an invention's commercial success is unrelated to marketing or preexisting brand recognition will tend to show a nexus between the invention's ingenuity and its demand within the market. *Id.*

[73] *Graham*, 383 U.S. at 17–18.

[74] *See infra* Part I.B.1–4.

[75] *In re* Clay, 966 F.2d 656, 658 (Fed. Cir. 1992).

[76] 35 U.S.C. § 102. This definition assumes application of the AIA. *Id.* For technical definitions of prior art for patents operating under both pre- and post-AIA rules, see *supra* note 69 and accompanying text.

[77] *See* 35 U.S.C. § 103 (providing that obviousness is determined based on "the *differences* between the claimed invention and the prior art" (emphasis added)); Timothy R. Holbrook, *Patent Prior Art and Possession*, 60 WM. & MARY L. REV. 123, 127 (2018) (stating that obviousness is "relative" in that it "requires a comparison between the invention as claimed in the patent and the 'prior art'"). Considering fewer prior art references tends to make these differences appear greater and, thus, the invention less obvious. *See* Jeffrey T. Burgess, *The Analogous Art Test*, 7 BUFF. INTELL. PROP. L.J. 63, 79 (2009) (stating that for every reference that is part of the relevant prior art, "a patent practition-

plicitly outline the scope of prior art that should be considered, it provides that obviousness should be evaluated according to "the art to which the claimed invention pertains."[78] The U.S. Court of Appeals for the Federal Circuit has interpreted this to mean that only prior art that is "analogous" to the claimed invention should be considered.[79] The Federal Circuit is the primary court of review for all patent disputes.[80] Unlike other circuit courts, whose jurisdiction is based on geography, the Federal Circuit has nationwide jurisdiction over patent issues.[81]

In 1986, in *In re Deminski*, the Federal Circuit adopted a two-part test for defining the scope of analogous prior art.[82] First, courts consider whether prior art is within the same "field of . . . endeavor" as the claimed invention.[83] If it is, the prior art is deemed analogous.[84] Prior art within the same field of endeavor as the claimed invention is analogous, even if it has never been used to address the problem solved by the claimed invention.[85] Typically, the field of endeavor does not encompass the entire scientific discipline or industry.[86] Rather, it is narrowly constrained to an invention's "embodiments, function, and structure" as described in the patent application.[87] For example, the Federal

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er must enter the minefield of accurately portraying the differences between the reference and the invention").

[78] 35 U.S.C. § 103. Both the USPTO and courts play a role in evaluating patents. 6A DONALD S. CHISUM, CHISUM ON PATENTS § 19.02 (Matthew Bender ed., 2011). To obtain a patent, inventors must submit a patent application to the USPTO. 1 CHISUM, *supra* note 50, § 1. The USPTO assigns each patent application to one of its patent examiners who evaluates the application and determines whether to grant a patent based on various statutory requirements. *Id.* Inventors who successfully complete this process and receive a patent may then sue those who infringe upon the patent. *Id.* Alleged infringers can defend themselves by asserting noninfringement—meaning that the patent's claims do not apply to their use of a given technology—or by claiming that the patent is invalid. 6A CHISUM, *supra*, § 19.02. To argue that a patent is invalid, one essentially must make the case that the patent examiner made a mistake in granting the patent because the invention fails an essential requirement, such as novelty, utility, or nonobviousness. *Id.* Even if a defendant has infringed upon the patent at issue, the individual could escape liability by proving that the patent is invalid. *Id.*

[79] Potts v. Creager, 155 U.S. 597, 607–08 (1895). The analogous art doctrine stems from an 1895 Supreme Court decision concerning an invention for crushing clay into fine pieces that was very similar to a preexisting apparatus used for polishing wood. *Id.* at 600–01. In spite of the similarities between the inventions, the Court upheld the patent, holding that, in order to invalidate a patent, prior art must be used in a way that is so analogous to the claimed invention that a mechanic of ordinary skill would have thought to apply it. *Id.* at 608.

[80] 28 U.S.C. § 1295.

[81] *Id.*; Jason Rantanen, *The Landscape of Modern Patent Appeals*, 67 AM. U. L. REV. 985, 990–91 (2018).

[82] 796 F.2d 436, 442 (Fed. Cir. 1986).

[83] *Id.*

[84] *Id.*

[85] *Id.*

[86] *See In re* Clay, 966 F.2d 656, 659 (Fed. Cir. 1992) (stating that the claimed invention did not share the same field of endeavor as an instance of prior art "merely because both relate[d] to the petroleum industry").

[87] *In re* Bigio, 381 F.3d 1320, 1325 (Fed. Cir. 2004).

Circuit has distinguished surgical instruments employing ultrasonic energy from surgical instruments that do not as separate fields of endeavor.[88]

Prior art that is not in the same field of endeavor can still be analogous if it reasonably pertains to the obstacle that the new invention overcomes.[89] This includes all prior art that an inventor would naturally consult for inspiration when attempting to address a similar issue.[90] For example, the Federal Circuit has held that prior art involving a bed that folds into the wall was reasonably pertinent to a treadmill with a folding base.[91] Once a court has identified all analogous art, it then imputes this knowledge to the hypothetical PHOSITA.[92] Having determined what a PHOSITA would know, the next Subsection describes how courts identify the PHOSITA's level of skill.[93]

2. Identifying the PHOSITA

The nonobviousness test hinges on whether a PHOSITA, knowing all the relevant prior art and seeking to solve the same problem, would have thought to create the claimed invention.[94] The PHOSITA is not an actual person working within the same field as the invention, but rather a legal fiction created to conceptualize the ingenuity exhibited by a claimed invention over preexisting technology.[95] The PHOSITA is a strange creature, comprehending the entire world of relevant prior art (a potentially superhuman feat depending on the scope of the prior art), while having only ordinary skill and creativity in how it solves the problem addressed by the claimed invention.[96]

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[88] Tyco Healthcare Grp. LP v. Ethicon Endo-Surgery, Inc., 774 F.3d 968, 979 (Fed. Cir. 2014). The Federal Circuit also has distinguished the extraction of crude petroleum from the storage of refined petroleum derivatives as separate fields of endeavor. *In re Clay*, 966 F.2d at 659. *But see In re Bigio*, 381 F.3d at 1325–27 (holding that a preexisting toothbrush design was within the same field of endeavor as a hairbrush for which the inventor sought a patent). The result in *In re Bigio* was likely due to the simplicity of the technology involved in the dispute. *See* Burgess, *supra* note 77, at 73 (stating that the field of endeavor tends to expand when the claimed invention is simple and accordingly contract when the invention is complicated).

[89] *In re Deminski*, 796 F.2d at 442.

[90] *In re* ICON Health & Fitness, 496 F.3d 1374, 1379–80 (Fed. Cir. 2007).

[91] *Id.* at 1377, 1380. Although the court held that the bed was outside the treadmill's field of endeavor, it determined that the inventive mechanism "generally addresse[d] problems of supporting the weight of such a mechanism and providing a stable resting position." *Id.* at 1380.

[92] Burgess, *supra* note 77, at 68–69.

[93] *See infra* Part I.B.2.

[94] 35 U.S.C. § 103.

[95] 2 CHISUM, *supra* note 18, § 5.04A[1].

[96] *See* Robert P. Merges, *Uncertainty and the Standard of Patentability*, 7 HIGH TECH. L.J. 1, 14–15 (1992) (conceptualizing the PHOSITA as a "roomful" of skilled workers); Jonathan J. Darrow, Note, *The Neglected Dimension of Patent Law's PHOSITA Standard*, 23 HARV. J.L. & TECH. 227, 235 (2009) (describing the PHOSITA as an imagined person whose characteristics reflect the needs of the patent system as opposed to traits that could be attributed to an actual human being); Joseph P. Meara, Comment, *Just Who Is the Person Having Ordinary Skill in the Art? Patent Law's Mysterious Personage*, 77 WASH. L. REV. 267, 293 (2002) (reasoning that in some fields the interdisciplinary

Given the PHOSITA standard, the nonobviousness requirement is a high bar to meet.[97] Because many inventions that appear inventive are, in reality, obvious when evaluated against a PHOSITA with such omniscient knowledge of all relevant prior art, the standard is difficult to overcome.[98] Although the breadth of information that the PHOSITA possesses may seem too lofty a standard to meet, the standard is well-founded.[99] Although no one expects inventors to possess an all-encompassing knowledge of the prior art, this standard is necessary to ensure that only significant advancements are awarded patents.[100] If an invention cannot show nonobviousness when compared to all prior art within the same field of endeavor or reasonably pertinent to the problem solved by the claimed invention, then it is not a significant advancement.[101]

Given that the PHOSITA has such extraordinary knowledge of the relevant prior art, the level of skill attributed to the PHOSITA is critical.[102] The Federal Circuit has specified a number of factors to determine the PHOSITA's level of skill, including: (1) the sorts of issues common to the field of study, (2) the solutions to those issues that exist within the prior art, (3) the frequency with which improvements occur, (4) the complexity and refinement of the technology involved, and (5) the extent of schooling obtained by technicians currently working in the field.[103]

The Federal Circuit also has listed the inventor's education level as a sixth factor in a number of cases.[104] Recently, however, the Federal Circuit has placed less weight on this factor, employing it cautiously and only when there

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nature of discovery is such that the PHOSITA is best thought of as a team of workers, each skilled in the appropriate field).

[97] Jasper L. Tran, *Timing Matters: Prior Art's Age Infers Patent Nonovbiousness*, 50 GONZ. L. REV. 189, 193 (2014).

[98] 2 CHISUM, *supra* note 18, § 5.04A[1][b].

[99] *See id.* (stating that, by holding inventors accountable for such a broad array of prior art, the obviousness doctrine encourages inventors not to reinvent the wheel, but rather to examine the prior art before attempting to invent a new solution).

[100] *Id.*

[101] *See* Atl. Works v. Brady, 107 U.S. 192, 200 (1883) (stating that granting a patent for "every slight advance made . . . is unjust in principle and injurious in its consequences"). *But see* Daralyn J. Durie & Mark A. Lemley, *A Realistic Approach to the Obviousness of Inventions*, 50 WM. & MARY L. REV. 989, 1015–17 (2008) (arguing for a more realistic conception of the PHOSITA that better approximates what an actual skilled worker would be expected to know).

[102] *See* Burk & Lemley, *supra* note 61, at 1191–92 (noting the disparities in the level of skill attributed to the PHOSITA across various industries, and arguing that such disparities lead to inconsistent results).

