2016

There's No Such Thing as a Computer-Authored Work - And It's a Good Thing, Too

James Grimmelmann
Cornell Law School, james.grimmelmann@cornell.edu

There's No Such Thing as a Computer-Authored Work—And It's a Good Thing, Too*

James Grimmelmann**

INTRODUCTION

I would like to talk about computer-authored works—I would like to, except that they don't exist. Copyright law doesn't recognize computer programs as authors, and it shouldn't.[1] Some day it might make sense to, but if that day ever comes, copyright will be the least of our concerns.

Instead, I will say something about why computer authorship is such a "bad penny of a question," to use Annemarie Bridy's felicitous phrase, even though it is so utterly speculative.[2] The scholarship pondering the possibility of computer-authored works is surprisingly extensive, even though no one has ever exhibited even one work that could plausibly claim to have a computer for an "author" in the sense that the Copyright Act uses the term.[3]

---

* This Essay is based on a talk that was given on October 2, 2015, at the Kernochan Center Annual Symposium at Columbia Law School.

** Professor of Law, University of Maryland. My thanks to Aislinn Black, Annemarie Bridy, Bruce Boyden, Timothy McGovern, Christina Spiesel, and the participants in the Kernochan Center Symposium "Copyright Outside the Box" for their suggestions.

1. *See* U.S. COPYRIGHT OFFICE, COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES (THIRD) § 313.2 (3d ed. 2014) ("Similarly, the Office will not register works produced by a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author.")

2. Annemarie Bridy, *Coding Creativity: Copyright and the Artificially Intelligent Author*, 5 STAN. TECH. L. REV. 1, ¶ 52 (2012).

3. Bridy, *supra* note 2, at ¶¶ 50–52; Timothy L. Butler, *Can a Computer Be an Author - Copyright Aspects of Artificial Intelligence*, 4 COMM/ENT L.S. 707, 739–42 (1982); Ralph D. Clifford, *Intellectual Property in the Era of the Creative Computer Program: Will the True Creator Please Stand up*, 71 TUL. L. REV. 1675, 1685–86, 1694–95 (1996); Evan H. Farr, *Copyrightability of Computer-Created Works*, 15 RUTGERS COMPUTER & TECH. L.J. 63, 79 (1989); Dane E. Johnson, *Statute of Anne-Imals: Should Copyright Protect Sentient Non-Human Creators*, 15 ANIMAL L. 15, 19–21 (2008); Karl F. Milde, Jr., *Can a Computer Be an "Author" or an "Inventor"?*, 51 J. PAT. OFF. SOC'Y 378, 392–95 (1969); Arthur R. Miller, *Copyright Protection for Computer Programs, Databases, and Computer-Generated Works: Is Anything New Since CONTU?*, HARV. L. REV. 977, 1056–72 (1993); William T. Ralston, *Copyright in Computer-Composed Music: HAL Meets Handel*, 52 J. COPYRIGHT SOC'Y U.S.A. 281, 302–3 (2004–05); Pamela Samuelson, *Allocating Ownership Rights in Computer-Generated Works*, 47 U. PITT. L. REV. 1185, 1192–1200 (1986); Andrew J. Wu, *From Video Games to Artificial Intelligence: Assigning Copyright Ownership to Works Generated by Increasingly Sophisticated Computer Programs*, 25 AIPLA Q. J. 131, 155–57 (1997).

Most of these authors sensibly conclude that computers are not authors, for now at least, but it

My view is that the idea of computer-*authored* works responds to perceived problems of deciding who should be considered the authors of computer-*generated* works. The difficulty of saying who is the author of a work when one person runs an unpredictably complicated computer program written by another makes it tempting to say that the program itself is the author. But this suggestion is unnecessary, because the underlying problems of assigning authorship are more apparent then real—or rather, they are no worse here than elsewhere in copyright. I can imagine five reasons why computer-generated works might be considered meaningfully different from human-generated works:[4]

(1) They are embedded in digital copies.
(2) People create them using computers rather than by hand.
(3) Programs can generate them algorithmically.
(4) Programmers as well as users contribute to them.
(5) Programs can generate them non-deterministically.

All of these distinctions are spurious. Old-fashioned pen-and-paper works raise all of the same issues; there is nothing new under the sun.[5] These issues have been with us since the Statute of Anne; they will be with us as long as copyright considers it important to assign ownership of a work to an "author" who is causally responsible for the work's existence.

