PATENTS IN AN ERA OF INFINITE MONKEYS AND ARTIFICIAL INTELLIGENCE

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ABSTRACT

We have entered an era in which computers are not just crunching numbers but generating works of a sort that have historically been protected as "creative." Indeed, at least one company is claiming (satirically, it appears) that its computers are already in the process of generating essentially all possible creative text—the modern-day equivalent of Emile Borel's army of typing monkeys randomly reproducing the complete works of Shakespeare. The march of automation into fields historically dependent on human ingenuity raises important questions about the extent to which materials developed without human intervention deserve protection under our intellectual property laws.

The coming wave of computer-generated material is on a collision course with our patent laws. At least one new company is already using brute-force computing power (not satirically, it appears) to mechanically compose text for thousands of patent claims covering potentially novel inventions and also to generate defensive publications designed to prevent others from obtaining competing patent protection. This Article considers whether technologies invented by such techniques should be patentable, and, if so, who exactly should be credited with inventorship. Additionally, the Article examines the extent to which publication of computer-generated content should be treated as prior art and allowed to prevent others from obtaining patent protection on independently created inventions.

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TABLE OF CONTENTS

INTRODUCTION

More than a century ago, French mathematician Emile Borel proposed that, given enough time, monkeys randomly striking keys on a typewriter would reproduce the complete works of Shakespeare.[1] His hypothesis, later named the "Infinite Monkey Theorem," turned out to be far more prophetic than Borel could have imagined. Although primatologists have yet to assemble large teams of typing monkeys, engineers have managed to assemble billions of transistors into architectures capable of brute-force computation on a scale that was unimaginable a century ago.[2] Advances in machine learning have been developed in parallel and can now automatically focus resources on those areas where desired results are most likely to be found, vastly improving computational efficiency.

We have entered an era in which computers are not just crunching numbers but generating works of a sort that have historically been protected as "creative." As this new age dawned, engineers succeeded in programming computers to compose musical scores autonomously.[3] Shortly thereafter, relatively primitive software known as Racter produced a full book of poetry[4]—a book that surprisingly received critical acclaim.[5] More recently, IBM's Watson

1. Prakash Gorroochurn, CLASSIC PROBLEMS OF PROBABILITY 209-10 (2012).

2. More than four decades after Borel introduced his monkey metaphor in 1913, a leading scientific publication boldly predicted: "Where a calculator like ENIAC today is equipped with 18,000 vacuum tubes and weighs 30 tons, computers in the future may have only 1,000 vacuum tubes and perhaps weigh only 1½ tons." *Brains that Click*, POPULAR MECHANICS, March 1949, at 258, http://www.nytimes.com/2000/12/31/weekinreview/place-virtual-space-odyssey-this-time-future-closer-than-you-think.html.

3. *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.

4. RACTER, THE POLICEMAN'S BEARD IS HALF CONSTRUCTED (1984), http://www.ubu.com/concept/racter.html.

5. Terry Nasta, *Thief of Arts*, PC MAGAZINE, Dec. 25, 1984, at 62, https://books.google.com (search for "terry nasta thief of arts December 25 1984" and select first result).

supercomputer was famously able to defeat the best human contestants on the game show *Jeopardy!*[6] Following that victory, Watson was converted into an inspired chef, generating quadrillions of different ingredient combinations and predicting whether new dishes will be tasty by using artificial intelligence to tease out patterns in regional cuisines.[7]

In recent years, computers have been manufacturing "creative" content at exponentially increasing rates, as the amount of available computing power continues to increase and as efficiency has been enhanced through machine learning. Indeed, one new company is claiming (satirically, it appears) that its computers are already in the process of generating essentially all possible creative text.[8] Claims such as these, coupled with the inexorable march of automation into fields historically dependent on human ingenuity, raise important questions about the extent to which materials developed without human intervention may be protectable under our intellectual property laws.

Fortunately, those aspiring to be the next Shakespeare need not worry much about being accused of copyright infringement by the owners of these machines. The Copyright Office has already announced that it "will not register works produced by a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author."[9] Further, a business model grounded in enforcing such copyrights would not likely succeed because later creators cannot be held liable for copyright infringement if they independently created their own content.[10] On the other hand, it remains conceivable that the owner of a machine that subsequently but independently generated the *Harry Potter* series could compete with its author, J.K. Rowling, in selling the books. To date, however, decisions allowing parallel commercial exploitation of copyrighted works have involved subsequent works of authorship

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6. John Markoff, *Computer Wins on 'Jeopardy!': Trivial, It's Not*, N.Y. TIMES, Feb. 16, 2011, at A1.

7. Leah Hunter, *How Creative Can Computers Be?*, FAST COMPANY, Mar. 14, 2014, http://www.fastcompany.com/3027293/how-creative-can-computers-be (discussing the culinary creations of IBM's supercomputer Watson that "can generate trillions or quadrillions of combinations of ingredients and also predict if a) they will be novel and b) if they will be pleasant").

8. QENTIS, http://www.qentis.com/the company-2/ (last visited May 5, 2015). *But see* Tim Cushing, *New "Company" Claims It Uses Algorithms to Create Content Faster than Creators Can, Making All Future Creations "Infringing"*, TECHDIRT, Sept. 29, 2014, https://www.techdirt.com/articles/20140929/08500728662/new-company-claims-it-uses-algorithms-to-create-content-faster-than-creators-can-making-all-future-creations-infringing.shtml.

9. U.S. COPYRIGHT OFFICE, THE COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES § 306 (3d ed. 2014); *see also* U.S. COPYRIGHT OFFICE, THE COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES § 202.02(b) (2d ed. 1984) , http://copyright.gov/history/comp/compendium-two.pdf ("The term 'authorship' implies that, for a work to be copyrightable, it must owe its origin to a human being.").

10. Three Boys Music Corp. v. Bolton, 212 F.3d 477, 486 (9th Cir. 2000). Note, however, that a prima facie case of infringement can be maintained even where there is no proof that the defendant accessed the copyrighted work if the two works are "strikingly similar." *Id.* at 485.

that were themselves copyrightable.[11] It remains to be seen whether equitable considerations will persuade courts to prevent owners of works generated by brute computational force (and therefore would not be otherwise copyrightable) from piggybacking on the success of identical works made popular by others, or whether legislative intervention in the copyright arena will be required to address these recent technological advances.

