I "THINK," THEREFORE I CREATE:
Claiming Copyright in the Outputs of Algorithms

Samantha Fink Hedrick

Abstract

Artificial intelligence (AI) has often been viewed as either an ally or an adversary—a powerful analytical system to be harnessed or a source of risk to be managed. In copyright law, AI has been treated much the same way, with academic debates focused primarily on whether AI-generated works should be owned by the AI itself, or on a potential copyright battle between the human programmer who created the AI and the end user. However, little attention has been paid to how the use of AI in the creative process can affect the validity of ownership claims asserted by any of these human actors in computer-generated works—a question that may have a far greater impact on creative industries.

In this article, I examine whether the use of AI as a tool of creation interferes with a human's ability to claim copyright in the resulting works. First, I identify the various human actors who could plausibly own the copyright in the creative outputs of AI and evaluate the relative merits of their claims. In the second part, I analyze the doctrine of authorship to determine not *which* human should own the copyright in a computer-generated work, but rather whether the use of AI presents a barrier to *any* human claiming authorship in these outputs. Finally, I explain how AI operates in the creative process and the various mechanisms of control available to humans to modify these outputs.

Ultimately, I argue that the humans who create and use AI retain sufficient control over the AI's "decisions" that the use of AI does not constitute a barrier to human ownership of copyrightable computer-generated works. The "original intellectual conceptions" represented in computer-generated works are still those of the humans creating and controlling the algorithms used in the creative process, not those of the AI itself. Like a camera, AI functions merely as a tool of creation, not as a sentient "author."

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INTRODUCTION

Artificial intelligence is taking over the world.[1] Some people mean that literally and would have you believe that the reign of humans in the world is swiftly coming to a close.[2] Others simply mean that the Internet of Things will soon include nearly every object we interact with in the course of our day.[3] Regardless, it is unarguable that this technology is becoming increasingly prevalent and is constantly spreading to affect more and more areas of our daily lives. AI has been getting a lot of visibility in areas like bail reform, sentencing, and employment decisions,[4] and is being used in many other ways as well, some predictable and some surprising—including medical diagnosis,[5] facial recognition,[6] smart assistants,[7] driverless cars,[8]

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[1] Wikipedia, the Free Encyclopedia, *AI Takeover* (last visited May 16, 2018), http://en.wikipedia.org/wiki/AI_takeover.

[2] *See* Samuel Gibbs, *Elon Musk: Artificial Intelligence Is Our Biggest Existential Threat*, *The Guardian* (Oct. 27, 2014), https://www.theguardian.com/technology/2014/oct/27/elon-musk-artificial-intelligence-ai-biggest-existential-threat; Rory Cellan-Jones, *Stephen Hawking Warns Artificial Intelligence Could End Mankind*, *BBC News* (Dec. 2, 2014), http://www.bbc.com/news/technology-30290540; Matt Chessen, *Artificial Intelligence Will Be the End of Humanity, But Not for the Reasons You Think*, *Medium* (May 24, 2016), https://medium.com/short-bytes/artificial-intelligence-will-be-the-end-of-humanity-but-not-for-the-reasons-you-think-482fbfa6858f; *Universal Paperclips*, http://www.decisionproblem.com/paperclips/; *Terminator* (Orion Pictures 1984); *Westworld*, Season 2, Episode 1 (Home Box Office (HBO) 2017).

[3] *See, e.g.*, Daniel Burrus, *The Internet of Things Is Far Bigger Than Anyone Realizes*, *Wired* (Nov. 2014), https://www.wired.com/insights/2014/11/the-internet-of-things-bigger/ (discussing "smart cement" and suggesting that the Internet of Things is "going to make everything in our lives from streetlights to seaports 'smart'"); Scott Stephenson, *No Place Like Home: The Internet of Things and Its Promise for Consumers*, *Forbes* (Dec. 18, 2017), https://www.forbes.com/sites/scottstephenson/2017/12/18/no-place-like-home-the-internet-of-things-and-its-promise-for-consumers/#66ab4fcb5fe2 (describing the existing elements of the "connected home"); Shane Greenstein, *The Expanding Internet of Things Creates Significant Challenges for Telecom Companies*, *Forbes* (Apr. 13, 2017), https://www.forbes.com/sites/quora/2017/04/13/the-expanding-internet-of-things-creates-significant-challenges-for-telecom-companies/#75bb95b8c24e (discussing the burden on telecommunications companies resulting from the proliferation of sensors in the Internet of Things).

[4] *See, e.g.*, Julia Powles, *New York City's Bold, Flawed Attempt to Make Algorithms Accountable*, *New Yorker* (Dec. 20, 2017), https://www.newyorker.com/tech/elements/new-york-citys-bold-flawed-attempt-to-make-algorithms-accountable.

[5] Wojciech Samek, Thomas Wiegand, Klaus-Robert Muller, *Explainable Artificial Intelligence: Understanding Visualizing and Interpreting Deep Learning Models* (Aug. 2017), https://arxiv.org/pdf/1708.08296.pdf.

[6] Tim Macuga, Australian Centre for Robotic Vision, *What Is Deep Learning and How Does It Work?* (Aug. 23, 2017), https://cosmosmagazine.com/technology/what-is-deep-learning-and-how-does-it-work.

[7] Microsoft, *Cortana* (last visited May 14, 2018), https://www.microsoft.com/en-us/AI/cortana; MathWorks, *What Is Deep Learning? 3 Things You Need to Know* (last visited May 16, 2018), https://www.mathworks.com/discovery/deep-learning.html.

[8] MathWorks, *supra* note 7.

imaging historical landmarks,[9] mastering games,[10] weather prediction,[11] online ad serving,[12] drafting form email responses,[13] and even helping the blind navigate the offline, physical world.[14] One court even imposed liability on a trucking company in the 1980s for having *failed* to use available technology to track the hours and shifts of drivers in order to prevent fatigue.[15]

As more aspects of our lives are affected by AI, many people are understandably calling for increased transparency and accountability. That, however, has been difficult to achieve, partly due to the complexity of the technology and the relative technological inexperience of much of the public, and partly because these algorithms tend to be proprietary and closely guarded by the companies that create and own them. Furthermore, as AI seemingly becomes more "human," it is increasingly difficult to parse out works that were created by humans and those created by machines. Questions of ownership over works created using technology also accordingly become more difficult. While a discussion of transparency and accountability in algorithms generally is outside the scope of this article, these issues may guide how we view claims of ownership that result from the use of such algorithms to create copyrightable works.

不讨论算法的透明性和可追溯性问题，重点讨论是否算法本身拥有版权

有版权的工作，即创造的工作本身自带版权

Previous scholarship has focused primarily on the push and pull between the claims of the AI and the claims of the humans by exploring the arguments that would support a claim that

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[9] '*Heritage Activists' Preserve Global Landmarks Ruined in War, Threatened by Time*, Microsoft: Transform (last visited May 16, 2018), https://news.microsoft.com/transform/heritage-activists-preserve-global-landmarks-ruined-in-war-threatened-by-time/?utm_source=Direct.

[10] *AlphaGo*, Deep Mind (last visited May 16, 2018), https://deepmind.com/research/alphago/; *Watson*, IBM (last visited May 16, 2018), https://www.ibm.com/watson/; Macuga, *supra* note 6.

[11] Radu Raicea, *Want to Know How Deep Learning Works? Here's a Quick Guide for Everyone.*, *Medium* (Oct. 23, 2017), https://medium.freecodecamp.org/want-to-know-how-deep-learning-works-heres-a-quick-guide-for-everyone-1aedeca88076.

[12] Moustafa Mahmoud, *How AI Is Changing the Face of Online Advertising*, *Gulf Marketing Review* (Nov. 19, 2017), https://gulfmarketingreview.com/advertising/ai-changing-face-online-advertising/.

[13] Tim Moynihan, *How Google's AI Auto-Magically Answers Your Emails*, *Wired* (Mar. 17, 2016), https://www.wired.com/2016/03/google-inbox-auto-answers-emails/.

[14] Heather Kelly, *Google's Plans to Use AI to Help the Blind*, *CNN* (May 11, 2018), http://money.cnn.com/2018/05/11/technology/google-lookout-app/index.html.

[15] *Torres v. North American Van Lines*, 135 Ariz. 35 (1982).

作者的讨论不在特定的人应该拥有版权（程序员还是用户），而是算法是否拥有版权

the AI itself should be deemed the author of computer-generated works. In discussing the claims of the human actors, the debate has been around which human should "win" the copyright instead. My focus in this article is less about who the exact human author should be (from among the choices identified below), but rather on whether the interposition of an algorithm between the programmer (or user) and the output should present a barrier to that human's claim of authorship in the output. I conclude that it should not.

The crux of the issue is really about control over the outputs. Even with extremely complex deep-learning algorithms, there are human programmers and users who write the algorithm's code, decide what kinds of outputs are desired, set the objective functions and other parameters, and much more.[16] These humans are exercising sufficient control such that the "original intellectual conceptions" embodied in the resulting works are truthfully those of the human, not the algorithm. Like a camera, the AI is merely a tool of creation, not a sentient being developing "original intellectual conceptions" of its own.

AI算法如同Camera，人虽然只是按下快门，但是拥有照片的版权

Part I will discuss the possible options for allocation of copyright in computer-generated works (to the algorithm,[17] the programmer, the user, the data owner, some combination of those entities via joint ownership, or no one (i.e., the public domain)) and summarize the arguments for and against each option. Part II will discuss the doctrinal underpinnings of authorship and creativity. Part III will apply the doctrine to algorithms—in particular, deep learning algorithms—by delving into their operations and addressing issues like accountability and transparency.

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[16] *See, e.g.*, David Lehr & Paul Ohm, *Playing with the Data: What Legal Scholars Should Learn About Machine Learning*, 51 U.C. Davis L. Rev. 653 (Dec. 2017).

[17] In this article, "AI," "algorithm," "program," "computer," and other related terms are all used mostly interchangeably. While there are clear differences among them, this article is discussing whether any of these varieties of non-human, digital tools of creation are capable of undermining a human's claim to their outputs. For the purposes of this article, there is no difference between them, in that they are all referring to code that is capable of generating a creative (and potentially copyrightable) work.

PART I: EENY MEENY MINY MOE: WHO OWNS COMPUTER-GENERATED WORKS?

As AI technology has evolved to mimic more and more human capabilities, the question of how to allocate copyright in the works these programs create has become increasingly complicated. Potentially-copyrightable, computer-generated works have long vexed scholars and legislators—as Annemarie Bridy puts it, "we know that these works would be copyrightable if they were done by people, but we do not know what to do with them if they are done by computers."[18] Both scholars and non-academics generally seem willing to attribute some degree of agency, autonomy, or even intent to AI, particularly as the technology becomes more complex, less intuitively explainable, and more human-like in its abilities (or perhaps, in some situations, *less* human-like, in that some AI appears to complete tasks that humans would be unable to do).[19] Literary works and films have invoked the idea of autonomous, sentient AI, and this fictional possibility is difficult to ignore. As a result, the interposition of an algorithm

[18] Annemarie Bridy, *The Evolution of Authorship: Works Made by Code*, 39 Colum. J.L. & Arts 395, 400 (Spring 2016) (citing U.S. Office of Tech. Assessment, *Intellectual Property Rights in an Age of Electronics and Information* 69 (1986), https://www.princeton.edu/<diff>ota/disk2/1986/8610/8610.PDF [https://perma.cc/XUV3-E979]).

[19] *Cf.* David Chang, *Considering Moral Agency in Artifical Intelligence and Autonomous Vehicles*, *Medium* (2017), https://medium.com/@dchang13/using-intent-to-unpack-the-ethics-behind-autonomous-vehicles-and-artificial-intelligence-1ef2ccf7a658; Don Berkich, *Autonomous Machine Agency*, *Doctoral Dissertations 1896-Feb. 2014* 2341 (2002), https://scholarworks.umass.edu/dissertations_1/2341; Mark Muraven, *Designing a Safe Autonomous Artificial Intelligence Agent based on Human Self-Regulation*, *arXiv:1701.01487* (2017), https://arxiv.org/abs/1701.01487?context=cs; Michael P. Wellman & Uday Rajan, *Ethical Issues for Autonomous Trading Agents*, *Minds and Machines* 27 (2017); Deborah G. Johnson & Mario Verdicchio, *AI, Agency and Responsibility: The VW Fraud Case and Beyond*, A.I. & Soc. (2018), https://doi.org/10.1007/s00146-017-0781-9.

6种可能的版权拥有者：AI，程序开发者，用户，数据持有者，多作者，no one （无版权）

between the human "author" and the creative output of the algorithm feels different from the presence of a tool such as a camera or a paintbrush.

So who should own the copyright in computer-generated works? There are six possible answers to this question: the AI itself,[20] the programmer,[21] the user,[22] the data owner, some combination with joint authorship,[23] or no one.[24]

These debates have been raging for over 50 years, with little resolution in any direction. Indeed, the arguments being made for each outcome remain essentially the same as they were at the beginning of the computer age. In 1966, the Register of Copyrights noted in the office's 68th annual report that

> [t]he crucial question appears to be whether the 'work' is basically one of human authorship, with the computer merely being an assisting instrument, or whether the traditional elements of authorship in the work (literary, artistic, or musical expression or elements of selection, arrangement, etc.) were actually conceived and executed not by man but by a machine.[25]

Copyright Office拒绝了Push Button Bertha的版权申请因为由计算机创作

In 1956, the Copyright Office refused to register "Push Button Bertha," a song composed by a Datatron computer, simply because it was not created by a human, and there was no precedent for such a claim.[26] In 1974, Congress created the National Commission on New Technological

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[20] Annemarie Bridy, *Coding Creativity: Copyright and the Artificially Intelligent Author*, 2012 Stan. Tech. L. Rev. P5 (Mar. 29, 2012); Yvette Joy Liebesman, *The Wisdom of Legislating for Anticipated Technological Advancements*, 10 J. Marshall Rev. Intell. Prop. L. 153 (Fall 2010); Kalin Hristov, *Artificial Intelligence and the Copyright Dilemma*, 57 IDEA 431 (2017); Karl F. Milde, Jr., *Can a Computer Be an "Author" or an "Inventor"?*, 51 J. Pat. Off. Soc'y 378 (1969); Bridy, *Works Made by Code*, *supra* note 18, at 395-401. *But see* James Grimmelmann, *There's No Such Thing as a Computer-Authored Work - And It's a Good Thing, Too*, 39 Colum. J.L. & Arts 403 (Spring 2016).