I. DIGITAL COPIES

What might we mean by a "computer-generated work" in the first place? The simplest answer is that since a computer-generated work is at some point emitted by a computer, it exists in digital copies, as contrasted with traditional works that exist in analog copies. A book is a physical object that exists in the physical world: it consists of patterns of ink on rectangular sheets of paper bound together into a codex. A sculpture is a hunk of marble with physical properties (most obviously, mass). A painting is pigment on canvas; canvas has a texture and paint has a thickness. But a digital copy, one might say, is just ones and zeroes; it exists entirely as an abstract mathematical representation.

This is not even a fair characterization of digital copies. They are still "copies"

---

is striking how often the question has been asked. The supposed problem has also been much reported on by experts. COPYRIGHT OFFICE, SIXTY-EIGHTH ANNUAL REPORT OF THE REGISTER OF COPYRIGHTS 5 (1966); COMM'N ON NEW TECH. USES, FINAL REPORT OF THE NAT'L COMM'N ON NEW TECH. USES OF COPYRIGHTED WORKS 43–46 (1978); OFFICE OF TECH. ASSESSMENT, INTELLECTUAL PROP. RIGHTS IN AN AGE OF ELECS. AND INFO. 69–73 (1986); OFFICE OF TECH. ASSESSMENT, FINDING A BALANCE: COMPUTER SOFTWARE, INTELLECTUAL PROP. AND THE CHALLENGE OF TECHNOLOGICAL CHANGE 112–13 (1992).

4. This is not to say that these reasons are commonly advanced by copyright commentators. The first two in particular are straw men. But there is value in knowing not just that they fail, but why.

5. *But see* Bruce Boyden, *Emergent Works*, 39 COLUM J.L. & ARTS 377 (2016) (arguing that works generated by unpredictable computer programs raise authorship issues that are genuinely different in kind); Annemarie Bridy, *The Evolution of Authorship: Work Made by Code*, 39 COLUM J.L. & ARTS 395 (2016) (giving interesting and challenging examples of such programs and the works they have generated).

in the copyright sense: "material objects . . . in which a work is fixed by any method now known or later developed, and from which the work can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device."[6] This definition obliterates any doctrinal distinction between digital and analog copies. Bits may be abstract and intangible, but memory chips and hard drives are very much "material objects." Digital copies are not second-class citizens of copyright's domain.

Of course, a work is stored differently in a digital copy than in an analog one. The text in a book is legible to a reader who picks it up and flips through the pages, while the pattern of ones and zeroes on a hard drive is invisible to the naked eye, even when those ones and zeroes encode the very same novel. But Congress quite rightly recognized that what matters is whether the work "*can be* perceived" from a copy (possibly with "the aid of a machine or device"), not whether it is directly perceptible when the copy is sitting inert on the shelf.[7] The text of a book is also invisible to humans unless they take it down from a shelf and look between its covers.

Even if there were a relevant difference between digital and analog copies of a work, it would be a property of the copies, not a property of the work itself. Any "categor[y]" of "authorship" cognizable under the Copyright Act can be fixed in digital copies with a suitable encoding.[8] Literary works are made up of letters, numbers, and other characters. Those characters can be translated into binary using standard encodings such as UTF-8. Pictorial works can be broken down into pixels, and each pixel broken down into the intensities of its constituent colors. The pitches and durations of notes in a musical work can be represented by numbers, which in turn can be represented in binary. For musical works with unusual features,[9] an alternative is to write the score out on a piece of paper and digitize the image of the paper, pixel by pixel.

This last trick shows why the technique works for any conceivable work of authorship protected by the Copyright Act. "Copyright protection subsists . . . [only] in works of authorship fixed in any tangible medium of expression."[10] Any work subject to copyright must therefore exist in some "tangible medium." That's enough. Find the "material object" in which the work is fixed and digitize that object with enough detail to capture whatever aspect of the object embodies the work. Architectural works exist in blueprints; find a copy and take a high-resolution photograph. Sculptural works exist in sculptures; find one and take a

---

6. 17 U.S.C. § 101 (2012). The phrase "any method now known or later developed" makes emphatically clear Congress's insistence on technological neutrality and its rejection of "artificial and largely unjustifiable distinctions . . . under which statutory copyrightability in certain cases has been made to depend upon the form or medium in which the work is fixed." H.R. Rep. No. 94-1476, at 51 (1976). The point is reiterated in § 102(a), which protects works "fixed in *any* tangible medium of expression, *now known or later developed*." (emphasis added).

7. 17 U.S.C. § 101 (2012) (emphasis added).

