To: Andrei Iancu, Under Secretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office ("USPTO")

From: Nina Brown, J.D., Assistant Professor, Media and Communications Law, S.I. Newhouse School of Public Communications, Syracuse University

Date: December 6, 2019

Re: Response to Request for Comments on Intellectual property Protection for Artificial Intelligence Innovation

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Director Iancu:

I write in response to the questions published by the USPTO on October 30, 2019 related to the impact of artificial intelligence inventions on patent law and policy and request for public comments. My responses to these inquiries, below, is based on a more than 2-year research focus on the precise question of whether and when works produced by an algorithm should be eligible for copyright protection. I have also attached a copy of a law review article I wrote on this precise topic, *Artificial Authors: A Case for Copyright in Computer-Generated Works*, published in Fall 2018 with the Columbia Science and Technology Law Review.

Apart from that specific research project, I have dedicated a considerable amount of my career as both a practicing attorney and professor to the study and practice of copyright law. I have been a professor at the S.I. Newhouse School of Public Communications at Syracuse University since 2015, and prior to that I practiced at the law firm Hancock & Estabrook. I graduated from Cornell Law School in 2010.

If I can be of further assistance to your office on this matter, please do not hesitate to reach out to me. I can be reached at: nmibrown@syr.edu, 315-443-9330.

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1. Should a work produced by an AI algorithm or process, without the involvement of a natural person contributing expression to the resulting work, qualify as a work of authorship protectable under U.S. copyright law? Why or why not?

Yes, a work produced by an AI algorithm or process, without the involvement of a natural person contributing to the expression to the resulting work, should be *eligible* to qualify as a work of authorship protectable under U.S. copyright law. That is, it must also meet the requirements of originality and fixation.

Such protection would directly advance copyright's purpose of encouraging the production of original literary, artistic, and musical expression for the good of the public—"the Progress of Science and useful Arts."[1] The goal, after all, is *progress*, and this objective is no less served if it is achieved by computers, humans, or a combination thereof. Certainly, the increased production of creative works constitutes progress within the meaning of copyright law. That these works have been produced by machines is arguably evidence of progress, in that humans have given machines the ability to contribute to the wealth of arts and literature available for consumption.

Here, some examples prove illustrative. Increasingly sophisticated artificial intelligence ("AI") software can teach computers to create music,[2] art,[3] short films,[4] poetry,[5] and news stories.[6] Since 2014, the Associated Press has used AI to produce quarterly earnings articles.[7]

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[1] U.S. CONST. art. I, § 8, cl. 8.

[2] Amy X. Wang, *The Musical AI is Now Working on Its Debut Album(s)—and Wants to do the Beatles better than the Beatles*, QUARTZ (Oct. 18, 2016), https://qz.com/812231/sony-is-making-an-artificial-intelligence-algorithm-that-writes-perfect-hit-making-songs/.

[3] Tim Nudd, *Inside 'The Next Rembrandt': How JWT Got a Computer to Paint like the Old Master*, ADWEEK (June 27, 2016), http://www.adweek.com/brand-marketing/inside-next-rembrandt-how-jwt-got-computer-paint-old-master-172257/.

[4] Annalee Newitz, *Movie Written by Algorithm Turns Out to be Hilarious and Intense*, ARS TECHNICA (June 9, 2016, 6:30 AM), https://arstechnica.com/gaming/2016/06/an-ai-wrote-this-movie-and-its-strangely-moving/.

[5] Matt Reynolds, *Neural Network Poetry is So Bad We Think it's Written by Humans*, NEW SCIENTIST (July 7, 2017), https://www.newscientist.com/article/2140014-neural-network-poetry-is-so-bad-we-think-its-written-by-humans/.

[6]Ravi Somaiya, *The A.P. Plans to Automate Quarterly Earnings Articles*, N.Y. TIMES (June 30, 2014), https://www.nytimes.com/2014/07/01/business/media/the-ap-plans-for-computers-to-write-corporate-earnings-news.html?_r=0.

[7] Somaiya, *supra* note 7.

The Washington Post also employs automated technology, which helped it deliver more than 850 stories in 2017 alone about political races, local sports, and more.[8] Dozens of companies are exploring the field of computer-generated music, and Sony has already released songs created by artificial intelligence.[9]

Perhaps most impressive is that AI is beginning to produce art that is hard to distinguish from human-created art. As this technology continues to advance, AI programs will only become better at simulating human creation. A competition at Dartmouth College capitalizes on this growth, and judges "poetry, literature, music and dance created by machines against works created by humans. Awards are given to the artificial intelligence creations that are the most indistinguishable from human work."[10] These examples represent a small sample of what AI-generated work exists, and what is possible.

Denying copyrights for computer-generated works runs the risk of stifling innovation. Copyright law bestows broad—and valuable—exclusive rights to authors of original works.[11] These rights serve as a bunch of carrots dangled to incentivize new works. Indeed, the primary objective of copyright law "is to encourage the production of original literary, artistic, and musical expression for the good of the public."[12] To further this goal, the law automatically protects fixed original works of authorship.[13] Based on these two requirements of fixation and originality, it seems plausible that a computer-generated work could earn copyright protection (consider one of the songs created by Sony's algorithm, for example, which easily meets the

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[8] Lucia Moses, *The Washington Post's Robot Reporter Has Published 850 Articles in the Past Year*, DIGIDAY (Sept. 14, 2017), https://digiday.com/media/washington-posts-robot-reporter-published-500-articles-last-year/.

[9] Stuart Dredge, *AI and Music: Will We Be Slaves to the Algorithm?*, THE GUARDIAN (Aug. 6, 2017), https://www.theguardian.com/technology/2017/aug/06/artificial-intelligence-and-will-we-be-slaves-to-the-algorithm.

[10] *Creative Turing Tests 2017 Winners,* BREGMAN.DARTMOUTH.EDU, http://bregman.dartmouth.edu/turingtests/2017Winners (last visited Mar. 30, 2018).

[11] Stephen E. Siwek, *Copyright Industries in the U.S. Economy: The 2003-2007 Report*, 2009 INT'L INTELL. PROP. ALLIANCE, 1, 10-12 (June 2009) (illustrating the specific value added estimates produced by the U.S. Bureau of Economic Analysis ["BEA"]); *Copyright and The Public Domain*, UNIV. OF CHI., https://www.lib.uchicago.edu/copyrightinfo/pubdomain.html (last visited Mar. 31, 2018).

[12] Fogerty v. Fantasy, Inc., 510 U.S. 517, 524 (1994).

[13] 17 U.S.C.A. § 102(a) (1976); S*ee,* Star Athletica, L.L.C. v. Varsity Brands, Inc., 137 S. Ct. 1002, 1008 (2017).

threshold for originality, and is fixed). But the United States Copyright Office has explicitly taken the position that to have a copyright, the author must be human.[14]

As a result, all works created by artificially intelligent programs enter the public domain upon creation, free for anyone to use and distribute. The carrot is removed: no promise of copyright exists to encourage growth in such creative works. Some commentators suggest this is the proper outcome because computers cannot be "encouraged" to create new works.[15] But this argument ignores the possibility that without copyright protection, innovators may eventually shy away from investing their time and effort in this field. Just as "the motivation to produce would be diminished if an author knew that once a novel was written, a picture painted, or a song composed, anyone could reproduce or otherwise exploit it,"[16] so too will the motivation of inventors to write computer code that does the same thing.

The fields of artificial intelligence and machine learning have been consistently and rapidly growing. Projections suggest they could lead to "economic hypergrowth"[17] and become a $70 billion industry by 2020.[18] This "exponential growth in computing power is poised to take

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[14] U.S. COPYRIGHT OFFICE, COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES § 313.2 (3d ed. 2017); Naruto v. Slater, No. 15-CV-04324-WHO, 2016 WL 362231, at *8–10 (N.D. Cal. Jan. 28, 2016) (dismissing copyright claim filed on behalf of a monkey); Naruto v. Slater, 888 F.3d 418, 426 (9th Cir. 2018) (affirming dismissal and holding that the Copyright Act does not expressly authorize animals to file copyright suits under the statute). Both cases will be discussed in greater length in section III(C)(3), *infra*.

[15] Steve Schlackman, *The Next Rembrandt: Who Holds the Copyright in Computer Generated Art?,* ART L. J. (Apr. 22, 2016), http://alj.orangenius.com/the-next-rembrandt-who-holds-the-copyright-in-computer-generated-art/.

[16] *Id.*

[17] Thomas Frank, *Machine Learning Could Lead to Economic Hypergrowth, New Research Suggests*, CNBC (Oct. 21, 2017, 9:50 AM), https://www.cnbc.com/2017/10/21/machine-learning-could-lead-to-economic-hypergrowth-new-research-suggests.html; Philippe Aghion et al., *Artificial Intelligence and Economic Growth*, 4–34 (Nat'l Bureau of Econ. Research, Working Paper No. 23928, 2017), https://web.stanford.edu/~chadj/AI.pdf; Mark Purdy & Paul Daugherty, *How AI Boosts Industry Profits and Innovation*, ACCENTURE (2017) (Accenture research shows that AI has the potential to boost rates of profitability by an average of 38 percent by 2035 and lead to an economic boost of US$14 trillion across 16 industries in 12 economies by 2035), https://www.accenture.com/t20171005T065812Z__w__/us-en/_acnmedia/Accenture/next-gen-5/insight-ai-industry-growth/pdf/Accenture-AI-Industry-Growth-Full-Report.pdfla=en?la=en.

[18] Shlomit Yanisky-Ravid & Luis Antonio Velez-Hernandez, *Copyrightability of Artworks Produced by Creative Robots and Originality: The Formality-Objective Model*, 19 MINN. J.L. SCI. & TECH. 1, 6 (2018).

creative machines from novelties to major drivers of economic growth."[19] Denying a copyright for the works created by algorithms risks turning otherwise interested innovators away from developing AI that could contribute to the arts.

Yet the Copyright office has determined that only humans may be authors. In its 2017 Compendium of U.S. Copyright Practices, the Copyright Office details two major categories of non-human works barred from copyright protection: nature-made and machine-made. As examples of nature-made works ineligible for copyright protection, the Office lists a mural painted by an elephant, driftwood that has been shaped and smoothed by the ocean, a song naming the Holy Spirit as the author of the work, and a photograph taken by a monkey.[20] These exclusions make sense. One of the purposes of copyright law is to incentivize authors to create new works. Conferring copyright protection on their works does not encourage an elephant, the ocean, the Holy Spirit, or a monkey to produce more works.[21]

The second excluded category covers works "produced by a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author."[22] Among the listed examples, the Office lists "a mechanical weaving process that randomly produces irregular shapes in the fabric without any discernible pattern;" "[t]ransposing a song from B major to C major;" "[m]edical imaging produced by x-rays, ultrasounds, magnetic resonance imaging, or other diagnostic equipment;" and "[r]educing or

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[19] Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C. L. REV. 1079, 1079–80 (2016).

[20] *Id*.; *see also* Naruto v. Slater, No. 15-CV-04324-WHO, 2016 WL 362231, at *3 (N.D. Cal. Jan. 28, 2016) (holding that a photograph taken by Naruto, a monkey, cannot be an author within the meaning of the Copyright Act).

[21] However, there is an argument that those who teach the elephant to paint, or the monkey to take a selfie, are the artists who might be incentivized to assist in the creation of new works if those works were protected, and that denying copyright protection results in fewer of those creative efforts. See, e.g., Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C. L. REV. 1079, 1121 (2016) (discussing Naruto v. Slater, the case of photographer David Slater and the "monkey selfie" photographs, and noting that "Mr. Slater, a photographer familiar with macaques, reported that he carefully staged the environment in such a way that Naruto would be likely to take his own photograph. If accurate, he probably did so in part due to an expectation of selling the resulting photographs. Had Mr. Slater known in advance that the images would pass into the public domain, he might never have taken the photographs.").

[22] U.S. COPYRIGHT OFFICE, COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES § 313.2 (3d ed. 2017); *see also* Kelley v. Chicago Park Dist., 635 F.3d 290, 304 (7th Cir. 2011) (citing William Patry, Patry on Copyright § 1:1 at 1-19 (2016) for the proposition that "[a]uthors of copyrightable works must be human; works owing their form to the forces of nature cannot be copyrighted").

enlarging the size of a preexisting work of authorship."[23] Notably, these are examples of rote computer processes and are generated without any machine "thinking."[24] Transposing a song from B major to C major does not meet the working definition of "computer-generated work" because the specific output, C major, has been predetermined by the programmer. Similarly, medical imaging produced by x-rays does not meet the definition because its output is based on electromagnetic radiation and not machine "thinking." A machine's aiding the creation of a specific work is very different from a computer making decisions about how to create a new work.

Despite this directive from the Office precluding computer authorship, it is not clear that the Constitution or the Copyright Act of 1976 demands human authorship. The Constitution provides that "authors" shall have the "exclusive right to their [] writings," but defines neither term. Nor has Congress defined "author" in the Copyright Act, let alone defined it to mean "human author."[25] On the contrary, the Copyright Act specifically provides for authorship of non-humans. In the "work for hire" doctrine, the Act provides that "[i]n the case of a work made for hire, the employer or other person for whom the work was prepared is considered the author."[26] Though the employer has legal personhood—complete with rights and obligations—in most cases it is a corporate entity, not a human. Yet the Act still contemplates that this non-human is the author. This alone is a reasonable basis to argue that authors need not be human.

Congress considered this issue more than forty years ago, when it examined the impact of computers on copyright law, but did not devise a solution because it did not anticipate that computer- generated works were on the horizon. Confronted with the growth of computers in the 1970s and concerned about their impact on copyright law, Congress created the Commission on New Technological Uses of Copyrighted Works (CONTU).[27] CONTU determined that "there was no need for special treatment of computer-generated works because computers were not autonomously generating creative results without human intervention; computers were simply

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[23] U.S. COPYRIGHT OFFICE, *supra* note 22, § 313.2.

[24] *See* Robert C. Denicola, *Ex Machina: Copyright Protection for Computer-Generated Works*, 69 RUTGERS U.L. REV. 251, 268 (2018) ("Those works, however, would probably lack the creativity necessary for copyright even if done entirely by a human being.").

[25] *See generally* 17 U.S.C. § 101 (2012).

[26] 17 U.S.C. § 201(b) (2012).

[27] Arthur R. Miller, *Copyright Protection for Computer Programs, Databases and Computer-Generated Works: Is Anything New Since CONTU?*, 106 HARV. L. REV. 977, 1065 (1993).

functioning as tools to assist human authors."[28] It also found that autonomously creative AI was not foreseeable.[29] Much has changed.

Until recently, the courts had not frequently addressed whether "authorship" was limited to humans. In early copyright jurisprudence, the Supreme Court defined "author" to mean "he to whom anything owes its origin; originator; maker."[30] This stemmed from a late-19th century case, Burrow-Giles Lithographic Co. v. Sarony, where the Court was confronted with whether photographs—a new medium—were copyrightable. The argument against copyrightability was that they were "mere mechanical reproduction[s]" and "involve[d] no originality of thought or any novelty in the intellectual operation connected with its visible reproduction in shape of a picture."[31] Yet the Court held that photographs were copyrightable because they could be "traced quite directly back to the governing consciousness and sensibility of the photographer, the person behind the lens who posed the subject just so and altered the lighting just so."[32] The authorship was granted in the person who made the resulting photograph possible.[33]

Today, the word "author" should be interpreted to include computers acting in that role. Despite the pronouncement of the Copyright Office to the contrary, it is not at all clear that the law demands human authorship. The Constitution does not define authors as human. Congress, through the Copyright Act, has not defined authors as human (but specifically provides for non-human authors in the case of works for hire).

