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RETHINKING THE MENTAL STEPS DOCTRINE AND OTHER BARRIERS TO PATENTABILITY OF ARTIFICIAL INTELLIGENCE[†]

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In recent years, our federal courts have given increased attention to the question of what subject matter is eligible for patent protection. The resulting caselaw, developed mostly in the context of business methods or other relatively straight forward technologies, exhibits a number of trends that broadly call into question the patentability of inventions in the field of artificial intelligence. In particular, one series of cases has revitalized the "mental steps doctrine" as a mechanism for invalidating patents. These cases suggest that technology for emulating or replicating activities that could otherwise be accomplished by the human thought process are not patentable. A second series of cases has placed undue emphasis on quantifiable operational improvements as a yardstick for patent-eligibility of computer-related inventions. These cases suggest that even the most ingenious and useful advances in that area may be unpatentable if they do not also provide a readily measurable improvement in performance. Although this precedent was largely crafted outside the artificial intelligence context, it is nonetheless being used by inventors, investors, and courts to gauge the patentability of advances in artificial intelligence. As a result, incentives to innovate in that field are being considerably diminished and, in some instances, altogether eliminated—a consequence that does not appear to have been

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considered by the deciding courts. This Article highlights this growing problem, explains why the eligibility barriers developed in the series of cases described above should generally not be applied to prevent patenting of advances in artificial intelligence, and proposes better ways forward.

I. INTRODUCTION

In recent years, unprecedented amounts of time and money have been spent developing machines capable of emulating sophisticated human behavior—artificial intelligence.[1] The

1. Computer scientist John McCarthy, who coined the term in 1955, defined "artificial intelligence" as "the science and engineering of making intelligent machines." *See* John McCarthy, *What is AI? / Basic Questions*, PROFESSOR JOHN MCCARTHY – FATHER OF AI (last visited Apr. 15, 2018), http://jmc.stanford.edu/artificial-intelligence/what-is-ai/index.html. Nils Nilsson, another pioneer in the field, defined "intelligence" in this context as "that quality that enables an entity to function appropriately and with foresight in its environment." *See, e.g.*, NILS J. NILSSON, THE QUEST FOR ARTIFICIAL INTELLIGENCE xiii (2010). The general field of artificial intelligence encompasses multiple specific approaches to achieving "intelligence" in various domains. *See, e.g.*, Jay Jacobs, *Artificial Intelligence, Explained*, BARRON'S (Oct. 25, 2017), http://www.barrons.com/articles/sponsored/artificial-intelligence-explained-

resulting innovation has already changed life as we know it. Artificial intelligence is being used for pharmaceutical development. Intelligent systems have infiltrated our homes in the form of robotic vacuums and smart thermostats. And they have found their way into our pockets as personal assistants on smartphones. Technologists project that we will have fleets of self-driving cars[2] and affordable domestic robots.[3] We will have devices that flawlessly recognize not only text and speech, but also images. We will have autonomous weapon systems. We will have tools to aid medical determinations in real time, which diagnose illnesses based on an individual patient's genetics and environmental exposure, develop individualized medical treatment plans, and monitor a patient's recovery.[4] Indeed, advances in a variety of fields are already laying the foundations for an "artificial general intelligence" that, like a human, will be able to adapt to many different tasks and environments.[5]

Development of these advances has been and will continue to be quite costly. Companies and governments are investing billions of dollars each year into artificial intelligence research and development.[6] As high as the current costs are, the long-term

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1508530169 (techniques to achieve artificial intelligence include machine learning and a specific type of machine learning called deep learning).

2. *See, e.g.*, Mike Isaac, *What It Feels Like to Ride in a Self-Driving Uber*, N.Y. TIMES (Sept. 14, 2016), http://www.nytimes.com/2016/09/15/technology/our-reporter-goes-for-a-spin-in-a-self-driving-uber-car.html (describing Uber's September 2016 pilot test of a small number of driverless cars in Pittsburgh).

3. *See, e.g.*, Sharon Gaudin, *Elon Musk Wants to Build You a Robotic Housekeeper*, COMPUTERWORLD (June 21, 2016, 12:55 PM), https://www.computerworld.com/article/3086931/artificial-intelligence/elon-musk-wants-to-build-you-a-robotic-housekeeper.html.

4. *See, e.g.,* Yuichi Mori et al., *Computer-Aided Diagnosis for Colonoscopy*, 49 ENDOSCOPY 813 (2017), https://www.researchgate.net/publication/317147787_Computer-aided_diagnosis_for_colonoscopy (using machine learning to automatically detect and classify potentially cancerous polyps during colonoscopy).

5. Gideon Lewis-Kraus, *The Great A.I. Awakening*, N.Y. TIMES MAG. (Dec. 14, 2016), https://www.nytimes.com/2016/12/14/magazine/the-great-ai-awakening.html ("Artificial general intelligence will not involve dutiful adherence to explicit instructions, but instead will demonstrate a facility with the implicit, the interpretive. It will be a general tool, designed for general purposes in a general context.").

6. *See, e.g.*, JACQUES BUGHIN ET AL., MCKINSEY & CO., ARTIFICIAL INTELLIGENCE: THE NEXT DIGITAL FRONTIER? 4 (June 2017), https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/how-artificial-intelligence-can-deliver-real-value-to-companies (follow "Discussion Paper" hyperlink) ("Globally, we estimate tech giants spent $20 billion to $30

economic and societal benefits of artificial intelligence are projected to be massive.[7]

One might expect our patent system to encourage innovation in artificial intelligence. It has done so for more than two centuries with other new fields.[8] There have been no changes to the Constitutional mandate around which our patent system was created,[9] nor any statutory changes designed to dissuade the progress in artificial intelligence. And only a few decades ago, the Supreme Court observed Congress's apparent intent for patent-eligible subject matter to "include anything under the sun that is made by man."[10] At the time, computers were already carrying out many tasks that humans had historically performed.[11]

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billion on AI in 2016, with 90 percent of this spent on R&D and deployment, and 10 percent on AI acquisitions."); Cade Metz, *Tech Giants Are Paying Huge Salaries for Scarce A.I. Talent*, N.Y. TIMES (Oct. 22, 2017), https://www.nytimes.com/2017/10/22/technology/artificial-intelligence-experts-salaries.html (describing the high demand for experts in artificial intelligence and the substantial salaries they command); Paul Mozur, *Beijing Wants A.I. to Be Made in China by 2030*, N.Y. TIMES (July 20, 2017), https://www.nytimes.com/2017/07/20/business/china-artificial-intelligence.html ("The world's second-largest economy will be investing heavily to ensure its companies, government and military leap to the front of the pack in a technology many think will one day form the basis of computing.").

7. *See, e.g.*, MARK PURDY & PAUL DAUGHERTY, ACCENTURE, WHY ARTIFICIAL INTELLIGENCE IS THE FUTURE OF GROWTH 19 (2016), https://www.accenture.com/t20170927T080049Z__w__/us-en/_acnmedia/PDF-33/Accenture-Why-AI-is-the-Future-of-Growth.pdf ("Accenture research forecasts a significant increase in United States's GVA growth, from 2.6 percent to 4.6 percent in 2035 . . . translat[ing] to an additional US$8.3 trillion GVA in 2035 . . . .").

8. *See, e.g.*, J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred Int'l, Inc., 534 U.S. 124, 135 (2001) ("[Section 101 of the 1952 Patent Act] is a dynamic provision designed to encompass new and unforeseen inventions."); Diamond v. Chakrabarty, 447 U.S. 303, 308 (1980) ("The [1793 Patent] Act embodied Jefferson's philosophy that 'ingenuity should receive a liberal encouragement.'").

9. U.S. CONST. art. I, § 8, cl. 1, 8 ("The Congress shall have Power . . . To 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 . . . .").

10. *Chakrabarty*, 447 U.S. at 309 (1980) (citing congressional committee reports accompanying the 1952 Patent Act).