In the patent realm, however, there is an even greater chance of collision between our intellectual property laws and approaches to generating content without human input. Indeed, computers are already independently designing genuinely useful inventions in a number of fields.[12] Engineers at Hitachi, for example, programmed a computer that independently designed a new nose cone for the Japanese bullet train, improving the train's aerodynamic performance and reducing the noise level for passengers.[13] Similarly, a computer was programmed to independently design a novel piston geometry that reduced fuel consumption in diesel engines.[14] Computers are also being used to develop new pharmaceutical compounds.[15]

At least one new company, Cloem, is now endeavoring to elevate the art of automated inventing to an entirely different level. Cloem is attempting (*not* satirically, it appears) to use brute-force computing to mechanically compose text for thousands of patent claims covering potentially novel inventions and also to generate defensive publications to prevent others from obtaining patent protection in the same field.[16] Below we consider whether technologies invented by linguistic manipulation should be patentable, as well as the extent to which publication of automatically generated content should be permitted to prevent

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11. *See, e.g.*, Feist Publ'ns, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 345-46 (1991) ("To illustrate, assume that two poets, each ignorant of the other, compose identical poems. Neither work is novel, yet both are original and, hence, copyrightable.").

12. The inventions discussed in this paragraph were generated using a technique called genetic programming. Genetic programming generally starts with a seed set of candidate solutions of known performance. The best-performing candidates are then either reproduced, crossed with each other to generate offspring that have some elements from each of the parents, or randomly mutated. That process of reproduction, crossover, and mutation repeats itself until the software converges on a set of sufficiently "fit" offspring. *See* JOHN R. KOZA, GENETIC PROGRAMMING: ON THE PROGRAMMING OF COMPUTERS BY MEANS OF NATURAL SELECTION 26 (1992). This method was used, for example, by Martin Keane and his co-inventors in obtaining a patent for new general-purpose proportional-integrative-derivative (PID) and non-PID electrical controllers. U.S. Patent No. 6,847,851 (filed Jul. 12, 2002). Neither Keane nor his co-inventors actually chose the layout or even the number of electrical elements in their new controllers; rather, they developed the software that churned through all the generations of potential solutions.

13. ROBERT PLOTKIN, THE GENIE IN THE MACHINE 61 (2009).

14. *Id.*

15. *Id.*; *see also* Computer Designed Stabilized Proteins & Method for Producing Same, U.S. Patent No. 4,908,773 (filed Apr. 6, 1987).

16. *See* OFFICIAL RECORDS – CLOEM, REGISTER OF COMMERCE AND COMPANIES, https://www.infogreffe.fr/societes/entreprise-societe/792987836-cloem-060213B005530000.html?typeProduitOnglet=EXTRAIT&afficherretour=true (last visited Jan. 29, 2015).

others from securing patent protection on independently created inventions.

I. AUTOMATED "INVENTING"

Companies such as Cloem have married processing power with machine learning to provide automated software that invents *en masse* in an "intelligent" manner.[17] Based on an initial set of seed patent claims, software employing automated drafting techniques can create tens of thousands of alternative patent claims by, for example, substituting hyponyms, meronyms, and antonyms for the components of the original seed claims.[18] The technology is evidently still imperfect and generates many nonsensical claims, but it also seems to craft grammatically correct phrases that, taken together, provide interesting variations on the original claims.[19]

There are many potential uses for automatically generated claims, such as:

Prior Art

- The computer-generated claims may serve as prior art to help invalidate other patents.
- Companies can use the computer-generated claims to saturate the technical space around their own patents to prevent competitors from obtaining improvement patents in the same area.
- Companies can also saturate the technical space around competitors' patents to prevent the competitors from subsequently patenting improvements on the competitors' own inventions.

Patenting

- Inventors may improve, broaden, or diversify claims already drafted by a human, using alternative wording and approaches suggested by the software.
- Patent prosecutors can use computer-generated claims as guides for broadening existing specifications to support broader and more diversified sets of claims.
- Applicants can file new or broadened patent applications based directly on the alternative claims generated by the software, or leverage the computer-generated claims as a source of inspiration for new inventions.[20]

II. COMPUTER-GENERATED CLAIMS AS PRIOR ART

Many questions flow from the commercial introduction of automatically generated patent claims. Below, we will first address the extent to which such

17. CLOEM, https://www.cloem.com/flat/technology/ (last visited May 23, 2015).
18. *Id.*
19. *Id.*
20. *Id.*

claims can be, and should be, treated as prior art to subsequent inventions under United States patent law.

A. *Under current law, do automatically generated claims qualify as prior art?*

To serve as prior art under 35 U.S.C. Section 102(b), automatically generated claims would, as a threshold matter, need to constitute a "printed publication."[21] Public accessibility has long been the critical determinant of whether a document qualifies as a "printed publication."[22] Public accessibility requires a showing that the document was "made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence[] can locate it."[23]

In the context of online "publications," courts look to all of the circumstances around disclosure to determine on a case-by-case basis whether a document was publicly accessible.[24] For example, in *Voter Verified, Inc. v. Premier Election Solutions, Inc.*,[25] the Federal Circuit held that an article made available online but not indexed by any general search engine was nonetheless a "printed publication" and could be used as invalidating prior art. The court relied largely on the fact that the article (which related to electronic voting systems, the field of the asserted patent) was available online in Risks Digest (a website dedicated to the risks associated with computer automation). That website, the court found, was well known in the relevant engineering community and contained many other articles related to the field of the invention.[26] The court explained that indexing by search engines is "a relevant factor" but "not a necessary condition."[27] Even though the article may not have been a simple Google search away from discovery, the publication was reasonably accessible to those interested in the risks of computer automation (the target demographic of Risks Digest) because they "would have been independently aware of [] Risks Digest as a prominent forum for discussing such technologies."[28]

Publications generated by companies such as Cloem present nearly the opposite of the situation analyzed in *Voter Verified*. Automatically generated

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21. There are a number of other forms of prior art, including patents, patent applications, or inventions that were in public use, on sale, or otherwise available to the public. 35 U.S.C. § 102(a) (2014). However, computer-generated alternative claims are most likely to fall under the category of "printed publications." *See id.*

22. Suffolk Techs., LLC v. AOL Inc., 752 F.3d 1358, 1364 (Fed. Cir. 2014).

23. *Id.* Public accessibility may also be found even without public availability if the reference had been sufficiently disseminated. *Id.* However, assuming that the sea of mechanically generated claims is not actually being disseminated or accessed, the means of achieving "public accessibility" are omitted from the analysis.