8. 17 U.S.C. § 102(a) (2012).

9. *E.g.*, John Stump, *Faerie's Aire and Death Waltz*, http://farm1.static.flickr.com/148/406258694_e65219a08c_o.jpg [https://perma.cc/9NLR-Z5MY] (last visited Mar. 12, 2016).

10. 17 U.S.C. § 102(a) (2012).

high-resolution three-dimensional laser scan.

Vinyl purists and other analog aesthetes may insist that analog copies capture nuances that no digital copy ever can. They are wrong. Human perception is limited by the capacities of our senses. The human eye cannot see details finer than about thirty arc-seconds. Digitize a painting at a higher resolution than a person with her nose pressed up against it can distinguish, and the resulting copy is effectively perfect, as far as she can tell. The human ear cannot hear sounds at a frequency greater than about twenty kilohertz; the CD audio standard plays it safe and goes up to 22.05 kHz. An audiophile who claims she can hear more on a vinyl recording is right only in the sense that record players add hisses and pops, or, as non-audiophiles call them, *noise*.

Of course, some works exist in digital copies and others do not. But the works that do not *might as well have*. Nothing important about their status as copyrightable works would be lost by digitizing them—and nothing important would be gained, either. Digital copies are convenient for computers to work with, and they can be remarkably convenient for bringing works to audiences. (Too convenient, some would say.) But the contingent fact of whether a work exists in digital copies, analog copies, or both does not affect its status as a work of authorship: the expression it contains is exactly the same "regardless of the nature of the material objects . . . in which [it is] embodied."[11]

II. DIGITAL WORKS

The next-simplest answer to what counts as a computer-generated work is one that was created using a computer. Some poets write longhand; others type. Again, we might posit that there would be some relevant differences, as a class, between works using computers and works created entirely without computers. Again, we would be wrong.

Every kind of copyrightable work can be—and regularly is—created using computers. Take the list of categories in § 102(a). There is specialized software to create every single one of them:

(1) "literary works": Microsoft Word, Apple Pages, Scrivener
(2) "musical works": Finale, Sibelius, Noteflight
(3) "dramatic works": Microsoft Word again, Final Draft
(4) "pantomimes and choreographic works": Dance Designer, DanceForms
(5) "pictorial, graphic, and sculptural works": Adobe Photoshop, Photo Booth, Adobe Illustrator, Affinity Designer, SketchUp, AutoCAD
(6) "motion pictures and other audiovisual works": Final Cut Pro, Maya, Adobe Flash
(7) "sound recordings": Garage Band, Pro Tools
(8) "architectural works": AutoCAD again, Chief Architect, SoftPlan[12]

11. 17 U.S.C. § 101 (2012).
12. 17 U.S.C. § 102(a) (2012).

As a result, a large and growing fraction of all copyrightable works are born digital. They are not aberrations from the normal processes of creativity; increasingly, they *are* the normal processes of creativity.

Nor is there is a clear dividing line between the creative techniques used by digital and analog authors. Cutting and pasting is easier and faster on a computer, but the verbs "cut" and "paste" betray their analog origin. Digital and film cameras have the same kinds of controls and can be indistinguishable except on close inspection. Graphic artists who draw with a stylus on a tablet make the same hand motions as those who draw with a pen on paper.

Anything an author does with a computer she could in theory do without it. Looping a drum track in Garage Band is quick and easy, but you could do the same thing with a literal loop of magnetic tape, or with a drummer friend who keeps good time. Even computationally complicated operations—such as rendering a detailed three-dimensional scene using raycasting and texture maps—are really just (much) faster versions of operations that could be carried out by hand. If nothing else, an artist could step through the computer program, one instruction at a time, precisely imitating the computer's operations as it supports her creativity. It would be immensely, almost unbelievably slower, but she could do it. Computers make some kinds of creativity practically *feasible*, but they do not make anything newly *possible*.

The reverse is also true: any analog creative process can be perfectly imitated by a digital one. Consider an analog artist, Annelise, who is drawing on a blank sheet of paper with a pen. Imagine that she has a digital doppelgänger, Dennis, sitting next to her and perfectly mirroring her actions, except that he is using Adobe Illustrator and drawing on a Wacom tablet with a stylus. Every time Annelise moves her hand to draw a line, Dennis moves his hand in the same way. Every time she changes pens, he clicks on the color picker and switches colors to match. Every time she picks up a brush, he clicks the brush tool instead. At the end of the session, they will have identical images—and identical works. The two of them made exactly the same creative choices, with exactly the same results. Authorship is not altered by the manner of first fixation.