[21] Pamela Samuelson, *Symposium: The Future of Software Protection: Allocating Ownership Rights in Computer-Generated Works*, 47 U. Pitt. L. Rev. 1185, 1205-09 (Summer 1986).

[22] *Id*. at 1200 n.67 (quoting National Comm'n on New Technological Uses of Copyrighted Works, Final Report (1979)); Stephen Breyer, *The Uneasy Case for Copyright: A Study of Copyright in Books, Photocopies, and Computer Programs*, 84 Harv. L. Rev. 281, 284-93 (1970); Ralph S. Brown, *Eligibility for Copyright Protection: A Search for Principled Standards*, 70 Minn. L. Rev. 579, 596 (1985).

[23] Samuelson, *supra* note 21, at 1221-24.

[24] Daniel Schönberger, *Deep Copyright: Up- and Downstream - Questions Related to Artificial Intelligence (AI) and Machine Learning (ML)*, Droit d'auteur 4.0, *11, 2018; Samuelson, *supra* note 21, at 1224-28.

[25] Register of Copyrights, Sixty-Eighth Annual Rep. of the Register of Copyrights 5 (1966).

[26] Bridy, *Works Made by Code*, *supra* note 18, at 395; Martin Klein & Douglas Bolitho, *Push Button Bertha* (1956), available at https://www.youtube.com/watch?v=V-XZKS4BItI.

但是到了1980中期，对计算机生成作品的版权受理非常普遍，很多作品都是依靠计算机创作的

Uses of Copyrighted Works (CONTU) to analyze this issue (along with several others related to the computer revolution, then in its infancy).[27] Interestingly, CONTU found that "existing statute and case law adequately cover any questions involved" in computer-aided creation.[28]

Nearly a decade later, in the mid-1980s, Pam Samuelson noted that "[w]hen one thinks of how widespread are uses of computer programs to generate other works . . . one can see that the stakes of the allocation of ownership rights in computer-generated works are very high indeed. When the stakes are high and the statute ambiguous, the stage would seem to be set for a hot contest."[29] That same year, Congress' Office of Technology Assessment noted that "[computer-aided creation] greatly complicates the process of determining originality and authorship, and of assigning rights. Similarly, with advances in artificial intelligence, computer-aided design, and computer-generated software, it will become increasingly difficult to determine what creators have actually created."[30] 作者权的归属变得困难

Yet even today, more than three decades after that stage was observed to be set, scholars are still grappling with these same questions.[31] The discussion has even made its way into pop culture.[32]

Some countries today have laws that expressly address the issue of ownership in computer-generated works. For example, the UK and New Zealand both stipulate that the person

[27] Samuelson, *supra* note 21, at 1212.
[28] Nat'l Comm'n on New Technological Uses of Copyrighted Works, Final Report 46 (1979) (hereinafter cited as CONTU Final Report).
[29] Samuelson, *supra* note 21, at 1187 n.4.
[30] U.S. Congress, Office of Technology Assessment, Intellectual Property Rights in an Age of Electronics and Information 301 (1986) (hereinafter cited as OTA Report).
[31] *See, e.g.*, Schönberger, *supra* note 24; Grimmelmann, *No Such Thing*, *supra* note 20; Bridy, *Works Made by Code*, *supra* note 18; Bridy, *Coding Creativity*, *supra* note 20.
[32] Dan Brown, *Origin* 66 (2017) ("Langdon had recently read about . . . teaching computers to create algorithmic art - that is art generated by highly complex computer programs. It raised an uncomfortable question: When a computer creates art, who is the artist - the computer or the programmer? At MIT, a recent exhibit of highly accomplished algorithmic art had put an awkward spin on the Harvard humanities course: *Is Art What Makes Us Human?*").

deemed to be the author of such a work is "the person by whom the arrangements necessary for the creation of the work are undertaken."[33] France, Germany, Greece, Switzerland, and Hungary expressly limit authorship to "humans" or "natural persons."[34] The U.S does not have laws that currently address this issue directly, although the Copyright Office has expressly stated that it will not recognize non-human authors.[35]

My focus in this article is less about who the exact human author should be (from among the choices above), but rather on whether the interposition of an algorithm between the programmer or user and the output should present a barrier to that human (or corporate) being's claim of authorship in the output. I conclude that it should not. Even with extremely complex deep-learning algorithms, there are human programmers and users who write the algorithm's code, set the objective functions and other parameters of the algorithm, and decide whether the algorithm is creating the desired outputs or whether it ought to be tweaked. These humans are masterminding the creative process, and even complex models are simply following the humans' commands (or at least creative guidelines, criteria, and rules).

人主导了作品创建，再复杂的模型也仅仅是遵循人的命令。
（放在现在的大模型背景下，还适用？数据拥有者的位置呢）

In order to make any general assertions about the claims of humans to AI-generated works, the first step is to examine each possible claim of authorship on its own merits. Only then can we examine how the use of AI might interfere with any or all of these claims of authorship (and, therefore, ownership).

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[33] UK Copyright, Designs and Patents Act 1988, Section 9; Bridy, *Works Made by Code*, *supra* note 18, at 400 (noting that Hong Kong and India (also common law countries) take a similar approach). This language does not choose *ex ante* between the programmer and the user (where they are different people); for the reasons discussed below in Section II.D this is a wise choice by the legislators.

[34] Schönberger, *supra* note 24, at *2; Bridy, *Works Made by Code*, *supra* note 18, at 400 (noting that all of these are civil law countries).

[35] Compendium of U.S. Copyright Office Practices § 306 (3d ed. 2014) (hereinafter cited as Compendium) (the Copyright Office "will register an original work of authorship, provided that the work was created by a human being. . . .Because copyright law is limited to 'original intellectual conceptions of the author,' the Office will refuse to register a claim if it determines that a human being did not create the work."). *See also Naruto v. Slater*, Case No. 15-cv-04324-WHO (N.D. Cal. 2016).

A. I "Think," Therefore I Am an Author: Computer as Author

When discussing computer-generated works, many scholars have focused on the question of whether the algorithm itself ought to be recognized as the author of an AI-generated work. There is of course a colorable argument that AI is capable of meeting the explicit criteria for copyrightability in its outputs:[36] 1) a "work of authorship" that falls within the subject matter of copyright (including the categories listed in Section 102 of the Copyright Act;[37] 2) fixation in a tangible medium of expression;[38] and 3) originality,[39] which post-*Feist* has two elements of its own: a) independent creation and b) a "modicum of creativity."[40]

US专利局不承认非人类作者

However, deeming the AI to be the author for copyright purposes is nonsensical and impractical. First, the U.S. Copyright Office does not recognize non-human authors.[41] Bridy noted a "deep-seated . . . assumption that authors are necessarily human," citing the Northern District of California in *Naruto v. Slater*, which lists several quotations from cases in the Ninth Circuit that use the word "human" or "natural persons" in their discussion of authorship.[42]

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[36] There are many different types of outputs for an algorithm (ranging from a simple prediction or number to a full novel). In this article, "outputs" refers to creative works that would be eligible for copyright protection, such as poems, novels, images, music, or even other software.
[37] 17 U.S.C. § 102.
[38] *Id*.
[39] U.S. Const. art. I, § 8, cl. 8; *Feist Publ'ns, Inc. v. Rural Tel. Serv. Co.*, 499 U.S. 340, 345 (1991) ("The *sine qua non* of copyright is originality.").
[40] *Feist*, 499 U.S. at 346, 362.
[41] Compendium, *supra* note 35 § 306, 313.2 (3d ed. 2014) (". . . Because copyright law is limited to 'original intellectual conceptions of the author,' the Office will refuse to register a claim if it determines that a human being did not create the work."); Compendium § 802.5(C) (addressing human authorship of musical works) ("To be copyrightable, musical works, like all works of authorship, must be of human origin…[M]usic generated entirely by a mechanical or an automated process is not copyrightable. For example, the automated transposition of a musical work from one key to another is not registrable. Nor could a musical composition created solely by a computer algorithm be registered."); *Naruto v. Slater*, 2016 U.S. Dist. LEXIS 11041, at *9-10 (N.D. Cal. 2016) ("In section 306 of the Compendium, entitled 'The Human Authorship Requirement,' the Copyright Office relies on citations from Trade-Mark Cases, 101 U.S. 94 (1879) and Burrow-Giles to conclude that it 'will register an original work of authorship, provided that the work was created by a human being.' Similarly, in a section titled 'Works That Lack Human Authorship,' the Compendium states that, '[t]o qualify as a work of 'authorship' a work must be created by a human being. Works that do not satisfy this requirement are not copyrightable.'").
[42] Bridy, *Works Made by Code*, *supra* note 18, at 395, 399; *Naruto*, 2016 U.S. Dist. LEXIS 11041, at *8-9.

版权的授予取决于作品中最小人类创造性工作的比例，如果是公司的员工，那版权属于公司。如果是多人合作，则属于joint authorship

CONTU also noted that "[t]he eligibility of any work for protection by copyright depends not upon the device or devices used in its creation, but rather upon the presence of at least minimal *human* creative effort at the time the work is produced."[43] International law also generally agrees on this issue and, as noted above, a large handful of countries have laws that explicitly state that only human authors will be recognized.

It is easy to say that these statutes and policies should simply be changed so that copyright *can* be granted to non-human authors, but the reason for this rule comes directly from the Constitution of the United States and the underlying justifications for copyright protection. The IP Clause of the U.S. Constitution permits Congress to grant copyright protection to "Authors and Inventors" to "promote the Progress of Science and the useful Arts."[44] The purpose of copyright law, therefore, is to provide incentives for authors to create so that the public domain of creative works will continuously increase.[45] Machines cannot be incentivized in the same way that humans can.[46] Algorithms follow the orders of their programmers and need no further incentives to create. While some human is likely to benefit commercially from the outputs of AI algorithms and would therefore be incentivized to create, use, and improve them,

机器无法被激励来创作新的产品，因此与版权法的初衷相悖

[43] CONTU Final Report, *supra* note 28, at 45 (emphasis added).
[44] U.S. Const., art. 1, § 8, cl. 8.
[45] 1 Nimmer on Copyright § 1.03(A) ("Thus, the authorization to grant to individual authors the limited monopoly of copyright is predicated upon the dual premises that the public benefits from the creative activities of authors, and that the copyright monopoly is a necessary condition to the full realization of such creative activities.").
[46] OTA Report, *supra* note 30, at 76: ("When the element of human labor involved in the processing of information is replaced by automation, the incentive of copyright protection may become entirely disconnected from the authorship that it seeks to inspire. Information that is automatically generated by a computer is ''authored, if at all, by a program that is indifferent to legal incentives.'"); Schönberger, *supra* note 24, at *10 ("Robots do not need protection, because copyright's incentives for creativity will and naturally must remain entirely unresponded to by them."); Samuelson, *supra* note 21, at 1200-01 ("The system has allocated rights only to humans for a very good reason: it simply does not make any sense to allocate intellectual property rights to machines because they do not need to be given incentives to generate output. All it takes is electricity (or some other motive force) to get the machines into production."); James Grimmelmann, *Copyright for Literate Robots*, Iowa L. Rev. (2016); Mike Masnick, *Another Dumb Idea Out of the EU: Giving Robots & Computer Copyright*, *TechDirt* (Jun. 28, 2016, https://www.techdirt.com/articles/20160624/17260834817/another-dumb-idea-out-eu-giving-robots-computers-copyright.shtml.

the incentives are, at the very least, less direct and less certain when provided to the machine instead of the human. Granting the copyright to the AI would therefore undermine the efficacy of the inherent incentives of copyright law. The way to incentivize a robot to create is to incentivize its programmer to instruct it to create.

Finally, allocating copyright to an algorithm would, for all practical purposes, be moot. Allocation of copyright to AI would normally just result in ownership of the copyright by the company or individual who owns the AI itself, since the owner of the AI would also own any of the AI's "possessions." In many cases, the owner would be the company who employed the programmer(s) who created it (as a work made for hire, or otherwise assigned through employment agreements or other contracts). Only in situations where no copyright is held in the algorithm's code itself would this option change the outcome in practice.[47] Given that it also distorts the incentives for the human creators who could be influenced instead, it does not make any practical sense to go down this road.

In addition to making initial vesting of the copyright in the AI moot, the ability to transfer ownership of the copyright by transferring ownership of the algorithm also undermines the protections that copyright law has put in place for initial authors (for example, the programmer (assuming his or her work on the algorithm was not considered a work made for hire)), such as termination of transfers. Such protections are intended to ensure that authors are properly incentivized; interrupting such protections and, therefore, such incentives, ought to be

软件和计算机代码是毫无疑问具有版权的

[47] It is also worth noting that software and computer code is at this point indisputably copyrightable. *Apple v. Franklin*, 714 F.2d 1240 (3d Cir. 1983), *cert. dismissed*, 464 U.S. 1033 (1984); 1 Nimmer on Copyright § 2A.10(E) ("Regardless of one's perspectives, there would seem to be no turning back: Congress enacted CONTU's recommendations into law in the 1980 amendment….In addition, copyright protection for software has become far too embedded in the world trade order to permit any realistic prospect of its abandonment in the foreseeable future."); Samuelson, *supra* note 21, 1187 n.5.

accompanied by a serious discussion of the significance of these repercussions and whether modifications to existing law would be required in order to preserve them in these situations.

One particular focus of existing scholarship has been around the work made for hire doctrine as a justification for deeming the AI to be the legal author of an AI-generated work.[48] However, this stretches the doctrine to its breaking point. The factors that contribute to a determination of whether someone is an employee include language that—at least in today's world—solely applies to humans, such as "the extent of the hired party's discretion over when and how long to work; . . . the provision of employee benefits; and the tax treatment of the hired party."[49] Such factors would not make logical sense if applied to AI. This doctrine also requires that the conduct is "actuated, at least in part, by a purpose to serve the master."[50] These factors suggest intentionality and choice, and it would be difficult to plausibly argue that an algorithm possesses either one.

传统对版权人的定义无法适用于AI

Finally, although it is hotly disputed, computers are simply not the type of creative "authors" that copyright law contemplates. After being tasked by Congress to look into issues of copyright in computer-generated works, CONTU concluded that a computer was more like an inert tool used by a human in the creative process, "completely lacking in creative capabilities while requiring human direction to bring about a creative result,"[51] stating that "there is no reasonable basis for considering that a computer in any way contributes authorship to a work produced through its use."[52]

AI需要人的指导来取得创造性结果

[48] *See, e.g.*, Bridy, *Works Made by Code*, *supra* note 18, at 400 (Bridy, however, uses the work made for hire doctrine as a means of enabling the programmer to retain rights in the work, finding the ultimate grant of copyright to AI to be "impracticable"); Bridy, *Coding Creativity*, *supra* note 20, at P6, 66-69.
[49] *Community for Creative Non-Violence v. Reid*, 490 U.S. 730, 751-52 (1989).
[50] *Rouse v. Walter & Assoc., LLC*, 513 F. Supp. 2d 1041, 1056 (S.D. Iowa 2007) (listing this as one element in determining whether the work was created within the scope of employment, which is itself an element in determining whether the work is a work made for hire by an employee).
[51] Samuelson, *supra* note 21, at 1195 (summarizing CONTU Final Report).
[52] CONTU Final Report, *supra* note 28, at 44.