24. Voter Verified, Inc. v. Premier Election Solutions, Inc., 698 F.3d 1374, 1380 (Fed. Cir. 2012).

25. *Id.* at 1380-81.

26. *Id.*

27. *Id.* at 1380.

28. *Id.* at 1381.

publications may each receive their own unique and persistent web address that would presumably yield an indexed URL.[29] Yet these companies do not provide an online forum that fosters a technical community like Risks Digest did in *Voter Verified*, so those interested in the relevant technology would probably not spend much time searching through the links to the software's publications.[30] Furthermore, as the computer-generated claims are currently published alone—devoid of context or technical background surrounding the claim language—it is unclear that they are catalogued in any "meaningful way."[31] If anything, they appear to be published in a manner that would hamper a searcher's ability to find them with conventional search engines. Although these automatically generated claims might technically be retrievable, requiring inventors to sift through millions of results from a search query may be insisting on far more than a "reasonable" search.

Even if the page displaying a computer-generated claim did qualify as a "printed publication," in order to constitute invalidating prior art the publication would also need to be enabling. Enablement is classically described in the *Incandescent Lamp Patent* decision.[32] In that case, inventors Sawyer and Man claimed to have invented the modern incandescent light bulb using "fibrous or textile material" as the filament.[33] The inventors then sued Edison, who had commercialized an incandescent bulb using a portion of bamboo stem, one type of "fibrous" material.[34] The inventors, in contrast, had created their invention using only carbonized paper and wood—another of the multitude of different types of "fibrous" materials.[35] There is not a fundamental characteristic inherent in all "fibrous" materials that make them suitable for use in an incandescent bulb, and the patentees did not provide guidance regarding how to identify the subset of materials that would work as a filament.[36] The Supreme Court held the patent invalid for lack of enablement because it did not teach the public how to create the claimed invention without having to undertake significant additional experimentation.[37]

The current state of the art in computerized inventing produces mere claims—no specification or other background information. Such limited disclosure is likely to cut against the utility of the mechanically generated claims as prior art, since these disclosures will often not be enabled. On the other hand,

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29. *Id.*

30. *See id.*

31. SRI Int'l, Inc. v. Internet Sec. Sys., Inc., 511 F.3d 1186, 1194-98 (Fed. Cir. 2008) (holding that a paper placed on an FTP site but neither indexed nor catalogued in any "meaningful way" was not publicly accessible).

32. Consol. Elec. Light Co. v. McKeesport Light Co., 159 U.S. 465 (1895).

33. *Id.* at 467.

34. *Id.* at 471.

35. *Id.* at 471-73.

36. *Id.*

37. *Id.* at 477.

both patent applicants[38] and patentees confronted with an invalidity challenge[39] still do face a presumption that such prior art is enabled, whether that prior art is an issued patent or non-patent literature. Indeed, "[e]ven if a reference discloses an inoperative device, it is [still] prior art for *all* that it teaches."[40] Patent applicants and infringement plaintiffs might therefore have difficulty overcoming an on-target claim produced by software, especially if used in combination with a more detailed, operational reference in an obviousness context.

Computer-generated claims in their current form may be extraordinarily difficult to locate and, if located, may not be instructive to persons of skill in relevant technological fields; nevertheless, under current law such claims might still be available and useful as defensive prior art. Looking forward, as natural language processing improves and computing power becomes cheaper, automatically generated abstracts or even complete specifications will become feasible and could provide richer context to such alternative claims. In addition, indexing of the web will continue to improve over time. Therefore, absent a change in the law, automatically generated claims will be increasingly available as prior art in the years ahead. The following section discusses whether such a result would be beneficial to society and whether expected technological improvements bolster the case for allowing software-created claims to prevent humans from patenting related inventions.

B. *Should automatically generated claims qualify as prior art?*

The concept of defensive[41] publication is nothing new. For example, Research Disclosure has served since 1960 as a prominent service for disseminating research as prior art when an entity wants to protect itself from competitors without incurring the costs of seeking patent protection on unimportant inventions.[42] IBM has been particularly notorious for defensive publication, publishing so much material that it was given its own section in

38. In re Antor Media Corp., 689 F.3d 1282, 1289 (Fed. Cir. 2012) ("[W]e therefore hold that, during patent prosecution, an examiner is entitled to reject claims as anticipated by a prior art publication or patent without conducting an inquiry into whether or not that prior art reference is enabling.").

39. Robocast, Inc. v. Apple Inc., No. 11-235-RGA, 2014 U.S. Dist. LEXIS 55516, at *27 (D. Del. Apr. 22, 2014) ("I hold that a district court should presume that a prior art printed publication is enabled."); Amgen Inc. v. Hoechst Marion Roussel, Inc., 314 F.3d 1313, 1355 (Fed. Cir. 2003) ("We hold that an accused infringer should be similarly entitled to have the district court presume the enablement of unclaimed (and claimed) material in a prior art patent defendant asserts against a plaintiff [in challenging validity].").

40. In re Antor, 689 F.3d at 1290 (emphasis added) (quoting another source) (internal quotation marks omitted).

41. The benefits of publication without patenting are not necessarily entirely defensive. For example, a company might publish for publicity and prestige. *See also* Scott Baker & Claudio Mezzetti, *Disclosure as a Strategy in the Patent Race*, 48 J.L. & Econ. 173, 177 (2005) (discussing additional offensive benefits of research publication).

42. RESEARCH DISCLOSURE, http://www.researchdisclosure.com/ (last visited May 23, 2015).

Research Disclosure.[43] These disclosures appear to be working, as they have spawned thousands of citations to IBM's publications and have forced competitors to narrow claims and overcome higher hurdles on their paths to obtaining patents.[44] An automated publishing approach departs from historical precedent in major ways, however, especially with respect to the amount and relative proportion of published prior art that is useless and difficult to locate. As such, current approaches to automated publication merit their own analysis.