11. By this time, for instance, engineers had succeeded in programming computers to compose musical scores autonomously. *See, e.g.*, Lev Grossman, *2045: The Year Man Becomes Immortal*, TIME (Feb. 10, 2011), http://content.time.com/time/magazine/article/0,9171,2048299,00.html. Shortly after, software known as Racter produced a full book of poetry. RACTER, THE POLICEMAN'S BEARD IS HALF CONSTRUCTED (1984), http://www.ubu.com/concept/racter.html.

Everyone knew that computers would continue to become increasingly sophisticated and, along the way, take over an expanding array of functions from humans. People welcomed these developments, recognizing that they would lead to vast improvements in quality of life. Indeed, artificial intelligence advances were, and are, widely celebrated in both the marketplace[12] and in popular culture.[13]

There has nonetheless been a recent sea change in the scope of patent protection for artificial intelligence. Following *Alice Corp. v. CLS Bank International*,[14] many courts have delivered broad pronouncements on the scope of patentable subject matter. In many instances, these edicts have been rendered in the context of pure business methods or quintessentially abstract ideas undeserving of patent protection. But unfortunately, many of the opinions are filled with expansive language that, if taken at face value, extend well beyond the circumstances of the cases being decided and into vastly dissimilar fields. If these opinions are removed from their original contexts and applied indiscriminately to the field of artificial intelligence, they would severely curtail or even eliminate patent protection for legitimate inventions.

As one example of this, courts in the aftermath of *Alice* have revived the "mental steps" doctrine as a primary yardstick for assessing patent-eligibility. Under this doctrine, if method claims

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12. The services of many highly valued companies, such as Google and Facebook, depend heavily on automated recognition of what humans find relevant. *See, e.g.*, Vindu Goel, *When Yahoo Ruled the Valley: Stories of the Original 'Surfers'*, N.Y. TIMES (July 16, 2016), http://www.nytimes.com/2016/07/17/technology/when-yahoo-ruled-the-valley-stories-of-the-original-surfers.html (discussing the early use of humans to catalog information on the web as having been "long since eclipsed by Google and Facebook"); Gil Press, *Why Yahoo Lost and Google Won*, FORBES (July 26, 2016), http://www.forbes.com/sites/gilpress/2016/07/26/why-yahoo-lost-and-google-won/ (citing automation as "the heart of Google's success").

13. For example, artificially intelligent computer systems were featured in multiple episodes of the original *Star Trek* series (1966–69), including one titled "The Ultimate Computer," in which a computer capable of learning and adapting was given command of the Enterprise. The television show *Knight Rider* (1982–86) focused on the exploits of a futuristic, computer-driven sports car run using artificial intelligence. *Buck Rogers in the 25th Century* (1979–1981) involved an array of artificially intelligent robots that served as assistants to humans. 2001: A SPACE ODYSSEY (1968) and its sequel 2010: THE YEAR WE MAKE CONTACT (1984) both centered on artificial intelligence-based computer systems. THE TERMINATOR (1984) featured a human-looking cyborg sent from the future. Perhaps most famously, the original STAR WARS trilogy (1977–1983) included robots that had human-like capabilities and foibles.

14. 134 S. Ct. 2347 (2014).

can be characterized as able to be performed within the mind of a human being, perhaps with the aid of a pencil and paper, a presumption of patent-ineligibility attaches. Numerous recent cases have relied on the mental steps doctrine to invalidate non-business method claims, with parallel system claims regularly being dispatched on the same basis. Of particular concern, many of these decisions contain pronouncements broad enough to encompass inventions in the field of artificial intelligence, which can often be portrayed as consisting of mental steps or their equivalent and are therefore at risk under the revitalized doctrine.

As a second example, during their patent-eligibility analyses, courts are now placing increased weight on whether an invention is directed to improving quantifiable performance characteristics of a computer, such as its speed. Inventions providing quantifiable performance improvements fall into an eligibility safe harbor, which was originally intended as a non-exclusive test. But in delineating the bounds of this safe harbor, courts have so regularly questioned the patentability of inventions that do not quantifiably improve existing performance metrics that the safe harbor is, as a practical matter, being transformed into a prerequisite to patentability of computer-related inventions. For this additional reason, artificial intelligence advances that enable entirely new capabilities have become unduly vulnerable to eligibility challenges.

Although these lines of cases have developed almost entirely outside of the artificial intelligence context, the precedents they have established are being used by inventors, investors, and courts to gauge the patentability of advances in artificial intelligence. As a result, incentives to innovate in that field are being considerably diminished and, in some instances, altogether eliminated—a consequence that does not appear to have been considered by the deciding courts. At stake is an extraordinary amount of capital currently being invested in the field and the great economic impact expected to result from that investment. The purpose of this paper is to raise awareness of this problem and to suggest better ways forward.

II. *ALICE* SIGNIFICANTLY ALTERED PATENTABILITY ANALYSES FOR COMPUTER-IMPLEMENTED INVENTIONS

The scope of patent protection for artificial intelligence has, to date, closely aligned with the protection accorded to computer software in general. This is principally because most artificial

intelligence innovations, at least historically, *are* software.[15] Many potential advances in artificial intelligence will include algorithms capable of executing on a standard computer or smartphone. The scope has also aligned because no judicially-recognized distinctions between software in general, and artificial intelligence software in particular, have yet arisen. Such distinctions were previously unnecessary because for many years nearly all varieties of software, except for the most abstractly mathematical, were considered patent-eligible by default. A famous line of Supreme Court cases, ending with *Diamond v. Diehr*, had generally supported the patentability of computer software throughout the 1980s, 1990s, and 2000s.[16] Software that had some practical application in the real world was protected.[17]

The Supreme Court's most recent general guidance on patent-eligibility in *Alice* applied a two-step framework in which a court first assesses whether a claim is directed to a "patent-ineligible concept."[18] If so, the court next asks whether any of the claim's elements "transform the nature of the claim" into a patent-eligible

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15. There are, of course, artificial intelligence inventions that use specialized, new hardware. For example, Intel recently debuted "the world's first family of processors designed from the ground up for artificial intelligence (AI)." Naveen Rao, *Intel Nervana Neural Network Processors (NNP) Redefine AI Silicon*, INTEL AI (Oct. 17, 2017), https://ai.intel.com/intel-nervana-neural-network-processors-nnp-redefine-ai-silicon/.

16. *See, e.g.,* Gottschalk v. Benson, 409 U.S. 63, 71–72 (1972) (holding patent-ineligible an algorithm for performing certain numerical conversions on a general-purpose digital computer) ("It is said that the decision precludes a patent for any program servicing a computer. We do not so hold."); Parker v. Flook, 437 U.S. 584, 584, 590 (1978) (holding that a computer-implemented algorithm is not made patent-eligible by "identification of a limited category of useful, though conventional, post-solution applications," but noting that "a process is not unpatentable simply because it contains . . . a mathematical algorithm."); Diamond v. Diehr, 450 U.S. 175, 187–88 (1981) (holding that using a well-known mathematical equation in a real-world rubber curing process was patent-eligible and noting that "a claim drawn to subject matter otherwise statutory does not become nonstatutory simply because it uses a mathematical formula, computer program, or digital computer").

17. *See, e.g.*, Arrhythmia Research Tech., Inc. v. Corazonix Corp., 958 F.2d 1053, 1056–57 (Fed. Cir. 1992) (finding algorithm for computer analysis of electrocardiographic signals to determine heart function patentable subject matter) ("As the jurisprudence developed, inventions that were implemented by the mathematically-directed performance of computers were viewed in the context of the practical application to which the computer-generated data were put.").

18. Alice Corp. v. CLS Bank Int'l, 134 S. Ct. 2347, 2355 (2014) (referring to the three historical categories of patent-ineligible subject matter under §101: laws of nature, natural phenomena, and abstract ideas).

application of the idea.[19] This framework had been articulated outside the context of software just two years earlier in *Mayo v. Prometheus*.[20] *Alice* built on *Mayo v. Prometheus* by holding that a "generic computer implementation" of an otherwise-abstract idea was insufficient to transform the nature of the claim.[21]

Although *Alice* was not the first move toward increased emphasis on patent-eligibility as a ground for invalidating patents, its impact was particularly dramatic. In the four-year period from 2007 through 2010, district courts issued only eleven decisions finding patents invalid for failure to comply with § 101.[22] While district courts made fourteen such decisions in 2013, [23] in the six months after *Alice*, courts made fifteen such decisions,[24] in several cases, at the motion to dismiss stage (including motions on the pleadings).[25] This posture remains common.[26] On a single day in

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19. *Id.* (citing Mayo Collaborative Servs. v. Prometheus Labs., Inc., 556 U.S. 66, 78 (2012)).

