RECOMMENDED FOR YOU

Prediction, creation, and the cultural work of algorithms

by William Uricchio

WE TELL OUR HISTORIES in predictable ways, particularly when it comes to technology. Looking back on the developments that litter the past, we tend to see inevitability, squeezing the facts, as needed, to fit the tale of our present. The uncertainties that necessarily abound with any new technology, when things like standards, formats, uses, and social protocols get worked out, seem largely filtered from our recollection of the past. Inherited technologies seem to hew to a narrative of progress, entering the world conceptually, like Venus, fully formed.

This tendency makes the appearance of new technologies something to be savored. For a brief moment, uncertainty looms large. A contradictory mix of anxieties and expectations, fears of disruption and hopes for salvation swirls around—until the dust finally settles and, like its predecessors, the once-new technology settles into a state of taken-for-grantedness. In this sense, the recent explosion of headlines in which the term "algorithm" figures prominently and often apocalyptically suggests that we are enjoying such a moment, as a "new" technology appears in the full regalia of unruliness. Better, the emerging algorithmic regime is more than "just another" temporarily disruptive new technology. It offers insights into a fundamentally different way of articulating our relationship to the world, different, that is, from the project of the modern as first formulated in the early fifteenth century and embodied in technologies such as the printing press and three-point perspective. I realize that this "added value" argument fits the usual pattern of apocalyptic expectation and anxiety regarding new and not yet familiar technologies—but even paranoids have enemies.

My thesis is that the algorithm, an approach to problem solving that goes back at least to Euclid's *Elements* (ca. 300 BC) and that enjoyed significant development in the hands of Leibniz and Pascal, has achieved new cultural force as a technology thanks to a confluence of factors that include big data, intensive processing power, and high-speed networks. It embodies a configuration of the subject-object relationship quite different from technologies that have been used to articulate the project of the modern (the press, etc.). Yet, like these technologies, the algorithm can be read as defining an emerging epistemic era. If we are indeed like those in the early fifteenth century who were poised on the edge of a new order of things, will we, like some of them, be inclined to embrace their potentials for a new vision of ourselves in the world, a new social order? Or will we miss the radical potentials of a new technology, retrofitting them to serve the still-dominant interests of the old? Technologies do not, of themselves, change anything, but are rather socially constructed and deployed. And in this sense, as we watch the possibilities of a new technology take shape in the hands of the highest bidder, we have good reason to be anxious. But the algorithm is less the problem than the mentality of those it serves.

Definitional Dynamics

THE TERM "ALGORITHM" seems to conjure up responses disproportionate to the simplicity of its meaning. Formally speaking, an algorithm is simply a recipe, a process or set of rules usually expressed in algebraic notation. The actual values plugged into the algorithm are less the point than the step-by-step formulations for their processing. They scale easily, whether working with the relatively thin data of the pre-computer era or the over 2.5 quintillion bytes of data generated daily (as of this writing). Yet, despite their relative simplicity, algorithms today pose some significant definitional problems, mostly through a series of misapprehensions.

Communications theorist Tarleton Gillespie has noted three broad uses of the term that obscure its meaning. Algorithms are invoked as *synecdoche* when the term stands in for a sociotechnical assemblage that includes the algorithm, model, data set, application, and so on. They function as *talismans* when the term implies an

"objectifying" scientific claim. And they reveal a *commitment to procedure*, formalizing social facts into measureable data and clarifying problems into models for solution. Indeed, one might step back and note that these three uses say much more about social anxieties and aspirations than they do about algorithms. How, for example, can one make a claim to "objectivity" with an authored protocol whose operations depend on the highly variable character and structure of a particular data set?

The definition of the algorithm is also complicated by more insistent epistemological problems. Sociocultural anthropologist Nick Seaver finds that most discussions of algorithms get caught up with issues of access and expertise. Access is an issue because many commercial algorithms, Google's for instance, are closely guarded secrets. *If only we had access . . . ,* the mantra goes. But even if we did have access, we would immediately face the expertise problem, for most individual algorithms inhabit vast interdependent algorithmic systems (not to mention models, goals, data profiles, testing protocols, etc.)—and making sense of them typically requires large teams of experts. Even more troublesome is the fact that any given process usually has many possible algorithmic combinations (ca. ten million in the case of a Bing search), some of which might be uniquely deployed or used for purposes of personalization. Individual algorithms and algorithmic clusters are recycled and appear in different settings, with pre-World War II era elements still in circulation today. This means that we can never be precisely sure of which set of algorithmic functions we are examining. Even if we were, the work of personalization would limit our ability to compare findings.