However, my recommendation is not to vest ownership in the algorithm/computer itself, as it is a piece of chattel rendering it incapable of owning anything. Rather, I recommend that ownership is vested with the person/entity responsible for fixing the work, as discussed more in my response to question 5, below.

2. Assuming involvement by a natural person is or should be required, what kind of involvement would or should be sufficient so that the work qualifies for copyright protection? For example, should it be sufficient if a person (i) designed the AI algorithm or process that created the work; (ii) contributed to the design of the algorithm or process;

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[28] Ryan Abbott, *I think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C. L. REV. 1079, 1100 (2016).

[29] *Id*.

[30] Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53, 58 (1884); Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 346 (1991).

[31] Burrow-Giles, 111 U.S. at 58-59.

[32] Annemarie Bridy, *Coding Creativity: Copyright and the Artificially Intelligent Author*, 2012 STAN. TECH. L. REV. 5, 11 (2012).

[33] *Id*.

(iii) chose data used by the algorithm for training or otherwise; (iv) caused the AI algorithm or process to be used to yield the work; or (v) engaged in some specific combination of the foregoing activities? Are there other contributions a person could make in a potentially copyrightable AI-generated work in order to be considered an ''author''?

If involvement by a natural person is or required to qualify for copyright protection, it should be sufficient if any of the above options are met. After all, copyright protection depends on the contribution of the work to the arts and sciences, not the effort or involvement in creation.

4. To the extent an AI algorithm or process learns its function(s) by ingesting large volumes of copyrighted material, does the existing statutory language (e.g., the fair use doctrine) and related case law adequately address the legality of making such use? Should authors be recognized for this type of use of their works? If so, how?

Existing statutory language and case law adequately addresses the legality of the use of copyrighted material. That a work is created by an algorithm should not change the analysis of whether it is eligible for copyright protection, has infringed another work, or is a fair use of other works.

Each one of the four fair use factors would apply to a work created by an algorithm just as it would a work created by a human. The purpose of the use does not depend on the work's creator, nor does the nature of the original work or the effect on the market. The third factor is likely going to be the most challenging, to determine just how much of a work was used, and whether it was the heart of the work. But again, this analysis is no different than when a human has created a new work after having been influenced by others.

It is also worth noting that machines must be able to generate works that are both independently created and sufficiently creative to meet the requirement of originality for copyrightability. If the work does not possess the required modicum of creativity, it cannot receive a copyright. However, this threshold can certainly be met by computers generating creative works. The Next Rembrandt serves as a prime example. Relying on a partnership between art historians, developers, engineers, and data scientists, the advertising agency J. Walter Thompson taught a computer to produce a 3-D printed painting, mimicking the depth and texture of a true painting, in the style of the Dutch master artist Rembrandt van Rijn. The computer-generated image, which looks like it could have been painted by Rembrandt himself, is based on 168,263 Rembrandt painting fragments and contains more than 148 million pixels.The algorithm was designed to generate a new work based on millions of data points, but the specific creative output was not predetermined by the human programmers.[34] The resulting painting was

[34] Note that this is distinct from assistive programs, like word processors, that allow a human user to dictate the precise output and that simply create the means to do so.

not copied from other works, but instead created in a similar style, and thus can be properly viewed as independently created.[35]

The counterargument is that depending on how the algorithm or other AI is coded, there exists a plausible argument that the work would not be original. Much of the underlying technology with generative AI work is done by analyzing vast amounts of data, learning to recognize structures and patterns, and finally creating a new work—be it a song, poem, or visual work of art. For example, "[i]n order to produce a melody, they are trained using thousands of previous melodies, and the structure inherent in these previous works is then reproduced by the neural network when composing a new piece of music."[36] This serves as the basis for arguments that computers cannot truly be independent creators: their works are based on analysis of existing works—regardless of how different their output is from those works.

However, this is no different from "independent" human creators. An art student creating a sculpture has been no doubt influenced by the artists he has studied. Artists draw from the work of those who have come before them.[37] Indeed, one of the earliest known theories of art is Imitation Theory, the idea that the essence of art is imitation.[38] In Renaissance Italy, young artists and apprentices learned by copying the works of their masters, other artists, and the work found in their cities.[39] "Students were trained to work in the master's style and succeeded to such a degree that it is sometimes hard for today's art historians to distinguish the hand of a master from that of his most talented pupils."[40] Further evidence of artists' influence from existing works can be seen in Édouard Manet's Le Déjeuner sur l'herbe, which drew its inspiration from

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[35] *See*, e.g., Brown v. McCormick, 23 F. Supp. 2d 594, 604 (D. Md. 1998) (finding originality satisfied where copyright owner created quilt designs herself despite relying on a script that gave vague descriptions of some of the elements for the designs); *see also* McMahon v. Prentice-Hall, Inc., 486 F. Supp. 1296, 1304 (E.D. Mo. 1980) (noting that "the fact that the defendants' works may present the same ideas, concepts, and theories in the same style similarly does not amount to copyright infringement").

[36] Arthur Juliani, *Are Neural Networks Truly Creative?*, MEDIUM (July 29, 2016), https://medium.com/@awjuliani/are-neural-networks-truly-creative- e713ac963f05.

[37] *See*, e.g., Daniel J. Gifford*, Innovation and Creativity in the Fine Arts: The Relevance and Irrelevance of Copyright*, 18 CARDOZO ARTS & ENT. L.J. 569, 581 (2000) (discussing that, throughout history, artists have drawn from the works of others).

[38] Glen Cheng, *The Aesthetics of Copyright Adjudication*, 19 UCLA ENT. L. REV. 113, 136–37 (2012) (identifying Imitation Theory, advanced by Plato and Aristotle, as the prevailing theory of art as late as the eighteenth century).

[39] Italian Renaissance Learning Resources, *The Making of an Artist: Training and Practice*, http://www.italianrenaissanceresources.com/units/unit- 3/essays/training-and-practice/.

[40] *Id*.

an Italian Renaissance print.[41] Pablo Picasso borrowed from popular culture and "could never have painted his breakthrough works of the 1900s without recourse to African sculpture."[42]

Likewise, musicians draw on influences from other performers, genres, and sounds to create new works.[43] Perhaps the most obvious example is hip-hop music, which is well known for its practices of sampling and looping.[44] But this phenomenon is not limited to hip- hop, nor is it new. Indeed, Handel, Bach, Beethoven, Debussy, and Wagner borrowed from or reworked existing music.[45] Charles Ives, an early 20th century American composer, borrowed extensively from existing songs and hymns.[46] This evidence supports the idea that artists do not create in a bubble, and that to a certain degree, all creativity requires influence. However, that their work is built on a process of information gathering, distilling, and re-imagining does not negate the fact that these artists are independent creators of their works. Of course, a different result emerges when creators, after studying existing works, produce substantially similar works. In those circumstances, there is no copyright in the new work, and it is treated as an infringement.[47] These same results should apply to works created by computers, as well.

4. Are current laws for assigning liability for copyright infringement adequate to address a situation in which an AI process creates a work that infringes a copyrighted work?

Yes, current laws for assigning liability for copyright infringement are adequate to address a situation in which an AI process creates a work that infringes a copyrighted work. That a work is created by an algorithm should not change the analysis of whether it has infringed another work, or is a fair use of that work.

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[41] Roderick Conway Morris, *How Italy Cast a Spell Over Manet*, N.Y. TIMES (June 5, 2013), https://www.nytimes.com/2013/06/06/arts/06iht- manet06.html.

[42] Jason Farago, *Good Artists Copy, Great Artists Steal*, BBC (Nov. 12, 2014), http://www.bbc.com/culture/story/20141112-great-artists-steal. *See also* Julie C. Van Camp, *Originality in Postmodern Appropriation Art*, 36 J. ARTS MGMT., LAW, AND SOC'Y 247 (2010).

[43] *See* Olufunmilayo B. Arewa, *From J.C. Bach to Hip Hop: Musical Borrowing, Copyright and Cultural Context*, 84 N.C. L. REV. 547, 604 (2006) ("Musical borrowing is a pervasive aspect of musical creation in all genres and all periods.").

[44] *See id*. at 559-61.

[45] *See id*. at 601-05.

[46] *See id*. at 606.

[47] Segrets, Inc. v. Gillman Knitwear Co., 207 F.3d 56, 62 (1st Cir. 2000).

5. Should an entity or entities other than a natural person, or company to which a natural person assigns a copyrighted work, be able to own the copyright on the AI work? For example: Should a company who trains the artificial intelligence process that creates the work be able to be an owner?

Yes. Indeed, it makes the most sense to award ownership rights in computer-generated creative output to the *end user* (trainer, for example) of the computer program, whether that user is an individual or a corporate entity.

When it comes to works created by computers, there are three possible parties to consider when it comes to the determination of where to vest the legal authorship: the developer of the algorithm, the end user of that algorithm, or a joint ownership scheme. The algorithm/computer itself cannot be the owner, as it is a piece of chattel, rendering it incapable of owning anything, including intellectual property. But because both the developers and end users are not just stakeholders who could have an interest in laying claim to the copyright, but are also critical to the work's creation, it is not immediately obvious where ownership should vest.

While it is not at all controversial to assign to a programmer the copyright for original code, or to code that has evolved in ways that are clearly derivative, once this code begins to grow in ways the programmer *did not conceive or direct*, it becomes less clear that the programmer has as strong a claim to the "evolving" code. To be clear, I am not arguing that the programmer should or should not own this secondary copyright. It will likely be a case-by-case analysis, and thus it cannot be fairly said that the copyright incentives given to the programmer for writing the original code are sufficient to stimulate continued progress in this field when the programmer may not have as strong a copyright claim to the "evolving" code.

Consider a seemingly straightforward application of generative software: an algorithm (written by a programmer) is sold to a news organization to use to create news stories. Perhaps the news organization merely "turns on" the algorithm to generate the content. Or perhaps it is more involved, and members of the news organization provide significant data to the algorithm to direct its creative output. (After all, a machine-learning algorithm is only as good as its data.) Should the author be the programmer, the end user, or both?

Joint ownership is not a feasible outcome because joint copyrights are only appropriate when (1) the contributions of each author constitute an independently copyrightable contribution, and (2) there is an intent by both parties to be co-authors.[48] In the case of computer-generated works, it is unlikely that these requirements will be met. The work the software developer or programmer does—data input, coding instructions—result in *code* that is copyrightable, but not *output* that is copyrightable. In other words, if the subject work is a news story, the programmer has written protectable code that tells the computer to use particular language and speech patterns to write the story based on certain inputs. But this is a contribution to the *development* of

[48] Childress v. Taylor, 945 F.2d 500, 505 (2d Cir. 1991); Aalmuhammed v. Lee, 202 F.3d 1227, 1234 (9th Cir. 2000).

the article, and not directly to the article, as the law requires. Further, the contributions by the end user—perhaps the AP or another news agency—are likely at best limited to directing the computer to obtain information from specific inputs (for example, statistics from sporting events or earnings reports from financial firms), or, at worst, to simply pushing a button and waiting for the article to appear. Neither would constitute an independently copyrightable contribution. The second requirement is also problematic because it will often be impossible for the developer to know who the various end users will be, thereby making it impossible that they share an intent to be co-authors. A secondary reason to be skeptical of a joint authorship framework is that it could "result in a 'fractionalization' of ownership rights," where claims to ownership could be made by a variety of disentangled parties, including "the operating system programmer, the computer manufacturer, etc."[49]

There is a compelling reason to award authorship to developers because they exercise the most creative control in determining the parameters for the creative output and the processes the algorithm will use to create that work. Perhaps most importantly, they program the algorithm not just to create, but to *think* creatively. Without these developers, there would be no algorithms to produce creative works. Considering that copyright law is built on an incentive to motivate creative activity,[50] the software developers seem the appropriate recipient of the grant of authorship. It is their creative activity, after all, that makes computer-generated works possible.

Despite these compelling reasons, there are countervailing factors that suggest copyright should perhaps not vest in software developers. First, the Court has held that the author of a work must be the party that fixes the work.[51] Specifically, the work must be fixed in a copy or phonorecord "by or under the authority of the author."[52] In order for the developer to be considered the author of the work, the developer—and not the end user—would have to execute the algorithm to fix the work. This creates a catch-22: if the author of a work is "he to whom anything owes its origin,"[53] and the author of a work must also fix the work,[54] it would frustrate

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[49] William T. Ralston, *Copyright in Computer-Composed Music: Hal Meets Handel*, 52 J. COPYRIGHT SOC'Y U.S.A. 281, 306 (2005).

[50] Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417, 429 (1984).

[51] Cmty. for Creative Non-Violence v. Reid, 490 U.S. 730, 737 (1989). *See also* 16 Casa Duse, LLC v. Merkin, 791 F.3d 247, 258 (2d Cir. 2015) (discussing that authors are not entitled to copyright protection except for the "works of authorship" they create and fix); Am. Broad. Companies, Inc. v. United States, 129 F.3d 1243, 1246, n1 (Fed. Cir. 1997) ("Because the copyright vests initially with the author once the author fixes the work in a tangible medium").

[52] U.S. Copyright Office, *supra* note 22, § 313.2. Although there is an argument that an end-user who fixes the work does so under the authority of the developer, this argument is weakened by the fact that in many (if not most) cases, the developer will not know the identity of the end users.

[53] *Burrow-Giles Lithographic Co.*, 111 U.S. at 58.

[54] *See Sony Corp. of Am*, 464 U.S. 417.

the ability of developers to sell their software to entities that could benefit from the ability to produce such works.

Second, software developers already have a valuable copyright in the code itself. By owning the rights to the algorithm, the developers can control its distribution and usage. Assuming many end users cannot develop this software on their own and rely on programmers to deliver it, this software is an important asset. Importantly, this software is *far more valuable* if computer-generated works are copyrightable. But allowing the developer to reap the reward of copyright for the software and for the creative end product of the software gives them two bites at the apple. Instead, if the copyrights in the creative works were allocated to another party, such as the end user, the developer's incentive to write generative algorithms is stimulated: there will be increased demand for computer-generated works by end users because of the certainty they will have of their own proprietary rights for those works. In other words, this rights distribution scheme would not diminish value to the software developer. In fact, it increases the worth of the software itself, and thus, the ability of the software developer to exploit it. (And of course, if the developer expects the computer-generated work to have significant copyright value, they could retain the product and exploit it themselves.)

It makes the most sense to award ownership rights in computer-generated creative output to the end user of the computer program. Purchasers of software "might reasonably expect to be able to use [and control] the output produced by the program."[55] If the end user cannot exploit the copyright for the works its computer creates, those works—and the software that creates them—have less value for that user. This is especially true if another entity, such as the developer, owns the rights to the output. In such a case, there is little use for the product for any end user absent a complicated licensing arrangement between the parties that allows for distribution, copying, etc.

Thus, conferring a copyright to computer-generated works on end users seems to make the most practical sense. However, we must return to the catch-22 that impedes recognition of the developer as author: although the end user is the party to "fix" the work, courts reward the "inventive or master mind" with the authorship,[56] which is not likely to be a user who is simply executing an algorithm written by another party. Surely, there are circumstances when the end user provides creative contributions that help shape the output, such as collecting the data inputs for the algorithm. In such circumstances, an argument might be made that this contribution is valuable enough to confer authorship. But *requiring* that type of addition limits the pool of end users to those who have the interest or ability to make such contributions, which in turn weakens the value of the copyright in the algorithm itself because it is less salable.