20. *Mayo*, 566 U.S. at 79–80 (2012) ("[T]he claims inform a relevant audience about certain laws of nature; any additional steps consist of well understood, routine, conventional activity already engaged in by the scientific community; and those steps, when viewed as a whole, add nothing significant beyond the sum of their parts taken separately. For these reasons we believe that the steps are not sufficient to transform unpatentable natural correlations into patentable applications of those regularities.").

21. *Alice*, 134 S. Ct. at 2357. Under this distinction between specialized and generic computers, some hardware-specific artificial intelligence inventions, like Intel's Nervana processor, *supra* note 15, may have significantly stronger protection under the current interpretation of § 101 than artificial intelligence techniques implemented as software on commodity personal computers.

22. OWEN BYRD & BRIAN HOWARD, LEX MACHINA 2013 PATENT LITIGATION YEAR IN REVIEW, LEX MACHINA 11 (2013).

23. *Id.*

24. *See, e.g.*, Dan Liu, *A Sea Change After Alice: Recent Court Decisions Show Patents Are Vulnerable under Section 101 Attack*, GLASER WEIL (Oct. 28, 2014), http://www.glaserweil.com/news-resources/insights/ip-file/a-sea-change-after-alice-recent-court-decisions-show-patents-are-vulnerable.

25. *See, e.g.*, Ultramercial, Inc. v. Hulu, LLC, 772 F.3d 709 (Fed. Cir. 2014) (affirming district court grant of motion to dismiss based on lack of patentable subject matter).

26. *See, e.g.*, Edward Tulin & Leslie Demers, *A Look at Post-Alice Rule 12 Motions Over The Last 2 Years*, LAW360 (Jan. 27, 2017), https://www.law360.com/articles/882111/a-look-at-post-alice-rule-12-motions-over-the-last-2-years (concluding that although the grant rate for motions to dismiss declined from 90 percent immediately after *Alice* to 53 percent in 2016, the absolute number of such motions filed (seventy-seven) and granted (forty-one) in 2016 far exceeded the rate before *Alice*); *see also, e.g.*, Internet Patents Corp. v. Active Network, Inc., 790 F.3d 1343 (Fed. Cir. 2015) (affirming district court grant of motion to dismiss based on lack of patentable subject matter); OIP Techs., Inc. v. Amazon.com Inc., 788 F.3d 1359 (Fed. Cir. 2015) (affirming

September 2014, five different decisions invalidated software patents under *Alice*.[27] There were as many or more invalidations under § 101 on that one day than in any single *year* between 2007 and 2011.[28] Since *Alice*, claims of more than 500 separate patents have been found invalid under § 101.[29]

The lack of an explicit definition of an "abstract idea" in *Alice* itself has led the lower courts to rule primarily by analogy to the facts of previous cases.[30] While each decision applying *Alice* is the response of a court to particular circumstances, general themes have emerged from lower courts' attempts to distill and apply the Supreme Court's guidance. Some of these themes are particularly troublesome for artificial intelligence.

III. COURTS HAVE INTERPRETED *ALICE* IN WAYS HOSTILE TO ARTIFICIAL INTELLIGENCE BY REANIMATING AND EXPANDING THE MENTAL STEPS DOCTRINE

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district court grant of motion for judgment on the pleadings based on lack of patentable subject matter).

27. *See, e.g.*, Gregory Garre, et al., *Early Lessons on Alice Corp. v. CLS Bank International and Section 101 From Recent Court Decisions*, LATHAM & WATKINS (Sept. 19, 2014), *available at* http://www.lw.com/thoughtLeadership/lw-alice-corp-cls-bank-section-101.

28. BYRD & HOWARD, *supra* note 22, at 11 (discovering that no more than five patents were invalidated for lack of patentable subject matter between the years of 2007–2011).

29. Robert Sachs, *#Alicestorm: April Update and the Impact of TC Heartland on Patent Eligibility*, BILSKIBLOG (June 1, 2017), http://www.bilskiblog.com/blog/2017/06/alicestorm-april-update-and-the-impact-of-tc-heartland.html (stating that, as of June 1, 2017, district courts had invalidated claims of 515 patents under § 101 in 242 decisions since *Alice* and the Federal Circuit had affirmed 91.7% of the appeals from those decisions).

30. *See, e.g.*, Amdocs (Israel) Ltd. v. Openet Telecom, Inc., 841 F.3d 1288, 1294 (Fed. Cir. 2016) ("Whether the more detailed analysis is undertaken at step one or at step two, the analysis presumably would be based on a generally-accepted and understood *definition* of, or test for, what an 'abstract idea' encompasses. However, a search for a single test or definition in the decided cases concerning § 101 from this court, and indeed from the Supreme Court, reveals that at present there is no such single, succinct, usable definition or test. The problem with articulating a single, universal definition of 'abstract idea' is that it is difficult to fashion a workable definition to be applied to as-yet-unknown cases with as-yet-unknown inventions. That is not for want of trying; to the extent the efforts so far have been unsuccessful it is because they often end up using alternative but equally abstract terms or are overly narrow. Instead of a definition, then, the decisional mechanism courts now apply is to examine earlier cases in which a similar or parallel descriptive nature can be seen—what prior cases were about, and which way they were decided.").

Perhaps the most ominous dicta for artificial intelligence occur in cases finding that challenged claims are unpatentable abstract ideas at *Alice's* step one because the claims describe methods that could be performed by a human brain.[31] This is sometimes called the "mental steps doctrine." The test is occasionally articulated as a bar to claims that could be practiced by a human using a pencil and paper. Taken literally, such a test would make any invention that sought to emulate, supplement, or replace human thought subject to the additional scrutiny of *Alice's* second step. Identifying an invention as abstract in step one is often fatal because step two does not allow implementation on a generic computer to save the claims.[32]

This is in strong contrast to the situation before *Alice*. The law had generally protected mental steps that were claimed as implemented on a computer. Cases from the dawn of the computer age had drawn a distinction between computerized and non-computerized processes.[33] Judge Rich made the same distinction between "purely mental" steps that could *only* be performed by a human and steps that were mental in nature but could be performed by a computer.[34] Judge Rich noted that there

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31. Robert Sachs, *The Mind as Computer Metaphor: Benson and the Mistaken Application of Mental Steps to Software*, BILSKIBLOG (Apr. 6, 2016), http://www.bilskiblog.com/blog/2016/04/the-mind-as-computer-metaphor-benson-and-the-mistaken-application-of-mental-steps-to-software.html ("Between the June 2014 *Alice* decision and March 29, 2016, there have been 175 federal court decisions invalidating patents under Section 101, and 24% of those decisions relied upon the 'mental steps' doctrine. The eighty-two patents thus invalidated were not limited to suspect categories such as 'business methods,' but included electronic design automation, computer and database security, information retrieval, microbiology, user interfaces for interactive television, telecommunications, and digital image management.").

32. Alice Corp. v. CLS Bank Int'l, 134 S. Ct. 2347, 2357 (2014) ("We conclude that the method claims, which merely require generic computer implementation, fail to transform that abstract idea into a patent-eligible invention.").

33. *See, e.g.*, *In re* Bernhart, 417 F.2d 1395, 1401 (C.C.P.A 1969) ("Looking then to method claim 13, we find that it in no way covers any mental steps but requires both a 'digital computer' and a 'planar plotting apparatus' to carry it out. To find that the claimed process could be done mentally would require us to hold that a human mind is a digital computer or its equivalent . . . . We conclude that the method defined by claim 13 is statutory . . . .").