A further twist appears in the form of disciplinary specificity. The valences of the term "algorithm" differ in mathematics, computer science, governance, predictive analytics, law, and culture, complicating cross-disciplinary discussion. And unlike earlier technologies, developments in machine learning have enabled algorithms to self-optimize and generate their own improvements. They can now self-author and self-create. This greatly complicates notions of authorship, agency, and even their status as tools, which imply an end user. Together, these various factors combine to render the simple definition of an algorithm as a "rule set" into something quite loaded.

Algorithmic Culture

GIVEN THE ROLE that algorithms currently play in shaping our access to information (Google) and the social world (Facebook), and their centrality to finance (algorithmic trading) and governance (from predictive policing to NSA-style parsing of vast troves of data), looking at their *cultural* work might seem a low priority. Each of these sectors reveals some affordances of the algorithm, and their most visible—and disturbing—applications reflect the interests of the prevailing power structure. The abusive deployment of algorithms says more about the contradictions of our social order than the algorithm per se, and focusing on the latter puts us in the position of a bull fixated with the matador's cape.

But the cultural use of algorithms throws into sharp relief the capacities of this technology to reorder the subject-object relationships at the heart of representation. Although we may still look at algorithmically enabled art the same way we look at the art of the past (just as some look at algorithmically enabled tools and see another means of old-fashioned control), it is far easier to see through the representation process and find there the residue of algorithmic capacity. The arts help us to see more clearly.

Just as algorithms have a deep history and have recently achieved new power thanks to their changing circumstances (big data and dramatic improvements in processing and transmission), their use in the arts also has a long history and a dynamic and quite powerful present. The canon form in music, essentially an algorithm, goes back at least to the Middle Ages; and algorithms have appeared from the *Musikalisches Würfelspiel* attributed to Mozart to Lejaren Hiller's work with the ILLIAC computer, in the 1950s. The musician Brian Eno summarized the artistic stance of this work well when he said,

> *Since I have always preferred making plans to executing them, I have gravitated towards situations and systems that, once set into operation, could create music with little or no intervention on my part. That is to say, I tend towards the roles of planner and programmer, and then become an audience to the results.*

This disaggregation of artistic process is nothing new (Rodin famously relied on it for his major scuptural works), but it has served as a persistent characteristic in the long history of algorithmic art.

In the visual arts, the group known today as the Algorists (Roman Verostko, Manfred Mohr, A. Michael Noll, Frieder Nake, and others) began, in the 1970s, to use computer-driven algorithms in a similar manner, deploying them as tools by programming instructions and watching the printer do the work. Just as canons demostrate the power of a simple melody to grow into incredible complexity, visual pieces such as Roman Verostko's *Floating Cloud* attest to the ability of relatively small programs to generate works of striking beauty. In these works and others across media, something of the artisanal paradigm still survives. Explicitly positioned within what the sociologist Howard Becker would term an "art world," this work, whether musical or visual, nevertheless faced some of the same problems as photography in the nineteenth century and film in the twentieth. Can a "machine" create art? Is the absence of the human touch a net loss to the creative act? Can the so-called autographic arts (painting, for example) legitimately disaggregate design and execution? These examples of algorithmic art, like early film and photography before them, emulated traditional art works (display, authorship, galleries, buyers) but were subject to a critique of their "true" aesthetic value.

Today, in an era of the newly enabled algorithm, these (still ongoing!) historical battles seem almost quaint, rendered marginal by the appearance of two new deployments of algorithms in the cultural sector: taste prediction and text generation. Consider EchoNest's prediction algorithms that comb through millions of users' behaviors as well as musical texts, seeking correlations by extrapolating from past behaviors to future desires or by searching for other users' patterns that might offer a basis for suggestions. To the extent that users play along and offer consistent feedback, Pandora, Spotify, or other streaming music services that use EchoNest's algorithms demonstrate an uncanny ability to identify and provide access to the desired, the familiar, and the reassuring. The same principles apply to Amazon's book recommendation service or Netflix's film and video suggestions. The past is prologue, as the data generated through our earlier interactions shapes the textual world selected for us. No "surprises" or "unwanted" encounters, just uncannily familiar themes and variations. This logic extends into the informational domain as well, where it has been the subject of a well tred but sharp critique that argues algorithms have created an informational "echo chamber," in which our already existing views of the world are reinforced but rarely challenged.