Patent applicants are assumed to be knowledgeable of an expansive set of prior art. That set of art is sometimes described as "Winslow's tableau," in reference to a case that memorably described its scope. In *In re Winslow*, the court rejected a patent as obvious based on the following caricature of an inventor designing a new packaging machine:

> [F]irst picture the inventor as working in his shop with the prior art references—which he is presumed to know—hanging on the walls around him. One then notes that what applicant Winslow built here he admits is basically a [well-known] bag holder . . . to which he has added two bag retaining pins. If there were any bag holding problem in the [well-known bag holder] machine . . . Winslow would have said to himself, "Now what can I do to hold them more securely?" Looking around the walls, he would see [prior art reference] Hellman . . . . He would then say to himself, 'Ha! I can punch holes in my bags and put a little rod (pin) through the holes . . . as does Hellman."[45]

In other words, "[t]he person of ordinary skill [for purposes of determining obviousness] is a hypothetical person who is presumed to be aware of *all* the pertinent prior art."[46]

The burden on applicants is mitigated in part because applicants are only required to be familiar with analogous prior art.[47] To the extent that automatically generated claims are created by substituting antonyms into original claims or by transposing the original claims to a different technical field,[48] it is possible that such references would not be considered pertinent or analogous prior art, meaning that an applicant would not be held to account for those references.[49] But even when the scope of available prior art is restricted to the

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43. Bill Barrett, *Defensive Use of Publications in an Intellectual Property Strategy*, BIOENTREPRENEUR (2003), http://www.nature.com/bioent/2003/030101/full/nbt0202-191.html#B1.

44. *Id.*

45. 365 F.2d 1017, 1020 (C.C.P.A. 1965).

46. Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc., 807 F.2d 955, 962 (Fed. Cir. 1986) (emphasis added).

47. *Id.*; In re Klein, 647 F.3d 1343, 1348 (Fed. Cir. 2011).

48. *Benefits*, CLOEM (2014), https://www.cloem.com/flat/benefits/.

49. *See* Wyers v. Master Lock Co., 616 F.3d 1231, 1237 (Fed. Cir. 2010) ("Two criteria are relevant in determining whether prior art is analogous: (1) whether the art is from *the same field of endeavor*, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved." (emphasis added) (quoting another source) (internal quotation marks omitted)).

analogous, computers are still capable of generating enormous quantities of information—far more than any human being could read in a lifetime—raising significant policy questions about what legal significance such material deserves.

On one hand, it may not benefit society to lower the threshold of knowledge imputed to a person of ordinary skill in the art to include less than all analogous published material. Indeed, restricting the beneficial use of knowledge already in the public domain might run counter to the foundational objectives of the patent laws.[50] But on the other hand, as the amount of publicly accessible information grows exponentially, it is increasingly unrealistic to presume omniscience on the part of inventors. The patent system is already struggling under the weight of ever-accumulating documentation. The Patent Office, for instance, has been forced to rely increasingly on "crowdsourcing" of prior art searches, calling on the public to help locate relevant prior art, especially non-patent literature.[51] When mechanically generated claims are inevitably overlooked by the Patent Office after being thrown into a nameless heap of prior art rather than published in a well-indexed collection or field-specific journal, the burden of improving patent quality is shifted to the courts to determine *ex post facto* whether such claims should be treated as prior art and, if so, whether that art is invalidating. The primary beneficiary of a regime would arguably be the ecosystem of lawyers and search firms that patent infringement defendants hire to scour the globe for prior art.[52]

In establishing rules addressing whether automatically generated materials qualify as prior art, it would of course be easiest to indiscriminately declare that all such material, or none of it, has legal significance. But we submit that an intermediate approach would be more prudent, and that the seeds of such an approach can be found in the concept of "analogous" art. As discussed above, a reference qualifies as prior art only when it is analogous to the claimed invention, which in turn requires either that (1) the reference is from the same field of endeavor or (2) the reference is "reasonably pertinent" to the problem the inventor sought to solve.[53] But a reference is only "reasonably pertinent" if its relevance is recognizable with the foresight of a person of ordinary skill.[54] If policy suggests that a non-analogous reference should not qualify as prior art because the reference would not "commend[] itself to an inventor's attention in considering his problem," the same result should seemingly apply if a person of ordinary skill would never look to a set of publications that was known to be

50. *See* Graham v. John Deere Co., 383 U.S. 1, 5-6 (1966).

51. *USPTO-led Executive Actions on High Tech Patent Issues*, USPTO (Feb. 20, 2014, 2:35 PM), http://www.uspto.gov/patents/init_events/executive_actions.jsp.

52. *See* Cheryl Milone, *A Powerful New Weapon Against Patent Trolls*, FORBES (Nov. 15, 2012, 5:21 PM), http://www.forbes.com/sites/forbesleadershipforum/2012/11/15/a-powerful-new-weapon-against-patent-trolls/.

53. In re Klein, 647 F.3d at 1348.

54. Scientific Plastic Prods., Inc. v. Biotage AB, 766 F.3d 1355, 1359 (Fed. Cir. Sept. 10, 2014).

almost entirely useless.[55] In the current era, it seems sensible to focus the inquiry on what resources people of skill in the pertinent art would actually look to, and what they would not reasonably consider, in determining what constitutes prior art to a particular invention.

The recommended analysis would be undertaken on a case-by-case basis and would heavily emphasize the quality of the output generated by a computer's algorithms.[56] On one end of the spectrum, if a computer generated a focused set of high-quality variations on claim language, then it would be easier to justify folding such knowledge into the scope of the prior art. At the other end of the spectrum, if a computer published millions of variations of claims such that all but a few were useless from a technical or grammatical perspective, then it would be easier to justify not requiring inventors to account for that sea of information. The manner and locations in which such variations were published, including the ease of locating that information, would also continue to be factors in the analysis.[57] In *Voter Verified*,[58] for instance, it was important that the Internet domain that housed the publications in question served as a resource to those of ordinary skill in the particular art at issue. Recognizing these considerations as factors central to the analysis not only seems equitable but also would incentivize claim-generating companies to improve the intelligence of their algorithms.