34. *In re* Musgrave, 431 F.2d 882, 890 (C.C.P.A. 1970) ("If so construed as to encompass only steps incapable of being performed by a machine or apparatus, [the mental steps doctrine] might lead to a correct result . . . . If the expression 'purely mental' is construed (as the board apparently did here) so as

was no support in the statute for barring mental steps performed by a computer.[35] Indeed, there were many such claims that covered new technological improvements that deserved patent protection.[36] Although ultimately invalidating the challenged patent, dicta in *Parker v. Flook* similarly appeared to reject the "pencil and paper" test if the claimed process was primarily intended to be computerized.[37]

Although the Federal Circuit in *In re Comiskey* criticized "mental processes standing alone" as unpatentable abstract ideas,[38] that case was limited to claims that covered mental steps that were *not* computerized.[39] The mental steps doctrine was also used before *Alice* to invalidate claims for which the goal was not to replace or augment human activity, but simply to cover a medical diagnostic test that involves a human comparison between two or

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to encompass steps performable by apparatus, as well as mentally, then the [doctrine] is unsound . . . .").

35. *Id.* ("As may be seen from the statutory language, it contains nothing whatever which would either include or exclude claims containing 'mental steps' and whatever law there may be on the subject cannot be attributed to Congress.").

36. *Id.* at 893 ("We cannot agree with the board that these claims (all the steps of which can be carried out by the disclosed apparatus) are directed to non-statutory processes merely because some or all of the steps therein can also be carried out in or with the aid of the human mind or because it may be necessary for one performing the processes to think. All that is necessary, in our view, to make a sequence of operational steps a statutory 'process' within 35 U.S.C. § 101 is that it be in the technological arts so as to be in consonance with the Constitutional purpose to promote the progress of 'useful arts.'" (quoting U.S. CONST. art. I, § 8, cl. 8)).

37. 437 U.S. 584, 586 (1978) ("Although the computations can be made by pencil and paper calculations, the abstract of disclosure makes it clear that the formula is primarily useful for computerized calculations producing automatic adjustments in alarm settings.").

38. *In re* Comiskey, 554 F.3d 967, 979 (Fed Cir. 2009) ("[M]ental processes—or processes of human thinking—standing alone are not patentable even if they have practical application.").

39. *Id.* at 980 ("It is thus clear that the present statute does not allow patents to be issued on particular business systems—such as a particular type of arbitration—that depend *entirely* on the use of mental processes. In other words, the patent statute does not allow patents on particular systems that depend for their operation *on human intelligence alone*, a field of endeavor that both the framers and Congress intended to be beyond the reach of patentable subject matter. Thus, it is established that the application of human intelligence to the solution of practical problems is not *in and of itself* patentable.") (emphasis added); *id.* at 970 ("[T]he parties agree that these claims do not require . . . the use of a mechanical device such as a computer.").

more pieces of information.[40] Thus, leading up to *Alice*, the mental steps doctrine tended to be used to invalidate patents that had no explicit connection to a computer.[41]

Nonetheless, the Supreme Court itself had laid a foundation for expanding the mental steps doctrine to computerized inventions with dicta in *Gottschalk v. Benson* analogizing a computer to a brain: "A digital computer, as distinguished from an analog computer, operates on data expressed in digits, solving a problem by doing arithmetic as a person would do it by head and hand."[42] This computer-brain equivalence lay dormant for a period, but has now been revitalized by *Alice*, just as the mental steps doctrine itself has been raised from the dead.

A. The Current Interpretation of Mental Steps Indiscriminately Stamps Out Computer-Implemented Inventions

In *Alice's* wake, software patents have become particularly susceptible to invalidation under the mental steps doctrine. One district court case, *Broadband iTV v. Oceanic Time Warner Cable*, affirmed by the Federal Circuit, invalidated a patent on delivery of video-on-demand content that "describe[d] a process that a person could perform using a pen, paper, and her own brain."[43] The patent was invalidated even though the district court conceded that it "anticipates that its steps will be performed through computer operation."[44] In fact, the claims of the invalidated patent included numerous aspects that, on their face, appeared to require implementation by a computer and preclude

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40. *See, e.g.*, PerkinElmer, Inc. v. Intema Ltd., 496 F. App'x 65, 73 (Fed. Cir. 2012) (referring to such a comparison as a "[patent-]ineligible mental step").

41. *See, e.g.*, CyberSource Corp. v. Retail Decisions, Inc., 654 F.3d 1366, 1372 (Fed. Cir. 2011) (invalidating method that did not require computer implementation under § 101 when all of its steps "can be performed in the human mind, or by a human using a pen and paper"). One commentator has characterized *CyberSource* as fundamentally flipping the test that Judge Rich had articulated, from whether a human brain must necessarily practice a step to whether it could. Sachs, *supra* note 31 ("The emphasis on *can be* [in *CyberSource*] is intentional and important: it reflects the fundamental shift in the patent eligibility jurisprudence from considering whether the claimed invention was intended *in fact* to be performed mentally (the 'factual form' of mental steps) to a hypothetical embodiment of whether it *could be* (the 'fictional form' of mental steps).").

42. 409 U.S. 63, 65 (1972).

43. Broadband iTV, Inc. v. Oceanic Time Warner Cable, LLC, 135 F. Supp. 3d 1175, 1186–87 (D. Haw. 2015), *aff'd*, 669 F. App'x 555 (Fed. Cir. 2016).

44. *Id.* at 1186.

implementation by a human alone, including enabling the "uploading [of] video content in a digital video format via an online network" and "converting the content uploaded to the Web-based content management server into a standard TV digital format."[45] The district court discounted these additional details in its analysis of *Alice* step two, finding that no meaningful additional ingredients were added to the abstract mental steps.[46]

Another recent Federal Circuit case, *Coffelt v. NVIDIA*, invalidated claims directed to "deriving a pixel color in a graphic image."[47] Even though the claims explicitly required a computer to perform various algorithm steps, the court in effect rewrote the claims to eliminate the computer requirement and substituted a more abstract version of the actual claim language that was fitted to mental performance by a human.[48] This rewrite of the claims was justified on the basis that the claimed computer was general-purpose and thus squarely addressed by *Alice*'s instructions on how to apply step two.[49]

Yet another contemporary Federal Circuit case, *FairWarning v. Iatric*, upheld the district court's invalidation of claims directed to computer-implemented fraud detection techniques.[50] The

45. U.S. Patent No. 7,631,336 at col. 2 l. 60–66 (filed Mar. 12, 2007).

46. *Broadband iTV*, 135 F. Supp. 3d at 1190 ("Moreover, the fact that a patent provides specific details of implementation is not enough to secure patent eligibility if those 'details' continue to encompass merely 'generic computer implementation' and 'routine activities.'"). The district court also repeated troubling dicta about how it would not matter for patent purposes if the inventor were the first person to implement the process on a computer. *Id.* at 1187 ("[T]he fact that a company may be the first to successfully apply an abstract idea within a new technological context does not transform the abstract idea into something tangible and patentable.") (quoting OpenTV, Inc. v. Apple, Inc., Case No. 14-cv-01622-HSG, 2015 WL 1535328, at *6 (N.D. Cal. Apr. 6, 2015)).

47. Coffelt v. NVIDIA Corp., 680 F. App'x 1010 (Fed. Cir. 2017).

48. U.S. Patent No. 8,614,710 at col. 14 l. 1–3 ("for a first pixel, a computer deriving a pixel color for said first position vector from a result of said length comparison"); *Coffelt*, 680 F. App'x at 1011 ("[T]he claims at issue here are directed to the abstract idea of calculating and comparing regions in space . . . . The claims thus recite nothing more than a mathematical algorithm that could be implemented using a pen and paper.").

49. *Coffelt*, 680 F. App'x at 1011 ("The parties do not dispute that the claims can be implemented on a generic computer . . . . [T]he inventive concept must 'transform' the patent-ineligible algorithm into a 'patent-eligible application' of the algorithm, and do so by more than merely implementing the algorithm on a generic computer.") (citing Alice Corp. v. CLS Bank Int'l, 134 S. Ct. 2347, 2355 (2014)).