Perhaps this is really just an issue of framing—if we focus on the bare minimum of sufficiency for meeting authorship requirements, AI could potentially pass the test. However, if we look instead at the "human" elements of authorship, AI may fall far short. This could conceivably change in the future, but the discussion of control in Section III below should still resolve this issue in favor of a human author and not an algorithm.

B. Pygmalion: Programmer as Author

There are two main arguments for allocating copyright in the outputs of algorithms to the programmer(s) of the algorithm itself: 1) the programmer's creative choices in preparing the algorithm to create its outputs (e.g., designing the algorithm, selecting a type of model, setting the objective function and other key parameters, and training and adjusting the algorithm)[53] contribute very substantially to the resulting outputs as well, and 2) the incentives the programmer would receive are well-aligned with the goals of copyright.

David Lehr and Paul Ohm describe eight "stages of machine learning": 1) problem definition, 2) data collection, 3) data cleaning, 4) summary statistics review, 5) data partitioning, 6) model selection, 7) model training (including tuning, assessment, and feature selection), and 8) model deployment.[54] In designing and building an algorithm, one of the key decisions made by the programmer is which model is best suited to his or her needs, based on the desired outputs.[55] There are many types of models (including supervised and unsupervised models, or reinforcement learning) and levels of complexity (from simple computational algorithms to deep learning models (e.g., deep neural networks) that integrate multiple layers of algorithms). The

[53] Lehr & Ohm, *supra* note 16.
[54] *Id*. at 669-702.
[55] *Id*. at 688-95.

programmer also defines the objective function, which is one of the critical steps in the development of the algorithm and determines the general characteristics of the outputs (e.g., the format and what is being optimized). Then the programmer sets other parameters (e.g., bias and variance, which determine the accuracy and speed of the algorithm).[56] Next, the programmer selects data sets with which to train the algorithm, including decisions on how to divide the data for training and testing purposes.[57] The size of the data and the representativeness of the data (i.e., how accurate extrapolations from sample data to a broader data set will be) significantly affect the accuracy of the algorithm's predictions and the usefulness of its outputs.[58] Finally, the programmer makes myriad decisions on how and how much to adjust the parameters and data before deciding that the algorithm is ready to "go live."[59] Only after all of those decisions have been made is the algorithm set loose to create an output "on its own." However, in light of all those decisions made by the programmer prior to this point in the creative process, it is easy to see why the programmer would be a sensible choice as the "author" of the algorithm's outputs, given his or her very substantial contribution to—and control over—the form and creative parameters of the outputs.

As discussed in greater detail in Part III below, even where the steps between the programmer's final decisions and the actual moment of creation are complicated and difficult for humans to fully comprehend (e.g., when using complex neural networks), these choices that the programmer made in the first phases of creation still strongly influence the characteristics of the outputs.[60] The programmer (or the user) also has the ability to adjust the parameters, data, and

[56] *See id*. at 696-97.
[57] *Id*. at 683-84.
[58] *Id*., 677-81
[59] *Id*., 695-701.
[60] *See generally id.*

other factors in order to influence the output—even if they do not understand the intermediate steps between those choices and the moment of creation at all.

For example, if the algorithm is conceived of as a tool, like a camera, the idea of recognizing authorship in the user is more readily acceptable to many scholars.[61] A novice photographer can pick up a DSLR camera, put it in "sunset" mode, and effectively capture an autumn-hued landscape photograph, despite it being broad daylight in the spring.[62] The resulting photograph is not considered any less copyrightable when taken by that novice than it is when taken by a professional photographer who fully understands every special effect and mathematical calculation performed by the camera's software. Why, then, should the use of an algorithm be thought of any differently? Perhaps it is our society's romantic notions of humanoid robots from science-fiction stories that make the "choices" and processes of an algorithm feel more intentional and thoughtful than they truly are.

If the idea to create something (even if reasonably specific—e.g., a 100-page romance novel set in Paris with a protagonist who owns a cafe) comes from the programmer, but the actual copyrightable expression of that idea comes from the algorithm, can the programmer claim that expression as his own? My response to this is that the expression still ultimately truly comes from the programmer, because the programmer selects all the parameters and training data that guide the algorithm in its choice of each word, plot twist, and style choice. If an author can claim the accidental variation resulting from a clap of thunder "as his own,"[63] then certainly

[61] *See, e.g.*, Bridy, *Coding Creativity*, *supra* note 20, at P10-11, 23 (explaining the causation theory of authorship by referencing *Burrow-Giles* and the justification for copyright in photographs, and further analogizing to computer programmers: "Like the photographer standing behind the camera, an intelligent programmer…stands behind every artificially intelligent machine. People create the rules, and machines obediently follow them…"); Samuelson, *supra* note 21, at 1195 (discussing CONTU's comparison of a computer to a camera); CONTU Final Report, *supra* note 28, at 45 ("The computer may be analogized to or equated with, for example, a camera, and the computer affects the copyright status of a resultant work no more than the employment of a…camera…").
[62] This author has done just this many times using both her Canon point-and-shoot and Canon DSLR.
[63] *Alfred Bell & Co. v. Catalda Fine Arts, Inc.*, 191 F.2d 99, 105 (2d Cir. 1951).

variation within the narrow (or even broad) set of choices the programmer allows to the AI should belong to him as well. Any randomness or rule-based "creativity" that results (certainly in the sense of novelty if nothing else) comes about in the same way that selecting a mode on a camera and pressing the shutter button produces a photo that may not exactly follow the photographer's precise conception of what it would end up looking like, but does follow from his initial choices and parameters.

The programmer also breathes whatever life we perceive in AI into it. The programmer's choices in designing and calibrating the algorithm are what provide the algorithm with all of its "creative" capabilities[64]—the algorithm has no ability to create outputs except that ability which the programmer provides to it. An algorithm is therefore more of an extension of the human programmer's own creative mind than it is an independent being capable of originality and creativity. Even when an algorithm generates something H-creative (historically creative—never before created by humans),[65] that was only possible as a result of the instructions and capabilities programmed into it by its creator (the programmer or user). Such "creativity" results from randomness and other rules dictated by the (creative) choices of the programmer.[66]

作者强调，AI的创造性也是开发者赋予的

A programmer is also able to be swayed by financial incentives in a way that an algorithm is not. Programmers are, like writers, painters, composers, and other traditional creators, the very type of "Authors and Inventors" contemplated by the drafters of the Copyright Clause. While an algorithm will blindly follow the instructions it is given by its programmer (whether to create or to stop creating) and will not be swayed by financial gain (unless it is instructed to be), the programmers themselves can be incentivized to create, use, and improve

[64] Samuelson, *supra* note 21, at 1194-96.
[65] *See* Margaret Boden, *Creativity: How Does It Work?*, Creativity East Midlands *1 (2007); *see also* Bridy, *Coding Creativity*, *supra* note 20, at P29-31.
[66] See Part II.C for a detailed discussion of this issue.

algorithms in order to generate additional works. This is true whether the output is a novel, a song, a painting, or even another AI program.

Finally, labor theory, while discredited by the Supreme Court in *Feist* as a basis for copyright protection, certainly nonetheless logically supports the allocation of copyright to the programmer.[67] The endless choices described above add up to a very substantial expenditure of time, resources, and creativity by the programmer. As Samuelson puts it, the programmer will always, at the very least, be a "substantial contributor to the production of any output."[68] Samuelson also discussed (pre-*Feist*) what she termed the "comparative sweat test"; however, even after *Feist*, while labor itself is not dispositive in granting copyright in the work, there is still some logic in comparing the relative creative contributions of the various contributors in order to determine who should be granted ownership of the copyright (provided that the work and perhaps also the contribution meet the minimum threshold requirements of copyrightability). For example, the more modern "mastermind" doctrine for joint authorship[69] rewards the
联合署名的主谋理论，用于奖励主要贡献者
contributor who is seen as having provided the largest creative contribution—the "original intellectual conceptions" or "vision" for the work.[70]

However, some scholars have argued against granting copyright in computer-generated works to the programmer. Samuelson argues that "[t]he programmer creates the potentiality for

[67] Samuelson, *supra* note 21, at 1201 n.74, 1205 n.87. *But see Feist*, 499 U.S. at 349-50. Samuelson's arguments in favor of copyright ownership by the programmer is based on the programmer being a "substantial contributor to the production of any output," arguing that the programmer deserves to be rewarded (impliedly, through at least partial ownership of copyright) because the work of programming is "intellectually demanding, as well as time-consuming and expensive for the programmer." She also notes that "[t]he effort that is put into creation of a copyrightable work is sometimes said to be among the things the copyright laws intend to protect." It should be noted, however, that that article was written prior to the seminal opinion in *Feist*, which dismissed the idea of using Lockean labor theory as a basis for granting copyright.
[68] Samuelson, *supra* note 21, at 1205.
[69] *Aalmuhammed v. Lee*, 202 F.3d 1227, 1234 (9th Cir. 2000).
[70] *Id.*; *Lindsay v. The Wrecked and Abandoned Vessel R.M.S. Titanic*, 52 U.S.P.Q.2d 1609 (S.D.N.Y. 1999).

开发者为生成的内容提供了可能性，但没有将之现实化

the creation of the output, but not its actuality."[71] Bridy inverts the labor theory to argue that the programmer has *not* expended sufficient labor to create the outputs—that a programmer "doesn't lift a finger to create them," viewing the process (and labor) of creating the algorithm as an entirely separate process (and labor) from that of creation once the algorithm is operational.[72] CONTU supported this view: "It appears to the Commission that authorship of the program or of the input data is entirely separate from authorship of the final work."[73] However, to say that the programmer has expended no "minimal human creative effort"[74] to create the work once the algorithm has been made operational is to discount not only all the previous labor that was spent building and calibrating the algorithm, but also (and more importantly to current copyright doctrine) all of the programmer's creative choices in model selection, parameter setting, data selection and allocation, calibration, testing, and all the other steps along the path from the original idea for the output to its final execution, as well as the ongoing tasks of monitoring and modifying the algorithm once it is operational.[75]

程序的版权和输入的版权与最终工作的作者是分离的。

Another objection by Bridy to granting the copyright in the outputs of an algorithm to its programmer is that the algorithm, not the human, is the actual agent of fixation.[76] However, this has been rejected by courts as an obstacle to copyright. Photographs have been deemed copyrightable despite the camera being the actual "agent of fixation,"[77] and novels (or articles like this very one) are still considered copyrightable despite having been typed on (and therefore fixed by) a computer with word-processing software. Furthermore, the Southern District of New

[71] Samuelson, *supra* note 21, at 1209.
[72] Bridy, *Works Made by Code*, *supra* note 18, at 397-98.
[73] CONTU Final Report, *supra* note 28, at 45. Interestingly, the analogy the Commission made to drive this point home was to compare the outputs of an algorithm to a translation of a book - thereby implying that the outputs are actually, in some sense, derivative works of the algorithm and/or the data.
[74] *Id.*
[75] *See* Lehr & Ohm, *supra* note 16.
[76] Bridy, *Works Made by Code*, *supra* note 18, at 398.
[77] *Id.* at 398. *See also Burrow-Giles Lithographic Co. v. Sarony*, 111 U.S. 53 (1884).

所以具有争议的地方在于，像是stable diffusion这样的生成模型，用户仅仅提供了几个关键字，AI做了余下的创作，original intellectual conceptions更像是AI的。
但AI不是human，不具备获得copyright的权利。注：OpenAI 允许用户有条件的分享生成内容，但未提及copyright的归属问题

York, in *Lindsay v. The Wrecked and Abandoned Vessel R.M.S. Titanic*, held that Lindsay was still the author of a documentary, despite a film crew having been not only the actual agents of fixation, but also the humans who actually captured the footage (including, presumably, at least some creative choices about framing, lighting, focus, etc.).[78] The mastermind doctrine established in *Lindsay* and *Aalmuhammed v. Lee* allows the human who "superintends" the process, or whose "original intellectual conceptions" the work embodies, to own the copyright, despite other sentient human beings actively making creative choices and contributing their own original and creative contributions to the work as a whole (unless there is an express intention to be considered joint authors).[79] If other humans cannot deprive the mastermind of his copyright, then surely an inert algorithm, just like an inert camera, should not either. David Nimmer agrees, stating that:

原创性是版权归属判断的关键，与工作完成的方式无关。就比如诗人请其他人记录自己的诗，版权还是属于诗人

> Given that copyright inheres only in works fixed in a tangible medium of expression, is the "author" to be construed as the party fixing the work? Important as fixation is, we have just seen that originality is the essence of authorship; accordingly, the originator, rather than the fixer, should be deemed the "author." For the distinction between one poet who brandishes a quill (or word processor) and another who dictates to a stenographer cannot call for a differing legal conclusion as to "authorship." Poets, essayists, novelists, and the like may have copyrights even if they do not run the printing presses or process the photographic plates necessary to fix the writings into book form.[80]

As discussed above in Part I.A, one of the main arguments for granting copyright to the AI is the work made for hire doctrine, which is at best an awkward fit for non-human entities. Another benefit of using the mastermind doctrine to allocate the copyright to the programmer or user instead is that there is no tension in the doctrine that requires the AI to be or to act like a human. There is no intentionality required on the part of the AI—there is *room* for creativity or

[78] *Lindsay* 52 U.S.P.Q.2d.
[79] *Lindsay*, 52 U.S.P.Q.2d, *Aalmuhammed*, 202 F.3d 1227, 1234 (9th Cir. 2000).
[80] 1 Nimmer on Copyright § 1.06(A).

even intent, but unless the AI truly conceives and executes the idea without human guidance (which is not truthfully possible with today's technology, and unlikely to become possible any time in the near future), then the human is still "masterminding" the process, even if the AI is responsible for intermediate steps and creative decisions. The AI in this scenario is simply playing a role in executing the "original intellectual conceptions" of the programmer or user—just like the film crew in *Lindsay* or the sound engineers, makeup artists, costume and set designers, writers, producers, actors,[81] and consultants in *Aalmuhammed*.