This digital doppelgänger thought experiment is constructive: it applies to any work. All we need to do is observe how the author interacts with the copy taking shape before her and translate that sequence of interactions into interactions with an appropriate computer program. Such a program might not actually exist—there is not, to my knowledge, a perfect digital simulation of the process of chipping away at a block of marble—but it could, and that is good enough to make the point. We can imagine a digital creative process that perfectly parallels any analog one, which shows that there is nothing inherently different in kind about the analog process.

There is an instructive similarity between the digital-doppelgänger thought experiment and the digitization thought experiment described in Part I. Both of them take something in the physical world and demonstrate that it could have a digital duplicate that is identical in all respects relevant to authorship. Digital doppelgängers duplicate a verb—*creating*—while digitization duplicates a noun—the *copy*. Just as the analog creative process yields an analog copy in the physical

world, the digital creative process yields a digital copy on a computer. This is not something new about digitally created works. It merely makes explicit a causal relationship that has always inhered in creativity: a work, as fixed in a copy, is the result of what an author does.

III. ALGORITHMIC CREATION

A third way in which computer-generated works might be thought to be uniquely challenging for copyright is that they involve algorithmic creation. Rather than being produced intuitively through a process whose details are not available for inspection, they are the outputs of a process whose steps are precise and explicit.

This is not a distinction that ought to make a difference. True, rote rule-following does not look like copyrightable creativity; "slavish copying" is not originality.[13] But creativity can also inhere in a creator's selection of the rules she will follow. She can introduce copyrightable authorship through her choice of rules or through her choice among variations permitted by the rules, and as a general matter these two kinds of authorship are equivalent. A work does not know whether it was created freehand or by following rules. The use of rules at all is simply the choice to split the creative process into two stages rather than one. The inputs—whatever it is that we mean by "creativity" or "expression" or "authorship"—are indistinguishable, and so is the output—a fixed copy of the work.

If an author, for her own convenience, decides to automate some of the steps by programming a computer, copyright should not look any less generously upon her. Copyright does not turn up its nose at printmakers who engrave a single copper plate to make an edition of 500 prints, or on novelists who use movable type rather than writing each letter by hand. Their creative work is substantially complete by the time they ink a plate or fish sorts out of a type case; to complain that these steps are too mechanical to support a copyright is to go looking for authorship in all the wrong places.

This remains true even when an author acts without conscious attention to each detail; it is not that her hand is unguided, but rather that it is guided by neuronal firings in her brain in a way she does not consciously attempt to direct. In this sense, all authorship is algorithmic. To say that an author creates intuitively is simply to say that neither she nor we have ready access to the algorithm she follows.[14]

Indeed, the distinction between an algorithm and its output is often irrelevant for copyright purposes. One of the most fundamental insights of computer science is the idea that a program—software—is just another form of data.[15] That's what

13. Bridgeman Art Library, Ltd. v. Corel Corp., 25 F. Supp. 2d 421, 426–27 (2d Cir. 1998).

14. *See generally* Bridy, *supra* note 2; Alan L. Durham, *The Random Muse: Authorship and Indeterminacy*, 44 WM. & MARY L. REV. 569 (2002).

15. Alan Turing made this point in the article that created the field of computer science; he gave an explicit construction for writing out any possible program as a string of symbols. *See* A.M. Turing,

makes general-purpose computers possible; we can load new programs on them in the same simple way we load new data. Take an example: Microsoft Word is a program. It is represented digitally: as a sequence of ones and zeroes. Those bits are data; you install that data from a CD or by downloading it. In turn, your computer interprets that data a sequence of instructions, executing them one by one and thereby causing Word to do what it does. In the same way, a Word document is also data: a digital sequence of bits stored on a hard drive somewhere. Now for the crucial move: *a Word document is also a program*, one that tells Word itself what characters to display and how to format them. Your computer does not draw any fundamental distinction between the bits that make up Word and the bits that make up a Word document. Both are data; both are programs. Bits are bits. We could regard an MP3 file as a sequence of sound data, or we could regard it as a program for producing sound. Both descriptions are correct; every digital fixation of a work is a program for generating that work. And since every work can be fixed digitally, every work can be generated by a program.