Such an approach would also accord with the public policy behind the written description and enablement requirements, which is to force inventors to contribute contributive to advancing the general storehouse of public knowledge in exchange for granting them a government-sanctioned monopoly.[59] Publishing masses of nonsense achieves the opposite of what these requirements seek to accomplish—it dilutes the set of actual public knowledge, burying genuinely useful information and leaving society worse off. Rewarding private companies for flooding the Internet with mostly inoperable and irrelevant publications would also impose considerable burdens on both their competitors and the Patent Office. Thus, there are good policy reasons to conclude that endless volumes of largely nonsensical, computer-generated text resulting from insufficiently guided processing should not be accorded prior art status.

The approach outlined above also comports with the longstanding application of our patent laws in a manner that embraces unexpected

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55. *See id.* (quoting another source) (internal quotation marks omitted).

56. It is unclear how efficient Cloem's algorithm is. It appears likely, however, that a substantial portion of Cloem's alternate claims are nonsensical. *See F.A.Q.*, CLOEM (2014), https://www.cloem.com/flat/faq/ ("Why are so many cloems imperfect?").

57. The analysis would also take into account the education level and experience of people having ordinary skill in the art. *See* Mintz v. Dietz & Watson, Inc., 679 F.3d 1372, 1376 (Fed. Cir. 2012) ("Factors that may be considered in determining level of skill include: type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.") (quoting another source) (internal quotation marks omitted).

58. *See* 698 F.3d at 1380-81.

59. *See* Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 481 (1974).

technological developments. Courts have recognized that "times change," and for that reason flexibility is built into the system.[60] For example, "Section 101 [addressing patentable subject matter] is a dynamic provision designed to encompass new and unforeseen inventions. A categorical rule denying patent protection for inventions in areas not contemplated by Congress . . . would frustrate the purposes of the patent law."[61] There are already many instances in which computer-generated content is intelligible, innovative, and locatable by persons of skill, and meaningfully advances the state of technology. Eliminating incentives for sharing such content would hold back the progress of the useful arts, arguably in a manner contrary to the Constitutional mandate our federal intellectual property laws are predicated on. With these considerations in mind, we conclude that mechanically generated claims should, under the proper circumstances, be treated as prior art and that a balancing analysis should be employed to resolve whether the claims will be treated as prior art under the facts of each individual case.

III. PATENTABILITY OF COMPUTER-GENERATED INVENTIONS

The advent of computerized inventing leads to an additional set of questions regarding the patentability of innovations that results from such undertakings. As a general matter, if an invention described by computer-generated claims is patentable and distinct from original seed claims, then a patent applicant can apply for patent protection on the invention first described by software.[62] The concept of computer-generated invention is not novel. In the fields of chemistry and biology, for example, computers have been used for years in the invention of new compounds with desirable properties, even where the final, innovative compound was not derived by seeding the software with initial or target structural data.[63] Computers have also invented numerous electrical products that were previously independently invented and patented by others.[64]

There is reason to believe that at least some of these computer-conceived inventions will be treated as patentable. Indeed, patents have already been granted on inventions that were designed fully or in part by software.[65] There is also,

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60. *See* Bilski v. Kappos, 561 U.S. 593, 605 (2010).

61. *Id.* (citations omitted) (quoting other sources) (internal quotation marks omitted).

62. MPEP § 804 (9th ed.).

63. *See, e.g.*, Daniel Riester et al., *Thrombin Inhibitors Identified by Computer-assisted Multiparameter Design*, 102(24) PROC. NAT'L ACAD. SCI. U.S.A. 8597, 8597 (2005) (discussing the use of computer-assisted drug discovery starting "from a set of randomly chosen compounds").

64. *See, e.g.*, JOHN R. KOZA ET AL., GENETIC PROGRAMMING IV: ROUTINE HUMAN-COMPETITIVE MACHINE INTELLIGENCE 553 (2003) (discussing 21 electrical engineering patents that were independently invented by genetic programming), *preview* https://books.google.com/books?id=u8DZRPsh9VIC&lpg=PA581&dq=koza%20genetic%20programming%20IV%20553&pg=PA553#v=onepage&q&f=false.

65. *E.g.*, *CADD Center Patents*, University of Maryland School of Pharmacy, http://cadd.umaryland.edu/CADD_publications.shtml (last accessed Jan. 5, 2014). *Compare, e.g.*, Koza et al., *supra* note 64, at 553 (discussing a PID controller first invented by genetic

superficially at least, statutory support for the notion that computer-conceived inventions should be patentable. 35 U.S.C. Section 103 states: "Patentability shall not be negated by the manner in which the invention was made."[66] Case law applying that statute holds that the fact that an invention was created effectively by accident (similar to the computer's linguistic iterations in our analysis) rather than by focused research is immaterial.[67] But a deeper analysis of Section 103 suggests that it was not actually intended to permit computer-generated inventions to be patented. The legislative history behind the statute indicates that the sentence above was added to make clear that "it is immaterial whether [the invention] resulted from long toil and experimentation or from a flash of genius."[68] For example, a year of trial-and-error testing of different solvents in order to create the first reliable aerosol antiperspirant (which subsequently became known as Arrid) did not cut against its patentability by way of obviousness.[69] In other words, that portion of Section 103 was intended to direct courts to disregard whether an invention was conceived in a "eureka" moment or through random success. It was intended to address the process of invention undertaken by human inventors, not machines.

The courts do not appear to have explicitly ruled on whether computer-conceived inventions are patentable.[70] Of a sampling of issued patents that were conceived wholly or in part by computers,[71] none have ever been subject to litigation. However, only one or two percent of patents are ever subject to litigation,[72] and therefore the chances that one of the limited number of computer-conceived patents would have already found itself in court is relatively small. Interestingly, none of the patents in our sample appear to have been sold to a private buyer,[73] but given that many patents are never successfully monetized,[74] this limited set of data points also does not necessarily suggest that the market has

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programming), *with* U.S. Patent No. 6,847,851 (filed July 12, 2002) (issued patent on the aforementioned PID controller).

66. *See also* 35 U.S.C. § 103 (1952) (amended 2011).