Bridy's final argument against granting the copyright to the programmer is that unpredictability in the algorithm means that the programmer has insufficient control over the output to be deemed the author.[82] However, this too is a fallacy. As just discussed, the mere fact that some steps of the creative process are not known or fully understood by the programmer does not negate the programmer's contributions to the creative process, or the fact that the programmer is the true mastermind of the creative process. Just as the novice photographer expects that his photo will come out looking like a sunset, but does not understand why or how—or even if the photographer has no idea what effect the "sunset" setting will have on his photo at all—the resulting photograph is no less copyrightable. Furthermore, even when there is some unpredictability once the algorithm is set free to complete the creative process, the programmer can still make adjustments in later iterations to change and shape later output(s).[83] Furthermore, the Second Circuit rejected the idea that an unpredictable or accidental outcome could be denied copyrightability; following its famous reference to a "clap of thunder" that jars a painter's arm

不可预料的或者意外的输出不能作为拒绝赋予版权的依据

[81] *But see Garcia v. Google*, 786 F.3d 733 (9th Cir. 2015).
[82] Bridy, *Works Made by Code*, *supra* note 18, at 398.
[83] Jeff Dean, *Large Scale Deep Learning* (Nov. 2014), https://static.googleusercontent.com/media/research.google.com/en//people/jeff/CIKM-keynote-Nov2014.pdf.

尽管画家被雷声吓得手抖，导致作出了不是其意向的画作，但仍然可以获得版权

and changes the work, the court unequivocally stated that "[h]aving hit upon such a variation unintentionally, the author may adopt it as his and copyright it."[84]

A final, intriguing argument by Samuelson suggests that the very fact that the algorithm's code is copyrightable is the reason why the creative process leading to the creation of the algorithm itself should be considered as a separate process from that leading directly to the creation of the output.[85] Samuelson suggests that a programmer should only be allowed to commercialize one of those two creative processes—a form of election doctrine that forces the programmer to choose either to commercialize the software itself or to sell the outputs, but not both.[86] This idea, while intriguing, seems to bear more on the issue of whether the copyright should also or instead be allocated to the user when the programmer chooses to sell the software, but does not present a compelling reason to deny copyright to the programmer.

如果开发者选择出售软件，软件的生成物是否应该属于使用者

C. What Does This Button Do?: User as Author

The arguments for and against granting copyright in computer-generated works to the user largely track those for the programmer—the user (if the user and the programmer are different individuals) is also likely to have made a substantial contribution to the creative process, the user exercises similar control over the inputs and parameters of the algorithm, and the incentives are well-aligned with the goals of copyright law. The same challenges could be made to the user's claim as well. The user has expended even less labor than the programmer to create the output (although the user's labor may also be substantial—many of the choices around setting the parameters, selecting the data, and calibration could be performed by the user as well

[84] *Bell*, 191 F.2d at 105.
[85] Samuelson, *supra* note 21, at 1207-08.
[86] *Id.*

as (or in lieu of) the programmer). The algorithm still stands between the user and the output as the agent of fixation, and the same unpredictability exists for the user as for the programmer (and perhaps to a greater degree, since the user is more likely to be in the position of the novice photographer than an all-knowing codemaster).

However, there are also qualities that are unique to the user. First, the user is best positioned to bring the outputs to market,[87] and may therefore be better positioned than the programmer to fulfill the goals of copyright.[88] After all, copyright is not intended simply to encourage more works to be *created*, but also for them to be *disseminated*.[89] The existence of myriad secret libraries of works across the world would do nothing to "promote the Progress of Science and the Useful Arts"[90] if no one else were able build off of that knowledge or inspiration. Therefore, it may be better to allocate ownership to the person who can not only produce additional works but can also be swayed by the financial incentives of copyright to disseminate those works.

用户拥有版权的理由：1，版权不仅是鼓励创造，还鼓励传播，所以将生成物的版权赋予用户也具有意义

[87] *Id*. at 1226 n.67 ("Machines may not need rights to be induced to generate output, but that, of course, does not mean that no one needs incentives in order for products of generator programs to be made available."); Schönberger, *supra* note 24, at *14; OTA Report, *supra* note 30, at 158 ("In the marketplace for printed works, governed by copyright, the incentive to produce was linked to the incentive to disseminate printed copies as widely as possible; for selling copies was how producers generated income.").

[88] Samuelson, *supra* note 21, at 1227 (arguing that publishers are the true creators of value by bringing works to market, and therefore deserve (and usually receive) the lion's share of the profits).

[89] *See* 1 Nimmer on Copyright § 1.03(A). *See also Eldred v. Ashcroft*, 537 U.S. 186 ("The Copyright Clause and the First Amendment seek related objectives -- the creation and dissemination of information. When working in tandem, these provisions mutually reinforce each other, the first serving as an 'engine of free expression,' Harper & Row, Publishers, Inc. v. Nation Enterprises, 471 U.S. 539, 558, 85 L. Ed. 2d 588, 105 S. Ct. 2218 (1985), the second assuring that government throws up no obstacle to its dissemination."); *Harper & Row Publrs. v. Nation Enters.*, 471 U.S. 539, 558 ("[I]t should not be forgotten that the Framers intended copyright itself to be the engine of free expression. By establishing a marketable right to the use of one's expression, copyright supplies the economic incentive to create and disseminate ideas."); *Acuff-Rose Music, Inc. v. Campbell*, 754 F. Supp. 1150 (M.D. Tenn. 1991) ("To foster the widespread dissemination of ideas, the copyright system is "designed to assure contributors to the store of knowledge a fair return for their labors.") (citing *Harper & Row*). While publication is no longer required by copyright law in order to receive protection, dissemination remains one of the primary motivations behind offering copyright incentives to authors.

[90] U.S. Const., art. 1, § 8, cl. 8.

理由2：输出很大一部分也取决于用户调用算法时的输入

Second, in some instances, the user may set the parameters and provide data for the algorithm that vastly change the output (and even the way it operates).[91] In other words, the same software provided to two different users could result in two wildly different sets of outputs, depending on the creative choices made by the user, and regardless of the choices previously made by the programmer.

或许你想说的是prompt

理由3：用户具体化了作品

Third, the user is closer to being the agent of fixation, although the algorithm still stands between the user and the outputs. Samuelson, for example, compares the user to the person who records a jazz improv session (and therefore fixes the work).[92] In that sense, the user is fixing the work of both the programmer and the algorithm, and would have a claim to copyright even if she did not fully mastermind the entire creative process. However, as discussed above in Section II.B, the agent of fixation theory has not been accepted by courts.

理由4：用户对结果进行了筛选，起到决策作用

Finally, the user makes further decisions regarding the selection and editing of outputs in determining which to bring to market and disseminate, and which to destroy or discard.[93] Especially since one of the benefits of algorithms is their ability to operate at scale (and therefore produce vast quantities of potentially copyrightable works), the user will usually be forced to choose from among them rather than to flood the market with large numbers of works of varying quality. These choices represent originality and creativity of their own.

One additional argument against the user as author (and unique to the user) centers on the line of cases holding that the users of video games are not authors of the resulting audiovisual work, even when their interaction with the software influences the output.[94] *Midway v. Artic*

反对观点：电子游戏的玩家不拥有游玩视频的版权

[91] Lehr & Ohm, *supra* note 16.
[92] Samuelson, *supra* note 21, at 1202.
[93] *See, e.g.*, Samuelson, *supra* note 21, at 1209-21 (suggesting that the user's claim to the copyright would actually be as a derivative work of the raw outputs of the algorithm). I think this formulation of the right trivializes the user's contribution and does not sufficiently recognize the elements of control discussed below in Part II.
[94] *See, e.g., Midway Mfg. Co. v. Artic Int'l, Inc.*, 1981 U.S. Dist. LEXIS 16881 (1981).

International, a prominent video game case, rejected the claim that the video game users were the authors of the resulting audiovisual work; Samuelson suggests that the rationale for this is based on "the programmer's structuring of the degree of variability of the program."[95] In other words, if the programmer so constrains the creative process of the user—or the AI—one could use this reasoning to argue that the programmer should still be considered the author, perhaps because the resulting works still represent the programmer's "original intellectual conceptions."

反对观点：软件开发者创造了程序的变化性和创造性，所以用户不具有额外的创造。
但这取决于软件，比如将用word创作出的小说版权归于Microsoft显然是不合理的。
但如果用户仅按一个按钮就生成的小说，版权归于开发者便显得合理

D. You Say Tomato, I Say Tomahto: User vs. Programmer

As for the choice between the programmer and the user, the decision of to whom the copyright should be allocated would be very much fact-based and would differ based on the nature of the software.[96] For example, it would be extremely unfair (and doctrinally unsound) if the terms of service demanded ownership of the copyright in all outputs of a word processing program (since the copyrightable expression really belongs to the user, and the only hook for the programmer claiming the copyright would be as the agent of fixation, which was firmly rejected above).[97] On the other hand, if a program dispenses a story or a song on demand at the mere press of a button by the user (such as the program that created "Push Button Bertha"),[98] there might be a stronger argument for the programmer to own that copyright (both on its own merits, and relative to the argument for authorship by the user).[99] In those situations when an algorithm

[95] Samuelson, *supra* note 21 at 1206 n.91.
[96] For a detailed analysis of this issue, see Grimmelmann, *No Such Thing*, *supra* note 20, at 409-412.
[97] As a more specific example, a programmer (or, more likely, a massive team of programmers) created both Microsoft Word and Google Docs, but that doesn't mean that they should own the copyrightable expression in, say, this article.
[98] Bridy, *Works Made by Code*, *supra* note 18, at 395.
[99] One version of this argument can be seen in cases that allow the programmer to retain copyright in randomly-generated levels of video games, or even in the version of the game that is produced by the user's interaction with the software. *See, e.g.*, *Midway*, 1981 U.S. Dist. LEXIS 16881 (1981); *Micro Star v. FormGen Inc.*, 154 F.3d 1107 (9th Cir. 1998).

could produce wildly different outputs depending on the parameters and inputs selected by the user (e.g., Alfred Knipe's Great Automatic Grammatizator[100]), the user may have a stronger claim to sole ownership by arguing that the algorithm itself would be like any machine, tool, or instrument that facilitates creation of copyrightable works (e.g., a piano or a camera).

Furthermore, this issue is likely to be resolved *ex ante* by license agreements between these parties, making these arguments moot.[101] It is worth questioning the fairness of such licensing arrangements, especially in light of the proliferation of contracts of adhesion in today's increasingly online world, but that is a topic for another paper and another day.

可以通过提前约定的许可解决软件生成物的版权问题

Finally, there would be tremendous evidentiary issues that would further complicate this decision. It would be difficult to determine which algorithm created a particular work in order for the programmer to make a claim on it, and it might even be difficult to determine whether the work was created by *any* algorithm (as opposed to having been created solely by a human). As the "Turing test" for artwork becomes easier for AI to pass as the technology improves, this will only become more difficult.[102]

Given the fact dependency of this decision, blanket assumptions in favor of either the programmer or the user are unhelpful and misleading—attempting to argue for either the user or the programmer to prevail over the other, particularly without a specific case and fact pattern before us, is putting the cart before the horse. Therefore, I will refer to them collectively or nearly interchangeably throughout the remainder of this paper. This distinction is also unnecessary for the ultimate question this article seeks to resolve—not *which* human should own

版权所属人的判定需要结合特定例子和事实案例。

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[100] Roald Dahl, *The Great Automatic Grammatizator*, in *The Umbrella Man and Other Stories* (1996).
[101] Samuelson, *supra* note 21, at 1187 n.3.
[102] Bridy, *Works Made by Code*, *supra* note 18, at 399.

the copyright in a computer-generated work, but rather whether the use of AI presents a barrier to *any* human claiming authorship in the outputs.

E. The Proof Is in the Data: Data Owner as Author

This author was unable to find any published articles arguing for ownership of the outputs by the data owner.[103] Given the critical role of both the quantity and quality of the data used to train an algorithm,[104] it may make sense in certain situations for the owners of that data to receive at least partial ownership rights in the outputs created through the use of that data.[105] The accuracy and quality (and therefore the value) of the algorithm crucially depends on the data the algorithm is trained on, and the outputs can vary significantly based on the data on which the algorithm performs.[106] However, it is likely that this option would also be moot in practice, since such allocations of ownership almost certainly could and would be made through licensing agreements for the use of such data.

数据持有者对衍生产品的许可的归属问题通常由许可预先约定

Furthermore, when the data is being used under a fair use justification (e.g., a corpus of novels being used for the purposes of understanding language structure and patterns of conversation),[107] that would strongly undermine any claim for ownership in the outputs by the owners of the data, just as an author or publisher owning the rights in such a novel would not

为了解语言结构和对话模式而使用的小说语料库，小说作者很难申明对语料库的归属权

[103] Neither Samuelson and Grimmelmann, in their reasonably thorough discussions of the range of potential authors, mentioned the possible claim of the data owner. *See* Samuelson, *supra* note 21; Grimmelmann, *No Such Thing*, *supra* note 20.
[104] Dean, *supra* note 83, at 4; Lehr & Ohm, *supra* note 16, at 664-78, 677-81 ("[A]n algorithm is, at the end of the day, only as good as its data.").
[105] *But see* CONTU Final Report, *supra* note 28, at 45 ("It appears to the Commission that authorship of the program *or of the input data* is entirely separate from authorship of the final work.") (emphasis added).
[106] Lehr & Ohm, *supra* note 16, at 664-78, 677-81.
[107] Richard Lea, *Google Swallows 11,000 Novels to Improve AI's Conversation*, *The Guardian* (Sept. 28, 2016), https://www.theguardian.com/books/2016/sep/28/google-swallows-11000-novels-to-improve-ais-conversation.

have a claim to ownership in the search results or product features of Google Books, or a photographer would in an image search engine.[108]

F. Two Great Authors, Better Together: Joint Authorship

Another option is to grant joint authorship to some combination of the options above. For example, both the programmer and the user (if different people) will both have substantially contributed to the creative process. Similarly, if the AI actually is granted copyright in the work, there is certainly a strong argument that the programmer and/or the user will also have made substantial contributions to the work. Courts would have to decide whether this would in fact meet the test from *Aalmuhammed*[109] in the absence of expressed intent by the AI, and whether an intention by the programmer and/or user to merge their contributions with those of the AI into a single unitary work would be sufficient. Finally, in the absence of a contract for the use of the data on which the algorithm was trained or operated, there could be an argument for joint authorship by the data owner and any of the other parties, although the *Aalmuhammed* intent bar would be difficult to meet in such a situation, unless joint authorship was expressly made a condition of a license or grant of access to the data.