The point is even more apparent when we think about the actual creative process. Consider again the sequence of steps that analog Annelise and digital Dennis follow to create pictorial works. Annelise's creative acts look intuitive and inscrutable, while Dennis's creative acts leave behind a digital trail: the precise sequence of steps that he followed, as recorded by Adobe Illustrator. It keeps track of them in case Dennis hits "undo"; the only way to enable him to retrace his steps is to leave binary breadcrumbs along the route of his creative journey. But now suppose that Dennis, having repeatedly hit "undo" until he is back at a blank canvas, decides he likes what he made after all, and starts hitting "redo" until he has the finished illustration again. In other words, Illustrator's saved undo/redo information provides a precise set of instructions for recreating Dennis's work from scratch, one that causes Illustrator to repeat what it did when Dennis was driving—resulting in exactly the same image. Dennis's sequence of creative acts is *a program for generating the work*, and it is also *a copy of the work*, which means that *so are Annelise's creative acts*. All creativity is also algorithmic in the sense that we could encode the work as a program making completely explicit what the creator did to produce it.

IV. SEQUENTIAL CREATION

The next potential challenge posed by computer-generated works is that people frequently use computer programs written by others, which raises the question of how to allocate ownership of the resulting works between programmer and user. It is easy to give examples where one or the other has a better claim. On the one hand, where the program is Finale and the work is a string quartet, the user is the author of that musical work. Finale's programmers have no more of a copyright

---

On Computable Numbers, with an Application to the Entscheidungsproblem, 42 PROC. LONDON MATH. SOC. 230 (1936). Turing's insight is all the more remarkable for having been formulated before actual digital computers existed to run those programs.

claim than the penmaker would if a composer had written the quartet out by hand. On the other hand, where the program displays a fifteen-second animation of fireworks whenever the user pushes the space bar, the programmer is the author of that audiovisual work. The user has no copyright claim because "the program would have generated the same output no matter which human user caused the output to be generated."[16]

It seems, therefore, that the problem is to distinguish computer users who are genuine authors from users who merely push a button. But this is not a problem unique to computers. Even in the offline world, there are buttons and there are buttons. The user who pushes a button on a music box to start it playing is not an author; the user who pushes a button on a camera to take a photograph is. Trying to allocate copyrights between computer programmer and computer user is the same kind of task as trying to allocate them between thing-maker and thing-user.

These are problems of sequential creation: A and B both make contributions toward a work over time, one after the other. Who owns the work? It depends. There are at least six possible legal outcomes:

> *Infringing copy*: If B makes only *de minimis* modifications to A's work, then B is not an author in the copyright sense. Copyright in the resulting work continues to be owned solely by A. If I take your short story, format it entirely in small caps, and then hit "Save As" to store a copy, I am an infringer, not an author.
>
> *Unlawful derivative work*: If B modifies A's work enough to contribute copyrightable authorship, then B is the author of a derivative work. The copyright status of this work depends on whether B has A's permission, or makes a transformative fair use, or has some other statutory authorization to prepare a derivative work.[17] If B uses A's work "unlawfully," then A owns the copyright in the portions copied from her preexisting work, while B's incremental contributions are uncopyrightable. If I do substantial editorial work on your short story without your permission—rearranging scenes, adding new expository dialogue, and eliminating an unnecessary character—neither of us may be able to claim a copyright in these tweaks.
>
> *Lawful derivative work*: If, on the other hand, B creates a derivative work but does so "[]lawfully," then A owns the copyright in the portions copied from her preexisting work, while B owns the copyright in her incremental contributions. If you gave me permission to revise your story and copyright the revisions—or if my changes so alter the story's meaning as to make it a biting commentary on the original—I will own a copyright in my brilliant revisions and you will own a copyright in your inferior original.
>
> *Joint work*: Another possibility in the case where the resulting work reflects both A and B's contributions is that they mutually intend that their contributions "be merged into inseparable or interdependent parts of a unitary whole,"[18] making them the co-

16. Samuelson, *supra* note 3, at 1206–07.
17. 17 U.S.C. § 103(a) (2012).
18. 17 U.S.C. § 101 (2012).

owners of a joint work.[19] If you and I are bandmates, you lay down a vocal track, and I then add a drum line and guitar riffs, the resulting sound recording is most likely a joint work.

Sole-authored work: If B modifies A's work or discards portions of it to the point that the resulting work is no longer substantially similar to A's, and B also makes copyrightable contributions of her own, then B is the sole author and sole copyright owner of the resulting work. If I write a screenplay in Microsoft Word, I alone own the copyright, because the screenplay is not substantially similar to Word.