But taste prediction has another fast-growing dimension, in some settings effectively serving as a gatekeeper for cultural production. Epagogix, a company that specializes in risk mitigation, has found a niche in advising investors in the film and television industry about the likely success of a given project. The script as well as various casting configurations are assessed by their proprietary algorithms, and a financial assessment provided that may (or may not) serve as an incentive for investment. Needless to say, longtime industry specialists view such developments with suspicion, if not contempt, but investors, convinced by the seeming objectivity of numbers and the system's mostly accurate predictions, think otherwise. Investor response is understandable at a moment when most stock trading is algorithmically determined: it is a vernacular of sorts. But it also confirms Gillespie's observation of the algorithm as talisman, radiating an air of computer-confirmed objectivity, even though the programming parameters and data construction reveal deeply human prejudices. The bottom line is that decisions regarding what will and will not be produced are being based on data of unknown quality (What do they actually represent? How were they gathered?), which are fed into algorithms modeled in unknown ways (with "success" often meaning calculable profit rather than the less-measurable metric of aesthetic quality).

The second breakthrough of newly empowered algorithms is textual production. According to the *New York Times*, over one billion stories were algorithmically generated and published in 2014. In a quiz that appeared on March 7, 2015, the *Times* asked its readers "Did a Human or a Computer Write This?" with the tag, "A shocking amount of what we're reading is created not by humans, but by computer algorithms." The quiz doubtless confounded many of its readers, and the accompanying story described the rapid growth of storytelling algorithms that have nearly cornered routine sports and financial market reporting. These two domains are well-structured, with timelines and datapoints that enable easy characterization and serve as low-hanging fruit to an emergent industry. But the *Times* story gave a sense of the ambitions and the state of the game for storytelling algorithms produced by companies such as Narrative Science, and the results were impressive.

Similar developments can be found in the music industry, where the customized *production* of music—rather than simply the selection of pre-existing music—appears to be the next step after taste prediction; and in the film sector, where companies like Magisto claim to analyze image, sound, and their storytelling potentials, paving the way to production armed with "Emotion Sense Technology." Meanwhile, interactive documentaries, often in the form of textual environments that a user can navigate through, are slowly moving toward personalized "sit-back" experiences in which an algorithm seamlessly guides the user through the "most-relevant" elements of the data-set. Although interactive in principle, no choices are required from the user, who simply experiences a personalized linear film.

The nearly 300 reader responses to the *Times* article amply demonstrated the provocative nature of these developments: text-generating algorithms force us to ask what it means to be human and how that relates to artistic production. For most letter-writers, the answer was clear-cut: algorithmic creativity in traditional cultural sectors is oxymoronic. Culture is precisely about *human* expression, and anything else is either trickery or parody. But to designers of algorithms, such discourse—to the extent that it articulates a human *je ne sais quoi*—is useful in pinning down precisely what is disparate between human and algorithmic expressions, enabling engineers to define and chip away at the problem. Much like the issue of intelligence, the long-held assumptions regarding man-the-measure are undergoing a Copernican-like decentering, and in this sense, the coincidental appearance of developments such as post-humanism, actor-network theory, or object-oriented ontology suggest that sectors of the academy are indeed thinking seriously about a paradigm shift.

All of this is to say that the cultural deployment of algorithms has different valances. An early and continuing strand of creativity has harnessed algorithms to the work of familiar artistic paradigms, where things like authorship and attribution are still relevant. But a new and fast-emerging set of developments has seen algorithms used as filters, shaping our access to the cultural repertoire; as a gatekeeper, helping to determine what will and will not be produced; and as a semi-autonomous producerly force, writing texts, composing music, and constructing films. And these latter developments are growing more intensive, driven by the biennial doubling of processing capacity captured by Moore's Law, the ever-more pervasive place of computational systems in our lives, and the ability of algorithms to self-improve without active human intervention.

They raise crucial questions about agency and attribution: How to negotiate the space between human designers and machine learning? What is the nature of authorship and the creative act?; about point of view: Whose values, experiences, and perceptions are bound up in this new order?; and about cultural access: What notion of "personalization" enables or delimits our encounters with texts, and with what implication?