[103] *In re* GPAC Inc., 57 F.3d 1573, 1579 (Fed. Cir. 1995). In a given case, the court need not apply all factors and may choose to emphasize some factors over others. *Id.*

[104] *See, e.g.*, Daiichi Sankyo Co., Ltd. v. Apotex, Inc., 501 F.3d 1254, 1256 (Fed. Cir. 2007) (listing "the educational level of the inventor" as a factor for determining the PHOSITA's skill in the art), *rev'd*, 781 F.3d 1356 (Fed. Cir. 2015); Env't Designs, Inc. v. Union Oil Co., 713 F.2d 693, 696 (Fed. Cir. 1983) (same).

is reason to believe that it is especially illuminating in a particular case.[105] The Federal Circuit and multiple commentators recognize the danger of applying this factor which, unlike the others, focuses on the actual inventor's capabilities rather than those possessed by average workers in the field.[106] The PHOSITA is not meant to represent the actual inventor, but rather is a fictional representation of the average level of skill within the industry.[107] The current USPTO Manual of Patent Examining Procedure (MPEP) omits the education level of the inventor from its factors for finding PHOSITA.[108]

3. Final Determination of Obviousness

After identifying the scope and content of the prior art, and completing all other factual inquiries, courts must put all this information together to determine whether the claimed invention would have been obvious to a PHOSITA.[109] Due to the difficult factual underpinnings in place, courts still struggle with this final determination.[110] After all, judges typically do not possess technical training in the field of study that the invention claims to advance.[111] Further, it is hard to resist engaging in hindsight bias when determining the obvi-

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[105] *See In re* Coutts, 726 F. App'x 791, 796 (Fed. Cir. 2018) (reasoning that, although an inventor's education level is relevant in some circumstances—such as when an inventor's knowledge is especially indicative of the knowledge held by the average worker in the field—courts are generally wary of this type of inquiry because actual inventors differ in education level, ranging anywhere "'from ignorant geniuses to Nobel laureates'" (quoting Kimberly-Clark Corp. v. Johnson & Johnson & Pers. Prods. Co., 745 F.2d 1437, 1453 (Fed. Cir. 1984))).

[106] *In re Coutts*, 726 F. App'x at 796; Standard Oil Co. v. Am. Cyanamid Co., 774 F.2d 448, 454 (Fed. Cir. 1985); *Kimberly-Clark*, 745 F.2d at 1453; Nicholas J. Gingo, *Dumb Inventors Rejoice: How* Daiichi Sankyo v. Apotex *Violated the Federal Patent Statute*, 17 TEX. INTELL. PROP. L.J. 81, 98–99 (2008); Mandel, *supra* note 56, at 73; Meara, *supra* note 96, at 279.

[107] *See* Meara, *supra* note 96, at 279 (noting that taking the inventor's education level into consideration does not conform with conventional obviousness ideology, which forbids identifying the PHOSITA based on the knowledge and skill possessed by the actual inventor).

[108] *See* MPEP, *supra* note 72, § 2141.03 (listing the five other factors for determining PHOSITA, but not mentioning the education level of the actual inventor).

[109] KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 406–07 (2007). *Contra* Rebecca S. Eisenberg, *Obvious to Whom? Evaluating Inventions from the Perspective of PHOSITA*, 19 BERKELEY TECH. L.J. 885, 888 (2004) (arguing that, although the PHOSITA provides guidance on the scope of prior art, the PHOSITA "sits on the sidelines" while courts make the final obviousness determination).

[110] *See* Holte & Sichelman, *supra* note 62, at 165–67 (noting the disparities in how frequently various district courts and the Federal Circuit invalidate patents on obviousness grounds, and the policies and rationales that they rely on to do so).

[111] *See* Burk & Lemley, *supra* note 61, at 1196 ("Judges generally don't have any scientific background and, at the district court level at least, most law clerks don't either."); Doug Lichtman & Mark A. Lemley, *Rethinking Patent Law's Presumption of Validity*, 60 STAN. L. REV. 45, 67 (2007) ("District court judges are poorly equipped to read patent documents and construe technical patent claims."). Even on the Federal Circuit, which hears all patent appeals, only "nine out of thirty-eight, or less than one-fourth of the judges who have ever sat upon the Federal Circuit [have] technical backgrounds." Michael Goodman, *What's So Special About Patent Law?*, 26 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 797, 809 n.48 (2016).

ousness of an invention after the inventor already has disclosed it.[112] Much like hearing the answer before the riddle, it can be very difficult to place one's self in the shoes of a PHOSITA facing the problem anew after the invention has already provided the solution.[113]

In 1984, in *ACS Hospital Systems, Inc. v. Montefiore Hospital*, the Federal Circuit introduced a bright line rule for determining obviousness known as the "teaching, suggestion, and motivation" (TSM) test.[114] Concerned about the effect of hindsight bias, the Federal Circuit devised the test to guard against instances in which a court, looking back in time, may underestimate the ingenuity of an invention.[115] As originally conceived, the TSM test required that inventions formed by combining knowledge from two or more inventions in the prior art could only be found obvious if the prior art also provided a teaching, suggestion, or motivation for doing so.[116] For example, the Federal Circuit applied the TSM test to overturn an obviousness determination for a video display system that combined two prior art systems: (1) a television with menu options for adjusting audio/visual settings, and (2) a video game providing a tutorial on how to play the game.[117] Although both the patent examiner and the USPTO Board of Appeals determined that a PHOSITA would have found the combination obvious, the Federal Circuit vacated this finding because the prior art did not explicitly teach, suggest, or provide a motivation for such combination.[118]

In 2006, in *KSR International Co. v. Teleflex Inc.*, the Supreme Court rejected the Federal Circuit's strict application of the TSM test in favor of a more flexible application of the test laid out in *Graham*.[119] Although the TSM test is still consulted for guidance, it is only an instructive factor for finding obviousness and is not automatically determinative.[120] In *KSR*, the Court highlighted the

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[112] Gregory N. Mandel, *Patently Non-obvious: Empirical Demonstration That the Hindsight Bias Renders Patent Decisions Irrational*, 67 OHIO ST. L.J. 1391, 1443 (2006).

[113] *Id.*

[114] 732 F.2d 1572, 1577 (Fed. Cir. 1984); Glynn S. Lunney, Jr. & Christian T. Johnson, *Not So Obvious After All: Patent Law's Nonobviousness Requirement,* KSR*, and the Fear of Hindsight Bias*, 47 GA. L. REV. 41, 63–64 (2012).

[115] *In re* Dembiczak, 175 F.3d 994, 999 (Fed. Cir. 1999).

[116] *ACS Hosp. Sys.*, 732 F.2d at 1577.

[117] *In re* Lee, 277 F.3d 1338, 1340–41, 1344 (Fed. Cir. 2002).

[118] *Id.* at 1341, 1344.

[119] 550 U.S. 398, 415 (2007).

[120] *Id.* at 418–19. The USPTO Manual of Patent Examining Procedure (MPEP) provides a list of factors that may support a determination of obviousness, which includes the Federal Circuit's TSM rationale:

> (A) Combining prior art elements according to known methods to yield predictable results; (B) Simple substitution of one known element for another to obtain predictable results; (C) Use of known technique to improve similar devices (methods, or products) in the same way; (D) Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (E) "Obvious to try"—choosing

importance of utilizing a flexible test that could adapt to the specific technology involved.[121] The Court also provided that "design incentives and other market forces" can clue a PHOSITA into modifying existing technology to solve problems.[122] Thus, a PHOSITA is not always confined to the day-to-day knowledge of the art, but can also look to happenings in the market for guidance.[123]

This revelation, coupled with the Court's statement that the PHOSITA is "a person of ordinary creativity, not an automaton," appears to endow the PHOSITA with some measure of innovative potential.[124] Prior to this decision, the Federal Circuit had treated the PHOSITA as an unimaginative worker devoid of anything resembling creativity.[125] Now, however, the PHOSITA has both ordinary skill *and* creativity, and can look to things outside the day-to-day happenings to the relevant "design incentives and other market forces."[126] This raises the obviousness bar that inventions must overcome, in that fewer inventions will appear nonobvious as the PHOSITA grows more sophisticated.[127]

4. The Manner of Invention

To better understand the final sentence of § 103, which provides that patentability does not depend on "the manner in which the invention was made,"

> from a finite number of identified, predictable solutions, with a reasonable expectation of success; (F) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; (G) *Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention*.

MPEP, *supra* note 72, § 2141 (emphasis added). The MPEP is not binding legal authority; rather, it is a set of USPTO instructions that examiners rely on when evaluating patent applications. *In re* Fisher, 421 F.3d 1365, 1373 (Fed. Cir. 2005); MPEP, *supra* note 72, at Foreword.

[121] 550 U.S. at 419.

[122] *Id.* at 417.

[123] *Id.*

[124] *Id.* at 421; *see* Joseph Scott Miller, *Remixing Obviousness*, 16 TEX. INTELL. PROP. L.J. 237, 249–50 (2008) (reasoning that the *KSR* Court's decision changed the PHOSITA from an unimaginative "dullard" into a craftsperson capable of combining existing technologies to overcome routine issues); Darrow, *supra* note 96, at 228 (arguing that *KSR* attributes to the PHOSITA an ability to search for new methods and designs in order to solve a problem); *see also* John H. Barton, *Non-obviousness*, 43 IDEA 475, 496 (2003) (describing the Federal Circuit's conception of PHOSITA, prior to *KSR*, as a minimally competent and unimaginative worker, and suggesting that the PHOSITA should be equipped with the skill, resources, and aid that is typical of workers within the field).

[125] Miller, *supra* note 124, at 249–50.

[126] *KSR*, 550 U.S. at 417, 421.

[127] *See* Miller, *supra* note 124, at 249–50 (describing how *KSR* elevated the capabilities of the PHOSITA beyond the Federal Circuit's prior conceptions, which in turn enabled the PHOSITA to piece together information contained in prior art to create routine improvements).

it is useful to examine the now discarded "flash of genius" test.[128] In 1941, in *Cuno Engineering Corp. v. Automatic Devices Corp.*, the Supreme Court held that patents must demonstrate a "flash of creative genius, not merely the skill of the calling."[129] Some courts interpreted this "flash of creative genius" to mean that nonobviousness requires a showing of sudden brilliance (an "aha!" moment) rather than the sustained research and experimentation involved in many inventions.[130] This became known as the flash of genius test and was widely criticized for being difficult to apply and improperly directed at the mental faculties of the inventor, rather than the merits of the invention itself.[131] These and other concerns prompted President Franklin D. Roosevelt to initiate the National Patent Planning Commission in 1941 to evaluate the American patent system and determine how it could be improved.[132] The committee called on Congress to develop a test for evaluating the objective merits of the invention itself, rather than the subjective considerations of how it was developed.[133] Congress responded by enacting the U.S. Patent Act of 1952, which provided that patentability would not depend on "the manner in which the invention was made."[134] In 1966, in *Graham*, the Supreme Court interpreted this language as expressly disavowing the flash of genius test.[135]

Congress's most recent pronouncement on obviousness, the Leahy-Smith AIA, enacted in 2011, carried over this language from the 1952 Patent Act, thus

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[128] 35 U.S.C. § 103; *see* Graham v. John Deere Co., 383 U.S. 1, 15 (1966) (stating that Congress included the final sentence of § 103 as an express repudiation of the flash of genius test).