No copyright: Finally, if B discards A's work without adding anything copyrightable of her own, the output simply fails to be a copyrightable work at all. Neither A nor B is a copyright owner; anyone is free to copy it. If I open up Microsoft Word and immediately hit "print," neither Microsoft nor I has a copyright in what is on the page that emerges from the printer, because the page will be blank.

These six possibilities range over every combination of possible ownership by A and B. The resulting work could be owned solely by A (in whole or part), by A and B together (jointly or in separate portions), solely by B, or by no one.

The problem of allocating ownership between programmers and users is just a special case of this more general and very familiar problem. Both contribute to the final form of the work. The programmer goes first, and then the user, but more than that we cannot say without knowing about the particular program and the particular user input. The resulting work might be virtually identical to the program, or it might be virtually identical to the user's input, or it might be similar to both, but identical to neither, and we will have to inspect the expression in the program, the input, and the work to say for sure which is the case. The user might arrange segments of expression supplied by the programmer, as when a Garage Band user splices together loops and samples that come with the program. The user might apply complicated programmer-supplied transformations to her own expression, as when a Photoshop user applies filters that come with the program. The user might provide her own expressive elements and stitch them together using an underlying framework supplied by the programmer, as when an Adobe Flash Professional user makes an animation.

The fact that some of these examples of computer-assisted creation are algorithmic as well as sequential still does not make them genuinely new in kind. Offline sequential creation can also be algorithmic. A Spirograph enables one person to make a design according to a pattern specified by another. So do dress patterns, recipes, and, for that matter, blueprints. Sometimes, the author of the instructions is regarded as the sole author of the output; architects own copyright in built buildings, not the contractors who actually do the construction work. Sometimes, there is room for the rule-follower at copyright's table: if a "distinguishable variation" is enough for a copyright in a work created to the plan of another, I own the paint-by-numbers canvas I fill in, even if I only color inside

19. 17 U.S.C. § 201(a) (2012).

the lines.[20] We have not thought that these cases raise distinctive and difficult issues of the sort that would lead us to treat a Spirograph disc as the "author" of the resulting loops and whirls, or that an origami pattern owns the crane.

V. NONDETERMINISTIC CREATION

The last way in which computer-generated works are potentially different is that the same program can be run repeatedly with identical inputs to generate different works.[21] Take the 99-cent "Mozart's Dice Game" app for iOS by the developer Rodskagg.[22] Every time the user taps the "random" button, Mozart's Dice Game strings together pseudorandomly-selected measures of music to produce a new piano minuet and trio in a late 19th century style. It is unappealing to say that the act of tapping the button is an act of authorship justifying a copyright for the user. But the fact that the minuets are generated pseudorandomly also makes it unappealing to treat the programmers as the authors, since they did not compose any particular minuet.

This again is a hard problem, but again it is not a new one. The "Mozart's Dice Game" app is nothing more than a computer-implemented version of an actual dice game for composing music. This *Musikalisches Würfelspiel* was published in 1792 and apocryphally attributed to Mozart. People were composing music using nondeterministic processes long before there were computers; there is a rich history of of artistic creation incorporating variable elements.[23] Indeed, there is a rich history of creation that is sequential and algorithmic as well as nondeterministic: the people "composing" music at home by rolling dice were doing so according to instructions supplied by the game's designer.

It is helpful, I think, to look at how copyright deals with a related case: the one in which the same person both creates and uses the nondeterministic process. Consider a composer who rolls dice to choose notes according to a scheme of her own devising.[24] She is a perfectly plausible candidate for copyright ownership, for three possible reasons. One is to say that she is an author because of her creativity in defining the process itself. By describing a mapping from the die rolls to musical notes, she exercises creative control over some aspects of the composition;

---

20. Alfred Bell & Co. v. Catalda Fine Arts, 191 F.2d 99, 102 (2d Cir. 1951).

21. In an earlier draft, I referred to "random" rather than "nondeterministic" creation. *But see* Timothy McGovern, *Copyright Law Would Be Easy If It Wasn't for All the Damn Creativity*, HERDING BATS (Dec. 23, 2015), http://herdingbats.blogspot.com/2015/12/copyright-law-would-be-easy-if-it-wasnt.html (critiquing my usage of "random"). As McGovern explains:

> Randomness indicates either a deterministic process occurring at a scale too fine to measure, or a provably random process like radioactive decay, where the distribution of discrete events can be probabilistically predicted over time, but within any given timeframe their occurrence or non-occurrence is unpredictable (cite: I asked a physicist!). As computer scientists know, although we're working on randomness generators, basically the best we can get at this point is pseudorandomness.