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[55] William T. Ralston, *Copyright in Computer-Composed Music: Hal Meets Handel*, 52 J. COPYRIGHT SOC'Y U.S.A. 281, 303-04 (2005).

[56] *See, e.g., Burrow-Giles Lithographic Co*. at 61 (agreeing that "the author is the man who really represents, creates, or gives effect to the idea, fancy, or imagination"); Aalmuhammed v. Lee, 202 F.3d 1227, 1232, 1234 (9th Cir. 2000) (author is the "master mind" behind a work—the person with "creative control").

Our current legal framework dictates that neither the developer nor end user can meet the definition of author because typically one party creates and the other fixes the work. Nor is a joint copyright appropriate where there is no intent to merge and a lack of copyrightable contribution from one of the parties. And of course, the algorithm itself cannot own the copyright. Without some legal fiction, the reality is that the work will go into the public domain upon creation. Yet allowing the works to go into the public domain is an unappealing solution because this removes incentives to develop new creative works that promote the progress of science. Importantly, recognizing a copyright in the end user aligns with the Court's preference to define the author as the party who "translates an idea into a fixed, tangible expression entitled to copyright protection."[57]

Recognizing the end user as the author of computer-generated works does the most to advance the primary purpose of copyright law in promoting the progress of science: end users are incentivized to operate the program and generate new works. Their proprietary ownership of those works encourages them to purchase (or license) the software from developers. In addition, recognizing an ownership right in the end user has direct and indirect benefits for the software developer. As discussed above, the value of the software increases with its ability to secure copyright protection for its end users. And if the creative works produced by the algorithm have significant economic potential, the developer is in the enviable position of deciding whether to sell the software (at an increased price) or keep it to retain the copyright in the works.

[57] Community for Creative Non-Violence v. Reid, 490 U.S. 730, 737 (1988).

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ARTICLE

ARTIFICIAL AUTHORS: A CASE FOR COPYRIGHT IN COMPUTER-GENERATED WORKS†

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For years, computers have dominated humans at chess, poker, and even Jeopardy!. Now, they are competing in the arts. Increasingly sophisticated artificial intelligence is creating music, art, and stories. Though the purpose of copyright law is to encourage this exact type of artistic production, none of these works are protected, because the United States Copyright Office has determined that only humans can author copyrightable works. This requirement—not mandated by the Constitution or Congress—was developed in an era where computer-generated creativity worth protecting was simply unimaginable. But years have passed, technology has advanced, and machines are now capable of developing dynamic and even award-winning creative works. Instead of accepting that the law must lag behind technology, this Article explores whether copyright law can—and should—evolve.

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The crow crooked on more beautiful and free,
He journeyed off into the quarter sea.
his radiant ribs girdled empty and very –
least beautiful as dignified to see.[1]

I. INTRODUCTION

For years, computers have dominated humans at chess, poker, and even *Jeopardy!*.[2] Now, they are competing in more creative arenas. Increasingly sophisticated artificial intelligence (AI) software

1. Readers might be surprised—or not—to learn that this poem was created by a bot. The author takes credit for this terrible rhyme, however. *See* Grace Ballenger, *What Happens When an A.I. Program Tries to Write Poetry?*, SLATE (July 14, 2017, 8:58 AM), http://www.slate.com/blogs/future_tense/2017/07/14/what_happens_when_an_a_i_program_tries_to_write_poetry.html.

2. *See* Michael McConnell, *The AIs Are Winning: 5 Times When Computers Beat Humans*, MAKE USE OF (May 10, 2016), https://www.makeuseof.com/tag/ais-winning-5-times-computers-beat-humans/.

has the ability to teach computers to create music,[3] art,[4] short films,[5] poetry,[6] and news stories.[7] While critics are quick to point out that machine-generated art cannot truly "compete" with human-made art because computers lack human characteristics like intuition and emotion,[8] computers are nevertheless producing art. Consider that, since 2014, the Associated Press (AP) has used AI to produce quarterly earnings articles.[9] The Washington Post also employs automated technology, which helped it deliver more than 850 stories in 2017 alone about political races, local sports, and more.[10] Dozens of companies are exploring the field of computer-generated music, and Sony has already released two songs created by artificial intelligence.[11]

Perhaps most impressive is that AI is beginning to produce art that is hard to distinguish from human-created art. As this technology continues to advance, AI programs will only become

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3. *See, e.g.*, Amy X. Wang, *The Musical AI Is Now Working on Its Debut Album(s)—and Wants to Do the Beatles Better than the Beatles*, QUARTZ (Oct. 18, 2016), https://qz.com/812231/sony-is-making-an-artificial-intelligence-algorithm-that-writes-perfect-hit-making-songs/.

4. *See, e.g.*, Tim Nudd, *Inside 'The Next Rembrandt': How JWT Got a Computer to Paint like the Old Master*, ADWEEK (June 27, 2016), http://www.adweek.com/brand-marketing/inside-next-rembrandt-how-jwt-got-computer-paint-old-master-172257/.

5. *See, e.g.*, Annalee Newitz, *Movie Written by Algorithm Turns Out to Be Hilarious and Intense*, ARS TECHNICA (June 9, 2016, 6:30 AM), https://arstechnica.com/gaming/2016/06/an-ai-wrote-this-movie-and-its-strangely-moving/.

6. *See, e.g.*, Matt Reynolds, *Neural Network Poetry Is So Bad We Think It's Written by Humans*, NEW SCIENTIST (July 7, 2017), https://www.newscientist.com/article/2140014-neural-network-poetry-is-so-bad-we-think-its-written-by-humans/.

7. *See, e.g.*, Ravi Somaiya, *The A.P. Plans to Automate Quarterly Earnings Articles*, N.Y. TIMES (June 30, 2014), https://www.nytimes.com/2014/07/01/business/media/the-ap-plans-for-computers-to-write-corporate-earnings-news.html.

8. *See, e.g.*, Bennat Berger, *Who Gets the Credit When AI Makes Art?*, VENTURE BEAT (Jan. 30, 2018, 2:10 PM), https://venturebeat.com/2018/01/30/who-gets-the-credit-when-ai-makes-art/; Carissa Véliz, *Common Sense for A.I. Is a Great Idea*, SLATE (Mar. 19, 2018, 1:17 PM), https://slate.com/technology/2018/03/paul-allens-plan-to-teach-artificial-intelligence-common-sense.html.

9. Somaiya, *supra* note 7.

10. Lucia Moses, *The Washington Post's Robot Reporter Has Published 850 Articles in the Past Year*, DIGIDAY (Sept. 14, 2017), https://digiday.com/media/washington-posts-robot-reporter-published-500-articles-last-year/.

11. Stuart Dredge, *AI and Music: Will We Be Slaves to the Algorithm?*, GUARDIAN (Aug. 6, 2017), https://www.theguardian.com/technology/2017/aug/06/artificial-intelligence-and-will-we-be-slaves-to-the-algorithm.

better at simulating human creation. A competition at Dartmouth College capitalizes on this growth and judges "poetry, literature, music and dance created by machines against works created by humans. Awards are given to the artificial intelligence creations that are the most indistinguishable from human work."[12]

One computer has even been tasked with creating a true masterpiece: the "Next Rembrandt." Relying on a partnership between art historians, developers, engineers, and data scientists, the advertising agency J. Walter Thompson taught a computer to produce a 3-D printed painting, mimicking the depth and texture of a true painting, in the style of the Dutch master artist Rembrandt van Rijn. The computer-generated image, which looks like it could have been painted by Rembrandt himself, is based on 168,263 Rembrandt painting fragments and contains more than 148 million pixels.[13] But just like the real Rembrandts created some 400 years ago, the art created by the Next Rembrandt algorithm finds its home in the public domain.[14] The same is true of all AI-generated works created in the United States—none are protected by copyright.

Copyright law bestows broad—and valuable—exclusive rights to authors of original works.[15] These rights serve as a bunch of carrots dangled to incentivize new works. Indeed, the primary objective of copyright law "is to encourage the production of original literary, artistic, and musical expression for the good of the public."[16] To further this goal, the law automatically protects fixed, original works of authorship.[17] "The originality requirement for copyright

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12. *Creative Turing Tests 2017 Winners,* NEUKOM INSTITUTE TURING TESTS IN THE CREATIVE ARTS, http://bregman.dartmouth.edu/turingtests/2017Winners (last visited Mar. 30, 2018).

13. Mark Brown, *'New Rembrandt' to Be Unveiled in Amsterdam*, GUARDIAN (Apr. 5, 2016), https://www.theguardian.com/artanddesign/2016/apr/05/new-rembrandt-to-be-unveiled-in-amsterdam.

14. J. Walter Thompson Amsterdam, a company based in Holland, are the creators behind the Next Rembrandt. It is not clear whether Dutch law, like U.S. law, would also preclude copyrights for works made by computers. *See* Wet van 23 september 1912, Stb. 1912, § 2, http://wetten.overheid.nl/BWBR0001886/2017-09-01#HoofdstukI_Paragraaf2.

15. *See* Stephen E. Siwek, *Copyright Industries in the U.S. Economy: The 2003-2007 Report* 10-12 (2009) (illustrating the specific value-added estimates produced by the U.S. Bureau of Economic Analysis (BEA)); *Copyright and The Public Domain*, UNIV. OF CHI. LIBRARY: COPYRIGHT INFO. CTR., https://www.lib.uchicago.edu/copyrightinfo/pubdomain.html (last visited Mar. 31, 2018).

16. Fogerty v. Fantasy, Inc., 510 U.S. 517, 524 (1994).

17. 17 U.S.C. § 102(a) (2012); *See* Star Athletica, L.L.C. v. Varsity Brands, Inc., 137 S. Ct. 1002, 1008 (2017).

protection is not particularly rigorous."[18] It essentially means that the work is the independent creation of the author and was not copied from another source.[19] To be "fixed," a work must be put to paper or recorded in some form from which it can be duplicated.[20] Based on these requirements, it seems plausible that a computer-generated work could earn copyright protection (consider the songs created by Sony's algorithm or the images created by the Next Rembrandt, for example, none of which were copied from another work, and all of which are fixed). But the United States Copyright Office has explicitly taken the position that, to have a copyright, the author must be human.[21]

As a result, all works created by artificially intelligent programs enter the public domain upon creation, free for anyone to use and distribute. The carrot is removed: no promise of copyright exists to encourage growth in such creative works. Some commentators suggest this is the proper outcome because computers cannot be "encouraged" to create new works.[22] But this argument ignores the possibility that without copyright protection, innovators may eventually shy away from investing their time and effort in this field. Just as "the motivation to produce would be diminished if an author knew that once a novel was written, a picture painted, or a song composed, anyone could reproduce or otherwise exploit it,"[23] so too will the motivation of inventors to write computer code that does the same thing.[24]

The fields of artificial intelligence and machine learning have been consistently and rapidly growing. Projections suggest they

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18. Greenspan v. Random House, Inc., 859 F. Supp. 2d 206, 216 (D. Mass. 2012).

19. Ansehl v. Puritan Pharm. Co., 61 F.2d 131, 136 (8th Cir. 1932).

20. *See* 17 U.S.C. § 101 (2012).

21. U.S. COPYRIGHT OFFICE, COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES § 313.2 (3d ed. 2017). *Cf.* Naruto v. Slater, No. 15-CV-04324-WHO, 2016 WL 362231, at *8–10 (N.D. Cal. Jan. 28, 2016) (dismissing copyright claim filed on behalf of a monkey); Naruto v. Slater, 888 F.3d 418, 426 (9th Cir. 2018) (affirming dismissal and holding that the Copyright Act does not expressly authorize animals to file copyright suits under the statute). Both cases will be discussed in greater length in Section III.C.3, *infra*.

22. Steve Schlackman, *Who Holds the Copyright in Computer Generated Art?*, ART L. J. (Apr. 22, 2016), http://alj.orangenius.com/the-next-rembrandt-who-holds-the-copyright-in-computer-generated-art/.

23. *Id.*

24. To be clear, there is no dispute that the artificial intelligence software itself could be protected by copyright. Integral Dev. Corp. v. Tolat, 675 F. App'x 700, 704 (9th Cir. 2017). That is distinguishable from the creative works generated by that artificial intelligence software.

could lead to "economic hypergrowth"[25] and become a $70 billion industry by 2020.[26] This "exponential growth in computing power is poised to take creative machines from novelties to major drivers of economic growth."[27] Why risk turning otherwise interested innovators away from developing AI that could contribute to the arts?

Instead of accepting that the law must lag behind technology,[28] this Article explores the critical question of whether copyright law can—and should—provide this incentive. While other scholars have examined different aspects of this issue in the past,[29] the rapidly advancing fields of AI and machine learning based on neural networks are enabling computers to reach new creative heights and change the conversation on what it means to be an *author*. This Article builds on previous research by examining not only the most recent advances in artificial intelligence, but also those on the horizon. Thus, Part II discusses current and future developments in machine-generated creative works. Part III examines the framework of copyright law as it relates to these developments in machine-generated creative works. Part IV presents an argument for recognizing copyrights in computer-generated works, and Part V

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25. Thomas Franck, *Machine Learning Could Lead to Economic Hypergrowth, New Research Suggests*, CNBC (Oct. 21, 2017, 9:50 AM), https://www.cnbc.com/2017/10/21/machine-learning-could-lead-to-economic-hypergrowth-new-research-suggests.html; Philippe Aghion et al., *Artificial Intelligence and Economic Growth* 4–34 (Nat'l Bureau of Econ. Research, Working Paper No. 23928, 2017), https://web.stanford.edu/~chadj/AI.pdf; Mark Purdy & Paul Daugherty, *How AI Boosts Industry Profits and Innovation*, ACCENTURE (2017), https://www.accenture.com/t20171005T065812Z__w__/us-en/_acnmedia/Accenture/next-gen-5/insight-ai-industry-growth/pdf/Accenture-AI-Industry-Growth-Full-Report.pdf (estimating that AI has the potential to boost rates of profitability by an average of thirty-eight percent by 2035 and lead to an economic boost of $14 trillion across sixteen industries in twelve economies by 2035).

26. Shlomit Yanisky-Ravid & Luis Antonio Velez-Hernandez, *Copyrightability of Artworks Produced by Creative Robots and Originality: The Formality-Objective Model*, 19 MINN. J.L. SCI. & TECH. 1, 6 (2018).

27. Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C. L. REV. 1079, 1079–80 (2016).

28. *See* Lyria Bennett Moses, *Recurring Dilemmas: The Law's Race to Keep Up with Technological Change*, 2007 U. ILL. J.L. TECH. & POL'Y 239, 239 (2007) ("It is often stated that the law lags behind technology. As technology changes and creates new possibilities, lawyers and legal scholars struggle to deal with the implications.").

29. *See, e.g.*, Annemarie Bridy, *Coding Creativity: Copyright and the Artificially Intelligent Author*, 2012 STAN. TECH. L. REV. 5, 22 (2012); Robert C. Denicola, *Ex Machina: Copyright Protection for Computer-Generated Works*, 69 RUTGERS U.L. REV. 251, 262–63 (2016).

recommends a specific action Congress could take to encourage creative innovation in the United States.

II. THE FUTURE IS NOW: COMPUTERS ARE MAKING ART

A. The Technology Driving Creativity

The intersection between art and technology has never been stronger. Using advanced AI, developers are building cutting-edge computer programs that create art. This AI gives computers the ability to imitate human intelligence and "consists of multiple technologies that can be combined in different ways to sense, comprehend, act and learn."[30] Although artificial intelligence is not new, recent growth in this field has dramatically changed the meaning of machine learning.