50. FairWarning IP, LLC v. Iatric Sys., Inc., 839 F.3d 1089, 1094–95 (Fed. Cir. 2016).

invalidated claims specified rules for detecting fraudulent data that were essentially "questions (though perhaps phrased with different words) that humans in analogous situations detecting fraud have asked for decades."[51] Notably, the claimed fraud detection rules were not particularly complex or hard to implement.[52] Asking the questions with a computer did not sufficiently transform the claim from human mental steps under step two of *Alice*.[53]

Similarly, in *Intellectual Ventures v. Erie Indemnity*, the Federal Circuit invalidated claims directed to detecting undesirable files "stored on computer storage devices."[54] The detection could be based on file size, file type, or "whether the file comprises data beyond an end of data marker for the file."[55] The district court had "analogized the patent to solving problems faced by a librarian tasked with marking and removing books containing pornographic material from a library"—in other words, that the claims were at least analogous to mental steps.[56] The Federal Circuit agreed, noting that the specification admitted that "humans are capable of performing the first two selection criteria" (size and type).[57] And even though the third selection criterion (data beyond an end of data marker) likely could not be performed by a human, the Federal Circuit nevertheless found its "character as a whole" to be a patent-ineligible abstract idea.[58]

Only rarely do claims survive after being labeled as mental steps. For example, in the outlier case *BASCOM v. AT&T*, the Federal Circuit upheld claims directed to filtering access to certain websites on a computer.[59] The defendant "analogized the idea of filtering content to a parent or librarian forbidding children from reading certain books, and argued that performing the filtering on the Internet [did] not make the idea nonabstract."[60] The Federal Circuit credited this analysis and found the claims abstract under *Alice* step one because they captured "a longstanding, well-known

51. *Id.* at 1095.

52. *See generally* U.S. Patent No. 8,578,500.

53. *Id.* at 1095–96.

54. Intellectual Ventures I LLC v. Erie Indem. Co., 711 F. App'x 1012, 1013–14 (Fed. Cir. 2017).

55. *Id.* at 1014.

56. *Id.* at 1015.

57. *Id.*

58. *Id.* at 1016.

59. BASCOM Glob. Internet Servs. v. AT&T Mobility LLC, 827 F.3d 1341, 1349–50 (Fed. Cir. 2016).

60. *Id.* at 1346.

method of organizing human behavior."[61] The claims were nevertheless saved under *Alice* step two because they recited "a specific, discrete implementation of the abstract idea of filtering content" and because the patent described "how its particular arrangement of elements [was] a technical improvement over prior art ways of filtering such content."[62]

The cases exhibit some common themes, each potentially hazardous when applied to artificial intelligence. First, a majority of computer-implemented processes, including those underlying much of artificial intelligence, could probably be characterized as mental steps by a judge interpreting that doctrine expansively. There are many judicial descriptions of what does or does not qualify as mental steps that, if applied broadly in the artificial intelligence context, would make patenting in the area quite difficult. For example, the Federal Circuit has suggested that method claims that are merely "the equivalent of human mental work . . . are unpatentable abstract ideas."[63] Second, little to no weight is being given to claim elements that explicitly require computerization. For example, the Federal Circuit has made general pronouncements that "abstract ideas are essentially mental steps; they are not tangible even if they are written down or programmed into a physical machine."[64] Third, even computer-implemented *system* claims, which are manifestly not directed to mental steps, have nonetheless been treated as though they recited mental steps and invalidated where they were perceived as similar to other claims that did qualify as mental steps.[65]

B. The Mental Steps Doctrine Should Be Applied to Artificial Intelligence with Greater Care

We submit that particular caution should be taken with the mental steps doctrine in the context of artificial intelligence

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61. *Id.* at 1348.

62. *Id.* at 1350.

63. CyberSource Corp. v. Retail Decisions, Inc., 654 F.3d 1366, 1371 (Fed. Cir. 2011).

64. Ariosa Diagnostics, Inc. v. Sequenom, Inc., 809 F.3d 1282, 1285 (Fed. Cir. 2015); *see also* Elec. Power Grp., LLC v. Alstom S.A., 830 F.3d 1350, 1355 (Fed. Cir. 2016) ("In a similar vein, we have treated analyzing information by steps people go through in their minds, *or by mathematical algorithms*, without more, as essentially mental processes within the abstract-idea category.") (emphasis added).

65. *See, e.g.*, Intellectual Ventures I LLC v. Erie Indem. Co., 711 F. App'x 1012 (Fed. Cir. 2017) (invalidating all claims of U.S. Patent No. 7,757,298, including system claim 10, but only providing analysis of method claim 1).

inventions in order to preserve patent protection for meaningful advances in the field. For instance, the use of complex algorithms should not automatically be characterized as mental steps, particularly if unable to be implemented in real life, to similar effect, by a person. Given enough time, a sufficient number of pencils, and a large enough stack of paper, a human being could at least in theory replicate some claimed artificial intelligence methods. In many instances, however, that person would not be able to complete their work in a reasonable amount of time, at an appropriate cost, or with the requisite degree of accuracy, rendering their work product unsuitable as a replacement for an intelligent computer system. In these circumstances it would arguably be erroneous to conclude that the computer system was merely performing mental steps or their equivalent.[66]

These practical considerations are particularly crucial when evaluating technologies, such as neural networks, that are specifically designed to emulate human thought.[67] Such technologies would be particularly susceptible to challenges under the mental steps doctrine if statements about that doctrine in other contexts were applied mechanically and without further consideration. But the parallels between artificial intelligence and human mental steps are ultimately superficial. There is a fundamental conceptual difference between a claimed invention that seeks to *emulate* or *replace*, rather than simply *cover*, functions ordinarily carried out by a human. For example, on one hand an invention may address how to replace human functions with techniques performed by a machine. On the other hand, the claims may be written such that human activity itself could infringe. The fact that an artificial intelligence invention replicates human thought—particularly in outcomes—should certainly not end

66. When assessing equivalence in the infringement context, for example, courts frequently ask whether the alleged equivalent performs substantially the same function, in substantially the same way to achieve substantially the same result as the element literally claimed. Here the intelligent computer system would perform in a markedly different way, and provide materially more useful results, than a person working with pencils and paper. *See also* Robert Sachs, *The Mind as Computer Metaphor: Benson and the Mistaken Application of Mental Steps to Software (Part 3)*, BILSKIBLOG (Apr. 11, 2016), http://www.bilskiblog.com/blog/2016/04/the-mind-as-computer-metaphor-benson-and-the-mistaken-application-of-mental-steps-to-software-part-3.html ("The actual computation procedures performed by a computer [for arithmetic] are entirely different both in form and process from what a human does . . . .").

67. *See generally* RICHARD D. DEVEAUX & LYLE H. UNGAR, A BRIEF INTRODUCTION TO NEURAL NETWORKS (2002).

the patentability analysis; indeed, it arguably should not even be a factor weighing against patent-eligibility. The inquiry should instead focus on the extent to which the challenged claims improperly extend beyond computation or mechanization to cover exclusively human activity.[68]

Furthermore, an analysis of these issues should be conducted from start to finish with attention to the specific requirements of the challenged claims. Meaningful limitations requiring computation or mechanization should not be read out of the claims when the presence of a mental step is being evaluated. For instance, courts should respect claim limitations that explicitly require computation and should avoid sweeping pronouncements that implementation on a "general-purpose computer" is not entitled to any weight in the patentability analysis. *Alice* did not go that far. Arguably, the most that *Alice* holds is that implementation of an otherwise abstract idea on a generic computer cannot save a claim at *Alice* step two.[69] As applied to artificial intelligence claims, nothing in *Alice* is inconsistent with, at *Alice* step one, applying the approach from *In re Comiskey* where an explicit claim limitation requiring computation by a machine makes the mental steps doctrine

68. Nonetheless, cases that apply the mental steps doctrine frequently seem to object to the appearance of a claim that could make ordinary human activity infringing. *See, e.g.*, *generally*, PerkinElmer, Inc. v. Intema Ltd., 496 F. App'x 65 (Fed. Cir. 2012); Synopsys Inc. v. Mentor Graphics Corp., 839 F.3d 1138 (Fed. Cir. 2017) ("A review of the actual claims at issue shows that they are directed to the abstract idea of translating a functional description of a logic circuit into a hardware component description of the logic circuit. This idea of reviewing a description of certain functions and turning it into a representation of the logic component that performs those functions can be—and, indeed, was—performed mentally or by pencil and paper by one of ordinary skill in the art. Moreover, the claims do not call for the involvement of a computer."); *id.* at 1149 ("On their face, the claims do not call for any form of computer implementation of the claimed methods . . . . Because the Asserted Claims make no mention of employing a computer or any other physical device, they are so broad as to read on an individual performing the claimed steps mentally or with pencil and paper."). *But see, e.g.*, FairWarning IP, LLC v. Iatric Sys. Inc., 839 F.3d 1089, 1094–95 (Fed. Cir. 2016) (invalidating claims that required a computer but were analogous to human mental steps).