The Bigger Picture

WHY DO THESE QUESTIONS, and the increasing insistence with which they are posed, matter? What are the stakes? To put it in the apocalyptic rhetoric-of-the-new I warned of at the outset: it is because we may well be participating in the death of the modern (and the birth of some as-yet-unnamed epoch). Heidegger used an image, the *Weltbild*, to mark the modern's birth, saying that the moment at which the world becomes a picture is the same moment that the human emerges as the subject in a characteristically modern subject-object relationship. The world as picture (*Welt als Bild*), he tells us, "does not mean a picture of the world but the world conceived and grasped as picture." Heidegger goes on to specify that the world picture "does not change from an earlier medieval one into a modern one, but rather the fact that the world becomes picture at all is what distinguishes the essence of the modern age."

He argues that the modern social order can be defined through a representational system characterized by precisely defined subject-object relations (the world as picture), a metaphysics of exactitude, and an underlying spatiotemporal grid. Descartes emblematizes this order. But we can also point to earlier developments such as Gutenberg's press and Alberti's notion of perspective, born in the first half of the fifteenth century, for technologies that amplified the subject and her viewing position. Perspective offered a formal system to represent the world as seen by the subject, just as the printing press served as a resonator for the authorial self, and both technologies served the project identified by Heidegger as the modern.

The centuries between these early developments and Heidegger, despite countless historical undulations and discoveries, demonstrate a consistent logic of attribution, of a stable self and its relationship to the object-world, a notion of mathematics as a language of precision, calculability, and predictability. And this order remains deeply familiar to us, pervading our lives, whether through our financial systems, our notions of science, or the construction of our technologies of visual representation.

In contrast to the precision, calculability, and specificity of the modern subject-object relationship bound up in the *Weltbild*, the algorithmic layer stands between the calculating subject and the object calculated, and refracts the subject-centered world. It filters what we can see, produces our texts with unseen hands, and reshapes our texts, rendering them contingent, mutable, and "personalized." Its implications, if we take thinkers like Heidegger seriously, can be profound. Consider the contrast between Diderot's *Encyclopédie* and the crowd-sourced *Wikipedia*, or between Canaletto's painting of Piazza San Marco and the hundreds of differently authored photos that in the aggregate constitute Photosynth's "synth" of the same. In each case, one subject/author is known, their point of view embodied, their relationship to the object clear, and their text stable. And the other subject/author is collective and diffused, the points of view multiple, the relationship to the object algorithmically mediated, and the text changing and mutable. These differences, *grosso modo*, distinguish the project of the modern, the age of the *Weltbild*, from the enablements of the algorithmic.

Authorship, in the algorithmic context, is both pluriform and problematic. Although mostly effaced, in the case of Photosynth it is the author of the individual photos (or in an interactive documentary, the author of the video clips); largely enacted, it is the author of the experience—that is, the navigating user; fundamentally enabling, it is the author of the algorithm; and in terms of what we actually see and select from, it is the algorithm as author. Descartes' triumphant subject and the *Ich* implied in Heidegger's *Weltbild* are not eradicated, for their traces remain abundant. Rather, they are fundamentally repositioned by the algorithmic regimes that now stand between subject and object.

If we understand this, we can think through the opportunities that await, rather than panicking at the loss of the old certainties. We can explore the affordances of algorithmically enabled collaboration and the new forms of collective creativity that might ensue, rather than tolerating the crude use of algorithmic systems to exploit and oppress. We can try to understand the implications of widespread personalization, the challenges of a predictive economy in which data trails become constitutive, and the meaning of a culture of radical contingency. And we can probably learn from our predecessors in the late Middle Ages, poised on the cusp of the modern, first encountering the printing press and three-point perspective. What did people make of new and, in retrospect, era-defining technologies *before* that era was defined? The printing press was both a trigger for the modern (the stabilization and spread of knowledge), and unleasher of unruly practices that accompanied its initial decades. In one case, new technologies were embraced and put to work as harbingers of the new, and in the other, they took form in aberrant and contradictory ways reflecting the brackish waters of late-medieval thinking.

The "newness" of the algorithm comes with the danger that it will be retrofitted to sustain the excesses and contradictions of the fast-aging modern. But it also offers an opportunity for critical thinking and an imaginative embrace of what just might later come to be known as the Age of the Algorithm. □