Early forms of AI attempted to make computers "think" on their own by giving them a massive amount of information, along with instructions on how to process that information.[31] This is how computers were taught to play (and win at) chess against a human.[32] The computer "knew" every possible sequence that would lead to a win or loss. But this encyclopedic style of "thinking" had limits. The algorithms relied on sets of fixed rules that did not give the computers the chance to operate randomly, or creatively.

The recent growth in AI development allows machines to learn from examples and drive results on their own, "rather than being explicitly programmed for a particular outcome."[33] This is known as "deep learning," a process in which computers rely on artificial neural networks to learn specific behavior by analyzing vast amounts of data.[34] Like "neural" suggests, these networks are computer learning systems loosely modeled on the human brain and nervous system.[35] As journalist Cade Metz explains:

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30. Purdy & Daugherty, *supra* note 25, at 3.

31. Ophir Tanz & Cambron Carter, *Neural Networks Made Easy*, TECHCRUNCH (Apr. 13, 2017), https://techcrunch.com/2017/04/13/neural-networks-made-easy/.

32. *Id.*

33. Erik Brynjolfsson & Andrew McAfee, *The Business of Artificial Intelligence*, HARV. BUS. REV. (July 26, 2017), https://hbr.org/cover-story/2017/07/the-business-of-artificial-intelligence.

34. Cade Metz, *How A.I. Is Creating Building Blocks to Reshape Music and Art*, N.Y. TIMES (Aug. 14, 2017), https://www.nytimes.com/2017/08/14/arts/design/google-how-ai-creates-new-music-and-new-artists-project-magenta.html.

35. Larry Hardesty, *Explained: Neural Networks*, MIT NEWS (Apr. 14, 2017), http://news.mit.edu/2017/explained-neural-networks-deep-learning-0414.

> By looking for common patterns in millions of bicycle photos, for instance, a neural network can learn to recognize a bike. This is how Facebook identifies faces in online photos, how Android phones recognize spoken commands, and how Skype translates one language into another. But these complex systems can also create art. By analyzing a set of songs, for instance, they can learn to build similar sounds.[36]

Neural networks can even "generalize the information to solve new problems outside the scope of [their] initial training"[37] and create new works based on their approximations of how they should look or sound.

Some of the most recent advances in deep learning are through Generative Adversarial Networks (GANs), or pairs of networks that work together to give computers more realistic creations. They work like this: a first computer produces creative work, and the second computer analyzes the output to determine if it is real or fake.[38] The second computer sends this feedback to the generative computer, which tries again. This process repeats until the adversarial computer is satisfied with the output. "Because the second AI is working so hard to identify images as fake, the first learns to mimic the real in ways it couldn't on its own. In the process, these two neural networks can push AI toward a day when computers declare independence from their human teachers."[39] The computers are not simply imitating their data inputs, but instead are *learning* the contours of the subject they are told to create on their own. This is the essence of generative AI: "computational systems which, by taking on particular responsibilities, exhibit behaviours that unbiased observers would deem to be creative."[40]

As used throughout this Article, the term "computer-generated work" refers to works created by computers based on algorithms (or other sets of instructions) that allow the computer to *independently*

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36. Metz, *supra* note 34.

37. Dana S. Rao, *Neural Networks: Here, There, and Everywhere—An Examination of Available Intellectual Property Protection for Neural Networks in Europe and the United States*, 30 GEO. WASH. J. INT'L L. & ECON. 509, 509 (1996).

38. Cade Metz, *Google's Dueling Neural Networks Spar to Get Smarter, No Humans Required*, WIRED (Apr. 11, 2017, 7:00 AM), https://www.wired.com/2017/04/googles-dueling-neural-networks-spar-get-smarter-no-humans-required/.

39. *Id.*

40. Simon Colton & Geraint A. Wiggins, *Computational Creativity: The Final Frontier?*, 2012 PROC. EUR. CONF. ON ARTIFICIAL INTELLIGENCE 21, 21 (so defining "computational creativity").

create artwork in an uncertain environment, in other words, where the specific output has not been predetermined by the programmer(s). For example, the Next Rembrandt was designed to generate a painting based on millions of data points entered into the algorithm, but the specific creative output was not predetermined by the human programmer.[41] This definition necessarily excludes works that simply rearrange data points to create new works. It also excludes computers that function as mere tools in helping authors complete their own works, such as word-processing programs, photo-editing software, and the like. The term "artificial intelligence" refers generally to computers exhibiting (or mimicking) aspects of human intelligence.[42]

B. The Fruits of the Fruits of Tech Labor

One of the earliest examples of computer-generated art actually dates to the 1970s. Professor Harold Cohen, an early programmer, created a computer-programmed drawing machine named "Aaron." With the help of an apparatus, Aaron generated paintings with real paint on real canvas.[43] Aaron's art (along with Aaron itself) has been shown in major museums, such as the Tate in London.[44] Cohen, a painter himself, programmed Aaron to "draw lines with the irregularity of freehand drawing. As Aaron developed, it learned to make choices about open and closed shapes and foreground and background, and to recognize when an artwork had reached completion."[45] Cohen lamented that Aaron could not "reformulate its own 'mental model of the world,' a limitation [Cohen] tried to nibble away at in his later years."[46]

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41. Note that this is distinct from assistive programs, like word processors, that allow a human user to dictate the precise output and that simply create the means to do so.

42. This may be because "it can adapt itself to novel situations, has the capacity to reason, to understand the relationship between facts, to discover meanings, and to recognize the truth." Pamela Samuelson, *Allocating Ownership Rights in Computer-Generated Work*s, 47 U. PITT. L. REV. 1185, 1186 n.1 (1986) (quoting ENCYCLOPEDIA OF SCIENCE AND ENGINEERING 110-11 (A. Ralston 3d ed. 1983) (entry on "Artificial Intelligence")).

43. Denicola, *supra* note 29, at 263; William Grimes, *Harold Cohen, a Pioneer of Computer-Generated Art, Dies at 87*, N.Y. TIMES (May 6, 2016), https://www.nytimes.com/2016/05/07/arts/design/harold-cohen-a-pioneer-of-computer-generated-art-dies-at-87.html.

44. Grimes, *supra* note 43.

45. *Id.*

46. *Id.*

In recent years, other innovators have made great strides toward doing just that. Consider DeepDream, an algorithm that uses a neural network to create dream-like psychedelic artwork.[47] The algorithm is given an image to inspect and trained to recognize "hidden" shapes or images within that image. It then exaggerates and emphasizes those shapes and images to create a new work. As the inventors describe:

> We ask the network: "Whatever you see there, I want more of it!" This creates a feedback loop: if a cloud looks a little bit like a bird, the network will make it look more like a bird. This in turn will make the network recognize the bird even more strongly on the next pass and so forth, until a highly detailed bird appears, seemingly out of nowhere.[48]

The results transform ordinary images into hallucinogenic visions: a photograph of trees becomes a kaleidoscopic abstract image of birds and insects.[49] The inventors have taught the algorithm to make decisions based not on a fixed set of rules, but on a collection of millions of data points it has been previously fed.[50] In this way, the AI program is creating art based on information it has learned. The pieces created by DeepDream have been sold at auction for as much as $8000.[51]

The Next Rembrandt is an extension of this same process. The project collaborators designed an algorithm to recognize the most common facial structures, composition details, and geometric patterns.[52] It then gathered and fed the algorithm "enormous amounts of data about [Rembrandt's] paintings—the geometries, the composition patterns, even the height of the brush strokes off the canvas."[53] This gathering process took months and involved getting

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47. Robert Hart, *If an AI Creates a Work of Art, Who Owns the Right to It?,* QUARTZ (Aug. 15, 2017), https://qz.com/1054039/google-deepdream-art-if-an-ai-creates-a-work-of-art-who-owns-the-rights-to-it/; Matt McFarland, *Google's Psychedelic 'Paintbrush' Raises the Oldest Question in Art*, WASH. POST (Mar. 10, 2016), https://www.washingtonpost.com/news/innovations/wp/2016/03/10/googles-psychedelic-paint-brush-raises-the-oldest-question-in-art/.

48. Alexander Mordvintsev et al., *Inceptionism: Going Deeper into Neural Networks*, GOOGLE AI BLOG (June 17, 2015), http://ai.googleblog.com/2015/06/inceptionism-going-deeper-into-neural.html.

49. *Id.*

50. *Id.*

51. Hilary Brueck, *Google's Computers Are Making Thousands as Artists*, FORTUNE (Mar. 1, 2016), http://fortune.com/2016/03/01/google-deepdream-art/.

52. Schlackman, *supra* note 22.

53. Nudd, *supra* note 4.

as much visual information about the originals as possible.[54] "Almost 350 paintings were painstakingly scrutinized and 150 gigabytes of digitally rendered graphics were collected to provide the proper instruction set to produce the textures and layers necessary for Next Rembrandt to have the painterly presence of an original work by the old master."[55] The algorithm then "used the learned principles to replicate the style and generate new facial features for [the new] painting."[56] In other words, the computer studied the works of Rembrandt, a master artist, to produce a new piece of art in the same style—just as an art student might do.

Another field experiencing rapid, creative AI growth is journalism. Many media giants already employ some form of automated journalism. For example, the AP delivers content using an AI program called Wordsmith.[57] Wordsmith uses natural language generation to turn data into a written, plain-language narrative. It has been used by Yahoo! Sports to write draft reports, match previews, and match recaps,[58] and by the Orlando Magic and other organizations for automated narrative generation.[59]

Still in its infancy, many of Wordsmith's stories produced to date have been no-frills data-driven pieces about sporting events, financial markets, and the weather. Although these AI tools eliminate mundane tasks and free up journalists to focus on reporting more in-depth stories, there has been a drive to develop "an AI system that could generate explanatory, insightful articles."[60] The Washington Post's Heliograf is an early attempt at this effort. Heliograf offers a stronger editorial voice and generates sharper content. In just the last year, there has been staggering growth in the ability of algorithms to craft intelligent narratives. Now, "[t]hese robo-writers don't just regurgitate data, . . . they create human-sounding stories in whatever voice—from staid to sassy—befits the intended audience. Or different audiences. They're that smart. And when you read the

54. *Id.*

55. Schlackman, *supra* note 22.

56. *Id.*

57. *Associated Press*, AUTOMATED INSIGHTS, https://automatedinsights.com/customer-stories/associated-press (last visited Mar. 30, 2018).

58. *Yahoo!*, AUTOMATED INSIGHTS, https://automatedinsights.com/customer-stories/yahoo (last visited Mar. 30, 2018).

59. *Customer Stories*, AUTOMATED INSIGHTS, https://automatedinsights.com/customer-stories (last visited Mar. 30, 2018).

60. Joe Keohane, *What News-Writing Bots Mean for The Future of Journalism*, WIRED (Feb. 16, 2017, 7:00 AM), https://www.wired.com/2017/02/robots-wrote-this-story/.

output, you'd never guess the writer doesn't have a heartbeat."[61] As neural networks continue to advance and evolve, so too will the quality and amount of copy they are able to produce.

Some newsrooms are using AI to develop interactive video content as well. USA Today, for example, utilizes an algorithm that analyzes and summarizes information in news stories to create news videos complete with voice-overs, photos, and graphics.[62] It likely won't be long before newsrooms can generate avatars of reporters to deliver content.

In Hollywood, the supercomputer IBM Watson produced a film trailer for the 20th Century Fox horror film, *Morgan*.[63] Watson first analyzed the visuals, sounds, and composition of hundreds of horror film trailers to "learn" what trailers are supposed to accomplish.[64] It then examined *Morgan* and identified and selected the key parts of the film to include in the trailer, whittling down a ninety-minute film into ten scenes and just six minutes of footage.[65] "Only the final act of putting the sounds and images together to create the trailer required human intervention."[66] In the end, the result was that a week's worth of work by humans was completed in twenty-four hours by a machine.[67] Although the trailer produced by Watson did not weave a narrative through the trailer, it succeeded "in identifying the aesthetic and thematic motifs of the film, as well as the emotional charges that underpin them."[68] The addition of a narrative could be next.

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61. Shelley Podolny, *If an Algorithm Wrote This, How Would You Even Know?*, N.Y. TIMES (Mar. 7, 2015), https://www.nytimes.com/2015/03/08/opinion/sunday/if-an-algorithm-wrote-this-how-would-you-even-know.html.

62. Anthony Ha, *Automated Video Creation Startup Wibbitz Raises $20M*, TECHCRUNCH (Oct. 24, 2017), https://techcrunch.com/2017/10/23/wibbitz-series-c/; Jessica Rovello, *AI Is Changing These Newsrooms: What It Means for Digital Publishing*, MEDIASHIFT (Aug. 3, 2017), http://mediashift.org/2017/08/ai-changing-newsrooms-means-digital-publishing/.

63. Suman Ghosh, *A Supercomputer Just Made the World's First AI-Created Film Trailer – Here's How Well It Did*, CONVERSATION (Sep. 26, 2016, 11:50 AM), https://theconversation.com/a-supercomputer-just-made-the-worlds-first-ai-created-film-trailer-heres-how-well-it-did-65446.

64. *Id.*

65. Amelia Heathman, *IBM Watson Creates the First AI-Made Film Trailer – and It's Incredibly Creepy*, WIRED (Sept. 2, 2016), http://www.wired.co.uk/article/ibm-watson-ai-film-trailer.

66. Ghosh, *supra* note 63.

67. Heathman, *supra* note 65.

68. Ghosh, *supra* note 63.

Algorithms can also be surprisingly good at writing poetry. Though AI poetry has been around for decades,[69] machines are getting far better at mimicking humans—to the point where it can be difficult to distinguish human-written poetry from machine-generated.[70] A variety of automated poets exist online, from "a Twitter bot that couples public tweets written in iambic pentameter to create rhyming couplets [to a] . . . cybernetic poet, which generates short poems in the styles of various human poets."[71] Though some of the bots are fairly simple, others are based on detailed algorithms through which they have "learned to produce verse that adheres to particular rhythms, styles, and themes after being fed 7.56 million words of mostly 20th century poetry."[72] As one commentator notes, this is perhaps not surprising:

> A Shakespearean sonnet is basically a high-level algorithm: three four-line stanzas in iambic pentameter, each with rhyme scheme ABAB, ending with a rhyming couplet. It's just that for centuries, humans have been the ones executing the pattern. Now, with a good deal of thought and some creative applications of natural language processing principles, a smart team of information scientists can engage a machine as a collaborator.[73]

Experiments with AI-produced music have also taken off, with a variety of companies involved in content development. There are several projects dedicated to providing businesses with computer-generated background music specifically to avoid the "messy world of [copyright] royalties and licensing."[74] Other inventors are reaching higher and trying to teach computers to write mainstream

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69. Leah Henrickson, *Behold the Amazing Poetry-Generating Machine!*, SLATE (Aug. 29, 2017, 7:15 AM), http://www.slate.com/articles/technology/future_tense/2017/08/behold_the_amazing_poetry_generating_machine.html ("In 1959, German mathematician Theo Lutz created what is commonly considered the first computer poetry by writing a program that recombined Franz Kafka's unfinished novel Das Schloss (The Castle).").

70. *Id.*

71. *Id.*

72. *Id.*

73. Dan Rockmore & Allen Riddell, *There's a Clear Difference Between Robot-Generated and Human-Generated Art*, SLATE (July 1, 2016, 12:07 PM), http://www.slate.com/articles/technology/future_tense/2016/07/the_difference_between_robot_generated_art_and_human_generated_art_is_that.html.