22. Rodskagg, "Mozart's Dice Game," http://www.dicegame.rodskagg.com/ [https://perma.cc/S49K-X499].

23. *See generally* Durham, *supra* note 14.

24. *Cf.* Durham, *supra* note 14, at 602–03 (discussing John Cage's compositional practices).

that is enough, even if other aspects are literally out of her hands. Although this approach runs into some difficulties in defining substantial similarity and when the process is repeated, its basic claim is conceptually sound.[25] Transposing this reasoning back into cases of sequential creation suggests that the composer would still be an author even if someone else rolls the dice, and similarly the programmer of a nondeterministic algorithm can be an author of its outputs even if someone else pushes the button.

A second reason the composer can be an author is that she adds non-procedural creativity when she writes out the notes onto a sheet of staff paper; her handwriting is hers in the same way that a painter's brushstrokes are. This rationale reaches only the way she writes the notes, not the notes themselves, but it too is enough to justify a copyright. In sequential-creation cases, this reasoning suggests that the *Musikalisches Würfelspiel* player who writes out a dice-generated minuet longhand is also *pro tanto* an author. This kind of authorship drops out entirely from computer-generated works: the imperfections and variations introduced by a copyist's hand are absent. Hitting "save" to store a digital copy of a freshly-generated minuet introduces no new authorship.

The third reason is more openly pragmatic. We could admit that a composer who plays at dice does not control their fall, any more than Jackson Pollock controlled the fluid dynamics of his paint splatters. They do not "owe their origin to an act of authorship"[26]—but we are nonetheless willing to sweep them into the composer's copyrights. For one thing, there are no competing claimants. Either the composer owns the copyright in these aspects of the work, or no one does. Giving her a copyright does not deprive other authors of their due. For another thing, there is no great need for public access to this particular outcome. Giving the composer a copyright in the expression resulting from this particular roll of the dice means only that anyone enamored of the idea just needs to roll their own. The composer ends up with exclusive rights over only an infinitesimally small sliver of the possibility space; the random elements, being random, are exceedingly unlikely to fall the same way again. Treating the composer as the author in law, even if she is not the author in fact, is a harmless fiction—and one that avoids the difficult task of distinguishing the aspects of a work that result from random processes inside an author's body from the aspects that result from random processes outside of it.[27] The photographer who takes a picture of a chaotic ocean swell contributes authorship by choosing where to point the camera and when to click the shutter button, but she ends up with a copyright on patterns of waves and spray that are in no sense her expression.

---

25. *See generally* Dan L. Burk, *Method and Madness in Copyright Law*, 2007 UTAH L. REV. 587 (2007); Alan L. Durham, *Speaking of the World: Fact, Opinion and the Originality Standard of Copyright*, 33 ARIZ. ST. L.J. 791 (2001); James Grimmelmann, *Three Theories of Copyright in Ratings*, 14 VAND. J. ENT. & TECH. L. 851 (2011).

26. Feist Publ'ns, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 347 (1991).

27. *See* Durham, *supra* note 14, at 573 (questioning extent to which this distinction is maintainable). I owe the helpful terminological distinction between authorship in fact and authorship in law to Annemarie Bridy. Bridy, *supra* note 2, at ¶¶ 61–68.

But these simple pragmatic fictions break down when one person carries out a nondeterministic process designed by another. With multiple humans in the picture, an "attribute ownership to the human" rule becomes ambiguous. This is not to say that the rule becomes unusable: we could for equally pragmatic reasons say that the programmer owns a given nondeterministic algorithmic sequential work, or that the user does, or both. It is just that we must confront the full sixfold diversity of sequential creativity cases, which means that no rule can be both simple and pragmatic.

This problem was latent in offline examples like the *Musikalisches Würfelspiel*, but not a great source of worry. It does not appear that anyone fretted over whether the game's designer or players had a better claim to copyright its minuets. Two things changed with the advent of computer-assisted creativity. First, cases of algorithmic creation went from being literally parlor games to being all around us. Everyone who applies the Add Noise filter in Photoshop or records a speed run in a video game with procedurally generated levels creates using a nondeterministic algorithm written by other people, an algorithm whose inner workings and detailed effects the user may not even remotely comprehend. Second, the fact that a computer was involved seemed to offer a way out of the fact-bound swamp of deciding whether programmer, user, both, or neither qualified as an author. Perhaps in cases involving pseudorandom creation and limited user input, the *computer itself* might be regarded as the author?