69. Alice Corp. v. CLS Bank Int'l, 134 S. Ct. 2347, 2351 (2014) ("Here, the representative method claim does no more than simply instruct the practitioner to implement the abstract idea of intermediated settlement on a generic computer."); *see* also Gottschalk v. Benson, 409 U.S. 63, 64–65 (1972) (finding that a mathematical algorithm run on a "general purpose digital computer" is not patentable).

inapplicable.[70] The challenged artificial intelligence invention could still be found abstract for other reasons under *Alice* step one, but a proper analysis would not simply label the invention a mental step and summarily dispatch the claims.[71]

In addition, throughout this process, the burden for establishing the presence of a mental step should remain squarely on the defendant.[72] If the mental steps label is applied, the inquiry under *Alice* step two into whether there is an additional inventive concept should not be short-circuited. And the presence and possible invalidity of broad method claims should not automatically infect properly crafted and limited dependent claims, nor should it invalidate parallel system claims.

IV. COURTS HAVE APPLIED *ALICE* IN WAYS HOSTILE TO ARTIFICIAL INTELLIGENCE BY UNDULY FOCUSING ON QUANTIFIABLE TECHNOLOGICAL IMPROVEMENTS

70. *In re* Comiskey, 554 F.3d 967, 979 (Fed. Cir. 2009); *see also In re* Musgrave, 431 F.2d 882, 889 (C.C.P.A. 1970) ("If so construed as to encompass only steps incapable of being performed by a machine or apparatus, [the mental steps doctrine] might lead to a correct result.").

71. For example, claims could properly be found invalid if they specified an exclusively functional use of artificial intelligence, without any implementation requirements, such that they covered a patent-ineligible abstract idea that preempted an entire field. *See, e.g.*, Vehicle Intelligence & Safety LLC v. Mercedes-Benz USA, LLC, 635 F. App'x 914, 917 (Fed. Cir. 2015) (invalidating patent on an artificial intelligence "expert system") ("None of the claims at issue are limited to a particular kind of impairment, explain how to perform either screening or testing for any impairment, specify how to program the 'expert system' to perform any screening or testing, or explain the nature of control to be exercised on the vehicle in response to the test results. Much of Vehicle Intelligence's briefing centers on the use of an 'expert system' that improves over the prior art by providing faster, more accurate and reliable impairment testing. But neither the claims at issue nor the specification provide any details as to how this 'expert system' works or how it produces faster, more accurate and reliable results."); Elec. Power Grp., LLC v. Alstom S.A., 830 F.3d 1350, 1351–54 (Fed. Cir. 2016) (invalidating patent on an artificial intelligence-like method for overseeing a power grid) ("Here, the claims are clearly focused on the combination of those abstract-idea processes. The advance they purport to make is a process of gathering and analyzing information of a specified content, then displaying the results, and not any particular[ly] . . . inventive technology for performing those functions. They are therefore directed to an abstract idea.").

72. 35 U.S.C. § 282(a) (2016) ("A patent shall be presumed valid . . . . The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity.").

There is a second major trend in the post-*Alice* caselaw that should concern those seeking to protect artificial intelligence inventions: courts are now placing excessive emphasis during the patent-eligibility analysis on whether an invention improves traditional computer performance metrics, such as speed or memory capacity. Although such considerations were originally introduced to define a safe harbor protecting certain types of inventions, that safe harbor has in recent years become so central to analysis of eligibility questions in the computer space that it is beginning to resemble an exclusive test. As a practical result, under current law, inventions not clearly intended to increase computer performance metrics are far more susceptible to invalidation under § 101. Many artificial intelligence patents, by contrast, are directed to new capabilities or qualitative improvements and are therefore in unwarranted jeopardy.

A. Recent Cases Place an Increased Emphasis on Quantifiable Advances

This focus on quantifiable computer improvements and discounting of qualitative improvements has accelerated since *Alice*, driven primarily by *Enfish v. Microsoft*.[73] The claims upheld in *Enfish* related to "an innovative logical model for a computer database" that explained "how the various elements of information are related to one another."[74] By using a "self-referential model" that "can store all entity types in a single table" and "can define the table's columns by rows in that same table," a database using the claimed invention could store certain types of data more effectively and could be searched more quickly.[75] The Federal Circuit distinguished the invention from the methods invalidated in *Alice* by describing it as "a specific improvement to the way computers operate," "an improvement in the functioning of a computer," and "a specific implementation of a solution to a problem in the software arts."[76] The Federal Circuit therefore found the challenged claims patent-eligible at *Alice* step one, although it noted that the concept of a specific improvement to computer functionality could potentially be relevant under *Alice* step two as well.[77] In particular, the Federal Circuit appears to

73. Enfish, LLC v. Microsoft Corp., 822 F.3d 1327 (Fed. Cir. 2016).

74. *Id.* at 1330.

75. *Id.* at 1332–33.

76. *Id.* at 1336–39.

77. *Id.* at 1335 ("[W]e find it relevant to ask whether the claims are directed to an improvement to computer functionality versus being directed to an abstract idea, even at the first step of the *Alice* analysis."); *id. at* 1339

have seized on and extended dicta in *Alice* where the Supreme Court had noted that the claims invalidated in *Alice* did not "purport to improve the functioning of the computer itself," nor did they "effect an improvement in any other technology or technical field."[78] *Enfish* has been cited frequently, and has become the leading case supporting a patent-eligibility safe harbor for inventions that can be characterized as improvements to the functioning of computer systems. The Federal Circuit has repeatedly cited *Enfish* in later cases as a test for whether *Alice* step one is satisfied.[79]

For example, in *McRO v. Bandai Namco*, the Federal Circuit upheld as patent-eligible claims directed to automating facial 3-D keyframe animation by providing complex animation rules that "determine . . . morph weight outputs" by "taking into consideration the differences in mouth positions for similar phonemes based on context."[80] The invention was faster and more accurate than the prior art.[81] The *McRO* panel characterized *Enfish* as authorizing an inquiry into whether the challenged claims "focus on a specific means or method that improves the relevant technology."[82] The panel then described the claims in *McRO* as "directed to a patentable, technological improvement over the existing, manual 3-D animation techniques" that used "rules in a process specifically designed to achieve an improved technological result in conventional industry practice."[83]

("[T]here may be close calls about how to characterize what the claims are directed to. In such cases, an analysis of whether there are arguably concrete improvements in the recited computer technology could take place under step two.").

78. Alice Corp. v. CLS Bank Int'l, 134 S. Ct. 2347, 2359 (2014); *see also Enfish*, 822 F.3d at 1335 ("The Supreme Court has suggested that claims 'purport[ing] to improve the functioning of the computer itself' . . . might not succumb to the abstract idea exception." (quoting *Alice*, 134 S. Ct. at 2359).