67. *See* Oscar Mayer Foods Corp. v. ConAgra, Inc., No. 94-1247, 1994 U.S. App. LEXIS 36261, at *11-12 (Fed. Cir. Dec. 22, 1994).

68. 35 U.S.C. § 103 (Historical and Revision Notes).

69. Carter-Wallace, Inc. v. Gillette Co., 675 F.2d 10, 14 (1st Cir. 1982).

70. For example, a search for patent cases discussing genetic programming or computer-aided drug discovery (perhaps the two most common means of computerized inventive activity) yielded no pertinent results. *See* Plotkin, *supra* note 14, at 60.

71. U.S. Patent Nos. 4,908,773, 6,847,851, 7,521,463, 7,915,245, 8,053,477, 8,338,464, 8,445,537, 8,450,368, 8,476,273.

72. Kenneth Lustig, *No, the Patent System Is Not Broken*, FORBES (Feb. 9, 2012, 11:25 AM), http://www.forbes.com/sites/forbesleadershipforum/2012/02/09/no-the-patent-system-is-not-broken/.

73. *Assignment Search*, USPTO, http://assignment.uspto.gov/. Note that the '773 patent was assigned by original assignee Genex Corporation to Enzon, Inc. only a few days before Enzon announced its plan to acquire the entire company.

74. *Cf.* Alina Tugend, *Taking an Invention from Idea to the Store Shelf*, N.Y. TIMES, Aug. 23, 2013, at B5 (noting that only three percent of InventHelp's clients obtained licensing deals for their inventions).

issued its own *de facto* negative opinion about the patentability of computer-conceived inventions.This discussion, of course, presupposes that the mechanically generated claims are patentably distinct from the original seed claims, lest the applicant receive a statutory or obviousness-type double patenting rejection (or be forced to file a terminal disclaimer).[75] However, given the process by which companies such as Cloem generate patent claims, the claims that are most likely to describe genuinely useful inventions seem more likely than average to run into obviousness problems. The linguistic software, for instance, often simply adds or deletes phrases.[76] Thus, these software-generated claims would often involve some combination of mechanical parts or perhaps some limited set of parts rearranged in a particular way. This is likely to be problematic because "[w]hen . . . there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options [and if] this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense."[77] Intuitively, it also seems clear that of the few technically feasible inventions described by such software, many or most are likely to be the result of relatively slight rearrangement, and these minor modifications that work in predictable ways would by definition be considered obvious.[78] Nonetheless, if the software does manage to produce some genuine innovation, those alternative claims could be patentable. This raises a number of additional questions, such as whether they *should* be patentable and, if so, who the inventor should be. Those issues are addressed in the following subsections.

A. *Who is the inventor of subject matter first described by computer-generated claims?*

The applicant for a patent is required by law to identify and provide a declaration from the inventor or inventors of the advances for which a patent is sought.[79] The patent statutes on their face do not allow for a computer to be listed as an inventor. The patent statutes define "inventor" to mean "the *individual* . . . who invented or discovered the subject matter of the invention."[80] The statutes also describe joint inventors as the "two or more *persons*" who conceived of the invention.[81] In accord with these statutes, the courts have long cited to Congressional intent when describing patentable subject matter as conceivably extending to "anything under the sun that is made *by man*."[82] The

75. MPEP § 804 (9th ed.).

76. *Technology*, CLOEM, https://www.cloem.com/flat/technology/ (2015).

77. KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007).

78. *See id.*

79. 35 U.S.C. § 115(a).

80. *Id.* § 100(f) (emphasis added).

81. *Id.* § 116(a) (emphasis added).

82. Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980) (quoting another source) (internal quotation marks omitted). Note, however, that Supreme Court jurisprudence regarding eligible subject matter has evolved, although not in a manner that seems to eviscerate the implication

Federal Circuit, for instance, has explicitly barred legal entities from obtaining inventorship status because "*people* conceive, not companies."[83] Similarly in other contexts, courts routinely decline to extend legal rights to entities other than natural persons, such as animals.[84] Against this background, it seems highly unlikely that courts would bestow inventorship status on a computer.

We therefore turn to the question of which humans (if any) are most properly labeled an inventor of advances generated by a computer. This question is important for many reasons, in part because a patent that improperly omits an inventor may be held unenforceable[85] and because patent ownership often turns on the identity of the inventors.

An inventor is one who "conceives" of an invention, and conception requires a "definite and permanent idea of the complete and operative invention."[86] In the case of multiple entities working together to collectively conceive a single invention, each entity is considered a co-inventor even if he or she "did not make the same type or amount of contribution" to the ultimate invention.[87] All that is required to be a joint inventor is that the person contributed to the conception of an important or necessary component of the claimed invention in a manner that required more than just the exercise of ordinary skill.[88]

Demarcating more specifically the types of contributions that rise to the level of co-invention can be quite difficult. *Levin v. Septodont, Inc.* provides an illustration of how that line has been drawn in practice.[89] In that case, plaintiff Dr. Levin had the idea for an anesthetic and antiseptic mouth rinse that could be used by dental patients after their procedures, both to reduce pain and to prevent infection.[90] Dr. Levin approached Dr. Kilday and solicited suggestions for chemical ingredients that would serve those objectives. Dr. Kilday recommended benzocaine as the anesthetic and phenol as the antiseptic.[91] However, these ingredients needed to be dissolved in a rinsing liquid, and using alcohol as a

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that an inventor be human. *See, e.g.*, Alice Corp. v. CLS Bank Int'l, 134 S. Ct. 2347 (2014).

83. New Idea Farm. Equip. Corp. v. Sperry Corp., 916 F.2d 1561, 1566 n.4 (Fed. Cir. 1990) (emphasis added).

84. People ex rel. Nonhuman Rights Project, Inc. ex rel. Tommy v. Lavery, No. 518336, slip op. 8531 (N.Y. App. Div. Dec. 4, 2014) (holding that a chimpanzee is not a "person" entitled to the rights and protections afforded by the writ of habeas corpus), http://scholar.google.com/scholar_case?case=113498006843
90338164&hl=en&as_sdt=2006.