[129] 314 U.S. 84, 91 (1941), *superseded by statute*, 35 U.S.C. § 103(a).

[130] *See* Aram Boyajian, *The Flash of Creative Genius—An Alternative Interpretation*, 25 J. PAT. OFF. SOC'Y 776, 776–78 (1943) (detailing how various lower courts have interpreted the Supreme Court's language in *Cuno Engineering* as requiring a "flash of creative genius"); Comment, *The Flash of Genius Standard of Patentable Invention*, 13 FORDHAM L. REV. 84, 86–87 (1944) (detailing a number of Second Circuit decisions in which the court invalidated patents because the inventors could not show a flash of genius); *see also* Picard v. United Aircraft Corp., 128 F.2d 632, 636 (2d Cir.1942) (invalidating a patent on an engine lubricating and cooling system because it was the product of slow, grinding advancement rather than sudden discovery). Writing for the U.S. Court of Appeals for the Second Circuit, Judge Learned Hand held: "Unless we are to mistake for invention the slow but inevitable progress of an industry through trial and error, and confer a monopoly merely upon the exercise of persistent and intelligent search for improvement, there was no invention in this." *Picard*, 128 F.2d at 636.

[131] *See* Otto Raymond Barnett, *The "Flash of Genius" Fallacy*, 25 J. PAT. OFF. SOC'Y 785, 785–86 (1943) (arguing that the flash of genius test fails to consider that many inventions arise out of rigorous experimentation); Comment, *supra* note 130, at 88 (arguing that the flash of genius test looks to subjective considerations of the inventor's mental capabilities rather than objectively evaluating the invention itself).

[132] William Jarratt, *U.S. National Patent Planning Commission*, 153 NATURE 12, 12 (1944).

[133] NAT'L PAT. PLANNING COMM'N, THE AMERICAN PATENT SYSTEM, REPORT OF THE NATIONAL PATENT PLANNING COMMISSION, *reprinted in* 25 J. PAT. OFF. SOC'Y 455, 462–63 (1943).

[134] 35 U.S.C. § 103 (1952).

[135] 383 U.S. 1, 15 (1966). The Court explained that its prior language had been misunderstood, and that it never intended to make the inventor's state of mind an issue of obviousness. *Id.* at 15 n.7.

reaffirming that obviousness should focus on a claimed invention's contributions to the field of study rather than focusing on how the invention was developed.[136]

II. THE ROLE OF AI IN INNOVATION

Modern AI excels at specific, precisely defined tasks, but is incapable of the type of generalized understanding that would allow a single AI system to take the skills it learns in one area and apply them to a completely different cognitive endeavor.[137] Nevertheless, AI machines often perform narrow tasks far better than any human can.[138]

This highlights one of the many differences between human and machine intelligence.[139] Humans possess broadly applicable, generalized intelligence, but process data slowly.[140] In contrast, AI machines process data incredibly fast, but require extensive training using meticulously compiled datasets to perform new functions.[141] Even after mastering a skill, AI machines are incapable of taking what they have learned and applying it to learn a separate skill.[142] This Part describes AI and its limitations, and details how some of the most promising forms of AI technology operate.[143]

The term "artificial intelligence" has no universally accepted definition.[144] It is an umbrella term referring to computer programs designed to perform

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[136] *See* 35 U.S.C. § 103 (2018) ("Patentability shall not be negated by the manner in which the invention was made.").

[137] Calo, *supra* note 7, at 405.

[138] Tannya D. Jajal, *Distinguishing Between Narrow AI, General AI and Super AI*, MEDIUM (May 21, 2018), https://medium.com/@tjajal/distinguishing-between-narrow-ai-general-ai-and-super-ai-a4bc44172e22 [https://perma.cc/35PG-7JRX].

[139] *See* José Mira Mira, *Symbols Versus Connections: 50 Years of Artificial Intelligence*, 71 NEUROCOMPUTING 671, 677 (2008) ("It is so obvious that human nature is distinct from the nature of the computer and the robot that comparative analysis almost seems unnecessary.").

[140] Ben Dickson, *There's a Huge Difference Between AI and Human Intelligence—So Let's Stop Comparing Them*, TECHTALKS (Aug. 21, 2018), https://bdtechtalks.com/2018/08/21/artificial-intelligence-vs-human-mind-brain/ [https://perma.cc/4GHL-XENY].

[141] David Watson, *The Rhetoric and Reality of Anthropomorphism in Artificial Intelligence*, 29 MINDS & MACHS. 417, 423 (2019).

[142] *Id.*; Naveen Joshi, *How Far Are We from Achieving Artificial General Intelligence?*, FORBES (June 10, 2019), https://www.forbes.com/sites/cognitiveworld/2019/06/10/how-far-are-we-from-achieving-artificial-general-intelligence/#338a679c6dc4 [https://perma.cc/BSX7-6UJE]; Sherise Tan, *How to Train Your AI*, REVAIN (Mar. 28, 2019), https://medium.com/revain/how-to-train-your-ai-98113bdac101 [https://perma.cc/KUZ5-5L34].

[143] *See infra* notes 144–179 and accompanying text (defining AI, detailing its strengths and limitations, and discussing its role in augmenting human researchers and workers).

[144] *See* Calo, *supra* note 7, at 404 ("AI is best understood as a set of techniques aimed at approximating some aspect of human or animal cognition using machines."); Matthew U. Scherer, *Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies*, 29 HARV. J.L. & TECH. 353, 362 (2016) (defining AI as "machines that are capable of performing tasks that, if performed by a human, would be said to require intelligence"); Sean Semmler & Zeeve Rose, *Artificial Intelligence: Application Today and Implications Tomorrow*, 16 DUKE L. & TECH. REV. 85, 86 (2017) (defining AI as "the process of simulating human intelligence through machine processes").

tasks that would otherwise require human thinking.[145] AI systems are often divided into two classifications: General AI and Narrow AI.[146] General AI refers to theoretical machines with science-fiction level capabilities that can reason and understand the world around them at the same level as humans.[147] In other words, such a machine could learn from experiences in the abstract way in which humans do.[148] If an AI machine could reach this point, it would theoretically be capable of solving all the problems that a human could.[149] Currently, this level of AI is merely speculative, and experts are not certain when AI will reach this point.[150] Other experts are skeptical that machines will ever reach this level, contending that human and machine intelligence are completely different.[151]

Narrow AI refers to machines that focus on specific problems, typically within a single domain.[152] Today, Narrow AI is the current state of AI machines.[153] A subtype of existing Narrow AI, known as machine learning, refers

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[145] Scherer, *supra* note 144, at 362.

[146] Michael J. Garbade, *Clearing the Confusion: AI vs Machine Learning vs Deep Learning Differences*, TOWARDS DATA SCI. (Sept. 14, 2018), https://towardsdatascience.com/clearing-the-confusion-ai-vs-machine-learning-vs-deep-learning-differences-fce69b21d5eb [https://perma.cc/6UUF-3GKH]; Kathleen Walch, *Rethinking Weak vs. Strong AI*, FORBES (Oct. 4, 2019), https://www.forbes.com/sites/cognitiveworld/2019/10/04/rethinking-weak-vs-strong ai/#34016c3c6da3 [https://perma.cc/4CY8-W7UC].

[147] Walch, *supra* note 146.

[148] *See id.* (defining General AI as AI technology that would be able to perform all the cognitive tasks that humans are capable of); *see also* Dickson, *supra* note 140 (emphasizing the ability to think and reason abstractly as one of the ways in which human intelligence outshines AI).

[149] Naveen Joshi, *7 Types of Artificial Intelligence*, FORBES (June 19, 2019), https://www.forbes.com/sites/cognitiveworld/2019/06/19/7-types-of-artificial-intelligence/#15f91124233e [https://perma.cc/Z3LH-YSE2].

[150] PHILIP C. JACKSON, JR., INTRODUCTION TO ARTIFICIAL INTELLIGENCE 62 (Dover Publ'n, Inc., 3d ed. 2019) (1974). A recent survey of 352 experts predicted that there is a 50% chance that General AI will exist by the year 2060. Katja Grace et al., *Viewpoint: When Will AI Exceed Human Performance? Evidence from AI Experts*, 62 J. A.I. RSCH. 729, 729–30 (2018). An earlier survey reported that, on average, experts estimated a 10% chance that AGI would develop by 2036, a 50% chance it would develop by 2081, and a 90% chance it would develop by 2183. Vincent C. Müller & Nick Bostrom, *Future Progress in Artificial Intelligence: A Survey of Expert Opinion*, *in* FUNDAMENTAL ISSUES OF ARTIFICIAL INTELLIGENCE 553, 563 (Vincent C. Müller ed., 2016).

[151] *See* FRANÇOIS CHOLLET, DEEP LEARNING WITH PYTHON 8, 12 (2018) (stating that machine learning and human thought are entirely different things, and cautioning that "talk of human-level general intelligence shouldn't be taken too seriously"); Dickson, *supra* note 140 (reasoning that AI machines cannot make the sort of general abstractions that enable human intelligence). *See generally* Toby Walsh, *The Singularity May Never Be Near*, AI MAG., Fall 2017, at 58, 58 (questioning whether AI will ever surpass human intelligence).

[152] Jajal, *supra* note 138.