G. If I Can't Have It, No One Can: Computer-Generated Works as Belonging to the Public Domain

The final option would be to automatically dedicate the outputs of AI to the public domain. If none of the other actors discussed above were successful in arguing doctrinally that

[108] *See Authors Guild v. Google Inc.*, 804 F.3d 202 (2d Cir. 2015); *Perfect 10, Inc. v. Amazon.com, Inc.* 508 F.3d 1146 (9th Cir. 2007).
[109] See text accompanying note 78.

they should be entitled to authorship over the work, then this might be sensible. The ultimate goal of copyright law is to expand the public domain of creative works,[110] and this approach would certainly further that goal. 另外一种方法是将AI的输出贡献给公共领域，但是问题在于无人可以收到激励

However, the problem with this approach is its incentives. If humans are not appropriately incentivized to create the AI in the first place, or to spend the time and resources gathering data to train it or to make improvements to it, then the end result will be that fewer works will be created, which undermines the goal of increasing the public domain. Without financial incentives, it is likely that fewer companies and engineers would decide to create, improve, or use this type of AI. There are other incentives, of course, such as fame, academic respect, commercial gain through sales to other users, and a pure desire to create, but these would likely not result in the same type, quality, or scale of creation that traditional copyright incentives are believed to garner.[111] Even if such incentives were sufficient, there is no rational reason for treating the outputs of AI any differently from other means of creation.

PART II: I, AUTHOR: WHAT IT TRULY MEANS TO BE AN AUTHOR

Perhaps even more intriguing than who should be deemed the author of a computer-generated work is the question of what it means to be an "author" in the first place, and how our existing doctrine is (or should be) applied in the age of AI. Although "author" is not defined in the Constitution or in the Copyright Act,[112] caselaw has provided several answers. In *Burrow-*

[110] *See* 1 Nimmer on Copyright § 1.03(A).
[111] *See, e.g.*, Eric E. Johnson, Intellectual Property and the Incentive Fallacy, 39 Fla. St. U.L. Rev. 623, 628-31 (Spring 2012).
[112] Russ Versteeg, *Defining "Author" for Purposes of Copyright*, 45 Am. U.L. Rev. 1323 (June 1996) ("Who is an author? In other words, what does a person have to do in order to be characterized as an 'author' for purposes of copyright? This seemingly simple question is actually complex.").

Giles Lithographic Co. v. Sarony, the Court defined an author as "he to whom anything owes its origin; originator; maker; one who completes a work of science or literature."[113] By this definition, an algorithm certainly could be considered an author. However, the Court went on to say in the same case that "writings" refers to all forms of expression "by which the ideas in the mind of the author are given visible expression"[114] and that works are copyrightable "so far as they are representatives of original intellectual conceptions of the author."[115]

In 1999, the Court reiterated the focus on the "original intellectual conceptions" of an author in determining whether a documentary film director had a claim to the copyright in the film despite the actual footage having been shot by other members of his crew.[116] There, the Court concluded that "where a plaintiff alleges that he exercised such a high degree of control over a film operation . . . such that the final product duplicates his conceptions and visions of what the film should look like, the plaintiff may be said to be an 'author' within the meaning of the Copyright Act."

With respect to ownership of the outputs of algorithms, it is easy to draw an analogy to the *Lindsay* case, with the algorithm functioning as the film crew (or even the camera), and the programmer or user of the algorithm serving as the director—in other words, the author. To be sure, someone claiming to be an author "must supply more than mere direction or ideas,"[117] but the extent to which a programmer exercises control generally meets this bar.

Even more apropos is the "superintendence" or "master mind" doctrine, formulated in *Aalmuhammed v. Lee* (drawing from *Burrow-Giles*), which posits that a contributor to a work

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[113] *Burrow-Giles Lithographic Co. v. Sarony*, 111 U.S. 53, 58 (1884).
[114] *Id.*
[115] *Id.*
[116] *Lindsay*, 52 U.S.P.Q.2d at 13, 14.
[117] *Erickson v. Trinity Theatre, Inc.*, 13 F.3d 1061, 1071 (7th Cir. 1994). *See also* 28 U.S.C. § 102(b); discussion of contest rules in Section IV.

must "superintend" the work in order to be considered an author.[118] The case was addressing a claim of joint authorship by a consultant who made various contributions to the film, including writing two scenes, and the court found that the consultant "did not at any time have superintendence of the work"[119] and therefore could not be considered an author of the film.

顾问没有全时间参与作品的监督，所以不认为是电影的作者

Together with *Lindsay*, this suggests that even if the algorithm was seen to have some creative ability and to have contributed to the copyrightable expression in the final work, the human who orchestrates the process—whose vision the algorithm brings to life—could still be considered the "mastermind."[120]

最终协调算法形成最终结果的人被认为是mastermind

用因果关系来解释所属权，作者被认为是推动作品具现化的不可缺少的力量

This conclusion is further supported by Bridy's "authorship-as-causation" concept, suggesting that courts in *Burrow-Giles* and other authorship cases viewed the author as "the motive force without which it could not have come into existence."[121] The Court in *Burrow-Giles* in fact referred to the author as "the cause of the picture."[122] The effects of a programmer's or user's choices in designing and guiding an algorithm certainly support the concept of the programmer or user as the very proximate "cause" of the work (including its expression).

One way to determine whose creativity is represented in the expression of the final work is from a perspective of control (e.g., the mastermind doctrine). Another lens with which to analyze the process is creativity itself—if the decisions that inject the requisite originality or

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[118] *Aalmuhammed v. Lee*, 202 F.3d at 1234 ("[A]n author superintends the work by exercising control . . ."); *Burrow-Giles*, 111 U.S. 53, 61 ("Lord Justice Cotton said: 'In my opinion, 'author' involves originating, making, producing, as the inventive or master mind, the thing which is to be protected.'").

[119] *Aalmuhammed v. Lee*, 202 F.3d at 1235.

[120] It is interesting to note that *Aalmuhammed* also held that joint authors must "intend their contributions be merged inseparable or interdependent parts of a unitary whole." *Id*. In order for that to be possible in this context, the AI would have to be seen as possessing the capacity for true "intent" and would have to actually intend that its contributions were fused into a whole along with those of the humans who created and used it. However, if the algorithm is seen instead as a tool, or even as a helpful crew member, then the analysis might be more like that in *Lindsay*, where the human's "original intellectual conceptions" has been embodied in the work, and the human is therefore the author, just as Lindsay was for that documentary film. *See Lindsay*, 52 U.S.P.Q.2d at 13-14.

[121] Bridy, *Coding Creativity*, *supra* note 20, at P10.

[122] *Burrow-Giles Lithographic Co. v. Sarony*, 111 U.S. 53, 61 (1884).

creativity into the output result from the choices that the human programmer is making, then there should be no barrier to authorship. If, however, the creative elements of the output are instead arising from decisions and learnings that the algorithm alone is making, then perhaps the human cannot truly claim to be the "author" after all.

One challenge to a claim of authorship in computer-generated works is that an algorithm lies between the actions of the purported author and the expression itself. However, there is creativity on the part of both the programmer and the user (if they are different people). As discussed in Section II.B, the parameters a programmer selects, the data she chooses to train the algorithm on, the type of work she directs the algorithm to produce, and many more decisions along the way are decidedly creative directive choices.[123] Furthermore, the fact that a user does not mastermind every single detail of the process of creation does not undermine the argument for ownership and can be rebutted through analog examples. For example, simply because a photographer uses a DSLR camera to capture the perfect lighting without necessarily understanding how the inner workings of the camera operate, that would not interfere with that artist's ownership of the resulting work. As Bridy put it, "[l]ike the photographer standing behind the camera, an intelligent programmer . . . stands behind every artificially intelligent machine."[124] Similarly, while the film crew in *Lindsay* and the other contributors to the film in *Aalmuhammed* certainly made some creative choices in the process of creation, that did not interfere with the directors' claims in the final work.

As between the creator or user of the algorithm and the algorithm itself, there can really be no question as to which better fits the definitions of an author discussed above. It is not the

[123] Grimmelmann, *No Such Thing*, *supra* note 20, at 408.
[124] Bridy, *Coding Creativity*, *supra* note 20, at P23.

"mind"[125] of the algorithm that is creating a work—an algorithm follows the parameters that are programmed into it by the programmer or the user. The programmer or user therefore "superintends" and "masterminds" the work of the algorithm, providing it with the parameters that guide its functionality and the data which determines its trajectory. As James Grimmelmann astutely observed, "[a]nything an author does with a computer she could in theory do without it….Computers make some kinds of creativity practically feasible, but they do not make anything newly possible."[126]

Furthermore, these decisions to guide the algorithm on its course should overcome any unpredictability in the output of the algorithm. For example, imagine that Jackson Pollock, bored of flinging paint at the canvas, decided instead to build a machine with a little scoop that could hold paint and, when cranked, would fling the paint forward toward the canvas. Pollock would select the colors and load them up, and could decide to tilt, move, or rotate the canvas for the desired effect, but the actual painting would occur at the whim of physics—the weight of the paint, the strength of the wind, etc. I do not think anyone would seriously try to argue that the interposition of that tool would interfere with Pollock's ownership of the resulting painting. Even if Pollock did not use the machine, his own act of flinging paint at the canvas would have inherent randomness in it, so this is simply an example of an algorithm or machine mimicking human behavior, or substituting for human labor.

Next, imagine that an engineer builds an algorithm that fills in a certain number of pixels on a screen, at random. The number of pixels is selected by the user; the possible colors with which the pixels may be filled are selected by the user; but the actual selection of the pixels

[125] *Burrow-Giles*, 111 U.S. at 58, 61 ("Lord Justice Cotton said: 'In my opinion, 'author' involves originating, making, producing, as the inventive or master mind, the thing which is to be protected.'").
[126] Grimmelmann, *No Such Thing*, *supra* note 20, at 407; Bridy, *Coding Creativity*, *supra* note 20, P25-28 (discussing algorithmic composition by humans).

themselves and which of the available colors is used are done at random by the AI. Would anyone argue that the programmer should not own the resulting work? If a "clap of thunder" jarring one's arm is sufficient to be considered "original,"[127] how then could this type of planned, intentional randomness (or intentional "unpredictability") be any less original, or any less the "original intellectual conception" of the author?

Certainly, as algorithms become more complex and more decisions are made "by" the algorithm rather than the programmer, there is a stronger argument to be made that the resulting work is no longer the "original intellectual conception" of the programmer. However, the programmer or user may still adjust the outputs by adjusting the algorithm's parameters, or by feeding the algorithm different data. So long as the programmer or user still has control in that way, it seems the process is still working just as the pixel program is, or the paint-flinging machine—simply at a larger scale with more "random" elements programmed in. Unpredictability within selected parameters, or even inherent randomness throughout the process (especially when the randomness is intentionally included) should not interfere with the human programmer's ability to claim copyright over the work created. This is also true of *unintended* randomness, just as the result of the happy coincidence of a clap of thunder was considered to be copyrightable by the painter.

A. What Is Creativity? Creativity, Originality, Novelty, and Intent

There are many different definitions of creativity, and several key elements that recur across different perspectives and definitions.[128] In copyright, the cases decided by the Supreme

[127] *Alfred Bell & Co. v. Catalda Fine Arts, Inc.*, 191 F.2d 99, 105 (2d Cir. 1951).
[128] *See* Bridy, *Coding Creativity*, *supra* note 20, for a thorough discussion.

版权要求原创性，最小的创造性要求

Court have only required "originality,"[129] without defining that term clearly. The guidance it has provided includes a requirement of "more than a *de minimis* quantum of creativity"[130] (modifying its initial suggestion that original simply meant independently created[131]) and a definition of originality as referring to "the personal reaction of an individual upon nature . . . something irreducible, which is one man's alone."[132]

The Seventh Circuit, however, has provided a framework that breaks down creativity into three distinct elements: originality, creativity, and novelty.

> A work is original if it is the independent creation of its author. A work is creative if it embodies some modest amount of intellectual labor. A work is novel if it differs from existing works in some relevant respect. For a work to be copyrightable, it must be original and creative, but need not be novel . . .[133]

copyrightable需要是原创的，创造性的，不需要是新奇的

It is worth noting that, unlike patent law, copyright does not require novelty—that concept was rejected in *Alfred Bell*, where the court held that originality (at least under copyright law) does *not* mean "startling, novel or unusual, a marked departure from the past…[or] highly unusual in creativeness."[134] The legislative history of the 1976 Copyright Act also confirms this: "This standard [of originality] does not include requirements of novelty, ingenuity, or esthetic merit."[135]

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[129] *Feist Publ'ns , Inc. v. Rural Tel. Serv. Co.*, 499 U.S. 340, 345-46; *Burrow-Giles*, 111 U.S. at 58-60, *Bleistein v. Donaldson Lithographing Co.*, 188 U.S. 239 at *7 (1903).
[130] *Feist*, 499 U.S. at 363.
[131] *Burrow-Giles*, 111 U.S. at 57 ("An author . . . is 'he to whom anything owes its origin; originator; maker; one who completes a work of science or literature.'").
[132] *Bleistein*, 188 U.S. at 250 (in the context of an artist drawing something from the physical world, such as a nature landscape).
[133] *Baltimore Orioles, Inc. v. Major League Baseball Players Ass'n*, 805 F.2d 663, 668 n.6 (7th Cir. 1986). *See also Burrow-Giles*, 111 U.S. at 59 ("[T]he remainder of the process is merely mechanical, with no place for novelty, invention or originality.").
[134] *Alfred Bell & Co. v. Catalda Fine Arts, Inc.*, 191 F.2d 99, 102 (2d Cir. 1951).
[135] H.R. Rep. No. 94-1476, 94th Cong. 2d Sess. 51 (1976), *reprinted in* 1976 U.S.C.C.A.N. 5659, 5664.

Applied to an algorithm, originality is easily met—an algorithm relies on the data on which it is trained and the rules it is given, and that in fact makes it possible to verify that the output does not duplicate the expressive content of those inputs. Novelty, too, is easily conceded—an algorithm is capable of creating something H-creative (new to the world).[136] The difficult piece is whether an algorithm exhibits sufficient "intellectual labor"—or whether we would say that an algorithm is capable of exhibiting *any* intellectual labor, or true creativity, at all.

In addition to these three elements of creativity, there is another that seems to have been present throughout the history of copyright law, but has not received much attention. That unspoken requirement is intent. In 1884, the Supreme Court noted that the low bar for copyrightability meant that in an infringement claim, the author must prove "facts of originality, of intellectual production, of thought, and conception on the part of the author."[137] Even *Feist*'s "minimal degree of creativity"[138] and "some creative spark"[139] suggests that the author must actually intend for something to be creative (if only minimally), or at least for it to be what it is (with the court deciding whether it is actually "creative" after the fact).