74. Rich Haridy, *AI-Generated Pop Song Puts Human Composers on Notice*, NEW ATLAS (Aug. 23, 2017), https://newatlas.com/ai-pop-music-amper/51018/.

pop and jazz music. The Sony Computer Science Laboratory, for example, plans to release an album of computer-generated music through its FlowMachines algorithm.[75] Two of its first songs, *Daddy's Car* and *The Ballad of Mr. Shadow*, were composed by algorithms that reviewed a database of 13,000 songs to compose entirely new material.[76] Singer Taryn Southern has released music composed and produced entirely by AI.[77] Southern added the lyrics and vocals but used an algorithm to create her accompaniment. She "plugged in various parameters like mood, style, and tempo to auto-compose the underlying chords and instrumentation."[78] While this project relied on a collaboration between software and a human, some music-generators complete the song from start to finish, without any human post-production effort. The DeepMusic algorithm available on Amazon Alexa, for example, composes and produces songs without human editing.[79]

The variety of creative content generated by computers is astounding. Even more remarkable is that this technology is truly in its infancy and will continue to exponentially improve and grow.

III. FRAMEWORK OF COPYRIGHT LAW

A. The Purpose & Incentives of Copyright Law

The courts and Congress have been clear that the primary purpose of copyright law is to "encourage the production of original literary, artistic, and musical expression for the good of the public."[80]

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75. Olivia Goldhill, *The First Pop Song Ever Written by Artificial Intelligence Is Pretty Good, Actually*, QUARTZ (Sept. 24, 2016), https://qz.com/790523/daddys-car-the-first-song-ever-written-by-artificial-intelligence-is-actually-pretty-good/.

76. James Vincent, *This AI-Written Pop Song Is Almost Certainly a Dire Warning for Humanity*, VERGE (Sept. 26, 2016, 7:21 AM), https://www.theverge.com/2016/9/26/13055938/ai-pop-song-daddys-car-sony.

77. Keith Nelson Jr., *Taryn Southern's New Album Is Produced Entirely by AI*, DIGITAL TRENDS (Feb. 20, 2018, 6:00 AM), https://www.digitaltrends.com/music/artificial-intelligence-taryn-southern-album-interview/.

78. John Titlow, *This New AI-Composed Pop Song Sounds Like Something from a Spotify Playlist*, FAST COMPANY (Aug. 21, 2017), https://www.fastcompany.com/40455600/this-new-ai-composed-pop-song-sounds-like-something-from-a-spotify-playlist.

79. Dani Deahl, *This New Alexa Skill Will Play Music Generated by Artificial Intelligence*, VERGE (Mar. 14, 2018, 4:33 PM), https://www.theverge.com/2018/3/14/17120588/deepmusic-alexa-skill-ai-generated-music.

80. Fogarty v. Fantasy, Inc., 510 U.S. 517, 524 (1994); *see also* Fox Film Corp. v. Doyal, 286 U.S. 123, 127 (1932) ("The sole interest of the United States

The dominant theory[81] underpinning this purpose is the utilitarian tenet that creators will provide a value to society if given the right incentive.[82] Thus, copyright law encourages creative production by offering authors a "fair return" for their effort.[83]

The reciprocal benefit to authors is economic.[84] In exchange for their contributions to society, authors are rewarded with a bundle of valuable proprietary rights. And though these rights are significant, reward to the owner is a secondary consideration.[85] This exchange is made "[n]ot primarily for the benefit of the author, but primarily for the benefit of the public . . . [i]n that it will stimulate writing."[86] The law "realistically recognizes that the motivation to produce would be diminished if an author knew that once a novel was written, a picture painted, or a song composed, anyone could reproduce or otherwise exploit it. There must be some assurance of

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and the primary object in conferring the monopoly lie in the general benefits derived by the public from the labors of authors.").

81. Despite the fact that the utilitarian theory is consistently relied on by courts and trumpeted by leading scholars, many scholars urge the recognition of a natural rights justification for copyright protection. Natural rights theories may be based upon a belief that copyright is a reward for the labor of one's creation, or that it is a natural extension of personhood. However, these theories have been expressly and roundly rejected by Congress and the courts. For that reason, this article does not explore those theories. See William Patry, Patry on Copyright § 1:1 at 1-19 (2016); William M. Landes & Richard A. Posner, *An Economic Analysis of Copyright Law*, 18 J. LEGAL STUD. 325, 326-27 (1989); Peter S. Menell, *Intellectual Property: General Theories*, 2 ENCYCLOPEDIA OF LAW & ECONOMICS 129, 156-63 (Boudewijn Bouckaert & Gerrit de Geest eds., 2000); Lior Zemer, *The Making of a New Copyright Lockean*, 29 HARV. J.L. & PUB. POL'Y 892, 893-94 (2006). *See generally* H.R. REP. NO. 60-2222, at 7 (1909) ("The enactment of copyright legislation by Congress under the terms of the Constitution is *not based upon any natural right* that the author has in his writings . . . but upon the ground that the welfare of the public will be served and progress of science and useful arts will be promoted by securing to authors for limited periods the exclusive rights to their writings.") (emphasis added).

82. Harper & Row Publishers, Inc. v. Nation Enter., 471 U.S. 539, 546 (1984) (quoting Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417, 429 (1984)); Mazer v. Stein, 347 U.S. 201, 219 (1954). *See also* Kevin J. Hickey, *Copyright Paternalism*, 19 VAND. J. ENT. & TECH. L. 415, 422 (2017); Lucas S. Osborn, *The Limits of Creativity in Copyright: Digital Manufacturing Files and Lockout Codes*, 4 TEX. A&M J. PROP. L. 25, 26 (2017).

83. *Harper & Row Publishers*, 471 U.S. at 546 (quoting *Sony Corp.*, 464 U.S. at 429).

84. *Id.* at 558 (noting that copyright law "supplies the economic incentive to create and disseminate ideas").

85. United States v. Paramount Pictures, 334 U.S. 131, 158 (1948).

86. Denicola, *supra* note 29, at 271 (citing H.R. REP. NO. 60-2222, at 7 (1909)). *See also* Twentieth Century Music Corp. v. Aiken, 422 U.S. 151, 156 (1975).

a reward for creative effort."[87] Thus, the law is built on an incentive to motivate creative activity.[88] By "recognizing that the incentive to profit from the exploitation of copyrights will redound to the public benefit by resulting in the proliferation of knowledge," copyright law relies on the profit motive to ensure the progress of science.[89]

Importantly, this "monopoly" reward exists even though there may be other economic incentives for creating art.[90] Creators frequently earn significant revenue independent of copyright "earnings" tied to licenses, sales, and control of creative content. For example, musicians earn revenue from concert ticket sales, artists are commissioned to create new works, and newspapers derive the majority of their profits from the sale of their goods and advertising revenue—generated long before their copyrights are even registered. However, the existence of other incentives does not reduce the importance of copyright.[91] Nor does it limit copyright's application: a newspaper still owns a copyright in its content despite its other economic motivations, as do the musician and artist.[92]

Non-economic motivations for creation may be even stronger: "Social science and psychological research suggests that creativity is usually driven by urges for self-development, personal satisfaction,

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87. Arthur R. Miller, *Copyright Protection for Computer Programs, Databases, and Computer-Generated Works: Is Anything New Since CONTU?*, 106 HARV. L. REV. 977, 1066 (1993).

88. Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417, 429 (1984). *See also* Maureen Ryan, *Fair Use and Academic Expression: Rhetoric, Reality, and Restriction on Academic Freedom*, 8 CORNELL J.L. & PUB. POL'Y 541, 545 (1999) (discussing the incentive theory and how "copyright uses the economic rewards of the market to stimulate the production and dissemination of new works").

89. Eldred v. Ashcroft, 537 U.S. 186, 212 n.18 (2003) (quoting Am. Geophysical Union v. Texaco Inc., 802 F. Supp. 1, 27 (S.D.N.Y.1992), *aff'd*, 60 F.3d 913 (2d Cir. 1994)). *See also* Mazer v. Stein, 347 U.S. 201, 219 (1954) ("The economic philosophy behind the clause empowering Congress to grant patents and copyrights is the conviction that encouragement of individual effort by personal gain is the best way to advance public welfare through the talents of authors and inventors in 'Science and useful Arts.'").

90. *See* Sepehr Shahshahani, *The Design of Useful Article Exclusion: A Way Out of the Mess*, 57 J. COPYRIGHT SOC'Y U.S.A. 859, 877 (2010).

91. For a robust discussion of the need for copyright protection despite possible alternative incentives, see Jonathan M. Barnett, *Three Quasi-Fallacies in the Conventional Understanding of Intellectual Property*, 12 J.L. ECON. & POL'Y 1 (2016) and Johnathan M. Barnett, *Copyright Without Creators*, 9 REV. L. & ECON. 389, 394 (2013) [hereinafter Barnett, *Copyright*].

92. *See, e.g.*, Los Angeles Time v. Free Republic, No. CV98-7840-MMM(AJWX), 1999 WL 33644483 (C.D. Cal. Nov. 8, 1999) (enforcing plaintiffs' copyrights in their newspapers).

and a desire to challenge oneself. Personal accounts of creators ranging from famous authors to uncompensated writers of fan fiction assert that passion, desire, or reputation motivate them to create new works."[93] Of course, these motivations exist purely on the individual level. Corporations will remain motivated by the financial incentive of copyright.[94] This corporate incentive is often the mechanism for those motivated by personal incentives to do what they love: the "corporations might pay the artists and inventors to create, or acquire their work and do the costly job of bringing it to the masses."[95]

B. Requirements of Copyrightability

Under U.S. law, copyright protection is automatic once an "original work of authorship" is fixed in a "tangible medium of expression."[96] There are generally understood to be three requirements for a valid copyright to exist: (1) fixation, (2) originality, and (3) authorship.

1. Fixation

A work must be fixed to qualify for copyright protection. "A work is 'fixed' in a tangible medium of expression when its embodiment in a copy or phonorecord, by or under the authority of the author, is sufficiently permanent or stable to permit it to be perceived, reproduced, or otherwise communicated for a period of more than transitory duration."[97] There are countless ways that a work may be fixed in a copy or phonorecord, and "it makes no difference what the form, manner, or medium of fixation may be."[98]

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93. Hickey, *supra* note 82, at 419. *But cf.* Barnett, *Copyright supra* note 91, at 394 (arguing that the evidence for intrinsic motivation is "far from fully persuasive" and there "exists ample evidence that artists are motivated at least in part by economic considerations").

94. Mark A. Lemley, *IP in a World Without Scarcity*, 90 N.Y.U. L. REV. 461, 494 (2015).

95. *Id.*

96. 17 U.S.C. § 102(a) (2012).

97. 17 U.S.C. § 101 (2012).

98. U.S. COPYRIGHT OFFICE, *supra* note 21, § 305 (3d ed. 2017) (quoting H.R. REP. NO. 94-1476, at 52 (1976)).

2. Originality

Originality is the "sine qua non of copyright."[99] In *Feist Publications v. Rural Telephone Service Co.*, the Supreme Court defined the originality requirement by holding that to "qualify for copyright protection, a work must be 'independently created by the author' and 'possess[] at least some minimal degree of creativity.'"[100] Thus, originality is a dual requirement.

The first requirement of originality is independent creation. This requires that the author created the work on his or her own, without copying from other works.[101] This is not a particularly rigorous requirement. "[A] work may be original even though it closely resembles other works so long as the similarity is fortuitous, not the result of copying."[102] The author's inspiration and intent are irrelevant to this inquiry.[103] "Mental processes do not themselves provide an objective basis for evaluating creativity."[104] Also irrelevant are the novelty, ingenuity, aesthetic value, artistic merit, and intrinsic quality.[105] All that is required here is that the author created the work on his or her own. A "trivial" variation from another work is insufficient; the work must owe its creation to the author.[106]

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99. Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 345 (1991).

100. *Id.*

101. *See id.* Some commentators argue that originality should be determined by a formal objective approach that would evaluate the creative expression and the attendant effort and intention in creating the work. *See* Yanisky-Ravid & Velez-Hernandez, *supra* note 26, at 51–52. But this is not the current standard. Instead, the standard is merely whether the work is independently created.

102. *Feist Publications*, 499 U.S. at 345.

103. U.S. COPYRIGHT OFFICE, *supra* note 21, § 310.5 ("[T]he Office will focus solely on the appearance or sound of the work that has been submitted for registration to determine whether it is original and creative within the meaning of the statute and the relevant case law. The fact that creative thought may take place in the mind of the person who created a work (or a person viewing or listening to the work) has no bearing on the issue of originality unless the work objectively demonstrates original authorship."). Critics of computer-generated art may argue that a computer cannot create meaningful art because it lacks the capacity to feel emotion. *See, e.g.*, Berger, *supra* note 8 ("Many great works of art hold meaning and value, after all, because of the story and feeling behind the work. This includes Van Gogh's painting 'Starry Night,' the view from the window of an asylum, as well as Picasso's abstract depiction of war-torn Guernica City. It would be easy to call something that mimicked that depth cheating, or a farce."). Regardless of whether this is true, it is simply not an obstacle to obtaining copyright protection.

104. U.S. COPYRIGHT OFFICE, *supra* note 21, § 310.5.

105. *Id.* at §§ 310.1-310.2 ("The fact that a work may be novel, distinctive, innovative, or even unique is irrelevant to this analysis.").

106. L. Batlin & Son, Inc. v. Snyder, 536 F.2d 486, 490 (2d Cir. 1976).

The second requirement of originality is that there is a minimal degree of creativity. Although there is no standard definition for "creativity," it is commonly explained by courts in the negative—creativity is *not* "mechanical," "entirely typical," or "garden-variety."[107] Instead, the work must possess "some creative spark, 'no matter how crude, humble or obvious it might be.'"[108] The threshold is "extremely low," and even a minimal amount of creative expression will suffice.[109]

The requirement is satisfied if the new work offers a "faint trace of 'originality'" and if it provides a "distinguishable variation."[110] For example, a design of a pansy in lace for a women's lingerie product, despite not rising to the level of a "work of art," "possesse[d] more than the faint trace of originality required."[111] A website offering ratings and awards for healthcare providers met the minimum standard because it was "the product of a creative and original process that is informed by [its] judgment and choices on what data to include and how to weight it."[112] Prices contained in collectible coin guides qualified because the developer created the prices by "using their judgment to distill and extrapolate from factual data" collected from a variety of sources.[113]

3. Authorship

Though there is no explicit "authorship" requirement in the Copyright Act, the Copyright Clause of the Constitution empowers Congress to secure *authors* with exclusive rights to their writings.[114] Early on, the Supreme Court defined "author" to mean "he to whom anything owes its origin; originator; maker."[115] More recently, the Court has described the author as generally "the party who actually

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107. U.S. COPYRIGHT OFFICE, *supra* note 21, § 308.2 (citing *Feist Publications*, 499 U.S. at 362-63).

108. *Feist Publications*, 499 U.S. at 345.

109. *Id.*

110. Dan Kasoff, Inc. v. Novelty Jewelry Co., 309 F.2d 745, 746 (2d Cir.1962); Dam Things from Den. v. Russ Berrie & Co., 290 F.3d 548, 564 (3d Cir. 2002).