[153] Ron Miller, *Artificial Intelligence Is Not as Smart as You (or Elon Musk) Think*, TECH CRUNCH (July 25, 2017), https://techcrunch.com/2017/07/25/artificial-intelligence-is-not-as-smart-as-you-or-elon-musk-think/ [https://perma.cc/37D4-YJV7] (noting the differences between human intelligence and machine learning, and explaining that AI machines, although exceptional at very narrow tasks, are incompetent at generalized tasks).

to machines that have the ability to learn through exposure to data rather than from conventional programming.[154] Some of the most promising machine learning models employ artificial neural networks.[155] These neural networks involve layers of processors, known as nodes, which are connected together in a manner that is loosely akin to the way in which neurons are connected together in the human brain.[156] Nodes assign values to data signals that they receive from other nodes and decide whether to pass the signals on to the next node.[157] As this process is repeated, the AI machine will draw connections within the data and "learn" based on the similarities and patterns that it finds.[158]

Deep learning, which enables AI to perform some narrowly defined tasks at a superhuman level, utilizes these neural networks across dozens or sometimes hundreds of layers.[159] The term "deep" literally refers to the practice of stacking many neural layers on top of one another to apply machine learning on a large scale.[160] Although partially inspired by the human brain, artificial

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[154] Jef Akst, *A Primer: Artificial Intelligence Versus Neural Networks*, THESCIENTIST (May 1, 2019), https://www.the-scientist.com/magazine-issue/artificial-intelligence-versus-neural-networks-65802 [https://perma.cc/5T9U-Y358].

[155] Bernard Marr, *The Most Amazing Artificial Intelligence Milestones So Far*, FORBES (Dec. 31, 2018), https://www.forbes.com/sites/bernardmarr/2018/12/31/the-most-amazing-artificial-intelligence-milestones-so-far/#13b618217753 [https://perma.cc/M48U-ZB5Z].

[156] Mizuki Hashiguchi, *The Global Artificial Intelligence Revolution Challenges Patent Eligibility Laws*, 13 J. BUS. & TECH. L. 1, 3 (2017); Larry Hardesty, *Explained: Neural Networks*, MIT NEWS (Apr. 14, 2017), http://news.mit.edu/2017/explained-neural-networks-deep-learning-0414 [https://perma.cc/E559-MAC9]. The analogy between neural networks and the human brain is both common and controversial. *See, e.g.*, CHOLLET, *supra* note 151, at 8 (lamenting comparisons between deep learning and the structure of the human brain as "confusing and counterproductive"); Neil Savage, *Marriage of Mind and Machine*, 571 NATURE 15, 16 (2019) (analogizing neural networks to the structure of neurons in the human brain).

[157] Hardesty, *supra* note 156. Nodes make this decision by taking the sum of the values from all incoming connections and, should the sum exceed a threshold number, sending the number along all the node's outgoing connections to other nodes. *Id.* If the sum of the values does not reach the threshold number, then the node will not pass along the signal. *Id.*

[158] *Id.*

[159] CHOLLET, *supra* note 151, at 8; Gary Marcus, Deep Learning: A Critical Appraisal 7 (Jan. 2, 2018) (unpublished manuscript), https://arxiv.org/pdf/1801.00631.pdf [https://perma.cc/79UT-VL6C]; *see* Silver et al., *supra* note 2, at 1140 (stating that modern AI is capable of beating the best humans at chess and Go); Donna Lu, *DeepMind's StarCraft-Playing AI Beats 99.8 Per Cent of Human Gamers*, NEWSCIENTIST (Oct. 30, 2019), https://www.newscientist.com/article/2221840-deepminds-starcraft-playing-ai-beats-99-8-per-cent-of-human-gamers/ [https://perma.cc/2TK9-H4RR] (reporting an AI machine's success in the exceptionally complicated, online strategy game, StarCraft II); Andrew Ng, *What Artificial Intelligence Can and Can't Do Right Now*, HARV. BUS. REV. (Nov. 9, 2016), https://hbr.org/2016/11/what-artificial-intelligence-can-and-cant-do-right-now [https://perma.cc/MK6F-CNW3] ("If a typical person can do a mental task with less than one second of thought, we can probably automate it using AI either now or in the near future."); CARNEGIE MELLON UNIV., *AI Beats Professionals in Six-Player Poker*, SCIENCEDAILY (July 11, 2019), https://www.sciencedaily.com/releases/2019/07/190711141343.htm [https://perma.cc/B7YE-EXNA] (detailing an AI machine's Texas hold'em poker win against six professional players).

[160] CHOLLET, *supra* note 151, at 8.

neural networks function quite different from human thought.[161] Although incredibly adept at digesting large amounts of data, AI machines struggle when faced with tasks that require abstract thinking.[162]

The same state-of-the-art AI machines that can analyze mounds of data infinitely faster than any human are often baffled at their first encounter with abstract tasks that would not stump a toddler, such as identifying types of animals immediately after learning about them for the first time.[163] Humans, though much slower at processing data, make countless abstract generalizations with little effort.[164] Humans also can draw conceptual understanding from limited information, whereas AI machines cannot.[165]

In stark contrast to humans who require little information to generalize, AI machines require large amounts of meticulously screened datasets and the assistance of skilled programmers who can guide the machines as they interact with and learn from the data.[166] For example, consider Watson, IBM's famed AI system that defeated some of the very best human players at *Jeopardy!*.[167] This was no small feat considering the skill of the human participants and the often complicated way questions are posed on the game show.[168] Nevertheless, Watson cannot take what it learned from developing this superhuman trivia ability and apply that information to other cognitive endeavors as a human can.[169] Rather, programmers must input preselected datasets, which train Wat-

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[161] *Id.*

[162] *See* Watson, *supra* note 141, at 422 (finding that deep learning AI machines are "brittle, inefficient, and myopic" in comparison to human cognition). For example, in a recent study, researchers put an AI machine, known as DeepMind, up against a "highly constrained" version of an intelligence quotient test used to measure abstract reasoning in humans. David G.T. Barrett et al., Measuring Abstract Reasoning in Neural Networks 8 (July 11, 2018) (unpublished manuscript), https://arxiv.org/pdf/1807.04225.pdf [https://perma.cc/55G6-BVBW]. Researchers trained DeepMind for the test by teaching it problems similar to those on the test. Adam Santoro et al., *Measuring Abstract Reasoning in Neural Networks*, DEEPMIND (July 11, 2018), https://deepmind.com/blog/article/measuring-abstract-reasoning [https://perma.cc/63RH-QXKC]. DeepMind performed well on the test for problems that utilized the same abstract components as the practice sets, but even small changes between the training problems and the test problems would throw the machine off. *Id.* The study noted that "[e]ven within this constrained domain . . . [AI] performed strikingly poorly when required to extrapolate to inputs beyond their experience, or to deal with entirely unfamiliar attributes." Barrett et al., *supra*, at 8.

[163] Watson, *supra* note 141, at 423; Alison Gopnik, *Will A.I. Ever Be Smarter Than a Four-Year-Old?*, SMITHSONIAN MAG. (Feb. 22, 2019), https://www.smithsonianmag.com/innovation/will-ai-ever-be-smarter-than-four-year-old-180971259/ [https://perma.cc/X55Z-75ZJ].

[164] Gopnik, *supra* note 163.

[165] *Id.*

[166] Tan, *supra* note 142.

[167] Markoff, *supra* note 2.

[168] *Id.*

[169] Ying Chen et al., *IBM Watson: How Cognitive Computing Can Be Applied to Big Data Challenges in Life Sciences Research*, 38 CLINICAL THERAPEUTICS 688, 688, 691 (2016); *see* Kyle Babinowich, *Building the Ultimate Corpus for Watson Knowledge Studio Training*, MEDIUM (Jan. 18, 2018), https://medium.com/with-watson/building-the-ultimate-corpus-for-watson-knowledge-studio-

son to conduct specific tasks.[170] If programmers want to create a version of Watson that aids in medical research, they must first train Watson to recognize patterns and assign varying weights to scientific studies, news reports, opinion pieces, and other relevant documents or datasets.[171] Only *after* programmers have supplied Watson with datasets preselected to teach it to recognize important patterns and carefully curate its responses, can Watson successfully embark on this new task.[172]

Even after programmers have fully trained and integrated AI machines into a specific role, they often perform better when paired with human experts than on their own.[173] For example, one of AI's most promising modern applications is in the field of radiology, wherein AI programs have proven remarkably effective at detecting cancer.[174] In one study, an AI program designed to detect cancer cells in slide images of lymph nodes performed this task with an error rate of 7.5%, whereas a human pathologist had an error rate of 3.5%.[175] With the combination of both human and AI analysis, the error rate plunged to a mere 0.5%.[176] The errors made by human pathologists were usually different from those made by the AI program and vice versa.[177] Thus, the capabilities of the human pathologist and the AI program complemented one another, the strengths of each offsetting the shortcomings of the other.[178] Pairing AI computing and human brainpower has become the prevailing trend in most industries; rather than re-

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training-af6a7f1fc976 [https://perma.cc/XZ9X-SHUJ] (discussing tips to train Watson Knowledge Studio, IBM's AI system, to accomplish new tasks); James Vincent, *AI R&D Is Booming, but General Intelligence Is Still Out of Reach*, THE VERGE (Dec. 12, 2019), https://www.theverge.com/2019/12/12/21010671/ai-index-report-2019-machine-learning-artificial-intelligence-data-progress [https://perma.cc/C937-Z54K] ("With very few exceptions, AI systems trained at one task can't transfer what they've learned to another.").

[170] Chen et al., *supra* note 169, at 688, 691; Babinowich, *supra* note 169.

[171] Babinowich, *supra* note 169. Watson may already aid in medical research and will likely do so more often as programmers improve the AI training process and the datasets they use to train it. Nadine Bakkar et al., *Artificial Intelligence in Neurodegenerative Disease Research: Use of IBM Watson to Identify Additional RNA-Binding Proteins Altered in Amyotrophic Lateral Sclerosis*, 135 ACTA NEUROPATHOLOGICA 227, 243 (2018); Chen et al., *supra* note 169, at 698–99.

[172] Chen et al., *supra* note 169, at 688, 691.

[173] *See e.g.*, Louis Rosenberg et al., *Artificial Swarm Intelligence Employed to Amplify Diagnostic Accuracy in Radiology*, *in* 9TH ANNUAL INFORMATION TECHNOLOGY, ELECTRONICS, AND MOBILE COMMUNICATION CONFERENCE 1186, 1191 (2018), https://11s1ty2quyfy2qbmao3bwxzc-wpengine.netdna-ssl.com/wp-content/uploads/2018/09/ASI-for-Radiology-IEEE-IEMCON-2018.pdf [https://perma.cc/AK2J-9E3Z] (finding that a team of radiologists using a deep learning AI system performed better than both those same radiologists working individually and the AI system operating without any human involvement).

[174] *Id.* at 1186.

[175] Dayong Wang et al., Deep Learning for Identifying Metastatic Breast Cancer 1, 5 (June 18, 2016) (unpublished manuscript), https://arxiv.org/pdf/1606.05718.pdf [https://perma.cc/32LA-2HTX].

[176] *Id.*

[177] *Id.* at 6.