Nearly 70 years after *Burrow-Giles*, however, the Second Circuit flatly rejected any requirement of intent when it suggested that "bad eyesight of defective musculature, or a shock caused by a clap of thunder"[140] could inject the required originality into the work to make it copyrightable. The court went on to explicitly state that originality could be achieved by the author "unintentionally."[141] Despite this explicit rejection in *Bell*, the language from the other

[136] Boden, *supra* note 65, at *7; *see also* Bridy, *Coding Creativity*, *supra* note 20, at P29-31.
[137] *Burrow-Giles*, 111 U.S. at 60.
[138] *Feist* at 345, 348, 362.
[139] *Id* at 345.
[140] *Bell*, 191 F.2d at 105.
[141] *Id*.

cases just discussed—including the later case of *Feist*, decided in 1991—would seem to support the idea that some amount of intentionality must be present. Furthermore, this also does not necessarily conflict with *Bell* itself, since the painter there intended to paint—so perhaps intent applies to the decision to create in the first place, or to the decision to bring the creative work to market, not to the specific expression or the mode of creation.

Although not explicitly endorsed as a requirement for copyrightability, the language used by scholars discussing the originality requirement has also invoked the idea. Samuelson stated that "[c]onceiving a work is part of what traditional copyright doctrine has meant by authorship and creativity, without which rights should not inure in the programmer."[142] Bridy also rejects *Bell*'s accidental creation standard and interprets *Burrow-Giles* to mean that "creativity must be purposive or intentional."[143] Therefore, identifying the source of this intention (presumably a human) could affect the determination of whose creativity a work represents.

B. Programmed to Be Creative: Oxymoron or Truth?

There are many examples of highly "creative" AI today, from AARON, a program that writes music,[144] and BRUTUS, a program that writes short stories,[145] to Dan Brown's AI character Winston, who created an intriguing, inventive, and certainly H-creative "self-portrait" and boasted that he also writes music.[146] However, the debate over whether AI can ever truly be creative has been raging for decades—and maybe even centuries, ever since science fiction writers conceived of the idea of a "creative" robot.[147]

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[142] Samuelson, *supra* note 21, at 1209.
[143] Bridy, *Coding Creativity*, *supra* note 20, at P20.
[144] *Id*. at P51-52, 61.
[145] *Id*. at P38-41 (including a sample story that certainly comes close to passing the Turing test, if not clears it with flying colors).
[146] Dan Brown, *Origin* 66 (2017).
[147] *See, e.g.*, Schönberger, *supra* note 24, at *2, *11 (discussing Isaac Asimov's works).

One side of the debate posits that creativity is a uniquely human ability—an "intrinsically human space"[148]—and that no computer will ever truly be able to achieve it, no matter how good the AI gets at *imitating* it. Ada Lovelace perhaps said it best when she said that "the analytical engine has no pretensions whatever to originate anything. It can do only whatever we know how to order it to perform." CONTU, in its Final Report, echoed this sentiment when it firmly stated that

> there is no reasonable basis for considering that a computer in any way contributes authorship to a work produced through its use. The computer . . . is an inert instrument, capable of functioning only when activated either directly or indirectly by a human. When so activated it is capable of doing only what it is directed to do in the way it is directed to perform.[149]

CONTU further stated that "in every case, the work produced will result from the contents of the data base, the instructions indirectly provided in the program, and the direct discretionary intervention of a human involved in the process."[150] One can also argue that the language in the Compendium of U.S. Copyright Office Practices also supports this position. Section 306 states that ". . . because copyright law is limited to 'original intellectual conceptions of the author,' the Office will refuse to register a claim if it determines that a human being did not create the work."[151] In other words, only a human being can form "original intellectual conceptions," and non-human creators (e.g., monkeys and dolphins—or AI) cannot. Finally, CONTU followed up the passage just quoted with an assertion that no matter how "complex and powerful" computers may be, "it is a human power they extend."[152] Thus, even when computers exceed the capacity of

[148] *Id*. at 11.
[149] CONTU Final Report, *supra* note 28, at 44.
[150] *Id*.
[151] Compendium, *supra* note 35, at § 306.
[152] CONTU Final Report, *supra* note 28, at 45.

humans to create in a certain way, they are still merely tools amplifying their human users' capabilities. 程序的创造性是由开发者赋予的

Furthermore, Lovelace adherents emphasize that it is the programmer who creates the algorithm's capacity to create.[153] An algorithm does not think on its own—any capacity for "thought" comes from its code, and it can be controlled by its programmer.[154] For example, even as Bridy praises AARON as an example of an extremely creative AI, she also discusses how Harold Cohen, AARON's inventor, altered AARON's musical style over time. "Indeed, it was Cohen, through AARON's changing code, who redefined the outer bounds of AARON's artistic capacity."[155] Even with respect to deep neural networks, Jeff Dean, the head of AI at Google, has explained how engineers can adjust the weights and connections of the layers in order to adjust the outcomes.[156] Finally, as discussed in greater detail in Part II.C below, algorithms can be programmed to exhibit apparent creativity as the result of built-in randomness and other rules—or even instructions to break certain rules to create more unique works. However, that creativity is still the result of those rules (even when the rule is occasionally to break other rules), and of the creative choices made by the programmer and the user.

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[153] *See, e.g.*, Bridy, *Coding Creativity*, *supra* note 20, at P23 ("Like the photographer standing behind the camera, an intelligent programmer . . . stands behind every artificially intelligent machine."). *See also* Bridy, *Coding Creativity*, *supra* note 20, at P11 ("According to the Court's reasoning in *Burrow-Giles*, the machine taking the picture mediated but neither negated nor co-opted the process of artistic production, which 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. The camera functioned merely as an instrument, a means to the end of realizing the human operator's creative vision, which is the basis for copyright in the resulting photograph.").

[154] *See also* David Schultz, *Which Movies Get Artificial Intelligence Right*, *Science Magazine* (July 17, 2015), http://www.sciencemag.org/news/2015/07/which-movies-get-artificial-intelligence-right ("All the experts are quick to point out that robots do not change their programming, and the notion that they could spontaneously develop new agendas is pure fiction. Hutter says the underlying goals programmed into the machine are 'static.' 'There are mathematical theories that prove a perfectly rational goal-achieving agent has no motivation to change its own goals.'").

[155] Bridy, *Works Made by Code*, *supra* note 18, at 397. It is worth noting that Bridy ironically then concluded that Cohen is *not* the author of AARON's outputs because he didn't fix the works (AARON did), because the outputs are unpredictable, and because Cohen "doesn't lift a finger to create them." See Part I.B above for a rejection of each of these points.

[156] Dean, *supra* note 83, at 14-23.

The other side of the debate compares human thought to algorithms and code, and posits that creativity is entirely programmable, and that the language of AI itself accurately reflects this—we speak of "artificial *intelligence*" and "*neural* networks" because we are in fact capable of mimicking human thought processes so accurately that AI can "think" just as we do. Alan Turing himself suggested that "the only way by which one could be sure that a machine thinks is to be the machine and feel oneself thinking." This line of reasoning tends to raise existential questions about whether humans are just computers ourselves—in fact, recall that the word "computer" itself originally referred to humans performing mechanical mathematical tasks.[157] John Haugeland found the fact that an algorithm owes its existence and capabilities to a programmer close to irrelevant in determining whether it should be considered the creative force behind its outputs, indignantly asking why "an entity's potential for inventiveness [should] be determined by its ancestry . . . and not by its own manifest competence" and deriding the notion that "when we're creative, it's all our own, but when a computer printout contains something artistic, that's really the programmer's artistry, not the machine's."[158]

Bridy also discusses the idea of algorithmic creation in great detail, pointing out that humans could produce the same works in the same way by hand, and that computers are merely shortcuts for the labor, but not the creative choices.[159] In the most extreme examples of this, true unbridled creativity would end at the point where the rules and parameters had been determined and the actual process of creation of the work began, with the direct process of creation being devoid of all discretion and choice.[160] If neither pure randomness nor pure obedience to

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[157] *See* Bridy, *Works Made by Code*, *supra* note 18, at 397.
[158] Samuelson, *supra* note 21, at 1205 n.90 (quoting John Haugeland, *Artificial Intelligence: The Very Idea* 4, 9-12 (1985)).
[159] *See* Bridy, *Works Made by Code*, *supra* note 18, at 397.
[160] *Id*.

一种观点是，AI的创造性是人赋予的，例如随机生成机制，所以AI并没有显示出创造性。？是否能让AI自己设计自己呢?

predetermined rules is creativity (both of which, of course, are debatable), then algorithmic creation is not creative. The works certainly still exhibit *creativity*, and the choices of parameters, forms, and rules are unquestionably creative, but the actual steps leading from finalizing the rules to completion of the work would not be. If Samuelson and Bridy are correct that the process of creating the algorithm and the process of creation of the outputs are entirely separate,[161] then the AI has exhibited no creativity.

One interesting consequence of taking this view is that it also undermines the arguments set out above for why copyright is limited to human authors. Many authorities have limited authorship to humans, but the reasons given for this tend to invoke a requirement of sentience. If AI can truly "think" in the same way humans can, then these arguments might be weakened. For example, Bill Patry states that "works *owing their form to the forces of nature* cannot be copyrighted,"[162] and the Copyright Office refuses to register works created by non-human authors "[b]ecause copyright law is limited to original intellectual conceptions of the author."[163] A work by an AI would not "ow[e] its form to the forces of nature" any more than a human-generated work would, and if we accept that human thought is algorithmic and can be imitated by AI, then perhaps AI is also capable of generating "original intellectual conceptions." The final missing piece would be incentives, because copyright aims not only to encourage creation, but to incentivize it financially. If we accept that AI can be trained to think like humans, as Turing suggests, then we might posit that they could be trained to be incentivized by similar things. Setting the objective function to maximize revenue might be one way to encourage this—if an AI's strength is creating creative works and it discovers (or is told) that copyright is one way to

[161] *See* Part I.B.
[162] 2 Patry § 3:19 n.1 (emphasis added).
[163] Compendium, *supra* note 35, at § 306.

maximize profits from those works, then it could perhaps be taught to follow similar incentives to humans.[164] However, this once again comes down to the control that the human programmers are exerting over the functionality of the AI.

I do believe that AI is unquestionably capable of producing "creative" works. AARON's music and BRUTUS' short story[165] would certainly pass Bridy's "Turing test for creativity,"[166] in that many people would have difficulty telling the computer-generated works apart from human-generated works (as with Winston's self-portrait displayed in the Guggenheim in Dan Brown's *Origin*[167]).

However, the question of whether the AI is itself truly *creative* is a different question, and a much more difficult one—at least with respect to the type of creativity required to have "original intellectual conceptions" sufficient to be deemed the author of the work. As Bridy succinctly put it, "[w]e might not say that AARON is creative, but we can say that AARON's painting exhibits creativity."[168] After all, if we think of an algorithm as a tool, like a camera, the works created "by" that tool unquestionably meet the *Feist* bar of independent creation plus a modicum of creativity, but we do not challenge whether the human who pressed the button is the author—it is assumed that that modicum of creativity came from the human and not the machine. And while it is easy to say that the works themselves exhibit originality, creativity, and novelty, it is very difficult to make a plausible argument for intentionality by the AI (as opposed to the programmer or user). On the other hand, it is also clear that the operations being performed by the algorithm are the source—the proximate cause, perhaps—of the work, and the algorithm is

[164] The creator of the algorithm, however, would be wise to closely cabin the means of maximizing the objective function. *See, e.g., Universal Paperclips*, http://www.decisionproblem.com/paperclips/.
[165] *See* Bridy, *Coding Creativity*, *supra* note 20, at P38-41 (including a sample story and discussing it in relation to the Turing test).
[166] Bridy, *Works Made by Code*, *supra* note 18, at 399.
[167] Dan Brown, *Origin* 66 (2017)
[168] Bridy, *Works Made by Code*, *supra* note 18, at 399.

的确，例如stable diffusion，用户仅仅提供了几个prompt便能生成精细的图片，
就好比老师给仅学生提供了一些关键字，学生做出了画作，显然画作的original intellectual conceptions应该属于学生
即AI，尽管AI不能拥有版权

the agent of execution of the idea. The key question is simply whether it is the machine that takes the concept from an idea to copyrightable expression, or whether the programmer or user exercises sufficient "control" to be considered the mastermind of the process and claim the expression as well as the idea.

Thus, the question is really *whose* "original intellectual conceptions" are represented in the resulting work when a human programmer or user interacts with a complex algorithm to generate a copyrightable work. If creativity is seen to be programmable—if novelty, randomness, and independent creation are sufficient—then it is possible that AI can be creative, and it is then possible that we could make a colorable argument that the work in fact represents the original intellectual conceptions of the AI and not the human—or that of both. But *that* is not a question that is likely to be resolved any time soon. Therefore, control is perhaps our best proxy for determining whose conceptions (and creativity) the expression represents.

C. The Gift of Creativity: Intentional Unpredictability and Randomness

One of the biggest hurdles to a human claiming copyright in the outputs of an algorithm is the concept of unpredictability, including both randomness and the ability of computers to exceed human capabilities (for example, in speed, scale, and discrete skills such as pattern recognition).[169] After all, if the human claiming authorship cannot show that he could conceive of and control the output, it would be difficult to claim that it truly represents his "original intellectual conceptions." To be sure, deep neural networks and other complicated AI are capable of breathtakingly complex computations, and perhaps in some circumstances even outstrip the abilities of their human programmers. The outputs—and the process for creating them—may

[169] *See, e.g.*, *AlphaGo*, Deep Mind (last visited May 16, 2018), https://deepmind.com/research/alphago/; https://www.ibm.com/watson/; Macuga, *supra* note 6.

even become more complicated than the human brain could truly comprehend, predict, or intend. However, this is simply a difference in degree, not a difference in kind. The language used by engineers and scholars to describe AI reflects this: "It is a human power they extend."[170] "Anything an author does with a computer she could in theory do without it. . . . Computers make some kinds of creativity practically feasible, but they do not make anything newly possible."[171] "Anything a human can do in 0.1 sec, the right big 10-layer network can do too."[172] "Soon we won't program computers. We'll train them like dogs."[173] While it is certainly possible that computers in the future will be unmoored from the capabilities of humans, and they may be able to accomplish things that are truly different in kind from what a human is physically and intellectually able to do, that day is not yet upon us.[174] Even if (or when) it is, the reality is that the AI will still remain responsive to the programmer's or user's adjustments to the parameters, data, variable weights, and other components, which allows those humans to exercise control over the outputs, if not the exact steps of the creative process itself. The programmer also makes the decision to use those particular capabilities in the first place.