111. Thomas Wilson & Co. v. Irving J. Dorfman Co., 433 F.2d 409, 411 (2d Cir. 1970).

112. Health Grades, Inc. v. Robert Wood Johnson Univ. Hosp., Inc., 634 F. Supp. 2d 1226, 1235 (D. Colo. 2009).

113. CDN Inc. v. Kapes, 197 F.3d 1256, 1261 (9th Cir. 1999).

114. U.S. CONST. art. 1, § 8, cl. 8 (providing Congress with the authority to, inter alia, "secur[e] for limited Times to Authors . . . the exclusive Right to their respective Writings").

115. Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53, 58 (1884). *See also* Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 346 (1991).

creates the work, that is, the person who translates an idea into a fixed, tangible expression entitled to copyright protection."[116] The courts have not yet been confronted with determining whether a computer can meet that definition, or whether an author must be human.

Importantly, the Constitution does not define authors as human. Congress, through the Copyright Act, has not defined authors as human (and in fact specifically provides for non-human authors in the case of works for hire). However, the U.S. Copyright Office has recently taken the position that to "qualify as a work of 'authorship[,]' a work must be created by a human being,"[117] and specifically stated that "[w]orks that do not satisfy this requirement are not copyrightable."[118]

IV. THE ARGUMENT FOR COPYRIGHT OWNERSHIP IN MACHINE-GENERATED WORKS

U.S. copyright law has been built and continues to develop on an incentive model. For this reason, coupled with the fact that neither the Constitution nor Congress requires human authorship, limiting copyright to human authors is unnecessary. The Copyright Clause in the Constitution gives Congress the power "[t]o promote the Progress of Science and useful Arts."[119] The Copyright Office and the Supreme Court have consistently articulated that the "primary object in conferring [a copyright] lie[s] in the general benefits derived by the public from the labors of authors."[120] This object is directly served by allowing computer-generated works to qualify for copyright protection.

A. The Central Purpose of Copyright Law is Served by Allowing Ownership in Machine-Generated Works

Offering copyright protection to computer-generated works would directly advance copyright's purpose of encouraging the production of original literary, artistic, and musical expression for the good of the public—"the Progress of Science and useful Arts."[121] And this "objective is no less served if [progress] is promoted

116. Cmty. for Creative Non-Violence v. Reid, 490 U.S. 730, 737 (1988).

117. U.S. COPYRIGHT OFFICE, *supra* note 21, § 313.2 (citing *Burrow-Giles*, 111 U.S. at 58).

118. *Id.*

119. U.S. CONST. art. I, § 8, cl. 8.

120. Fox Film Corp. v. Doyal, 286 U.S. 123, 127 (1932).

121. U.S. CONST. art. I, § 8, cl. 8.

through computers, or by humans in collaboration with computers, rather than by humans alone."[122] The goal, after all, is *progress*. And certainly, the increased production of creative works constitutes progress within the meaning of copyright law. That these works have been produced by machines is arguably evidence of progress, in that humans have given machines the ability to contribute to the wealth of art and literature available for consumption. "To recognize the legitimacy of copyright in computer-generated works simply acknowledges that desirable works also may be created under [] different circumstances."[123] And "Utilitarianism suggests that works authored by an algorithm might bring equal value to a human audience as works authored by a human being."[124] As Professor Miller presciently observed twenty-five years ago:

> An incentive is just as appropriate for those who "collaborate" with the computer as it is for the starving artist or the impecunious writer. A computer will not refuse to function if its output does not receive copyright protection, but the people who are motivated to prepare its programming and operate the system might. The difference between effectively energizing the authorship process and failing to do so may depend on whether the human "collaborators" expect the benefits of copyright.[125]

As with all works, there may exist other market incentives to create certain computer-generated creative works. For example, algorithms that write news stories provide a value to news organizations independent of any copyright value: they eliminate mundane tasks for journalists and free them to focus on reporting more in-depth stories. This creates a market for those technologies and an incentive to use them perhaps even in the absence of copyright protection. But just as with the newspaper example given earlier, the fact that such a market *may* exist is irrelevant to the inquiry of whether copyright protection *should*.[126] Copyright law

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122. Miller, *supra* note 87, at 1067.

123. *Id.*

124. Margot E. Kaminski, *Authorship, Disrupted: AI Authors in Copyright and First Amendment Law*, 51 U.C. DAVIS L. REV. 589, 599 (2017) (suggesting that "this theoretical framing makes it more possible that an algorithmically authored work might receive copyright protection in the United States than in countries that rely on moral rights").

125. Miller, *supra* note 87, at 1067.

126. *See, e.g.*, Los Angeles Time v. Free Republic, No. CV98-7840-MMM(AJWX), 1999 WL 33644483 (C.D. Cal. Nov. 8, 1999).

protects works despite the existence of other possible economic incentives.[127] Denying protection where it is otherwise warranted "could ultimately limit innovation by dissuading developers and companies from investing in AI research, resulting not only in the decline of AI but also in the decline of innovation across a number of related sectors."[128] Copyright protection could well be the incentive to continue the momentum of this early research. Thus, the relevant inquiry is whether there is a compelling countervailing reason to deny copyright when a work is authored by a machine, given that offering protection advances the purpose of copyright law.

A common argument against providing copyright protection to computer-generated works is that machines cannot be incentivized to create works because they are not human.[129] This simplistic argument[130] overlooks the fact that certainty of copyright in computer-generated works could provide valuable incentives for the creators of the machines that generate those works. The algorithms do not need the incentive to create works, but the programmers need the incentive to write the algorithms. Copyright can provide this incentive by offering one of the stakeholders (the programmer, end user, or both) a "fair return" for their effort.[131] Thus, recognizing a copyright in these works increases the likelihood that innovators will continue to develop code to generate new creative works for the benefit of society.

B. The Double Dipping Concern

Because programmers (or the corporations that employ them) own a copyright for the code they write, some commentators argue that awarding a copyright for the creative output from that code

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127. *See* discussion, *supra* Section III.A.

128. Kalin Hristov, *Artificial Intelligence and the Copyright Dilemma*, 57 IDEA: J. FRANKLIN PIERCE FOR INTELL. PROP. 431, 438 (2017).

129. Amir H. Khoury, *Intellectual Property Rights for "Hubots": On the Legal Implications of Human-Like Robots as Innovators and Creators*, 35 CARDOZO ARTS & ENT. L.J. 635, 653 (2017).

130. This position also ignores the incentives given to non-human corporations all the time. *See, e.g.*, Veronica Root, *Coordinating Compliance Incentives*, 102 CORNELL L. REV. 1003 (2017) (discussing corporate incentives for regulatory compliance); Margaret Ryznar & Karen E. Woody, *A Framework on Mandating Versus Incentivizing Corporate Social Responsibility*, 98 MARQ L. REV. 1667, 1681 (2015) (discussing tax incentives for corporations).

131. *See, e.g.*, Harper & Row Publishers, Inc. v. Nation Enter., 471 U.S. 539, 546 (1985).

amounts to "double dipping."[132] In other words, copyright law already provides the incentive to write the deep-learning algorithm, and programmers need no additional incentive to develop an algorithm that creates art. This argument rests on two problematic assumptions. First, it assumes that the programmer owns the copyright to the works generated by the computer. As will be discussed in Part V, *infra*, this is not an obvious conclusion. Second, it assumes that the programmer owns the copyright to the deep-learning algorithm at the time it creates works. This assumption is suspect because the way an unsupervised machine learning system works is to evolve over time as it receives data inputs and interacts with other models. These data inputs and interactions change the algorithm in ways *never contemplated* by the algorithm's original programmer, and those changes form the basis on which these machines can be said to be creative.[133] Often, programmers cannot fully explain the behavior of the AI systems they designed.[134] Additionally, the data inputs will be gathered and fed to the algorithm by the end-users—those using the system in practice. For example, the AP is the end-user of Wordsmith. To generate narratives that are useful to the AP, it collects and feeds data to the software. Importantly, the value of the algorithm is in the data, which is what the algorithm uses to learn and evolve.[135]

While it is not at all controversial to assign to a programmer the copyright for original code, or for code that has evolved in ways that are clearly derivative, once this code begins to grow in ways the programmer *did not conceive or direct*, it becomes less clear that the programmer has as strong a claim to the "evolving" code. To be clear, I am not arguing that the programmer should or should not

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132. *See, e.g.*, Robert Yu, *The Machine Author: What Level of Copyright Protection Is Appropriate for Fully Independent Computer-Generated Works?*, 165 U. PA. L. REV. 1245, 1264 (2017).

133. *See, e.g.*, Adrienne LaFrance, *An Artificial Intelligence Developed Its Own Non-Human Language*, ATLANTIC (June 15, 2017), https://www.theatlantic.com/technology/archive/2017/06/artificial-intelligence-develops-its-own-non-human-language/530436/ (discussing how chatbots developed by Facebook developed their own language).

134. Will Knight, *The Dark Secret at the Heart of AI*, MIT TECH. REV. (Apr. 11, 2017), https://www.technologyreview.com/s/604087/the-dark-secret-at-the-heart-of-ai/.

135. Alon Halevy et al., *The Unreasonable Effectiveness of Data*, IEEE INTELLIGENT SYSTEMS (2009), https://static.googleusercontent.com/media/research.google.com/en//pubs/archive/35179.pdf; Soham Chatterjee, *Good Data and Machine Learning*, TOWARDS DATA SCI. (Aug. 24, 2017), https://towardsdatascience.com/data-correlation-can-make-or-break-your-machine-learning-project-82ee11039cc9.

own this secondary copyright. It will likely be a case-by-case analysis, and thus it cannot be fairly said that the copyright incentives given to the programmer for writing the original code are sufficient to stimulate continued progress in this field when the programmer may not have as strong a copyright claim to the "evolving" code.

C. The Requirements of Copyright Law Can Be Satisfied by Computers

1. The Element of Fixation Is Easily Met

Computer-generated works are embodied in exactly the same way as works generated by human authors: they are fixed on paper, saved on a hard drive, or contained in a recording. The fact that a work is generated by a machine has no bearing on whether it can be or is fixed: if the work is in a form from which it can be reproduced, the fixation element is not an obstacle to recognizing a copyright for these works.

2. Machines Can Generate Original Works

Machines must be able to generate works that are both independently created and sufficiently creative to meet the requirement of originality. The first requirement, independent creation, mandates that the author created the work on his or her own, without copying from other works.[136] This can certainly be met by computers generating creative works. The Next Rembrandt serves as a prime example. The algorithm was designed to generate a new work based on millions of data points, but the specific creative output was not predetermined by the human programmers.[137] The resulting painting was not copied from other works, but instead created in a similar style, and thus can be properly viewed as independently created. [138]

The counterargument is that depending on how the algorithm or other AI is coded, there exists a plausible argument that this element would not be met. Neural networks work by analyzing vast

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136. *See* Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 345 (1991); Yanisky-Ravid & Velez-Hernandez, *supra* note 26, at 51–52.

137. *See supra* text accompanying note 41.

138. *See, e.g.*, Brown v. McCormick, 23 F. Supp. 2d 594, 604 (D. Md. 1998) (finding originality satisfied where copyright owner created quilt designs herself despite relying on a script that gave vague descriptions of some of the elements for the designs); *see also* McMahon v. Prentice-Hall, Inc., 486 F. Supp. 1296, 1304 (E.D. Mo. 1980) (noting that "the fact that the defendants' works may present the same ideas, concepts, and theories in the same style similarly does not amount to copyright infringement").

amounts of data, learning to recognize structures and patterns, and finally creating a new work—be it a song, poem, or visual work of art. For example, "[i]n order to produce a melody, they are trained using thousands of previous melodies, and the structure inherent in these previous works is then reproduced by the neural network when composing a new piece of music."[139] This serves as the basis for arguments that computers cannot truly be independent creators: their works are based on analysis of existing works—regardless of how different their output is from those works.

However, this is no different from "independent" human creators. An art student creating a sculpture has been no doubt influenced by the artists he has studied. Artists draw from the work of those who have come before them.[140] Indeed, one of the earliest known theories of art is Imitation Theory, the idea that the essence of art is imitation.[141] In Renaissance Italy, young artists and apprentices learned by copying the works of their masters, other artists, and the work found in their cities.[142] "Students were trained to work in the master's style and succeeded to such a degree that it is sometimes hard for today's art historians to distinguish the hand of a master from that of his most talented pupils."[143] Further evidence of artists' influence from existing works can be seen in Édouard Manet's *Le Déjeuner sur l'herbe*, which drew its inspiration from an Italian Renaissance print.[144] Pablo Picasso borrowed from popular culture and "could never have painted his breakthrough works of the 1900s without recourse to African sculpture."[145]

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139. Arthur Juliani, *Are Neural Networks Truly Creative?*, MEDIUM (July 29, 2016), https://medium.com/@awjuliani/are-neural-networks-truly-creative-e713ac963f05.

140. *See, e.g.*, Daniel J. Gifford, *Innovation and Creativity in the Fine Arts: The Relevance and Irrelevance of Copyright*, 18 CARDOZO ARTS & ENT. L.J. 569, 581 (2000) (discussing that, throughout history, artists have drawn from the works of others).

141. Glen Cheng, *The Aesthetics of Copyright Adjudication*, 19 UCLA ENT. L. REV. 113, 136–37 (2012) (identifying Imitation Theory, advanced by Plato and Aristotle, as the prevailing theory of art as late as the eighteenth century).

142. Italian Renaissance Learning Resources, *The Making of an Artist: Training and Practice*, http://www.italianrenaissanceresources.com/units/unit-3/essays/training-and-practice/.

143. *Id.*

144. Roderick Conway Morris, *How Italy Cast a Spell Over Manet*, N.Y. TIMES (June 5, 2013), https://www.nytimes.com/2013/06/06/arts/06iht-manet06.html.

145. Jason Farago, *Good Artists Copy, Great Artists Steal*, BBC (Nov. 12, 2014), http://www.bbc.com/culture/story/20141112-great-artists-steal. *See also* Julie C. Van Camp, *Originality in Postmodern Appropriation Art*, 36 J. ARTS MGMT., LAW, AND SOC'Y 247 (2010).

Musicians draw on influences from other performers, genres, and sounds to create new works.[146] Perhaps the most obvious example is hip-hop music, which is well known for its practices of sampling and looping.[147] But this phenomenon is not limited to hip-hop, nor is it new. Indeed, Handel, Bach, Beethoven, Debussy, and Wagner borrowed from or reworked existing music.[148] Charles Ives, an early 20th century American composer, borrowed extensively from existing songs and hymns.[149] This evidence supports the idea that artists do not create in a bubble, and that to a certain degree, all creativity requires influence. However, that their work is built on a process of information gathering, distilling, and re-imagining does not negate the fact that these artists are independent creators of their works. Of course, a different result emerges when creators, after studying existing works, produce *substantially similar* works. In those circumstances, there is no copyright in the new work, and it is treated as an infringement.[150] These same results should apply to works created by computers, as well.

The second component of originality requires a minimum degree of creativity. Can computers be creative? There is likely a spectrum of creativity in works produced by algorithms. On one end are works generated by a process of programmed randomness that may or may not meet this "extremely low" threshold for creativity.[151] On the other end would seem to be works generated by neural networks that are models of computer "thinking" and decision-making. This is particularly true with adversarial neural network systems, where computers are learning the contours of the subjects they are told to create on their own. Again, the Next Rembrandt serves as a prime example where computers can be creative. The work certainly possesses a minimal amount of creative expression,

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146. *See* Olufunmilayo B. Arewa, *From J.C. Bach to Hip Hop: Musical Borrowing, Copyright and Cultural Context*, 84 N.C. L. REV. 547, 604 (2006) ("Musical borrowing is a pervasive aspect of musical creation in all genres and all periods.").