[178] *Id.* at 5–6.

placing humans, AI is typically used to augment human expertise, with both human and machine intelligence working in tandem to solve complex problems.[179]

III. AI AND THE OBVIOUSNESS DOCTRINE: PERCEIVED FLAWS IN THE EXISTING STANDARD AND CURRENT SOLUTIONS

As AI continues to improve, it will likely play a larger role in invention development.[180] AI augments researchers across many industries, contributing at varying levels to the development of patent-worthy inventions.[181] AI's increasing role in developing inventions has led some commentators to worry that existing doctrine will fail to keep up.[182] These commentators are concerned that the current obviousness standard focuses only on the skills that human inventors bring to the table.[183] The data processing, pattern recognition, and other functions that AI systems perform elevate the innovative capabilities

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[179] *See* Thomas Davenport & Ravi Kalakota, *The Potential for Artificial Intelligence in Healthcare*, 6 FUTURE HEALTHCARE J. 94, 97–98 (2019) (examining current and upcoming integrations of AI in the healthcare field, and finding that AI will likely enhance, rather than displace, human healthcare clinicians); Jeannette Paschen et al., *Collaborative Intelligence: How Human and Artificial Intelligence Create Value Along the B2B Sales Funnel*, 63 BUS. HORIZONS 1, 10 (2020) (finding that "AI will enhance, not replace" salespeople and stating that "humans still hold an upper hand in using intuition to deal with contradictory or uncertain information and to derive insights and implications"); Brian Whitworth & Hokyoung Ryu, *A Comparison of Human and Computer Information Processing*, *in* ENCYCLOPEDIA OF MULTIMEDIA TECHNOLOGY AND NETWORKING 230, 237–38 (Info. Sci. Reference, 2d ed. 2009) (stating that "the future of computers may lie not in replacing people but in becoming more human compatible," and listing a number of recent innovations that utilize human and computer collaboration); Ken Goldberg, *The Robot-Human Alliance*, WALL ST. J. (June 11, 2017), https://www.wsj.com/articles/the-robot-human-alliance-1497213576 [https://perma.cc/K7RC-9UNH] (describing how human and machine collaboration enables many innovative systems, such as Google's search engine and Netflix's video recommendation software); H. James Wilson & Paul R. Daugherty, *Collaborative Intelligence: Humans and AI Are Joining Forces*, HARV. BUS. REV. (2018), https://hbr.org/2018/07/collaborative-intelligence-humans-and-ai-are-joining-forces [https://perma.cc/GF6U-MREM] (researching AI implementation across fifteen hundred companies and finding that companies achieved greater improvements in efficiency when AI augmented, rather than replaced, human workers).

[180] Iain M. Cockburn et al., *The Impact of Artificial Intelligence on Innovation*, *in* THE ECONOMICS OF ARTIFICIAL INTELLIGENCE: AN AGENDA 2 (Ajay K. Agrawal et al. eds., 2019); *see* Edd Gent, *Why AI Won't Replace Human Inventors*, RACONTEUR (Dec. 9, 2019), https://www.raconteur.net/business-innovation/innovation-automation [https://perma.cc/JDQ3-SUGH] (discussing the increasing role that AI may play in developing new technologies as researchers leverage its ability to track patterns across data to identify new solutions).

[181] Hattenbach & Glucoft, *supra* note 8, at 35.

[182] PLOTKIN, *supra* note 9, at 105–07; Abbott, *supra* note 28, at 5.

[183] PLOTKIN, *supra* note 9, at 105–07; Abbott, *supra* note 28, at 35.

of workers who use them.[184] Thus, as the use of AI becomes standardized within an industry, the inventive capability of the average worker will increase.[185]

Commentators worry that the current obviousness doctrine fails to understand how AI technology influences the modern inventive process.[186] If true, this perceived blind spot in the doctrine would fail to equip the PHOSITA with the AI machines used by average workers in the field.[187] Impairing the PHOSITA's skill level in this way would result in the PHOSITA finding fewer inventions obvious.[188] Thus, inventions evaluated according to such a weakened PHOSITA would pass the obviousness test more easily and obtain patents that an appropriately calibrated PHOSITA standard would have disallowed.[189]

Section A of this Part discusses concerns regarding existing doctrine as applied to AI inventing.[190] Section B details recent proposals aimed at addressing these perceived doctrinal deficiencies.[191]

A. Perceived Insufficiencies in the Current Obviousness Doctrine

Some scholars worry that as AI technology becomes increasingly widespread, existing doctrine will fail to keep pace.[192] One criticism alleges that the

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[184] Hattenbach & Glucoft, *supra* note 8, at 35; Susan Y. Tull & Paula E. Miller, *Patenting Artificial Intelligence: Issues of Obviousness, Inventorship, and Patent Eligibility*, *in* 1 J. ROBOTICS, A.I. & L. 313, 320 (2018).

[185] Tull & Miller, *supra* note 184, at 320; Ana Ramalho, *Patentability of AI-Generated Inventions: Is a Reform of the Patent System Needed?*, INST. INTELL. PROP., FOUND. FOR INTELL. PROP. JAPAN 25 (2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3168703 [https://perma.cc/W3HL-MS6M].

[186] PLOTKIN, *supra* note 9, at 105–07; Abbott, *supra* note 28, at 35.

[187] Erica Fraser, *Computers as Inventors—Legal and Policy Implications of Artificial Intelligence on Patent Law*, 13 SCRIPTED 305, 321 (2016).

[188] KAY FIRTH-BUTTERFIELD & YOON CHAE, WORLD ECON. F., ARTIFICIAL INTELLIGENCE COLLIDES WITH PATENT LAW 12 (2018), http://www3.weforum.org/docs/WEF_48540_WP_End_of_Innovation_Protecting_Patent_Law.pdf [https://perma.cc/U37D-QK3Y].

[189] PLOTKIN, *supra* note 9, at 107; Abbott, *supra* note 28, at 5.

[190] *See infra* Part III.A.

[191] *See infra* Part III.B.

[192] *See* PLOTKIN, *supra* note 9, at 107 (finding the current application of the obviousness doctrine lacking in the face of machine inventiveness); Abbott, *supra* note 28, at 51–52 (asserting that patent law needs to be proactive in responding to AI technology, given that current doctrines are ill-suited for upcoming changes); Ravid & Liu, *supra* note 6, at 2252–53 (arguing that patent incentives are inapposite to AI inventions); Hattenbach & Glucoft, *supra* note 8, at 36–51 (discussing issues related to the patentability of AI inventions, including who should be named as the inventor and when computer-generated material should invalidate prior art). As previously mentioned, a threshold issue of current debate is whether creations performed autonomously by AI machines are eligible for patent protection. *Compare* Abbott, *supra* note 8, at 1103–04 (arguing that allowing AI machines to be inventors would encourage innovation by incentivizing the further development of inventive machines), *and* Hattenbach & Glucoft, *supra* note 8, at 50 (same), *with* Clifford, *supra* note 15, at 1702–03 (asserting that, unless AI machines achieve a level of consciousness such that they might respond to intellectual property incentives, their works should not qualify for protection), *and* Samuelson, *supra* note 28, at 1199–1200 (asserting that machines should not receive intellectual property protections because they

current obviousness analysis fails to consider adequately the role that AI plays in inventing.[193] This school of thought contends that inventions created using AI possess an unfair advantage because current law does not "explicitly" scrutinize the tools being used by workers in the field.[194]

For example, suppose that AI is responsible for the bulk of the work in developing an invention.[195] Because there is no requirement to report the use of AI, human inventors may simply file a patent on the invention and enjoy the benefits, even though the AI machine was the real source of ingenuity.[196] If the obviousness inquiry does not account for AI's role within an industry, then courts will not apply an appropriately elevated PHOSITA standard to the invention.[197] Thus, a court may find the invention nonobvious, even when the human inventor has exercised only ordinary skill.[198] This would result in too low an obviousness standard, as patents would issue on inventions that the average skilled worker could have created using ordinary skill and applying standard tools of the trade.[199] Furthermore, such a standard could lead to a slew of undeserved patents that would limit future research and impose heavy burdens on society.[200]

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do not need to be incentivized to create). Regardless of whether AI machines may be inventors, real workers will increasingly use AI. *See* NARRATIVE SCIENCE, OUTLOOK ON ARTIFICIAL INTELLIGENCE IN THE ENTERPRISE 3 (2019), https://narrativescience.com/wp-content/uploads/2019/02/Research-Report_Outlook-on-AI-for-the-Enterprise.pdf [https://perma.cc/ZT7X-BVHG] (surveying 196 business and technology executives and reporting that AI implementation across multiple industries had increased from 38% in 2017 to 61% in 2018). To put it another way, those results amount to a 60% increase in AI implementation within the span of one year. *Id.*; *see* Spyros Makridakis, *The Forthcoming Artificial Intelligence (AI) Revolution: Its Impact on Society and Firms*, 90 FUTURES 46, 58 (2017) (stating that AI technology has the potential to surpass "both the Industrial and digital revolutions put together" in how it transforms society and "affect[s] practically all tasks currently performed by humans").

[193] PLOTKIN, *supra* note 9, at 105–07; Abbott, *supra* note 28, at 35.

[194] *See* PLOTKIN, *supra* note 9, at 102 (stating that existing patent law "does not explicitly take into account the introduction of improved invention augmentation technology"); Abbott, *supra* note 28, at 6 (advocating for changes to existing doctrine that would "more explicitly take into account the fact that machines are already augmenting the capabilities of workers").

[195] *See* PLOTKIN, *supra* note 9, at 103–05 (providing a hypothetical in which a commonly available AI program invents a new automobile frame while the future patent applicant enjoys a bag of popcorn in front of the television).

[196] *See* Daryl Lim, *AI & IP: Innovation & Creativity in an Age of Accelerated Change*, 52 AKRON L. REV. 813, 861 (2018) (stating that patent applicants are not required to disclose the use of AI in developing an invention); Ramalho, *supra* note 185, at 25 (same).

[197] *See* Liza Vertinsky, *Thinking Machines and Patent Law*, *in* 18 RESEARCH HANDBOOK ON THE LAW OF ARTIFICIAL INTELLIGENCE 489, 503 (Woodrow Barfield & Ugo Pagallo eds., 2018) (noting that some inventions "may simply be the result of massive computational power that allows for rapid trial and error searching . . . while from the perspective of the PHOSITA without the aid of thinking machines the results produced may be surprising").

[198] PLOTKIN, *supra* note 9, at 105–07.

[199] *Id.*; Abbott, *supra* note 28, at 34.