This suggestion is essentially fallacious, the solution a mirage. No one, to my knowledge, has ever seriously entertained the idea that the *Musikalisches Würfelspiel* dice or the box they came in was the author of the resulting minuets. Why should it matter that in "Mozart's Dice Game" the die-rolling algorithm is implemented on a computer? Dice are not authors, and neither are computer programs. It is only the novelty and seeming strangeness of computers that have encouraged people to think otherwise.

It is possible that some future computer programs could qualify as authors. We could well have artificial intelligences that are responsive to incentives, unpredictable enough that we can't simply tell them what to do, and that have attributes of personality that make us willing to regard them as copyright owners.[28] But if that day ever comes, it will because we have already made a decision in other areas of life and law to treat them as persons, and copyright law will fall in line. But unless those mechanical minds also invent workable time travel, their future existence is of no bearing now. The copyright issues we would face on that far off day are fundamentally different in kind from those we face today.

---

28. *See* James Grimmelmann, *Copyright for Literate Robots*, 101 IOWA L. REV. 657 (2016) (discussing changes that would make it reasonable to treat artificial intelligences as authors and readers in a copyright sense).

CONCLUSION

Computer authorship is a law of the horse.[29] It is a special case of a more general problem, one that presents few new twists on familiar issues. This is a little surprising. Over on the infringement side of the aisle, computer copies are easy, cheap, instantaneous, worldwide, and inescapable. Infringement doctrine is in a state of complete upheaval, one that may bring to an end the three-hundred-year run of the "copy" as the basic unit of infringement analysis.[30] On one hand, digital rights management technologies offer copyright owners the option of regulating uses rather than copies; on the other, open access and peer production ask whether such regulation is necessary at all. Either way, big changes are afoot. Even back on the copyrightability side of the aisle, computer programs themselves pose fundamental questions about the nature of the authorship that copyright protects.[31] Programs are dual artifacts—useful texts—and they interleave creative choice and functional constraint in complex ways. Of course, copyright has always worried about the line between aesthetic and utilitarian, but computers raise the stakes because they are such literal-minded readers.

So computers do raise hard problems for copyright—just not here. For all present practical purposes, new copyright doctrines for computer-generated works are a terrible idea.[32] The problem of assigning copyright in computer-generated works may be a hard problem, but it is not a new problem. It is hard for the same reason that copyright has always been hard—it requires us to make objective legal judgments about the ultimate in human subjectivity: aesthetics. Putting a computer somewhere along the pathway from brain to brain brings some of these difficulties to the fore, but it does not change the nature of the question. There are no distinctive conceptual problems with computer-generated works, because all works are computer-generated—or at least, they might have been, which is close enough.

Because computer-generated works are no different in kind than other works, special-purpose doctrines have little to offer. Indeed, they can make things much worse; the danger of claiming that there is "a" rule for computer-generated works is that it blinds us to the immense diversity that category encompasses. There can be no rule treating all computer-generated works alike for the same reason there can be no rule treating all fair use cases alike: relevant differences require different treatment. It is only the apparent novelty of computer-generated works that seems

---

29. *See* Frank H. Easterbrook, *Cyberspace and the Law of the Horse*, 1996 U. CHI. LEGAL F. 207 (1996).

30. *See* Peter Yu, *The Copy in Copyright*, *in* INTELLECTUAL PROPERTY & ACCESS TO IMMATERIAL GOODS (Jessica C. Lai and Antoinette Maget Dominicé eds., Edward Elgar Publishing 2016).

31. *See, e.g.*, Pamela Samuelson et al., *A Manifesto Concerning the Legal Protection of Computer Programs*, 94 COLUM. L. REV. 2308 (1994).

32. To put it idiomatically, computers raise difficult § 102(b) issues, but not difficult § 102(a) issues. For a recent discussion of the § 102(b) issues, see Pamela Samuelson, *Functionality and Expression in Computer Programs: Refining the Tests for Software Copyright Infringement* (UC Berkeley Pub. L. Res. Paper No. 2667740), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2667740 [https://perma.cc/9XG4-52TB] (last visited Mar. 16, 2016).

to call out for new bright-line rules. But that is the same deadly siren song that new technologies always sing. There is no new categorical rule of personal jurisdiction on the Internet; there is no new categorical rule for drone overflights; there is no new categorical rule for privacy on social networks; there is no new categorical rule for a thousand other technologies, nor should there be. People are always talking about technology law, when they should be talking about technology facts.