85. Stark v. Advanced Magnetics, Inc., 119 F.3d 1551, 1555 (Fed. Cir. 1997) (holding that section 256, which provides for corrections to inaccurate inventorship as required under section 115, "allows addition of an unnamed actual inventor [to avoid unenforceability], but this error of nonjoinder cannot betray any deceptive intent by that inventor").

86. Tavory v. NTP, Inc., 297 Fed. Appx. 976, 979 (Fed. Cir. 2008) (quoting another source) (internal quotation marks omitted) (non-precedential).

87. 35 U.S.C. § 116(a).

88. Hess v. Advanced Cardiovascular Sys., 106 F.3d 976, 980 (Fed. Cir. 1997).

89. 34 Fed. Appx. 65 (4th Cir. 2002).

90. *Id.* at 67.

91. *Id.*

solvent (the easiest choice) caused undesirable burning.[92] Dr. Levin then approached Eastman Chemical Company for assistance in developing a nonalcoholic solvent in which the active ingredients could be suspended.[93] The mouth rinse was eventually patented, and the patent them became embroiled in litigation. During the litigation, a manufacturer argued that the patent was unenforceable because it failed to name Dr. Kilday as the inventor. The manufacturer contended that Dr. Kilday had to be named as in inventor because he had suggested the active ingredients that were explicitly enumerated in the claims of the patent.[94] The court, however, disagreed, finding that the explicit listing of his suggestions in the claim limitations was insufficient to qualify him as a co-inventor.[95] As the court explained, the inventorship inquiry requires consideration of "whether the contribution helped to make the invention patentable," and there the ingredients were not critical to making the invention nonobvious.[96] According to that court and others, co-inventorship requires a contribution that is "not insignificant in quality, when that contribution is measured against the dimension of the full invention."[97]

1. *The Original Inventors and Claim Drafters*

At least in the abstract, where improvements to an existing invention were devised automatically by computer software, the inventors of the original invention used to seed the claim-generating software and possibly also the drafters of the claims used to seed the software seem most likely to qualify as co-inventors of the resulting claims. Barring an unrecognizable transformation between the seed claims and the final claims, both of these sets of people seem—again in the abstract—more likely than anyone else to have contributed at least one or more of the important or necessary limitations found in the resulting claims.[98] The mere fact that a computer assisted with the process should not prevent these people from claiming inventorship. It is well-settled, after all, that an inventor can use "the services, ideas, and aid of others in the process of perfecting his invention without losing his right to a patent."[99] Whether linguistic manipulation by software would rise beyond such contributions to the level of co-inventorship is a fact-specific inquiry[100] and would likely depend on how materially the new claims departed from the original seed claims.

However, even if a limitation conceived by the original inventors or seed claim drafters is found in the final claims, their contribution still may not be

92. *Id.*
93. *Id.*
94. *Id.* at 68.
95. *Id.* at 72.
96. *Id.*
97. *Id.* at 70-71 (quoting Pannu v. Iolab Corp., 155 F.3d 1344, 1351 (Fed. Cir. 1998)).
98. *See* Tavory, 297 Fed. Appx. at 979; Hess, 106 F.3d at 980.
99. Hess, 106 F.3d at 981 (quoting another source) (internal quotation marks omitted).
100. *Id.*

sufficient to confer inventorship status. For example, in *Tavory v. NTP, Inc.*, the plaintiff filed an action to add himself as an inventor of several of the defendant's patents, which covered the delivery of email to pagers.[101] The plaintiff alleged he conceived of the "interface switch" that allowed the email network to actually interface with the radiofrequency network used by pagers that operated on a different protocol.[102] The "interface switch" was an explicit limitation found in multiple claims in each patent and was indisputably a vital component of the inventions because it was obviously required by the very nature of the idea.[103] The court, however, upheld a finding that the plaintiff did not exercise more than ordinary skill in the art simply because he wrote the software that enabled the interface switch to actually function; merely bringing the switch to life in reducing the claimed invention to practice was insufficient to warrant a reward of inventorship status where the necessity of the switch was obvious.[104] Therefore, even if the drafters or inventors of the original seed claims conceived of a limitation explicitly found in and vital to the resulting claims, if the inclusion of such a limitation would have been obvious to one of ordinary skill in the art, those persons may not qualify a co-inventor.

2. *The Software and Hardware Developers*

Other potential candidates for co-inventorship include the authors of the software used to generate the claims and the architects of the computer hardware on which the software was operated. However, it seems less likely, at least in the abstract, that these individuals would qualify as co-inventors.[105]

"[I]t is undisputed that this [Section 116 joint inventorship] language require[s] some form of collaboration," that joint inventors must be "working toward the same end," and that each inventor must contribute some element of the invention (as distinguished from a tool used, in turn, to provide such a contribution).[106] On one hand, the authors of the software and architects of the computer hardware may satisfy the collaboration requirement. Cases denying joint inventorship for lack of "collaboration" often do so only in the context of completely independent action.[107] It is conceivable that the act of coding software

101. Tavory, 297 Fed. Appx. at 977-78.

102. *Id.* at 979.

103. *Id.*

104. *Id.* at 979-80.

105. 35 U.S.C. § 116(a) does allow for joint inventorship even if the inventors did not (1) physically work together or at the same time, (2) make the same type or amount of contribution, or (3) each make a contribution to the subject matter of every claim.

106. Kimberly-Clark Corp., 973 F.2d at 916.

107. *Compare, e.g., id.* at 917 (denying joint inventorship status where the invention was independently conceived by colleagues), *with* Arbitron, Inc. v. Kiefl, No. 09-CV-04013 (PAC), 2010 U.S. Dist. LEXIS 83597, at *16-17 (S.D.N.Y. Aug. 13, 2010) (holding that a mere "quantum of collaboration" was required to sufficiently plead that prong of the test for inventorship).

designed to process a set of seed claims could exhibit the requisite "quantum of collaboration or connection" necessary to obtain status as a joint inventor. After all, "The test for establishing a quantum of collaboration . . . is not demanding and requires only an element of joint behavior. The test has been satisfied by [] tenuous collaborations . . . ."[108]

On the other hand, random collaboration is not sufficient—the joint inventors must be "working toward the same end" to be considered co-inventors.[109] Engineers who merely coded general purpose linguistic manipulation routines would generally have no idea what specific "end" their software would be used to "work[] toward" when run.[110]

The more formidable barrier to such actors qualifying as co-inventors is the "contribution" requirement. A software engineer who simply wrote general-purpose claim-generating code seemingly would not have contributed an important or necessary element of *the claimed invention*. Instead, they would merely have contributed *a tool* used by others to generate such contributions themselves. The same could be said of the architect of general-purpose computing hardware used to generate claims. In addition, even if such actors did make some sort of contribution to the ultimate invention, that contribution likely would not have involved the exercise of "more than just the exercise of ordinary skill" in the art to which the invention was directed. Indeed, as skilled as such people might be in designing computer hardware or coding software, they might have no skill at all in the art of the invention. Absent additional facts,[111] it would generally seem improper to consider these classes of actors as inventors of subject matter developed by downstream uses of tools they helped build.[112]

We now turn to the more fundamental question of whether automatically generated claims should be patentable at all.