[200] PLOTKIN, *supra* note 9, at 107.

B. Proposals to Modify Existing Doctrine to Emphasize the Role of AI in Developing Inventions

One proposal to modify the obviousness doctrine to ensure that it adapts to the use of AI technology is to require patent applicants to disclose when AI has contributed to a claimed invention.[201] Currently, patent applicants are not required to disclose what technology they used to develop an invention.[202] Proponents suggest that, when applying for a patent, inventors should be required to disclose the extent to which AI aided in the development of an invention.[203] Over time, patent offices could gauge how significantly AI has contributed to the inventive process within a field by analyzing these disclosures.[204] The obviousness test could then use this information to determine whether the use of AI is pervasive throughout an industry, such that a PHOSITA would have access to it.[205]

A second proposal, advanced by at least one commentator, suggests that the PHOSITA standard eventually should be replaced by an "inventive machine standard."[206] An "inventive machine," under this theory, is an AI machine that is capable of inventing without human involvement, such that "were [it] a natural person, it would qualify as a patent inventor."[207] According to this commentator, multiple existing AI programs are capable of autonomous invention, and thus qualify as "inventive machines."[208] This commentator contends that once these AI machines become the standard method for developing inventions within a field, the PHOSITA should be replaced by the average in-

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[201] *See id.* at 105–06 (discussing the shortcomings of existing doctrine and noting that patent applicants are not required to disclose their use of AI); Abbott, *supra* note 28, at 6 (arguing that patent offices should require patent applicants to disclose the use of AI in developing a claimed invention); Lim, *supra* note 196, at 861 ("It may be better for AI to be identified in a patent application as long as AI is used."); Ramalho, *supra* note 185, at 25–26 (stating that a problem with the current patent system is that applicants are not required to disclose the use of AI).

[202] *See* 35 U.S.C. § 112(a) (requiring that inventors disclose how to make and use the claimed invention, but not requiring inventors to disclose how they discovered the invention).

[203] Abbott, *supra* note 28, at 6; Ramalho, *supra* note 185, at 25–26.

[204] Abbott, *supra* note 28, at 6.

[205] *Id.*

[206] *Id.* at 37; *see also* Tull & Miller, *supra* note 184, at 320 (hypothesizing that as technology continues to improve "AI may become the 'person' of skill in the art"); Vertinsky, *supra* note 197, at 502 (suggesting that the existence of modern "thinking machines" may necessitate changing patent law's PHOSITA to "some kind of machine/person combination or 'M/PHOSITA'"). The "inventive machine standard" comes from Professor Ryan Abbott, who is easily one of the most prolific proponents of what he and others see as a pressing need to update existing patent laws to keep up with modern AI. *See Results of Ryan Abbott*, GOOGLE SCHOLAR, https://scholar.google.com/citations?user=ErytXL0AAAAJ&hl=en [https://perma.cc/CK22-HG5J] (listing a number of Professor Abbott's publications, many of which warn that current rules and regulations are failing to keep up with AI's rapid evolution).

[207] Abbott, *supra* note 28, at 4.

[208] *Id.*

ventive machine within the industry.[209] Therefore, this proposal attempts to calibrate the obviousness doctrine according to actual industry practice by highlighting that the AI machine is doing the inventing, rather than the human.[210]

These proposals attempt to raise the obviousness standard, as it relates to AI inventions, in order to address a perceived failure of the doctrine to account for the use of AI in developing inventions.[211]

IV. The Modern Test for Obviousness Is Equipped to Address the Increasing Role That AI Machines Play in Developing Inventions

The current obviousness doctrine is appropriately calibrated to address the expanding role that AI plays in inventing.[212] Requiring patent applicants to disclose the use of AI technology could lead courts to conceptualize the PHOSITA according to the skill exhibited by the invention at issue, rather than according to the average level of skill in the field.[213] Like the Federal Circuit's past reliance on the "education level of the inventor," this modification could erroneously equip the PHOSITA with the AI capabilities employed by the inventor, rather than by average workers in the field.[214] This would result in too high of an obviousness standard for many inventions created with the aid of AI.[215] In contrast, replacing the PHOSITA with an "inventive machine" standard could, rather than raising the obviousness standard in line with the use of AI, lower the obviousness standard by failing to account for human contribution in inventing.[216]

Section A of this Part avers that existing doctrine will reach the correct result as applied to AI inventions.[217] Section B further argues that requiring patent applicants to disclose the use of AI could confuse the obviousness analysis and lead to erroneous results.[218] Finally, Section C contends that replacing the PHOSITA with an inventive machine could result in too low an obviousness standard.[219]

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[209] *Id.* at 37.
[210] *Id.* at 6.
[211] Plotkin, *supra* note 9, at 105–07; Abbott, *supra* note 28, at 6.
[212] *See infra* Part IV.
[213] *See infra* Part IV.B.
[214] *See infra* Part IV.B.
[215] *See infra* Part IV.B.
[216] *See infra* Part IV.C.
[217] *See infra* Part IV.A.
[218] *See infra* Part IV.B.
[219] *See infra* Part IV.C.

A. The Current Obviousness Doctrine Will Reach the Correct Results for Inventions Created Using AI Technology

The thrust of the modern obviousness analysis focuses not on the inventor, but rather on the invention itself.[220] The test hinges on whether a claimed invention presents a significant advancement over prior art.[221] Therefore, the mere fact that an invention is created in part or entirely by an AI machine does not render it obvious under current doctrine.[222] Section 103 of the Leahy-Smith AIA explicitly reaffirmed that the "manner in which [an] invention was made" will not support an obviousness determination.[223] With or without the use of AI technology, the determination comes down to whether an average worker, with knowledge of all relevant, preexisting technology would find the claimed invention obvious.[224]

For example, an invention created by a team of researchers over the course of five years is not necessarily any less obvious than if it had been created by one researcher in a few days using an AI machine.[225] Suppose that, in the above example, researchers in the inventor's field widely use AI technology and that the researcher using the AI is a worker of ordinary skill.[226] The researchers who labored away for five years should not receive a patent for something that would have been obvious within a few days had they applied the tools commonly used in the industry.[227] Far from incentivizing innovation,

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[220] *See* Burgess, *supra* note 77, at 74 (reasoning that the scope of analogous art should not be determined based upon what the actual inventor considered, but instead upon what a PHOSITA would find pertinent to solving the problem); Gingo, *supra* note 106, at 98–99 (arguing that courts should not consider "the inventor's level of skill" when identifying the PHOSITA because the PHOSITA is meant to represent the skill of an *average* practitioner, rather than that of the *actual* inventor); Meara, *supra* note 96, at 279–80 (stating that consideration of the skill level of the actual inventor "has proven to be problematic" because it blurs the line between the *actual* inventor and the *average* practitioner represented by the PHOSITA).

[221] 35 U.S.C. § 103.

[222] *See* William Samore, *Artificial Intelligence and the Patent System: Can a New Tool Render a Once Patentable Idea Obvious?*, 29 SYRACUSE J. SCI. & TECH. L. 113, 130 (2013) (applying existing obviousness doctrine to an AI-created invention and concluding that the invention would be nonobvious so long as the PHOSITA did not have access to the same AI technology as the inventor).

[223] 35 U.S.C. § 103.

[224] *Id.*

[225] *See* PLOTKIN, *supra* note 9, at 104–05 (reasoning that once AI technology is common within a field inventors who fail to make use of the technology, these inventors will then be held to the same standard as if they had used AI).

[226] *See supra* note 225 and accompanying text (framing a hypothetical scenario, which illustrates that obviousness is not about how long or how many people work to create a given invention, but rather how much the invention advances the field of study).

[227] *See KSR*, 550 U.S. at 427 (stating that as new technologies become publicly available, they will set a new obviousness standard which future inventions must overcome); Olson, *supra* note 36, at 183 (reasoning that the goal of patents is to promote innovation).

allowing a patent in such a situation would reward the researchers for failing to stay up-to-date on the standard technology used in the field.[228]

In contrast, suppose that someone creates a superior AI machine or finds a way to incorporate AI in the inventive process better than their peers, which in turn results in an invention.[229] In this instance, the inventor has created a nonobvious invention and the fact that, in order to do so, the inventor ended up creating a better tool should not defeat his or her right to a patent.[230] The obviousness test, laid out by the Supreme Court, in 2006, in *KSR International Co. v. Teleflex Inc.*, arrives at the correct result for either situation by expanding the scope of prior art according to the standard technologies in the industry and endowing the PHOSITA with the ordinary skill and creativity that would lead the PHOSITA to use such technology.[231]

The analogous art test limits the scope of prior art to preexisting technologies within the "field of the endeavor" and to those technologies that are reasonably pertinent to the problem solved by the invention.[232] This test recognizes the ingenuity of those who examine technology from one sphere of study and apply it to something completely different.[233] At some point, the ability to draw inspiration from prior art in one practice area and apply it to solve a problem in a completely different area is nonobvious.[234] Arguably, AI is best suited to enhancing human capabilities in this particular area of invention.[235] Unlike human inventors who sometimes have mental barriers and preconceptions that inhibit looking for inspiration far-afield, AI machines do not have such hang-

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[228] *See KSR*, 550 U.S. at 427 (stating that once technological advances become part of society's shared knowledge, they "define a new threshold from which innovation starts once more"); PLOTKIN, *supra* note 9, at 104–05 (reasoning that, once AI is commonly used within a field, inventors who fail to use AI should not receive patents for inventions that would have been obvious had they used such technology).

[229] *See* PLOTKIN, *supra* note 9, at 51–61 (crediting AI with inventing the Oral-B Cross Action toothbrush, a new controller, a specialized antenna for use in space, and other novel inventions).

[230] *See* Hattenbach & Glucoft, *supra* note 8, at 50 (arguing that it is costly to develop AI and use it to generate inventions). The use of AI in inventing will "accelerate inventive activity, and that acceleration is, in and of itself, the type of innovation that society should desire to—and already does—reward with patents." *Id.* (footnotes omitted).

[231] *KSR*, 550 U.S. at 418–19; *see infra* notes 232–243 and accompanying text (explaining how the widespread use of AI could expand the scope of the prior art under the analogous arts doctrine and raise the PHOSITA's skill level).

[232] *In re* Deminski, 796 F.2d 436, 442 (Fed. Cir. 1986).

[233] Potts v. Creager, 155 U.S. 597, 607–08 (1895).