79. *See, e.g.*, BASCOM Glob. Internet Servs. v. AT&T Mobility LLC, 827 F.3d 1341, 1349 (Fed. Cir. 2016) ("The *Enfish* claims, understood in light of their specific limitations, were unambiguously directed to an improvement in computer capabilities. Here, in contrast, the claims and their specific limitations do not readily lend themselves to a step-one finding that they are directed to a nonabstract idea."); Amdocs (Israel) Ltd. v. Openet Telecom, Inc., 841 F.3d 1288, 1300 (Fed. Cir. 2016) ("[W]e have found eligibility when somewhat facially-similar claims are directed to an improvement in computer functionality under step one . . . ." (citing *Enfish*, 822 F.3d at 1335)).

80. McRO, Inc. v. Bandai Namco Games Am. Inc., 837 F.3d 1299, 1307 (Fed. Cir. 2016) (quoting U.S. Patent No. 6,307,576 col. 10 l. 6–7).

81. *Id.*

82. *Id.* at 1314.

83. *Id.* at 1316.

In *Thales v. United States*, the Federal Circuit continued its emphasis on whether the challenged claims represented a technological improvement.[84] Thales' patent was for "an inertial tracking system for tracking the motion of an object relative to a moving reference frame."[85] By "directly measur[ing] the gravitational field in the platform frame" the invention enabled "track[ing] the position and orientation of the object within the moving platform without input from a vehicle attitude reference system or calculating orientation or position of the moving platform itself."[86] Relying primarily on an analogy to the claimed rubber curing process in *Diamond v. Diehr*, the Federal Circuit upheld the patentability of the challenged claims.[87] But *Diehr* was now filtered through the lens of *Alice* and *Enfish*. The Federal Circuit characterized *Diehr*'s holding in terms of technological improvement: "In terms of the modern day *Alice* test, the *Diehr* claims were directed to an improvement in the rubber curing process, not a mathematical formula."[88]

Enfish was reaffirmed and extended in *Visual Memory v. NVIDIA*, in which the Federal Circuit found that claims directed to an "improved computer memory system" were patent-eligible.[89] The Federal Circuit even phrased the test for *Alice* step one as the question from *Enfish* of "whether the claims are directed to an improvement to computer functionality versus being directed to an abstract idea."[90] In finding that the memory storage claims at issue were valid, the Federal Circuit noted their linkage to computer architecture rather than "the abstract idea of categorical data storage."[91] The Federal Circuit also highlighted the ability of the claimed invention to improve general processor performance.[92]

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84. Thales Visionix Inc. v. United States, 850 F.3d 1343 (Fed. Cir. 2017).

85. *Id.* at 1344.

86. *Id.* at 1345.

87. *Id.* at 1348 ("For the purpose of evaluating patent eligibility, the '159 patent claims are nearly indistinguishable from the claims at issue in *Diehr*.").

88. *Id.*

89. Visual Memory LLC v. NVIDIA Corp., 867 F.3d 1253, 1259 (Fed. Cir. 2017).

90. *Id.* at 1258 (quoting Enfish, LLC v. Microsoft Corp., 822 F.3d 1327, 1335 (2016)).

91. *Id.* at 1259 (citing, among other things, the claims' limitations to "programmable operational characteristics" and "storing certain types of data").

92. *Id.* ("Although prior art memory systems possessed the flexibility to operate with multiple different processors, this one-size-fits-all approach frequently caused a tradeoff in processor performance. The '740 patent's teachings obviate the need to design a separate memory system for each type of processor, which proved to be costly and inefficient, and, at the same time,

The Federal Circuit appeared to recognize a patent-eligibility safe harbor for claims that are "directed to a technological improvement" and are supported by a specification that "discusses the advantages offered by the technological improvement."[93]

B. Unraveling the Enfish Paradox

The line of cases summarized above appears on its face to *expand* patent-eligibility. The cases do nominally support patent protection for improvements to computer functionality. However, the cases also make problematic and implicit characterizations about the scope of patent-eligibility under § 101, paradoxically raising concerns in the context of artificial intelligence inventions. What should be *one* possible avenue among many for software to be eligible after *Alice*—specifically, software oriented toward providing technical solutions to problems rooted in technology—is being transformed into the *only* available avenue. Worse yet, that solitary avenue is being interpreted quite narrowly.

Some cases, for instance, have generated attorney argument and judicial dicta suggesting that *Alice*, as filtered through *Enfish*, may broadly deny patent protection to software that is not solely devoted to improving performance metrics.[94] For example, lower courts often cite basic, quantifiable performance metrics as the touchstone of a protected technological improvement.[95] The

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avoid the performance problems of prior art memory systems.") (citations omitted).

93. *Id.* at 1259–60 ("As with *Enfish*'s self-referential table and the motion tracking system in *Thales*, the claims here are directed to a technological improvement: an enhanced computer memory system . . . . And like the patents at issue in *Enfish* and *Thales*, the specification discusses the advantages offered by the technological improvement. Accordingly, this is not a case where the claims merely recite the 'use of an abstract mathematical formula on any general purpose computer,' 'a purely conventional computer implementation of a mathematical formula,' or 'generalized steps to be performed on a computer using conventional computer activity.'") (citations omitted).

94. *See, e.g.*, Move, Inc. v. Real Estate All. Ltd., 221 F. Supp. 3d. 1149, 1160 (C.D. Cal. 2016) ("When computer-related claims are at issue, step one of the *Alice* inquiry 'asks whether the focus of the claims is on the specific asserted improvement in computer capabilities . . . or, instead, on a process that qualifies as an 'abstract idea' for which computers are invoked merely as a tool.'") (quoting Enfish, LLC v. Microsoft Corp., 822 F.3d 1327, 1335–36 (2016)).

95. *See, e.g.*, Evolved Wireless, LLC v. Apple Inc., 221 F. Supp. 3d 485, 493 (D. Del. 2016) (collecting examples of patent-eligible improvements, including "data accuracy and efficiency," "more accurate and efficient data transmission," and "improve[d] . . . image scanning rate for a scanner") (citations omitted); Zak v. Facebook, Inc., 206 F. Supp. 3d 1262, 1270 (E.D. Mich. 2016)

Federal Circuit has repeated in later cases a distinction, from *Enfish* itself, between protected improvements and unprotected computer-implemented inventions for "economic or other tasks for which a computer is used in its ordinary capacity."[96] A district court contrasted patent-eligible "solutions to computer-centric problems" with "performing abstract ideas in a digital medium."[97]

Lower courts have characterized this as deciding in *Alice* step one whether the challenged claims "are directed to an abstract idea or a specific improvement in computer capabilities"—i.e., that the opposite of an abstract idea is only a technological improvement and nothing else.[98] However, if read in this way, patent protection for artificial intelligence could largely evaporate. Artificial intelligence, after all, is not primarily concerned with making computers better at tasks that they already do. The quantitative benchmarks available in other applications of computer technology are unlikely to be available in claims directed to qualitative improvements in computer functionality—inventions that expand upon the ability of a computer to "see," or to "hear," or even to render informed judgments with incomplete information about subjective subject matter.

This Article submits that this is not a proper reading of the *Enfish* line of cases, which do not provide an exclusive test for the

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("Unlike the claims in *Enfish*, the claim in the present case, in consideration of its limitations, does not unambiguously purport to increase speed, improve storage, or improve functionality of the computer itself.").

96. *See, e.g.*, Secured Mail Sols. LLC v. Universal Wilde, Inc., 873 F.3d 905, 910 (Fed. Cir. 2017) (citing Enfish, LLC v. Microsoft Corp., 822 F.3d 1327, 1336) ("The court in *Enfish* held the claims relating to a computer database implementation to be patent-eligible under *Alice* step one because the claims focused on an improvement to computer functionality itself, *not on economic or other tasks for which a computer is used in its ordinary capacity*.") (emphasis added)).

97. Virginia Innovation Scis, Inc. v. Amazon.com, Inc., 227 F. Supp. 3d 582, 597 (E.D. Va. 2017) ("Comparing this to the other recent cases, while *McRO* and *Enfish* are efforts to improve data processing, the patents in *TLI* and this case are only possible *because* of data processing. Therefore, they are akin to performing abstract ideas in a digital medium rather than creating solutions to computer-centric problems.").