To revisit our camera analogy, even if a novice photographer does not understand what ISO means, but adjusts the settings and takes a photo on a bright sunny mountaintop with the result that his photo ends up looking like it was taken in a dark cave, that is no barrier to copyright. Just as the "clap of thunder" would result in a copyrightable painting, so too do other forms of accidental or random creation nonetheless result in copyrightable works (for example, the paint flung at the canvas (whether by a paint-flinging machine or by Jackson Pollock

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[170] CONTU Final Report, *supra* note 28, at 45.
[171] Grimmelmann, *No Such Thing*, *supra* note 20, at 407.
[172] Dean, *supra* note 83, at 26.
[173] Jason Tanz, *Soon We Won't Program Computers. We'll Train Them Like Dogs*, *Wired* (May 17, 2016), https://www.wired.com/2016/05/the-end-of-code.
[174] *See, e.g.*, Ron Miller, *Artificial Intelligence Is Not as Smart as You (or Elon Musk) Think*, *TechCrunch*, https://techcrunch.com/2017/07/25/artificial-intelligence-is-not-as-smart-as-you-or-elon-musk-think/.

himself), or the artwork resulting from random selection and coloring of pixels by a simple algorithm). The novice photographer is no less the author than a professional who fully understands the result of every setting chosen prior to taking the photograph. Therefore, we can dismiss the notion that the end result being unpredictable would undermine copyright in traditional forms of creation.

One specific form of unpredictability, however, has greatly troubled scholars and gets a lot of attention in literature about AI—randomness. It is common to program randomness into an algorithm's choices, particularly when the output is a creative work. There are certainly creative software programs that do not utilize randomness—a camera behaves the same way each time you take a photograph with the same settings, and a word processor inserts the precise letter that corresponds to the key you press (although either one *could* be programmed to inject randomness into your creations—the programmers have simply *chosen* not to do so). However, many other programs do contain built-in randomness. For example, in 1956, Martin Klein built an algorithm to compose music. He adopted six rules, three from Mozart and three from his own observations of music.[175] The algorithm started the process by selecting a note at random, and then followed a clear set of steps until all six rules of composition were satisfied. The decision to begin the song with a note selected at random helps make the body of resulting works more interesting—if every song instead started with a G, the possible number and variety of outputs would be severely reduced.

BRUTUS and other literary machines are doing something similar—albeit on a far more complicated scale and manner than the computer that generated "Push Button Bertha." These AIs

[175] Martin Klein, *Syncopation in Automation*, Radio-Electronics, June 1957, at 36, available at http://www.americanradiohistory.com/Archive-Radio-Electronics/50s/1957/Radio-Electronics-1957-06.pdf. *See also* Bridy, *Works Made by Code*, *supra* note 18, at 395-96.

are following rules of creation. The apparent creativity in their outputs comes from the variety of rules the machine is allowed to choose from and the vast vocabulary they are given. But the output is still precisely what their human creators intended—a story of a particular format and genre that mimics the language structure of human storytelling. The rules may be drawn from other human creations (e.g., human-generated stories), but the choices among those rules, among possible data sets, and among other parameters are the true creative choices that determine the end result.

Another reason for intentionally introducing randomness into an algorithm's choices is to increase the likelihood of discovering something H-creative.[176] For example, imagine an algorithm that tells a football coach what play to call next. What the coach wants, presumably, is the play call that will have the "best" result—in other words, the play that will maximize the chances of a win for his team. The data the algorithm would be trained on would likely be play calls from actual past games, along with the results (labeled data). However, you could also allow the algorithm to make choices and learn by testing options and seeing which ones lead to more positive outcomes (reinforcement learning).[177] Particularly in the latter scenario, if you truly want the algorithm to find the "best" play call, you would want it to consider *all* possible play calls. If you limit the algorithm's choices to those that have actually been made before, that may restrict the algorithm's choices. For example, if no coach in the history of football has ever chosen to punt on second down, and the algorithm is restricted to play calls present in the data set, the algorithm will also never recommend punting on second down. However, if it is

[176] *See* Schönberger, *supra* note 24, at *7 ("Another attempt to approximate creativity tested against the criteria of 'response uniqueness' and understood as 'the ability to do the unexpected or to deviate from rules' is the introduction of randomness into the algorithmic process.").

[177] These choices may be represented in the model selected for the algorithm. Feeding the algorithm data that is labeled as a positive outcome or a negative outcome and having it learn from the sheer scale of the data would be a form of supervised learning, and allowing it to test options and learn by winning or losing would be a form of reinforcement learning. *See* Dean, *supra* note 83, at 10; Lehr & Ohm, *supra* note 16, at 673, 676-77, 676 n.83.

programmed such that it is allowed to learn by choosing a play from the full panoply of play calls available, it may discover that punting on second down would be sensible in certain situations.[178]

Some would argue that introducing randomness or other forms of unpredictability automatically breaks the chain of control by the human programmer or user. For example, in 1964, the Copyright Office refused to register a design for a tile floor because it had been generated by a machine using random geometric patterns; the Register of Copyrights asserted that "the floor covering design had not been 'written' by a man, but a machine."[179] Bridy also interprets Ada Lovelace's famous quote as supporting a definition of creativity as "the ability to do the unexpected or to deviate from rules. Some people think computers can do this if their code incorporates elements of randomness, so that they make choices about composition that are governed at least in part by chance."[180] However, even if we accept this definition of creativity, accidental or unintentional creation is not a bar to copyrightability.[181] The fact that the accident was an intentional one rather than a truly unexpected "clap of thunder" should only buttress the conclusion that the programmer's "original intellectual conceptions" are still being represented. If randomness or unpredictability were a bar to creativity, Jackson Pollock would have been unable to claim copyright in any of his works, unless someone will try to claim that he knew

[178] Note that if the data set included all past NFL games, this play call would in fact be available to the algorithm, as the Eagles (in)famously punted on second down against the Redskins in 1986. It was on second and 40, followed four penalties, resulted in a blocked kick and a turnover for a touchdown, and the comments section on YouTube speaks with a rare unified voice in denouncing it as one of the worst plays (and worst drives) in NFL history. *See 2nd down punt, Eagles-Redskins 1986*, available at https://www.youtube.com/watch?v=kO2ILLMWEKs&feature=player_embedded. But perhaps the algorithm could prove us all wrong.

[179] *See* Arthur R. Miller, *Copyright Protection for Computer Programs, Databases, and Computer-Generated Works: Is Anything New Since CONTU?*, 106 Harv. L. Rev. 977. Armstrong brought a suit to compel registration, but it was dismissed when Armstrong refused to reveal details about the way the machine operated, which it considered a trade secret.

[180] Bridy, *Works Made by Code*, *supra* note 18, at 399 (citing David Levy, *Robots Unlimited: Life in a Virtual Age* (2005)).

[181] *See, e.g.*, *Alfred Bell & Co. v. Catalda Fine Arts, Inc.*, 191 F.2d 99, 105 (2d Cir. 1951).

precisely where each and every drop of paint would fall on the canvas, and the shape that every splatter would take upon contact. To claim copyright, control over a work must be sufficient, but not complete.

对于版权的声明，对工作的控制权必须是充分的，但不必是完整的。
例如上述的瓷砖的版权申请，其排列完全由机器控制，因此控制是不充分的。

PART III: A Journey to the Center of the Algorithm: Demystifying the "Black Box"

It is very common to see AI referred to as a "black box" that is difficult to access or understand.[182] There are two reasons for this. First, AI can be very complicated—in fact, as deep learning and neural network technology advances, we may reach a point where it is so complex that human beings are simply incapable of fully understanding every step of the process between creation of the algorithm and creation of the algorithm's output.[183] The other challenge levied against AI is that the proprietary nature of algorithms—and their tendency to be protected as trade secrets[184]—interferes with anyone other than the owner of the algorithm trying to understand and challenge anything from bias and discrimination in employment or sentencing

[182] *See, e.g.*, Lehr & Ohm, *supra* note 16; Roger Allan Ford & W. Nicholson Price II, *Privacy and Accountability in Black-Box Medicine*, 23 Mich. Telecomm. Tech. L. Rev. 1, *11 n.38 (Fall 2016) (describing some algorithms as being either "unavoidably opaque" or "deliberately opaque"); Danielle Keats Citron & Frank Pasquale, *The Scored Society: Due Process for Automated Predictions*, 89 Wash L. Rev. 1 (2014) (defining black boxes as algorithms that transform data sets (inputs) into outputs without giving the user any information about how they do so); Frank Pasquale, *The Black Box Society: The Secret Algorithms That Control Money and Information* (2015). *See also* John Searle, *Minds, Brains and Programs, The Behavioral and Brain Science* 3, 1980 (discussing his famous "Chinese Room" experiment and the possibly-false assumptions we draw when we can't access or can't understand the steps the algorithm is taking).

[183] *See, e.g.*, Kalev Leetaru, *In Machines We Trust: Algorithms Are Getting Too Complex to Understand*, *Forbes* (Jan. 4, 2016), https://www.forbes.com/sites/kalevleetaru/2016/01/04/in-machines-we-trust-algorithms-are-getting-too-complex-to-understand/#5c5b55d633a5; Marianne Lehnis, *Can We Trust AI if We Don't Know How It Works?*, *BBC* News (June 15, 2018), https://www.bbc.com/news/business-44466213. *But see* Phil Wainewright, *Why Humans Will Always Be Smarter Than Artificial Intelligence*, *Diginomica* (Feb. 15, 2018), https://diginomica.com/why-humans-will-always-be-smarter-than-artificial-intelligence/.

[184] *See, e.g.*, Register of Copyrights, Sixty-Seventh Annual Rep. of the Register of Copyrights 7 (1964) (discussing Armstrong Cork Co. v. Kaminstein, No. 119-64 (D.D.C. filed Jan. 16, 1964), later dismissed because Armstrong didn't wish to disclose how the machine operated, which it considered a trade secret).

decisions[185] to copyright infringement. This lack of transparency also makes it difficult to parse out which elements of the decision came from the algorithm, which came from the data, and which came from the programmer's choices in setting the parameters (for example, the relative weights of the variables). These are certainly valid concerns, and both will need to be addressed by owners and users of AI technology in order for AI to continue to be allowed to advance and flourish.

These arguments also do not logically support withholding copyright ownership from the programmers and users of algorithms. With respect to proprietary algorithms and claims of trade secrecy, one option is to allow social and political pressure to shape laws (or self-regulatory frameworks) around transparency and accountability, or even simple economic pressure from consumers to encourage companies to voluntarily provide the transparency and accountability users desire. Any of these options would be far more aligned with the purposes of copyright law than the approach of undermining the ability of the programmer or user to claim copyright in the outputs. Choosing to allocate copyright to the AI itself (or to the public domain) simply because the public does not fully understand how it functions would undermine incentives for the human programmers and users to create both the AI and the AI-generated works—resulting in fewer works being disseminated to the public—and would inhibit the growth of AI and the tremendous benefits to society that it makes possible.

The first reason, however—the sophistication of the technology itself—begs a deeper analysis. If the human "mastermind" is truly unable to understand or exercise sufficient control over the creative process, that could undermine their claim to ownership in the expression of the

[185] For a detailed discussion of how copyright law affects access to data sets that could mitigate bias in algorithms, *see* Amanda Levendowski, *How Copyright Law Can Fix Artificial Intelligence's Implicit Bias Problem*, 93 WASH. L. REV. 579 (2018).

resulting work. After all, if "the traditional elements of authorship in the work (literary, artistic, or musical expression or elements of selection, arrangement, etc.) were actually conceived and executed not by man but by a machine,"[186] then the expression could not be said to "duplicate the . . . conceptions and visions"[187] of the human claiming authorship. Therefore, we must look at whether humans are capable of sufficiently controlling the creative outputs of the algorithms they create and use.

Deep learning is one form of machine learning, and among the most complex forms of AI that exist today. Jeff Dean describes it as "a collection of simply trainable mathematical units, which collaborate to compute a complicated function."[188] Deep learning is compatible with many algorithmic models, including supervised, unsupervised, and reinforcement learning.[189] It can be used for tasks like pattern recognition for modeling human speech, vision, language understanding, predictions of online user behavior, or translation.[190] Deep learning requires massive amounts of data and tremendous computing power.[191] One common form of deep learning is neural networks, which have multiple layers of algorithms. Each layer performs a mathematical function on the data, and the layers are then connected to each other.[192]

When enlisting algorithms in the creative process, the first steps include such actions as setting the objective function and other parameters (e.g., variance and bias) and training the algorithm on one or more data sets.[193] There is, however, a conceptual leap or gap between the

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[186] Register of Copyrights, Sixty-Eighth Annual Rep. of the Register of Copyrights 5 (1966).
[187] *Lindsay v. The Wrecked and Abandoned Vessel R.M.S. Titanic*, 52 U.S.P.Q.2d 1613 (S.D.N.Y. 1999).
[188] Dean, *supra* note 83, at 12.
[189] *Id*.
[190] *Id*. at 2, 10, 24.
[191] MathWorks, *supra* note 7 ("When choosing between machine learning and deep learning, consider whether you have a high-performance GPU and lots of labeled data. If you don't have either of those things, it may make more sense to use machine learning instead of deep learning.").
[192] Nikhil Buduma, *Deep Learning in a Nutshell - What It Is, How It Works, Why Care?*, https://www.kdnuggets.com/2015/01/deep-learning-explanation-what-how-why.html.
[193] Lehr & Ohm, *supra* note 16, at 696-701.

decision that the algorithm is ready to go live and the actual creation of the output(s). For example, if a user purchases software that writes music on demand, this is the set of steps between hitting the "create" button and seeing the sheet music the software produces. Or in the case of the algorithm discussed earlier that colors a certain number of pixels on a screen one of a set of colors selected by the user, this would be the steps after the user selects the number of pixels and the colors, but before the final artwork appears on the screen. The crucial question is whether the ability to understand those intervening steps—or at least to control them—is a prerequisite to claiming authorship over the copyrightable expression in that work.

How much conceptual distance is too far a leap from the initial instructions provided by the programmer and the output of the algorithm? Does "learning" by a machine in the interim increase that distance? What is truly "unpredictable," as opposed to being the intended (if only vaguely planned or conceived) result of the programmer's instructions? What changes the AI from an inert tool to an intentional, creative being capable of being considered an author?[194]

Admittedly, merely setting guidelines and rules for creation does not automatically meet this bar[195]—for example, the person who organizes a writing competition will set the length of submissions, the genre, and other creative constraints, but certainly (in the absence of a voluntary contract to the contrary) would not own the works written and submitted by other human authors.