[234] *Id.*

[235] *See* Abbott, *supra* note 28, at 37 (stating that AI is capable of sifting through enormous amounts of data on its way to finding a solution); Lim, *supra* note 196, at 863 (stating that AI can "thread non-analogous art and is unfettered by biases due to prior failures"); *see also* Hattenbach & Glucoft, *supra* note 8, at 35 (describing an instance in which an AI machine employs its superior computing power to literally "brute-force" creative content).

ups.[236] Rather, AI machines simply look for patterns within preexisting technology by assigning values to the data signals they receive.[237] Not only will AI better equip humans to look beyond the blurry lines separating one field from the next, but it has the computing power to sift through an endless array of data for a solution to a problem.[238]

In 1966, in *Graham v. John Deere Co.*, the Supreme Court imposed upon inventors the heightened burden of showing nonobviousness against the wider scope of prior art incorporated by new technologies.[239] As a result, once AI is common in a given industry, inventors will have to meet the heightened burden of showing nonobviousness based on what a PHOSITA aided by AI—as well as any other widely available technology—would find reasonably pertinent to the problem solved by the invention.[240] Further, in *KSR*, in 2007, the Supreme Court endowed the PHOSITA with the "inferences and creative steps" that an ordinary worker would exhibit.[241] Such a PHOSITA would take advantage of the relevant

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[236] *See* James Vincent, *DeepMind's Go-Playing AI Doesn't Need Human Help to Beat Us Anymore*, THE VERGE (Oct. 18, 2017), https://www.theverge.com/2017/10/18/16495548/deepmind-ai-go-alphago-zero-self-taught [https://perma.cc/4V5U-QKWL] ("By not using human data . . . we've actually removed the constraints of human knowledge . . . . It's therefore able to create knowledge itself from first principles; from a blank slate [. . . .] This enables it to be much more powerful than previous versions.") (quoting the lead programmer of AlphaGo Zero).

[237] Chandu Siva, *Machine Learning and Pattern Recognition*, DZONE (Nov. 30, 2018), https://dzone.com/articles/machine-learning-and-pattern-recognition [https://perma.cc/3HFG-SYTC].

[238] Hattenbach & Glucoft, *supra* note 8, at 35–36; Ramalho, *supra* note 185, at 24.

[239] *See* 383 U.S. 1, 19 (1966) ("[T]he ambit of applicable art in given fields of science has widened by disciplines unheard of a half century ago. It is but an evenhanded application to require that those persons granted the benefit of a patent monopoly be charged with an awareness of these changed conditions."). In *Graham*, the Supreme Court consolidated three cases and invalidated two patents on obviousness grounds. *Id.* at 25–26, 37. The first patent concerned a plow shank that improved prior art by moving the hinge plate (part of the apparatus that attached individual shanks to the plow frame) from below the plow shank, to above it. *Id.* at 24–25. This change allowed for greater flexion and decreased the tendency of the shank to break when it encountered an obstruction. *Id.* The Court invalidated the patent, holding that a PHOSITA attempting to allow for greater flexion in the plow shank would find the patentee's solution obvious. *Id.* The other patent at issue in *Graham* involved a bottle-cap for dispensing insecticides. *Id.* at 27. Although a prior art reference had made use of the same type of device, the patentee claimed that it was not pertinent to the pump sprayers used in the insecticide industry because it concerned pouring spouts. *Id.* at 35. The Court rejected this characterization, holding that "[c]losure devices in such a closely related art as pouring spouts for liquid containers are at the very least pertinent references." *Id.*

[240] *See id.* at 19 (holding that the scope of the prior art expands in line with the capabilities of modern technologies).

[241] 550 U.S. 398, 418 (2007). In *KSR*, the Supreme Court invalidated a patent on an "adjustable pedal" with an electronic sensor that allowed a computer to adjust the air and fuel supplied to the engine. *Id.* at 422. The Court detailed prior art, describing each individual step of the patented design, which the inventor had combined to form the claimed invention. *Id.* at 408–10. The prior art disclosed methods of allowing adjustment of the accelerator pedal so that drivers of various heights could reach it without sitting too close to the steering wheel, instructed that electronic sensors perform better when placed on the pedal apparatus than when placed within the engine, dictated that sensors should be placed on fixed portions of the pedal apparatus at pivot points such that the sensor could detect pedal movements, and provided for interchangeable "modular sensors" that could be used for various vehi-

technologies employed in the industry to solve routine problems.[242] Thus, current doctrine accommodates the increasing role that AI plays in inventing by expanding the scope of prior art to include tools that a PHOSITA would have access to and by endowing the PHOSITA with the good sense to use them.[243]

B. Requiring Patent Applicants to Disclose the Use of AI Would Confuse the Obviousness Analysis

Some scholars have suggested that patent offices should require applicants to disclose the extent to which they used AI to develop a claimed invention.[244] This requirement stems from a perceived inability of the current doctrine to recognize the role that AI plays in creating inventions.[245] If obviousness does not take into account the use of AI, then the PHOSITA will not use AI when evaluating an invention even when the technology is widely used within the field.[246] This would result in too low an obviousness standard for inventions in industries in which the use of AI is pervasive.[247]

Requiring inventors to disclose the extent to which AI aided in the development of an invention has the potential to confuse the analysis, so as to hold inventions created using AI to a higher standard than those created without it.[248] Similar to the Federal Circuit's retreat from relying heavily on the education level of the actual inventor as a factor for determining PHOSITA, patent offices and courts should not focus on the abilities of the individual AI system employed during an invention's development.[249] Sound obviousness analysis

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cles. *Id.* The patentee's improvement combined these teachings by placing an electronic sensor on a "fixed pivot point" of the adjustable pedal apparatus. *Id.* at 411. The Court invalidated the patent on obviousness grounds, noting that the "marketplace . . . created a strong incentive to convert mechanical pedals to electronic pedals, and the prior art taught a number of methods for achieving this advance." *Id.* at 424. The Court held that the claimed invention would have been obvious to a PHOSITA of "ordinary skill" and "ordinary creativity." *Id.* at 421–22.

[242] *Id.* at 418.

[243] *See id.* (stating that courts will look to the creative reasoning that ordinary skilled works would exhibit); *Graham*, 383 U.S. at 19 (holding that the scope of relevant prior art expands in relation to modern technological methods).

[244] PLOTKIN, *supra* note 9, at 105–07 (stating that current patent law does not require inventors to disclose the use of AI in developing an invention, and reasoning that this enables the modern patent applicant to acquire a patent on inventions created using ordinary skill); Abbott, *supra* note 28, at 6 (stating that patent offices should require applicants to report the use of AI in developing claimed inventions).

[245] PLOTKIN, *supra* note 9, at 105–07; Abbott, *supra* note 28, at 5–6.

[246] PLOTKIN, *supra* note 9, at 105–07.

[247] *Id.*

[248] *See supra* notes 249–260 and accompanying text (arguing that requiring inventors to disclose the use of AI could lead courts to apply an inappropriately elevated obviousness standard to inventions created by or with the assistance of AI).

[249] *See In re* Coutts, 726 F. App'x 791, 796 (Fed. Cir. 2018) (finding that the education level of the actual inventor is only useful if it is especially indicative of the average level within the field, and

requires an important distinction between the capabilities of the actual inventor as compared to those of the average skilled worker in the field.[250] The inquiry should not focus on the abilities of the actual AI involved in creating the claimed invention, but rather on the standard within the industry.[251] Past cases have shown that focusing too closely on the expertise of the inventor as a factor for determining PHOSITA can confound the doctrine and lead courts to conceptualize the PHOSITA based on the actual inventor's education level rather than that possessed by average workers in the field.[252] Requiring applicants to disclose the use of AI in an invention likely will repeat these same mistakes.[253]

As inventors increasingly use AI, patent offices and courts must determine whether the use of AI is widespread in the industry from which a given invention arises.[254] If it is sufficiently widespread, officials must determine the capabilities of the average AI system.[255] In conducting these inquiries, the fact that an applicant reported the use of AI could lead patent offices and courts to attribute the same capabilities to the PHOSITA, despite average workers in the field not having such capabilities.[256] Misconstruing the PHOSITA's skill level in this way would frustrate the objective inquiry required by § 103 and defy the statute's explicit prohibition against rendering an invention obvious based on how it was created.[257]

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reaffirming that the PHOSITA is an objective representation of the ordinary worker rather than the actual inventor).

[250] *See* Mandel, *supra* note 56, at 123 ("[S]ociety's interest is in the objective likelihood of someone else solving the problem, not whether the invention was obvious to the inventor subjectively.").

[251] *See* Kimberly-Clark Corp. v. Johnson & Johnson & Pers. Prods. Co., 745 F.2d 1437, 1454 (Fed. Cir. 1984) (stating that courts look to the capabilities of the average skilled worker within the industry, rather than the means employed by the actual inventor).

[252] *See* Gingo, *supra* note 106, at 90–92 (cataloging Federal Circuit cases that oscillate between relying on the educational level of the inventor as a factor for identifying the PHOSITA, omitting it as a factor, or explicitly disregarding it); Mandel, *supra* note 56, at 73 (noting that courts frequently determine the PHOSITA's skill level based on the skill of the actual inventor, and arguing that such practice "displays a remarkable hindsight bias" and "transforms a supposedly objective standard into a more subjective analysis based on the inventor's particular education and training").

[253] *See* Douglas Y'Barbo, *Is Extrinsic Evidence Ever Necessary to Resolve Claim Construction Disputes?*, 81 J. PAT. & TRADEMARK OFF. SOC'Y 567, 605 (1999) ("[T]he actual inventor's skill is irrelevant because it does not represent a person of ordinary skill is of course, bedrock patent law.").

[254] KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 418 (2007); Samore, *supra* note 222, at 130.

[255] *KSR*, 550 U.S. at 418; Samore, *supra* note 222, at 130.

[256] *See* Standard Oil Co. v. Am. Cyanamid Co., 774 F.2d 448, 454 (Fed. Cir. 1985) (stating that the lower court relied on "all-too-often misconstrued and now obsolete principles of the obviousness inquiry" when it focused on the actual inventor's level of skill, rather than the standard level of skill in the field).

[257] 35 U.S.C. § 103; *see* Gingo, *supra* note 106, at 95 (arguing that focusing too closely on the skill level of the actual inventor cuts against both the first sentence of § 103, which requires an objective inquiry based on what a PHOSITA would find obvious, and the second sentence, which provides that obviousness should not depend on the method of invention).