147. *See id.* at 559-61.

148. *See id.* at 601-05.

149. *See id.* at 606.

150. Segrets, Inc. v. Gillman Knitwear Co., 207 F.3d 56, 62 (1st Cir. 2000).

151. *See* Stuart Ent., Inc. v. Am. Games, Inc., No. 1-96-CV-90036, slip op. (S.D. Iowa Mar. 19, 1998), *aff'd*, 205 F.3d 1347 (8th Cir. 1999) (rejecting copyright for algorithms that selected a combination of bingo cards); U.S. COPYRIGHT OFFICE, *supra* note 21, § 308.2. *But see* Ralph D. Clifford, *Random Numbers, Chaos Theory, and Cogitation: A Search for the Minimal Creativity Standard in Copyright Law*, 82 DENV. U. L. REV. 259, 283 (2004) ("[O]ne indicator of sufficient intellectual creativity for a compilation is whether the author selected items to be included within the compilation from a larger universe of choices.").

more than the required "faint trace of originality."[152] There can be little doubt that a painting that looks like it could have been painted by Rembrandt himself meets the low threshold required for originality.[153]

Must it be more? Must it be human? Copyright law does not (yet) require human creativity, but were that the case, "then machines *ex vi termini* will never be able to achieve it, no matter how sophisticated they become."[154] But that is simply not required under the current working legal definition of creativity. As long as the work expresses a minimal degree of creativity—in other words, it is not typical, garden-variety, or a programmed result—this requirement should not stand in the way of copyrightability. Indeed, Courts have specifically held that "compilations are excellent examples of the minimal nature of the originality requirement in the computer field."[155]

3. Computers Can Be Authors

Authorship is the biggest obstacle to recognizing a copyright in machine-generated works. The U.S. Copyright Office has taken the position that to "qualify as a work of 'authorship[,]' a work must be created by a human being."[156] "Works that do not satisfy this requirement are not copyrightable."[157] In its 2017 Compendium of U.S. Copyright Practices, the Copyright Office details two major categories of non-human works that are barred from copyright protection: nature-made and machine-made. As examples of nature-made works ineligible for copyright protection, the Office lists a mural painted by an elephant, driftwood that has been shaped and smoothed by the ocean, a song naming the Holy Spirit as the author

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152. *See, e.g.*, Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 345 (1991); Dan Kasoff, Inc. v. Novelty Jewelry Co., 309 F.2d 745, 746 (2d Cir.1962); Dam Things from Den. v. Russ Berrie & Co., 290 F.3d 548, 564 (3d Cir. 2002).

153. *See also* Thomas Wilson & Co. v. Irving J. Dorfman Co., 433 F.2d 409, 411 (2d Cir. 1970) (finding a design of a pansy in lace for a women's lingerie product to be original, despite not rising to the level of a "work of art").

154. Bridy, *supra* note 29, at 22 (discussing computational creativity and comparing it to human creativity).

155. M. Kramer Mfg. Co. v. Andrews, 783 F.2d 421, 438 (4th Cir. 1986).

156. U.S. COPYRIGHT OFFICE, *supra* note 21 (citing Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53, 58 (1884)).

157. *Id.*

of the work, and a photograph taken by a monkey.[158] These exclusions make sense. As discussed in Section III.A, *supra*, one of the purposes of copyright law is to incentivize authors to create new works. Conferring copyright protection on their works does not encourage an elephant, the ocean, the Holy Spirit, or a monkey to produce more works.[159]

The second excluded category covers works "produced by a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author."[160] Among the listed examples, the Office lists "a mechanical weaving process that randomly produces irregular shapes in the fabric without any discernible pattern;" "[t]ransposing a song from B major to C major;" "[m]edical imaging produced by x-rays, ultrasounds, magnetic resonance imaging, or other diagnostic equipment;" and "[r]educing or enlarging the size of a preexisting work of authorship."[161] Notably, these are examples of rote computer processes and are generated without any machine "thinking."[162] Transposing a song from B major to C major does not meet the working definition of "computer-generated work" because the specific output, C major, has been predetermined by the programmer. Similarly, medical imaging produced by x-rays does not meet the definition because its output is based on electromagnetic radiation and not machine "thinking." A machine's

158. *Id.*; *see also* Naruto v. Slater, No. 15-CV-04324-WHO, 2016 WL 362231, at *3 (N.D. Cal. Jan. 28, 2016) (holding that a photograph taken by Naruto, a monkey, cannot be an author within the meaning of the Copyright Act).

159. However, there is an argument that those who teach the elephant to paint, or the monkey to take a selfie, are the artists who might be incentivized to assist in the creation of new works if those works were protected, and that denying copyright protection results in fewer of those creative efforts. *See, e.g.*, Abbott, *supra* note 27, at 1121 (discussing *Naruto v. Slater*, the case of photographer David Slater and the "monkey selfie" photographs, and noting that "Mr. Slater, a photographer familiar with macaques, reported that he carefully staged the environment in such a way that Naruto would be likely to take his own photograph. If accurate, he probably did so in part due to an expectation of selling the resulting photographs. Had Mr. Slater known in advance that the images would pass into the public domain, he might never have taken the photographs.").

160. U.S. COPYRIGHT OFFICE, *supra* note 21; *see also* Kelley v. Chicago Park Dist., 635 F.3d 290, 304 (7th Cir. 2011) (citing Patry, *supra* note 81, for the proposition that "[a]uthors of copyrightable works must be human; works owing their form to the forces of nature cannot be copyrighted").

161. U.S. COPYRIGHT OFFICE, *supra* note 21, § 313.2.

162. *See* Denicola, *supra* note 29, at 268 ("Those works, however, would probably lack the creativity necessary for copyright even if done entirely by a human being.").

aiding the creation of a specific work is very different from a computer making decisions about how to create a new work.

Despite this directive from the Office precluding computer authorship, it is not clear that the Constitution or the Copyright Act of 1976 demands human authorship. The Constitution provides that "authors" shall have the "exclusive right to their [] writings," but defines neither term. Nor has Congress defined "author" in the Copyright Act, let alone defined it to mean "human author."[163] On the contrary, the Copyright Act specifically provides for authorship of non-humans. In the "work for hire" doctrine, the Act provides that "[i]n the case of a work made for hire, the employer or other person for whom the work was prepared is considered the author."[164] Though the employer has legal personhood—complete with rights and obligations—in most cases it is a corporate entity, not a human. Yet the Act still contemplates that this non-human is the *author*. This alone is a reasonable basis to argue that authors need not be human.

Congress considered this issue more than forty years ago, when it examined the impact of computers on copyright law, but did not devise a solution because it did not anticipate that computer-generated works were on the horizon. Confronted with the growth of computers in the 1970s and concerned about their impact on copyright law, Congress created the Commission on New Technological Uses of Copyrighted Works (CONTU).[165] CONTU determined that "there was no need for special treatment of computer-generated works because computers were not autonomously generating creative results without human intervention; computers were simply functioning as tools to assist human authors."[166] It also found that autonomously creative AI was not foreseeable.[167] Much has changed.

Until recently, the courts had not frequently addressed whether "authorship" was limited to humans. In early copyright jurisprudence, the Supreme Court defined "author" to mean "he to whom anything owes its origin; originator; maker."[168] This stemmed from a late-19th century case, *Burrow-Giles Lithographic Co. v. Sarony*, where the Court was confronted with whether

163. *See generally* 17 U.S.C. § 101 (2012).

164. 17 U.S.C. § 201(b) (2012).

165. Miller, *supra* note 87, at 1065.

166. *See* Abbott, *supra* note 27, at 1100.

167. *Id.*

168. Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53, 58 (1884); Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 346 (1991).

photographs—a new medium—were copyrightable. The argument against copyrightability was that they were "mere mechanical reproduction[s]" and "involve[d] no originality of thought or any novelty in the intellectual operation connected with its visible reproduction in shape of a picture."[169] Yet the Court held that photographs were copyrightable because they could be "traced quite directly back to the governing consciousness and sensibility of the photographer, the person behind the lens who posed the subject just so and altered the lighting just so."[170] The authorship was granted in the person who made the resulting photograph possible.[171]

A recent well-publicized case has confronted the specific question of whether non-humans can hold copyrights. In *Naruto v. Slater*, wildlife photographer David Slater was sued by People for the Ethical Treatment of Animals (PETA) for copyright infringement on behalf of Naruto, a six-year-old crested macaque.[172] Slater published a book containing images of Naruto and other crested macaques that were taken by the animals themselves—Slater maintained "that the selfies were the result of his ingenuity in coaxing the monkeys into pressing the shutter while looking into the lens, after he struggled to get them to keep their eyes open for a wide-angle close-up."[173] PETA argued that Naruto was the rightful owner of the images and that Slater and his publisher infringed on Naruto's copyright by falsely claiming to be the photographs' authors and by selling copies of the images for their profit.[174]

The District Court for the Northern District of California dismissed the claim, holding that the Copyright Act does not extend the concept of authorship to animals.[175] In so doing, the court relied on the Copyright Office's 2014 Compendium, which stated specifically that the Copyright Office will not register works produced by "nature, animals, or plants," including, by specific

169. *Burrow-Giles*, 111 U.S. at 58-59.

170. Bridy, *supra* note 29, at 11.

171. *Id.*

172. Naruto v. Slater, No. 15-CV-04324-WHO, 2016 WL 362231 (N.D. Cal. Jan. 28, 2016).

173. Julia Carrie Wong, *Monkey Selfie Photographer Says He's Broke: "I'm Thinking of Dog Walking"*, GUARDIAN (July 12, 2017), https://www.theguardian.com/environment/2017/jul/12/monkey-selfie-macaque-copyright-court-david-slater.

174. *Naruto*, 2016 WL 362231 at *1.

175. *Id.* at *3.

example, a "photograph taken by a monkey."[176] On appeal, the Ninth Circuit affirmed the dismissal on the basis that the Copyright Act does not expressly authorize animals to file copyright suits under the statute.[177] An earlier case from the Ninth Circuit had addressed whether animals have statutory standing when a group of cetaceans (whales, dolphins, and porpoises) sued the government under environmental law for injuries caused by the Navy's sonar systems.[178] In that case, the Ninth Circuit "crafted a simple rule of statutory interpretation: if an Act of Congress plainly states that animals have statutory standing, then animals have statutory standing. If the statute does not so plainly state, then animals do not have statutory standing."[179] Because the Copyright Act did not "expressly authorize animals to file copyright infringement suits under the statute," the court held that Naruto lacked statutory standing to sue.[180]

The *Naruto* court was also persuaded that terms in the Copyright Act such as "children," "grandchildren," "legitimate," "widow," and "widower" all "impl[ied] humanity and necessarily exclude[d] animals that do not marry and do not have heirs entitled to property by law.[181] This is a curious finding for two reasons. First, the Copyright Act permits statutory standing for corporations and unincorporated associations, which have the legal status of personhood but still cannot be "children," "grandchildren," "legitimate," "widows," or "widowers." Additionally, the Copyright Act permits these non-human entities to apply for, own, and bring suit—without express authorization. Thus, the fact that the Copyright Act contains these "human" terms does not necessarily demand the conclusion that, to have standing under the Act, one must be human. But the *Naruto* court was quick to dismiss the argument that because corporations are permitted to sue under the Copyright Act without express authorization, the same must be true for animals.[182] Its rationale was that it was bound by *Cetacean*, which plainly held that Congress must make clear any grant of statutory standing to animals.[183]

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176. U.S. COPYRIGHT OFFICE, COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES § 313.2 (3d ed. 2014). *See Naruto*, 2016 WL 362231 at *4.

177. Naruto v. Slater, 888 F.3d 418, 426 (9th Cir. 2018).

178. Cetacean Cmty. v. Bush, 386 F.3d 1169 (9th Cir. 2004).

179. *Naruto*, 888 F.3d at 425-26.

180. *Id.* at 426.

181. *Id.*

182. *Id.* at 426 n.9.

183. *Id.* But this did not respond to the argument that the statutory terms like "children" did not apply to corporations that *do* have standing, and thus did not

This finding also creates tension with an earlier Ninth Circuit case, *Urantia Foundation v. Maaherra*[184] (cited to by the *Naruto* district court). In *Urantia*, the Ninth Circuit was deciding a copyright dispute between parties who argued the copyrighted work was authored by celestial beings and merely transcribed by humans.[185] The plaintiff, the registrant of the work, was the transcriber for the celestial author.[186] The defendant claimed there could be no valid copyright in the book because it was not authored by a human, but the court disagreed, holding that the "copyright laws . . . do not expressly require 'human' authorship."[187] Such a holding does not directly conflict with *Cetacean* and *Naruto*, but exposes two types of statutory interpretation: one where, to have rights, the statute must expressly authorize it, and the other where rights may exist as long as the statute does not limit them to humans. In holding the latter to be true, the *Urantia* court did not recognize copyright ownership by divine beings, but rather by those "who were responsible for the creation of the tangible literary form that could be read by others."[188] Presciently, the Ninth Circuit in *Urantia* mentioned the uncertainty of whether a computer-generated work could be copyrighted.[189]

It is not surprising that the court recognized twenty years ago the difficulty of determining whether computers could be considered authors under the Copyright Act. Courts are often put in the position of reconciling timeworn laws with emerging technology, as legislators have difficulty predicting and accounting for future technological developments. This has been especially true with copyright law. When new technologies disrupt the balance, it has fallen to the courts to establish the boundaries of rights and liabilities.[190]

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provide an independent reason to deny standing. The *Naruto* court's effort to deny standing to animals independent of *Cetacean*'s requirement that the grant must come from Congress may be based on the fact that it believed *Cetacean* was wrongly decided. *See id.* at 426 n.7 ("While we believe *Cetacean* was incorrectly decided, it is binding circuit precedent that non-human animals enjoy constitutional standing to pursue claims in federal court.").

184. Urantia Found. v. Maaherra, 114 F.3d 955 (9th Cir. 1997).

185. *Id.*

186. *Id.* at 957.

187. *Id.* at 958 ("The copyright laws, of course, do not expressly require 'human' authorship, and considerable controversy has arisen in recent years over the copyrightability of computer-generated works.").

188. *Id.*

189. *Id.*

190. *See, e.g.*, White-Smith Music Publ'g Co. v. Apollo Co., 209 U.S. 1 (1908) (involving player pianos); Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417 (1984) (involving video cassette recorders); Metro-Goldwyn-Mayer

This was apparent nearly 150 years ago, when the Court in *Burrow-Giles* recognized the tension between law and emerging technology, concluding that the "only reason why photographs were not included in the extended list [of copyrightable subject matter] is, probably, *that they did not exist, as photography, as an art, was then unknown, and the scientific principle on which it rests, and the chemicals and machinery by which it is operated, have all been discovered long since that statute was enacted.*"[191] As Professor Miller explains:

> Two centuries ago, [writings] meant only maps, charts, and books, all of which at that time had only human authors. Today, of course, "Writings" embraces an amazing spectrum of modes of expression completely unknown at that time, including computer programs, computer databases, sound recordings, motion pictures, photographs, and countless others. There is no reason why "Authors" cannot undergo a comparable transformation. Certainly the policies underlying copyright do not prevent it; if anything, these policies might well be inhibited by a human author requirement.[192]

Today, the word "author" should perhaps be interpreted to include computers acting in that role. Despite the pronouncement of the Copyright Office to the contrary, it is not at all clear that the law demands human authorship. The Constitution does not define authors as human. Congress, through the Copyright Act, has not defined authors as human (but specifically provides for non-human authors in the case of works for hire). The courts have yet to directly address the issue of authorship for computer-generated works, but that day cannot be too far off.