98. *Evolved Wireless*, 221 F. Supp. 3d at 492 (D. Del. 2016) ("Accordingly, the court will consider under the first step of *Alice* whether the '916 and '481 patents are directed to an abstract idea or a specific improvement in computer capabilities . . . . In determining whether the mathematical algorithms disclosed in the patents at issue are directed to an abstract idea or technological improvement, the court finds instructive cases addressing similar technological problems and solutions.").

patentability of software.[99] The point of much artificial intelligence research, for instance, is to enable computers to solve problems *outside* the traditional realm of technology. It can be exceptionally valuable to solve problems long confronted by humans, and even problems long since solved by human thinking. Facial recognition and language translation are two prominent examples. Fortunately, at least some decisions following *Enfish* apply the technological improvement inquiry in an appropriate manner as a factor that can support patentability where the invention improves the speed, memory usage, or accuracy of software, but not as an indication of unpatentability.[100]

Indeed, undue focus on "quantifiable advances" would turn the longstanding incentive structure of the patent system on its head. Instead of valuing pioneering inventions in new areas, it would incentivize incremental and often minor improvements in existing, familiar technology. This could be particularly problematic in the field of artificial intelligence, in which, for instance, sufficiently powerful computers can simulate aspects of "intelligent" behavior without running sophisticated algorithms. As an illustrative example of this, simple chess programs can straightforwardly evaluate all possible outcomes some number of moves into the future, then pick paths that minimize foreseeable losses. On slow machines there is not enough time for these programs to look far ahead, and so they perform terribly. But on fast machines the

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99. There is no indication in the *Enfish* opinion that the Federal Circuit intended its opinion to be read in this way.

100. *See, e.g.*, Synchronoss Techs., Inc. v. Dropbox Inc., 226 F. Supp. 3d 1000, 1007 (N.D. Cal. 2016) ("The Court finds that *Enfish* compels the conclusion that the challenged claims, viewed in light of their respective specifications, are not directed to an abstract idea, and thus cover patentable subject matter. The claims, like those in *Enfish* and *McRO*, are directed on their face to an improvement to computer functionality: a more-efficient mechanism for synchronizing data between systems connected to a network by updating only changed data (or 'difference information'), rather than recopying all information."); Egenera, Inc. v. Cisco Sys., Inc., 234 F. Supp. 3d. 331, 344–45 (D. Mass. 2017) ("Like the self-referential data table of *Enfish* and the animation rules of *McRO*, the claimed processing platform presents an improvement in computer functionality. In addition to expediting system deployment, the platform removes a system's dependence on *specific* physical connections between processors while maintaining the desired performance. The ability to automatically deploy a virtual processing area network also provides efficiency, flexibility, and scalability not available in a manually cabled system . . . . Whether at *Alice* step 1 or step 2, because the '430 and '044 patents are directed to systems that improve computer functionality, they claim patent-eligible subject matter.").

same programs can defeat skilled opponents.[101] Under what is currently the prevailing reading of *Enfish*, the quantifiable performance improvement obtained by simply running the program on the faster machine would weigh in favor of patentability, even though this is arguably not innovation of the sort our patent system should be geared to reward.[102] Unwarranted industry focus on improving routine performance metrics, such as would be encouraged by treating the *Enfish* safe harbor as an exclusive test, would likely discourage fundamental innovation in artificial intelligence.

There is also good reason to treat *Enfish*'s reference to "specific improvements in computer capabilities" broadly in a manner that does not require quantitative advances. Even *Enfish* implied that a protected technological improvement may be to "logical structures and processes" of software, which does not necessarily exclude qualitative improvements.[103] And *Enfish* recognized that "in other cases involving computer-related claims, there may be close calls about how to characterize what the claims are directed to."[104] *Enfish* further noted in passing that one improvement offered by the challenged claims was "increased flexibility" in a database system.[105] The Federal Circuit in *BASCOM v. AT&T* similarly observed, when reading *Enfish* in light of *Alice*, that "it might become clear that the specific improvements in the recited computer technology go beyond well-understood, routine,

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101. On an idealized machine with unlimited processing power, the simple program would play perfect chess. Conversely, even sophisticated programs on machines with limited processing capability may be susceptible to "anti-computer" styles of play that would not fool skilled human opponents. *See, e.g.*, Tim Krabbé, *Defending Humanity's Honor* (2001), DE WEBSITE VAN TIM KRABBÉ, http://timkr.home.xs4all.nl/chess2/honor.htm (profiling a specialist in computer chess who "consistently beats the world's strongest commercial chess programs with a unique anti-computer style").

102. 2015–2016 STUDY PANEL OF THE ONE HUNDRED YEAR STUDY ON ARTIFICIAL INTELLIGENCE, STANFORD UNIV., ARTIFICIAL INTELLIGENCE AND LIFE IN 2030 13 (Sept. 2016), https://ai100.stanford.edu/sites/default/files/ai100report10032016fnl_singles.pdf (citing contemporary criticism of IBM's Deep Blue chess computer that beat Gary Kasparov in 1997 as "a collection of 'brute force methods' that wasn't 'real intelligence'").

103. Enfish, LLC v. Microsoft Corp., 822 F.3d 1327, 1339 (Fed. Cir. 2016) ("Much of the advancement made in computer technology consists of improvements to software that, by their very nature, may not be defined by particular physical features but rather by logical structures and processes. We do not see in *Bilski* or *Alice*, or our cases, an exclusion to patenting this large field of technological progress.").

104. *Id.*

105. *Id.* at 1337.

conventional activities and render the invention patent-eligible."[106] Lower courts largely appear to have overlooked this guidance. Consistent with the discussions of protection for technological improvements in both *Alice* and *Enfish*, one could readily conclude that most artificial intelligence inventions improve the functionality and operation of computers by adding new capabilities. This is particularly so where a patent's specification describes such new capabilities as improvements.[107] And as with mental steps analysis, ambiguity about what is a "specific improvement in computer capabilities," or whether such an improvement is found in a challenged patent, should be resolved in favor of the patentee.[108]

V. CONCLUSION

Recent decisions have revitalized the mental steps doctrine and placed outsized emphasis on quantifiable improvements when assessing eligibility of computer-related inventions. In both instances, broad principles have been announced in connection with relatively straightforward technologies but have not been restricted to those contexts. Transported without further consideration to the realm of artificial intelligence, a field in which life-transforming changes are underway—those principles have the potential to dramatically decrease much-needed incentives to invent.

Objectives of this Article have been to highlight this growing problem, to explain why the two lines of cases cannot be perfunctorily applied to artificial intelligence inventions, and to describe how that caselaw can be reconciled with an eligibility analysis that sensibly balances incentives to invent with the benefit of corresponding disclosures to society. In particular, this Article suggests that the mental steps doctrine should rarely, if ever, be applied in the context of artificial intelligence. Furthermore, any

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106. BASCOM Glob. Internet Servs. v. AT&T Mobility LLC, 827 F.3d 1341, 1348 (Fed. Cir. 2016) (quotation omitted).

107. *See, e.g.*, McRO, Inc. v. Bandai Namco Games Am. Inc., 837 F.3d 1299, 1313 (Fed. Cir. 2016) ("*As the specification confirms*, the claimed improvement here is allowing computers to produce 'accurate and realistic lip synchronization and facial expressions in animated characters' that previously could only be produced by human animators." (emphasis added) (quoting U.S. Patent No. 6,307,576 col. 2 ll. 49–50)).

108. 35 U.S.C. § 282(a) (2016) ("A patent shall be presumed valid . . . . The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity.").

application of the doctrine should respect the fundamental difference between inventions that emulate or replace human thought and those that simply cover existing human activity. It also suggests that the emerging focus on "specific improvements in computer capabilities" should not transform what was intended as a non-exclusive safe harbor into the sole test for eligibility of computer-related inventions. A broad array of novel artificial intelligence techniques warrant protection irrespective of whether they provide readily calculable increases in conventional computer performance metrics. Applying these considerations when evaluating the patentability of inventions in the field of artificial intelligence, courts can once again provide an appropriate scope of protection for this important technology.