Patents should encourage the development of improved AI machines.[258] An obviousness test that looks to the capabilities of the AI employed by the actual inventor, rather than the capabilities of the average skilled worker, would negate this incentive.[259] An invention created using superior AI, for which the inventor likely incurred significant costs to develop or acquire it, would face a higher bar for showing nonobviousness than inventors who used standard AI or no AI technology at all.[260]

C. The PHOSITA Should Not Be Replaced By an Inventive Machine

At least one commentator has suggested that once AI becomes the standard means of solving problems within a field, the PHOSITA should be replaced with an "inventive machine."[261] Perhaps if General AI ever comes to fruition, a paradigm shift from a PHOSITA to a machine of ordinary capabilities may be justified.[262] If AI continues to fall into the category of Narrow AI, however, AI machines should be thought of as tools employed by a PHOSITA.[263] This is not to say that Narrow AI machines could never develop nonobvious inventions with minimal human involvement—in fact, reports indicate that some AI machines, such as the DABUS, may have developed inventions on their own.[264]

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[258] *See* Hattenbach & Glucoft, *supra* note 8, at 50 (arguing that allowing patents on claims generated by or with the aid of AI machines will incentivize further AI development).

[259] *See* Yelderman, *supra* note 49, at 1224–26 (explaining that properly formulated patentability requirements indicate to the market that the patent system will protect deserving inventions, thereby incentivizing innovation).

[260] *See* Mandel, *supra* note 56, at 73 (stating that the actual inventor's level of skill often determines the level of skill of the PHOSITA, even though this is in direct contrast with the purpose of the PHOSITA standard).

[261] *See* Abbott, *supra* note 28, at 37 ("[T]he skilled person should be an inventive machine when the standard approach to research in a field or with respect to a particular problem is to use an inventive machine . . . ."); *see also* Tull & Miller, *supra* note 184, at 320 ("At some point, AI may become the 'person' of skill in the art, possessing actual knowledge of all known publications, patents, and prior art, transforming the hypothetical construct into reality."); Vertinsky, *supra* note 197, at 502 ("With thinking machines in the equation, however, policymakers might have to consider whether the PHOSITA should be modified to include thinking machines—perhaps some kind of machine/person combination or 'M/PHOSITA.'").

[262] *See* Nick Heath, *What Is Artificial General Intelligence?*, ZDNET (Aug. 22, 2018), https://www.zdnet.com/article/what-is-artificial-general-intelligence/ [https://perma.cc/VDP8-3NFY] (stating that General AI could do all the things that humans can do, while also possessing the type of command over data that defines existing computers' greatest strengths).

[263] *See* Edd Gent, *Why AI Won't Replace Human Inventors*, RACONTEUR (Dec. 9, 2019), https://www.raconteur.net/technology/artificial-intelligence/innovation-automation/ [https://perma.cc/5TQW-9NPG] (stating that "AI and humans have complimentary skills," and reporting that AI is more likely to enhance rather than replace human innovators); *see also* Watson, *supra* note 141, at 422–24 (alleging that, against certain obstacles such as limited or flawed data, AI machines are "brittle, inefficient, and myopic" compared to the brains of humans (emphasis omitted)).

[264] Angela Chen, *Can an AI Be an Inventor? Not Yet.*, MIT TECH. REV. (Jan. 8, 2020), https://www.technologyreview.com/s/615020/ai-inventor-patent-dabus-intellectual-property-uk-european-patent-office-law/ [https://perma.cc/L27J-C2HM].

Rather it is important because prematurely removing the "person" from the PHOSITA standard could result in some of the same problems as the Federal Circuit's rigid application of the TSM test.[265] Under the TSM test, courts looked only to explicit TSMs within the prior art to support an obviousness determination.[266] Similarly, replacing the "person" in PHOSITA with an "inventive machine" would require courts to look only to the sorts of data that the average AI machine would comprehend.[267] This standard would disregard the important role that humans often play in designing and directing AI machines, and interpreting the data that they produce.[268] AI is unlikely to displace humans altogether because humans and AI operate very differently.[269] For many inventions, humans and machines work in tandem to solve problems.[270] If patterns of past innovation hold true, the role of humans in the development of inventions will simply shift.[271] AI will automate many of the calculations and repetitive testing that human inventors have had to perform in the past.[272] This will free human inventors to focus their abilities on the more generalized tasks, where human intelligence outshines AI.[273] Simply stated, humans likely will continue to play a role in developing inventions even if that role takes on a different form.[274]

As the *KSR* Court noted, design preferences, market trends, and other incentives can prompt a PHOSITA to find a solution that it otherwise might not have found.[275] Applying this to the use of AI technology in developing new

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[265] *See* KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 415 (2007) (rejecting the Federal Circuit's rigid application of the TSM test and, instead, requiring that courts apply a flexible approach, which takes into account "common knowledge and common sense" (quoting Dystar Textilfarben GmbH v. C.H. Patrick Co., 464 F.3d 1356, 1367 (Fed. Cir. 2006))).

[266] ACS Hosp. Sys. v. Montefiore Hosp., 732 F.2d 1572, 1577 (Fed. Cir. 1984).

[267] *See KSR*, 550 U.S. at 419 (stating that obviousness "cannot be confined by a formalistic conception of the words teaching, suggestion, and motivation, or by overemphasis on the importance of published articles and the explicit content of issued patents"); Eisenberg, *supra* note 109, at 897 (reasoning that a PHOSITA "bring[s] more to a problem than may be found in written prior art, including training, judgment, intuition, and tacit knowledge acquired through field experience").

[268] *See* Eisenberg, *supra* note 109, at 897 ("Scientific and technological work involve the application of craft skills that are familiar to practitioners but defy explicit articulation.").

[269] *See infra* notes 159–179 and accompanying text (discussing important differences between human intelligence and AI); *see also* Watson, *supra* note 141, at 435 (discussing ethical issues surrounding modern AI models, and arguing that equating human and machine intelligence is "misleading and potentially dangerous").

[270] Gent, *supra* note 263.

[271] *See* Erik Brynjolfsson et al., *What Can Machines Learn and What Does It Mean for Occupations and the Economy?*, 108 AEA PAPERS & PROC. 43, 44, 47 (2018) (stating that although AI could revolutionize a number of jobs, "full automation will be less significant than the reengineering of processes and the reorganization of tasks").

[272] Wilson & Daugherty, *supra* note 179.

[273] Dickson, *supra* note 140.

[274] Brynjolfsson et al., *supra* note 271, at 46–47.

[275] 550 U.S. 398, 417 (2007).

inventions, one can imagine instances in which a skilled human would be more in-tune to these trends and other abstract understandings than an AI machine.[276] Although AI machines can absorb infinitely more data than humans, the generalized happenings within a market or industry that might steer a modern human inventor toward a new discovery would likely allude even the most sophisticated AI system in many instances.[277] As AI continues to improve, there may be some instances in which having a skilled machine standard might not result in a different outcome than a PHOSITA *using* AI standard.[278] But there likely would be many other instances in which the abstract, big picture intuition of a skilled human worker would find an invention obvious where the AI machine alone would not.[279]

Patent protection is meant only for those inventions that exhibit a significant advancement over prior art.[280] If the only thing inhibiting an obviousness determination for a particular invention is that the standard AI machine within an industry cannot extrapolate the abstract principles that a human of ordinary skill and creativity would have, then the invention is not a significant advancement.[281] Thus, in fields in which the use of AI machines in developing new inventions becomes commonplace, the test should look to what a PHOSITA *using* AI technology would find obvious rather than attempting to replace the PHOSITA with an "inventive machine."[282]

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[276] *See* Marcus, *supra* note 159, at 7 ("[H]umans are far more efficient in learning complex rules than deep learning systems are . . . ." (citations omitted)).

[277] *See id.* at 7–9 (stating that AI can often provide accurate answers for well-defined problems if given sufficient high quality data, but "[i]n problems where data are limited, deep learning often is not an ideal solution").

[278] PLOTKIN, *supra* note 9, at 51–61 (discussing various inventions that AI reportedly created with little to no human involvement).

[279] *See* NAT'L SCI. & TECH. COUNCIL, EXEC. OFFICE OF THE PRESIDENT, PREPARING FOR THE FUTURE OF ARTIFICIAL INTELLIGENCE 10–11 (2016), https://obamawhitehouse.archives.gov/sites/default/files/whitehouse_files/microsites/ostp/NSTC/preparing_for_the_future_of_ai.pdf [http://perma.cc/BHL5-ZKAB] (discussing instances in which humans and machines perform better together than either could by itself). These successful human and AI team-ups are becoming increasingly more common. *Id.* For instance, inferior AI engines can often defeat superior chess programs when provided with a skilled human partner. *Id.* This success occurs even when both of the AI chess programs are stronger than the human player. *Id.*

[280] Atl. Works v. Brady, 107 U.S. 192, 200 (1883).

[281] *See* KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 418 (2007) (describing the various amorphous factors that a court might expect a PHOSITA to consider, such as "interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art").

[282] *See* Brynjolfsson et al., *supra* note 271, at 47 (projecting that, for most professions, continued development of AI technology is more likely to reshape the role of humans rather than replacing them altogether). Beyond encouraging researchers to begin an inquiry, the patent incentive is also beneficial when a researcher already has made a promising discovery and is deciding whether to develop the discovery into a patentable invention. Merges, *supra* note 96, at 33. This principle could work in harmony with the complementary role that AI often performs in the inventive process, in that the AI machine could present an outside-the-box result and the human could develop it into a patentable

CONCLUSION

As AI continues to evolve, a flexible approach that accounts for the varying roles that AI plays in developing inventions is most appropriate. Current obviousness doctrine adequately fulfills this role. Recent proposals aimed at addressing perceived deficiencies in the doctrine, as it applies to AI, would confuse the doctrine and lead to erroneous results. Requiring applicants to disclose the use of AI could lead patent offices and courts to endow the PHOSITA with the AI capabilities possessed by the actual inventor before such technology is standard within the field. Further, replacing the PHOSITA with an inventive machine standard could lead to an overly rigid test that fails to consider the role that humans will continue to play in inventing.

New technologies present new challenges. As the patent system adapts to addressing the needs of expanding AI capability, it is important that past lessons inform modern practice. Even minor attempts to alter the doctrine based on whether a given technology contributes to an invention could throw the test into disarray. Current obviousness analysis provides a sufficiently flexible standard for evaluating inventions created by or with the aid of AI technology. Unless or until current obviousness doctrine proves unable to accommodate this expanding technology, we should not rush to alter it.

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invention. *See* Wilson & Daugherty, *supra* note 179 (describing how an inventor can provide an AI machine with parameters for a new chair design, such as load-bearing capacity, height of the seat from the ground, and sample designs, which are aesthetically pleasing, and the AI machine will then generate models that the inventor can choose from). This liberates the human inventor to focus on the high-level decision-making and product development for which human intelligence is particularly suited. *Id.*