是的，出题人并不是答案的版权人，现在的生成模型的用户很类似出题人，而不是创作人。而开发者更像是版权所有人

[194] *See, e.g.*, Samuelson, *supra* note 21, at 1195-96 (questioning "whether interactive computing employs the computer as a co-creator, rather than as an instrument of creation"); OTA Report, *supra* note 30, at 69-73, 72 (1986) ("The proportion of the work that is the product of the machine, and the proportion that is the product of a human may vary. In many cases, as with word processing programs, the machine contributes little to the creation of a work; it is 'transparent' to the writer's creativity. But with some programs, such as those that summarize (abstract) written articles, the processing done by the computer could constitute 'an original work of authorship' if it were done by a human being."); Schönberger, *supra* note 24, at *6, *9 (". . . some of these systems have alienated themselves from human creatorship to a degree of autonomy where the contribution of the robot is substantial enough to acknowledge the artificial agent as co- or even main creator…[I]t remains to be seen whether the initial programming of an artificial agent will keep sufficient legal proximity to the resulting work, even if the program has further developed possibly on its own account and to a degree of autonomy not predicted at its launch.").

[195] *Erickson v. Trinity Theatre, Inc.*, 13 F.3d 1061, 1071 (7th Cir. 1994) (stating that an author "must supply more than mere direction or ideas").

However, the choices made by a programmer in creating, configuring, and training an algorithm that would produce these same stories go far beyond simple contest rules. The computer has no choice but to follow the rules given to it by its programmer, and it can learn only from the data fed to it by the programmer or user. It cannot bring a tremendous wealth of inexact, volatile, and unintentional human experiences to the creative process the way a human author does. Even if it has been trained for hundreds of years on vast quantities of data, and even if it far exceeds in *scale* what a human would be capable of in hundreds of lifetimes, it is still beholden to that universe of data and cannot exceed the capabilities granted to it by its programmer(s) and the knowledge or data provided to it by its user(s).

A. Peeking Behind the Curtain: Mechanisms of Control

It is important to note that creative control does not require full and complete understanding of the operations of the algorithm. For example, the novice photographer selecting an ISO setting without understanding what it does or how it works will still be able to use those settings to manipulate the output (perhaps through trial and error). This is just as true for extremely complicated deep learning algorithms, and a programmer can still maintain this control even without a complete understanding of its operations. The programmer can adjust the variable weights,[196] provide the algorithm with different training data to correct perceived bias or even take the decision-making in a new direction,[197] or adjust the objective function (the metric the algorithm is trying to maximize).[198]

开发者不能控制生成过程，但是能控制训练过程。

[196] *See* Dean, *supra* note 83, at 21-23; Raicea, *supra* note 11.
[197] Lehr & Ohm, *supra* note 16, at 665, 684, 696, 698-700.
[198] *Id*. at 671-77.

Secondly, the criticism of algorithms as being opaque is relatively silly when one considers the alternative—a volatile, unpredictable human being. A human making similar decisions or creating similar works is also similarly obscure between the point at which the parameters of creation are finalized and the point at which the work is created, but with *less* ability to interrogate the results and determine which variables influenced the decision or creation. For example, the doctrine of subconscious copying[199] illustrates this point nicely. With an algorithm, we can examine its inputs and see exactly what "inspired" the output, or what the AI was drawing from to determine its patterns or rules of creation, and we can verify that no copyrightable expression was duplicated from its inputs. A person, on the other hand, brings to the process a whole lifetime of experiences and unmeasurable inputs, and there is no practical way to determine whether the creation was truly independent. Hence, the doctrine of "subconscious" copying. Nor is there an obvious way to adjust the inputs if desired—a person cannot delete memories at will, or intentionally avoid incorporating an input to which they have already been exposed. Similarly, with respect to bias and discrimination, an algorithm has no malicious or moral responses that influence the outputs—it simply follows rules. The rules themselves, or the data inputs, could contain bias, but that is caused by *human* error, not algorithmic.[200] Furthermore, many other criticisms or flaws of algorithms can be found in human behavior as well. For example, overfitting could be analogized to some forms of PTSD, where some innocuous loud sounds or sudden movements are perceived as serious and imminent threats.

[199] *See, e.g.*, *Selle v. Gibb*, 741 F.2d 896 (7th Cir. 1984).
[200] *See, e.g.*, Executive Office of the President, *Big Data: Seizing Opportunities, Preserving Values* 60 (recommending that "the federal government's lead civil rights and consumer protection agencies should expand their technical expertise to be able to identify practices and outcomes facilitated by big data analytics that have a discriminatory impact on protected classes, and develop a plan for investigating and resolving violations of law.").

Finally, and perhaps most significantly, there are methods of accountability that can tell us, for example, which variables were most important to an individual outcome of the algorithm, or which variables were most important to all decisions across the board. The next section will summarize some of these existing methods, but this is a rapidly evolving field that is receiving a lot of attention and resources. To be sure, as algorithms become more complex over time, accountability measures must keep up. But encouraging companies and individuals to create *responsibly* is still preferable to not encouraging them to create at all. Using failures of explainability or accountability as an excuse to deny programmers and users copyright in the outputs of the algorithms they create and use will not make the technology any more transparent, nor will it advance the goals of copyright law.

B. It's All Greek to Me: The "Black Box" and Explainability in Artificial Intelligence

One reason why understanding how an algorithm operates and how it interacts with its human programmers and users is so important is that we cannot otherwise determine whether the AI has done so much to generate the creative expression in the work that the human(s) can no longer be considered the author. To decide whether this line exists and where it might lie, we must dissect the ubiquitous "black box" arguments[201] that suggest that no human can truly understand the inner workings of an algorithm between the point where the inputs and parameters have been set, on one end, and the output on the other. That leap from inputs to outputs is a critical step that has not been addressed much in legal literature.[202] One obstacle for potential authors of computer-generated works in the future will be their ability to understand

[201] *See, e.g.*, Lehr & Ohm, *supra* note 16, at 706 n. 193; Ford & Price, *supra* note 182; Citron & Pasquale, *supra* note 182; Pasquale, *supra* note 182.
[202] *See* Lehr & Ohm, *supra* note 16, at 704-05.

and describe to others how the algorithm is analyzing its inputs, making decisions, and creating its outputs.

Lehr and Ohm refer to this as the "explainability" of the algorithm, and define it as "the ability of machine learning to give reasons for its estimations."[203] They suggest two viable ways in which programmers can currently do this: one that "describe[s] how important different input variables are to the resulting predictions," and one that "describe[s] how increases or decreases in the various input variables translate to changes in the outcome variable."[204] In other words, one approach identifies the most important variables for the algorithm's individual decisions and outputs, and the other looks at the relationship between the variables, comparing them to each other as well as to the outcome. The first provides "partial dependence plots" or "individual conditional expectation plots,"[205] and focuses on identifying those variables that were most important to a particular decision or prediction. The other includes such options as "variable importance plots"[206] that provide insight into which variables were most significant across the data set. However, Lehr and Ohm acknowledge that these approaches may not work for deep learning algorithms,[207] so additional methods will need to be developed for more complex models.

模型的可解释性，一种解读是从参数对模型结果的影响出发，另外一种解读是从输入对模型输出的影响出发

There are also a number of methods that are being developed to help make AI—and deep neural networks in particular—more explainable. The field is referred to as XAI—explainable AI.[208] David Gunning of DARPA optimistically notes that

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[203] *Id*. at 692-93.
[204] *Id*.
[205] *Id*. at 710.
[206] *Id*. at 708.
[207] *Id*. at 709-10
[208] Wikipedia, the Free Encyclopedia, *Explainable Artificial Intelligence* (last visited May 16, 2018), https://en.wikipedia.org/wiki/Explainable_Artificial_Intelligence.

> [n]ew machine-learning systems will have the ability to explain their rationale, characterize their strengths and weaknesses, and convey an understanding of how they will behave in the future….These models will be combined with state-of-the-art human-computer interface techniques capable of translating models into understandable and useful explanation dialogues for the end user.[209]

Katherine McTole of Bonsai describes five specific methods for achieving XAI: learning semantic associations, generating visual explanations, local, interpretable, model-agnostic explanations, rationalizing neural predictions, and explainable reinforcement learning.[210] An article in Science Magazine suggests that "[j]ust as the microscope revealed the cell, . . . researchers are crafting tools that will allow insight into how neural networks make decisions" and describes three approaches to achieving explainability: building in a "transparent layer" that helps provide control over the neural networks, "probing" the network by varying the inputs in an attempt to understand which variables are most important to a particular decision, and even using more neural networks to understand how other neural networks are operating (for example, by "expos[ing] knowledge gaps in the AI's logic").[211] Perhaps, ultimately, these XAI methods will result in the equivalent of an fMRI for the AI's artificial "brain," allowing us to see how it operates while it is "thinking."

In addition, the pressure on programmers to be able to explain how their algorithms work is increasing in many areas of law and life. Lawyers and advocates are calling for increased explainability and human oversight in automated bail and sentencing decisions;[212] medical

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[209] David Gunning, *Explainable Artificial Intelligence*, https://www.darpa.mil/program/explainable-artificial-intelligence (see Figure 2 for a nice visual representation of the effect that explainable AI can have on the creative process).
[210] Katherine McTole, Bonsai, *Bonsai Speaks on Explainability of Deep Learning at SF Meetup*, https://medium.com/@BonsaiAI/bonsai-speaks-on-explainability-of-deep-learning-at-sf-meetup-bef4c8a4e14e.
[211] Paul Voosen, *How AI Detectives Are Cracking Open the Black Box of Deep Learning*, *Science Magazine* (July 6, 2017), http://www.sciencemag.org/news/2017/07/how-ai-detectives-are-cracking-open-black-box-deep-learning.
[212] Ben Buchanan & Taylor Miller, Belfer Center, *Machine Learning for Policymakers* 32-43 (2017), https://www.belfercenter.org/sites/default/files/files/publication/MachineLearningforPolicymakers.pdf.

patients will clamor for increased transparency in automated diagnostic processes;[213] and Gunning emphasizes the importance of XAI in allowing the military "to understand, trust, and effectively manage this emerging generation of artificially intelligent partners."[214]

In August 2017, New York City Councilman James Vacca, chair of the Council's technology committee, introduced a bill initially proposing that the source code of any algorithm which a City agency used to make automated decisions be made available to the public, stating that "[i]f we're going to be governed by machines and algorithms and data, well, they better be transparent."[215] While that bill did not pass in its original form, New York City has now created a task force to make recommendations on "which types of algorithms should be regulated, how private citizens can 'meaningfully assess' the algorithms' functions and gain an explanation of decisions that affect them personally, and how the government can address 'instances in which a person is harmed' by algorithmic bias."[216] Similar calls for transparency are being made across the globe—even the European Union's General Data Protection Regulation mandates that a data subject have the right to request human intervention in automated decisions that have a substantial or legal effect on the data subject.[217]

As these pressures increase, programmers will necessarily find new ways of increasing explainability, and what seems incomprehensible today will continue to make more sense as the use of AI becomes increasingly commonplace and as future generations of humans become

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[213] Wojciech Samek, Thomas Wiegand, & Klaus-Robert Muller, *Explainable Artificial Intelligence: Understanding Visualizing and Interpreting Deep Learning Models* (Aug. 2017), https://arxiv.org/pdf/1708.08296.pdf.
[214] David Gunning, DARPA/I2O, *Explainable Artificial Intelligence*, https://www.cc.gatech.edu/~alanwags/DLAI2016/%28Gunning%29%20IJCAI-16%20DLAI%20WS.pdf.
[215] Julia Powles, *New Yorker*, *New York City's Bold, Flawed Attempt to Make Algorithms Accountable* (Dec. 20, 2017), https://www.newyorker.com/tech/elements/new-york-citys-bold-flawed-attempt-to-make-algorithms-accountable.
[216] *Id*.
[217] Council Regulation 2016/679 of Apr. 27, 2016, General Data Protection Regulation, art. 22, 13-14, 2016 O.J. (L 119/1) 40, 40-42.

increasingly well-versed in the workings of algorithms. We will find new ways to translate the AI's "thoughts" into a language we can understand. As described, we might even find ways to have the algorithm explain itself to us, rather than needing to analyze formulas and patterns to try to decipher it ourselves.[218] The rules that algorithms create from their training data sets will become easier to discover and understand, and the "black box" will become increasingly transparent.

PART V: CONCLUSION

AI is getting closer and closer to passing the Turing test for creative works every day. As AI continues to approximate human capabilities, the question of who should own the copyright in computer-generated works will only get more complicated. The crux of the issue is whether there is a point where the programmer and user have given over so much control of the creative process to the AI that the human programmer or user can no longer claim copyright in the expression of the resulting work. After all, if the idea is the programmer's, but the expression is fairly considered to be the work or "original intellectual conception"[219] of the AI—if it was in fact "conceived and executed not by man but by a machine"[220]—then it is difficult to justify a programmer's claim of ownership.

I conclude that, at least given the current state of AI technology, that line does not exist, and even with the most complex deep neural networks, human programmers and users still retain sufficient control over the creative process that the resulting work can be said to embody their

[218] Lehr & Ohm, *supra* note 16, at 692-93.
[219] *Burrow-Giles Lithographic Co. v. Sarony*, 111 U.S. 53, 58 (1884).
[220] Register of Copyrights, Sixty-Eighth Annual Rep. of the Register of Copyrights 5 (1966).

"original intellectual conceptions." Even when the process includes unpredictability (for example, due to the complexity of the technology or the relative inexperience of the user) or randomness (intentional or otherwise), the programmer and user retain the ability to adjust the algorithms' parameters, variable weights, and other factors in order to exercise control over the output. AI is also more of a glass box than a black box, and it will only continue to become more transparent as the pressure of society and the needs of the technology demand further development of XAI.

Furthermore, the incentives inherent in the copyright bargain—and the very reason that copyright exists—are only advanced when the copyright is allocated to a human, whether that is the programmer, the user, the data owner, or some combination of them. Otherwise, those human programmers and users will not be incentivized to continue to create, improve, and use "creative" AI. Thus, even if or when AI does reach a point where it could truly be considered to be developing "original intellectual conceptions" that are more attributable to the AI than to the humans who interact with it, granting copyright to an algorithm would not further the purposes of copyright law or fit with its incentives. AI has already changed the world, and it will continue to in the future—the question is whether we will properly harness its potential for creativity.