D. And the Author Is . . .

In order for the law to recognize copyrightability in computer-generated works, there must be a party with which to vest the legal authorship. There are three possibilities: the developer, the end user, or a joint ownership scheme. The computer itself cannot be the owner, as it is a piece of chattel, rendering it incapable of *owning*

Studios, Inc. v. Grokster, Ltd., 545 U.S. 913 (2005) (involving peer-to-peer file sharing).

191. Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53, 58 (1884) (emphasis added).

192. Miller, *supra* note 87, at 1065.

anything, including intellectual property. But because both the developers and end users are not just stakeholders who could have an interest in laying claim to the copyright, but are also critical to the work's creation, it is not immediately obvious where ownership should vest.

Consider a seemingly straightforward application of generative software: an algorithm (written by a programmer) is sold to a news organization to use to create news stories. Perhaps the news organization merely "turns on" the algorithm to generate the content. Or perhaps it is more involved, and members of the news organization provide significant data to the algorithm to direct its creative output. (After all, a machine-learning algorithm is only as good as its data.) Should the author be the programmer, the end user, or both?

Determining authorship is even more difficult to answer in instances where the relationship between programmers and end users is complex and multifaceted. The Next Rembrandt project, for example, involved a team working together to achieve a single creative goal. But it is still unclear whether authorship would vest in the data scientists and engineers who developed the algorithms, the material researchers and consulting art historians, or some scheme of joint authorship. This section will explore the legal realities of these possibilities.

1. Joint Ownership

The development of an algorithm that can create art, write poetry, or draft news stories will often be the result of a pooling of efforts. The algorithm is just half of the equation—the other half is the data. And it is the data that builds the universe from which the AI system *learns.* In many ways, the data is the most important component because a model will be only as good or as bad as its data.[193] The AI programmer and the data contributor thus both contribute to the success of the model.

But it does not legally follow that this should translate into a joint copyright. First, joint copyrights are only appropriate when (1) the contributions of each author constitute an independently copyrightable contribution, and (2) there is an intent by both parties to be co-authors.[194] In the case of computer-generated works, it is unlikely that these requirements will be met. The work the software

193. *See* Halevy, *supra* note 135; Chatterjee, *supra* note 135.

194. *See* Childress v. Taylor, 945 F.2d 500, 505 (2d Cir. 1991); Aalmuhammed v. Lee, 202 F.3d 1227, 1234 (9th Cir. 2000).

developer or programmer does—data input, coding instructions—result in *code* that is copyrightable, but not *output* that is copyrightable. In other words, if the subject work is a news story, the programmer has written protectable code that tells the computer to use particular language and speech patterns to write the story based on certain inputs. But this is a contribution to the *development* of the article, and not directly to the article, as the law requires. Further, the contributions by the end user—perhaps the AP or another news agency—are likely limited to, at best, directing the computer to obtain information from specific inputs (for example, statistics from sporting events or earnings reports from financial firms), or, at worst, simply pushing a button and waiting for the article to appear. Neither would constitute an independently copyrightable contribution. The second requirement is also problematic because it will often be impossible for the developer to know who the various end users will be, thereby making it impossible that they share an intent to be co-authors.

A secondary reason to be skeptical of a joint authorship framework is that it could "result in a 'fractionalization' of ownership rights," where claims to ownership could be made by a variety of disentangled parties, including "the operating system programmer, the computer manufacturer, etc."[195]

2. Software Developers' Claim to Authorship

Software developers are the true "masterminds" behind computer-generated works.[196] They exercise the most creative control in determining the parameters for the creative output and the processes the algorithm will use to create that work. Perhaps most importantly, they program the algorithm not just to create, but to *think* creatively. Indeed, although "[t]he human might not be in the loop after the input is given, [] the human is surely deeply represented in the design. And that is why it is successful."[197]

This is a compelling reason to award authorship to developers. Historically, courts have rewarded the creative masterminds behind

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195. William T. Ralston, *Copyright in Computer-Composed Music: Hal Meets Handel*, 52 J. COPYRIGHT SOC'Y U.S.A. 281, 306 (2005).

196. For the purposes of this article, the terms "software developer" and "programmer" are used interchangeably to refer to the individual that builds and creates software and applications, tests for errors, and executes the source code of a software application.

197. Rockmore *supra* note 73.

works with the authorship.[198] In *Burrow-Giles,* the Court defined "author" as "he to whom anything owes its origin; originator; maker; one who completes a work of science or literature."[199] Without these developers, there would be no algorithms to produce creative works. Considering that copyright law is built on an incentive to motivate creative activity,[200] the software developers seem the appropriate recipient of the grant of authorship. It is their creative activity, after all, that makes computer-generated works possible. Legally acknowledging another entity as the author could risk stifling innovation by discouraging those who might otherwise make significant contributions to the progress of science.

Recognizing software developers as authors would also allow for flexibility. In many cases, the developer will not be interested in controlling the rights and usage of the copyright of computer-generated works (in the case of news stories generated for a news organization, for example). In these circumstances, the developers have the ability to assign or license their rights to those end users or other parties interested in ownership.

Despite these compelling reasons, there are countervailing factors that suggest copyright should perhaps not vest in software developers. First, the Court has held that the author of a work must be the party that fixes the work.[201] Specifically, the work must be fixed in a copy or phonorecord "by or under the authority of the author."[202] In order for the developer to be considered the author of the work, the developer—and not the end user—would have to execute the algorithm to fix the work. This creates a catch-22: if the

198. *See, e.g.*, Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53, 61 (1884) (agreeing that "the author is the man who really represents, creates, or gives effect to the idea, fancy, or imagination"); *Aalmuhammed*, 202 F.3d at 1232, 1234 (defining author as the "master mind" behind a work—the person with "creative control").

199. *Burrow-Giles Lithographic Co.*, 111 U.S. at 58.

200. Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417, 429 (1984).

201. Cmty. for Creative Non-Violence v. Reid, 490 U.S. 730, 737 (1989); *see also* 16 Casa Duse, LLC v. Merkin, 791 F.3d 247, 258 (2d Cir. 2015) (discussing that authors are not entitled to copyright protection except for the "works of authorship" they create and fix); Am. Broad. Cos. v. United States, 129 F.3d 1243, 1246 n.1 (Fed. Cir. 1997) (observing that "the copyright vests initially with the author once the author fixes the work in a tangible medium").

202. U.S. COPYRIGHT OFFICE, *supra* note 21, § 313.2. Although there is an argument that an end-user who fixes the work does so under the authority of the developer, this argument is weakened by the fact that in many (if not most) cases, the developer will not know the identity of the end users.

author of a work is "he to whom anything owes its origin,"[203] and the author of a work must also fix the work,[204] it would frustrate the ability of developers to sell their software to entities that could benefit from the ability to produce such works.

Second, software developers already have a valuable copyright in the code itself. By owning the rights to the algorithm, the developers can control its distribution and usage. Assuming many end users cannot develop this software on their own and must rely on programmers to deliver it, this software is an important asset. Importantly, this software is *far more valuable* if computer-generated works are copyrightable. But allowing the developer to reap the reward of copyright for the software and for the creative end product of the software gives them two bites at the apple. Instead, if the copyrights in the creative works were allocated to another party, such as the end user, the developer's incentive to write generative algorithms is stimulated: there will be increased demand for computer-generated works by end users because of the certainty they will have regarding their own proprietary rights to those works. In other words, this rights-distribution scheme would not diminish value to the software developer. In fact, it increases the worth of the software itself, and thus, the ability of the software developer to exploit it. (And, of course, if the developer expects the computer-generated work to have significant copyright value, they could retain the product and exploit it themselves.)

3. Claim to Authorship by End Users

The final candidate for ownership rights in computer-generated creative output is the end user of the computer program. There are strong economic factors, discussed above, that make this group appealing to recognize as the author of these works. Additionally, "[u]sers who purchase the program might reasonably expect to be able to use [and control] the output produced by the program."[205] If the end user cannot exploit the copyright for the works its computer creates, those works—and the software that creates them—have less value for that user. This is especially true if another entity, such as the developer, owns the rights to the output. In such a case, there is little use for the product for any end user absent a complicated licensing arrangement between the parties that allows for distribution, copying, etc.

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203. *Burrow-Giles Lithographic Co.*, 111 U.S. at 58.

204. *See Sony Corp. of Am.*, 464 U.S. at 417.

205. Ralston, *supra* note 195, at 303-04.

Thus, conferring a copyright to computer-generated works on end users seems to make the most practical sense. However, we must return to the catch-22 that impedes recognition of the developer as author: although the end user is the party to "fix" the work, courts reward the "inventive or master mind" with the authorship,[206] which is not likely to be a user who is simply executing an algorithm written by another party. Surely, there are circumstances when the end user provides creative contributions that help shape the output, such as collecting the data inputs for the algorithm. In such circumstances, an argument might be made that this contribution is valuable enough to confer authorship. But *requiring* that type of addition limits the pool of end users to those who have the interest or ability to make such contributions, which in turn weakens the value of the copyright in the algorithm itself because it is less salable.

Our current legal framework dictates that neither the developer nor the end user can meet the definition of author because typically one party creates and the other fixes the work. Nor is a joint copyright appropriate where there is no intent to merge and a lack of copyrightable contribution from one of the parties. And, of course, the algorithm itself cannot own the copyright. Without some legal fiction, the reality is that the work will go into the public domain upon creation. Yet allowing the works to go into the public domain is an unappealing solution because, as discussed in Part III, *supra*, this removes incentives to develop new creative works that promote the progress of science. Importantly, recognizing a copyright in the end user aligns with the Court's preference to define the author as the party who "translates an idea into a fixed, tangible expression entitled to copyright protection."[207]

V. CONCLUSION: WHAT NEEDS TO BE DONE

Recognizing the end user as the author of computer-generated works does the most to advance the primary purpose of copyright law in promoting the progress of science: end users are incentivized to operate the program and generate new works. Their proprietary ownership of those works encourages them to purchase (or license) the software from developers. In addition, recognizing an ownership

206. *See, e.g.*, *Burrow-Giles Lithographic Co.* 111 U.S. at 61 (agreeing that "the author is the man who really represents, creates, or gives effect to the idea, fancy, or imagination"); Aalmuhammed v. Lee, 202 F.3d 1227, 1232, 1234 (9th Cir. 2000) (author is the "master mind" behind a work—the person with "creative control").

207. Cmty. for Creative Non-Violence v. Reid, 490 U.S. 730, 737 (1988).

right in the end user has direct and indirect benefits for the software developer. As discussed above, the value of the software increases with its ability to secure copyright protection for its end users. And if the creative works produced by the algorithm have significant economic potential, the developer is in the enviable position of deciding whether to sell the software (at an increased price) or keep it to retain the copyright in the works. However, to grant authorship in either the developer or end user requires a legal fiction.

This is not unchartered territory in copyright law. As other scholars have noted, copyright law already employs legal fictions in two circumstances to determine ownership: works for hire and joint owners.[208] In the work-for-hire doctrine, copyright authorship is vested in a person (often a corporate entity) that is not the actual author of the work, in order to enhance predictability and certainty of ownership.[209] In recognizing joint owners of copyrighted works, copyright law engages in another legal fiction. Copyright law acknowledges two authors of works when both (1) the contributions of each author constitute an independently copyrightable contribution, and (2) there is an intent by both parties to be co-authors.[210] "The result is that an author of a joint work co-owns the copyright even in parts of the work that she did not herself create."[211] This is precisely what is needed for computer-generated works.

Congress has explicitly carved out these two circumstances where it makes sense to legally recognize as an author an entity that has not met the legal definition of author. Computer-generated works presents a third opportunity. Identifying ownership in collaborative works clearly involves heavy transaction costs.[212] Acknowledging the availability of copyright protection to computer-generated works and identifying the author "would promote

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208. *See, e.g.*, Hristov, *supra* note 128, at 445; Bridy, *supra* note 29, at 66.

209. 17 U.S.C. § 201(b) (2012).

210. *See Aalmuhammed*, 202 F.3d at 1234.

211. Denicola, *supra* note 29, at 276.

212. Mark H. Jaffe, *Defusing the Time Bomb Once Again-Determining Authorship in a Sound Recording*, 53 J. COPYRIGHT SOC'Y U.S.A. 139, 156-57 (2006); *see also United States Copyright Office and Sound Recordings as Work Made for Hire: Hearing Before the Subcomm. on Courts and Intellectual Prop. of the H. Comm. on the Judiciary*, 106th Cong. 134 (2000) ("The economic rationale for the 1976 Copyright Act's work for hire provisions is rooted in the well-documented problem of transaction costs . . . . By allowing the parties to definitively confer for-hire status on these works, [the Act] promotes marketability by making it possible for parties to eliminate an otherwise chaotic state of copyright title, centering full ownership in a single individual or entity and thus facilitating the secure and fluent transfer of ownership interests over the life of the copyright.") (statement of Paul Goldstein, Stan. Law Professor).

marketability in a work by eliminating an undetermined state of authorship."[213] To achieve this goal, Congress should carve out another authorship right for the end users of computer-generated works, grounded in 17 U.S.C. § 201, along with works for hire and joint copyrights. Such a congressional response to emerging technology would be supported by case law:

> From its beginning, the law of copyright has developed in response to significant changes in technology. Indeed, it was the invention of a new form of copying equipment—the printing press—that gave rise to the original need for copyright protection. Repeatedly, as new developments have occurred in this country, it has been the Congress that has fashioned the new rules that new technology made necessary.[214]

But time is of the essence. Although "the relatively slow development of AI [has offered] a reprieve from the reactive, crisis-driven model of policymaking that has dominated copyright law in the digital era,"[215] that time is running out. Several countries have responded to the growth in artificial intelligence by recognizing copyrights in computer-generated works.[216] In these jurisdictions, the author is considered either the person by whom arrangements necessary for the creation of the work are undertaken, or the person who causes the work to be created.[217] There is a risk that if the United States does not recognize rights in computer-generated

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213. Jaffe, *supra* note 212, at 156-57.

214. Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417, 430-31 (1984).

215. Bridy, *supra* note 29.

216. In addition, the European Parliament advocated granting autonomous robots the legal status of "electronic persons" for purposes of copyright protection. *See* Copyright, Designs, and Patents Act 1988, c. 48, § 9(3) (U.K.) ("In the case of a literary, dramatic, musical or artistic work which is computer-generated, the author shall be taken to be the person by whom the arrangements necessary for the creation of the work are undertaken."); New Zealand Copyright Act 1994 (N.Z.); Andres Guadamuz, *Artificial Intelligence and Copyright*, WIPO MAG. (Oct. 2017), http://www.wipo.int/wipo_magazine/en/2017/05/article_0003.html; *see also* Gerlind Wisskirchen, *Digitalisation and Automation: How Will They Impact the Global Labour Market?*, CMS LAW-NOW (May 9, 2017), http://www.cms-lawnow.com/ealerts/2017/09/digitalisation-and-automation-how-will-they-impact-the-global-labour-market.

217. Ana Ramalho, *Will Robots Rule the (Artistic) World?*, 21 J. INTERNET L. 12 (July 2017).

works, the innovation will shift to countries where these rights *are* recognized.

It is critical that copyright law evolve to match technological innovation in order to continue that growth. Congress should incentivize the development of creative machines consistent with the purpose and intent of the Founders and of Congress.