B. *Should mechanically generated claims be patentable?*

A well-functioning patent regime is sufficiently important to have been called

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108. Arbitron, 2010 U.S. Dist. LEXIS 83597 at *17.

109. Kimberly-Clark Corp. v. Procter & Gamble Distrib. Co., 973 F.2d 911, 916 (Fed. Cir. 1992).

110. *Id.*

111. For instance, there would be a stronger argument for co-inventorship by developers of software specifically designed to improve a narrow class of technology, particularly in situations where a coder could point to specific subject matter introduced through the code that ended up as an element of the claims.

112. Resolution of issues such as these is likely to become even more complex as technology continues to evolve. As an extreme example of this, many technologists believe we are approaching the "singularity," the point in time when computers themselves will be able to invent increasingly more intelligent computers, resulting in a cycle of innovation that could spin rapidly out of control. Alva Noe, *The Ethics of the 'Singularity'*, NPR (Jan. 23, 2015 11:29AM), http://www.npr.org/blogs/13.7/2015/01/23/ 379322864/the-ethics-of-the-singularity. Developments such as those may necessitate significant revisions our entire intellectual property regime, not just our approach to analyzing questions of inventorship.

for by the Constitution. Article I, Section 8 of the Constitution empowered Congress "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." And as discussed above, some mechanically generated claims might technically be patentable under our current laws. That, however, does not mean that such claims *should* be patentable, particularly if the claims do not "promote the Progress of Science and useful Arts." But it is not clear that the law has failed to keep pace with technology in this regard. Why would the Patent Office not grant patents on computer-generated claims if they are useful, novel, non-obvious, supported by a written description, clearly articulated, and enabled,[113] just like any other patented claims?

In the context of invention by computer-powered linguistic manipulation, the type of work and ingenuity required may be different than that required for other types of computer-generated inventions. But the outcome is similar. Given that some entity would have to expend resources sifting through a mountain of computer-generated claims and determining whether a claim is actually useful, if a claim meets all the requirements of a patentable invention, has society not benefited from such diligence? Allowing such patents would reward not only those that perform the manual labor of identifying patentable inventions but also those that develop and improve computerized invention software itself. Producing such sophisticated software is incredibly complex and time-consuming,[114] to the point that it is undoubtedly more technologically complicated than the vast majority of inventions that have historically been patented.[115] Companies that invent in this manner arguably accelerate inventive activity, and that acceleration is, in and of itself, the type of innovation that society should desire to[116]—and already does[117]—reward with patents.

CONCLUSION

Our intellectual property system is suffering from growing pains in the digital age. The foundational principles of the system, and many of the laws implementing those principles, were developed in an era when steam engines and manual typewriters were cutting-edge technologies. Whereas existing copyright

113. 35 U.S.C. §§ 101, 102, 103, 112.

114. *See, e.g.*, David Ferrucci et al., *Building Watson: An Overview of the DeepQA Project*, 31 ASS'N FOR ADVANCEMENT ARTIFICIAL INTELLIGENCE 59, 59 (2010) (noting that IBM's Watson computer required "three years of intense research and development by a core team of about 20 researchers"), http://www.aaai.org/ojs/index.php/aimagazine/article/view/2303/2165.

115. *E.g.*, Beerbrella, U.S. Patent No. 6,637,447 (filed Oct. 19, 2001) ("The present invention provides a small umbrella ('Beerbrella') which may be removably attached to a beverage container in order to shade the beverage container from the direct rays of the sun.").

116. Gene Quinn, *Is IBM's Watson Still Patent Eligible*, IP WATCHDOG (May 13, 2013), http://www.ipwatchdog.com/2013/05/13/is-ibms-watson-still-patent-eligible/id=40264/.

117. *See* Computer Designed Stabilized Proteins and Method for Producing Same, U.S. Patent No. 4,908,773 (filed Apr. 6, 1987).

laws seem sufficiently robust to prevent the computerized equivalent of an army of monkeys from overrunning the Copyright Office, the same cannot necessarily be said of our patent laws. Our current patent laws do not seem particularly well-suited to handling the proliferation of computer-generated publications and inventions that may soon be headed toward the Patent Office and, thereafter, to the courts. While it seems sensible to treat at least some computer-generated claims as patentable and as prior art to other patents, careful thought must be given to establishing limits beyond which legal significance will not be accorded to such subject matter.

With respect to automated generation of defensive prior art, allowing companies to flood competitors with a sea of predominantly useless references would impose burdensome externalities on the Patent Office as well as other patent applicants, arguably without a commensurate benefit to society; in contrast, targeted and thoughtful publications, even of content generated by computers, could be beneficial. With respect to patenting computer-generated inventions, according some protections would be consistent with the Constitutional objective of advancing the progress of the useful arts; however, it would be helpful to have clearer standards delineating when such protections are and are not available (and, when available, who the beneficiaries of such protections would be).

The good news is that our present system remains reasonably well-suited to adjudicating the patentability questions of our time. Despite the unprecedented pace of recent technological progress, the majority of newly arising issues can still be resolved under longstanding principles of law. The extent to which brute-force computing coupled with artificial intelligence will require a departure from traditional legal doctrines remains to be seen, but ought to be determined promptly. The time has arrived for our federal courts and legislature to begin more carefully considering how computer-generated inventions should be treated in the patent ecosystem.