THE CODE ECONOMY

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A FORTY-THOUSAND-YEAR HISTORY

PHILIP E. AUERSWALD

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CONTENTS

13

Authenticity

Creating the Foundation for Reputation

It's the real thing.

—Coca-Cola advertisement

OVER THE SPAN of four days during the 2014 South by Southwest (SXSW) festival in Austin, Texas, a food truck manned by chefs from New York's Institute of Culinary Education (ICE) offered an eclectic mix of dishes: Vietnamese Apple Kebab, Caribbean Snapper Fish & Chips, Belgian Bacon Pudding, an Austrian Chocolate Burrito that featured lean ground beef and two ounces of dark chocolate, and, on the last day, Peruvian Potato Poutine. Aside from novelty, what these dishes had in common is that they all were created by a computer: IBM's Watson supercomputer, to be precise.

Nicolas Vanderveken, a Canadian digital strategist, organized a social media campaign to get poutine, a French fry and bean curd favorite of his native Quebec, on the menu for the SXSW Watson food truck. "I wanted to see how the system would work with a dish you've probably never heard of," said Vanderveken. Chef James Biscione responded before serving the Watson-created version, "I'm really nervous about this. I know that you've got some strong opinions about what poutine is, and that it is something near and dear to your heart, so I hope you're going to like what we've come up with here."[1]

IBM calls its food truck project Cognitive Cooking. The point of the experiment is to find out if computers can be creative. "The problem with making creative computers in the past was that computers could do novel things but there was no way to know if they were any good," observes Florian Pinel, the chef and IBM data scientist who leads the Cognitive Cooking project. "We chose cooking because this is something that everyone can refer to. The difference is that we have access to a lot of data and using Big Data we can predict the quality of the recipes. The computer can create something that tastes good, and it knows why it tastes good."[2]

How does Watson manage this? Employing machine-learning algorithms of the type I described in chapter six, it identifies ingredients that will combine well by mining large datasets. "The system doesn't look at ingredients the same way that chefs do," Pinel explains. "When a chef looks at an ingredient he thinks of the history of the ingredient and recipes where it's been used. The system does a little bit of the same, of course, but it also looks at the chemical composition of that ingredient. To understand why they go together, you have to look further at the compounds that are found in these ingredients."[3]

Steve Abrams, director of IBM Watson Life, of which Cognitive Cooking is a part, elaborates: "What you see is a system that was trained on 35,000 different recipes, as if it was digesting a giant cookbook. From reading that cookbook it has learned an awful lot about different cuisines and the ingredients that are often used in different cuisines, ingredients that are often paired together, and what it takes to make a particular dish—what it takes to make a burrito different from soup, or Japanese cuisine different from Tex-Mex."[4] To get to the combination of ingredients that resulted in Peruvian Potato Poutine and the other dishes served at SXSW, Watson tested more than a quintillion possible combinations. However, refining the most promising combinations and the template recipes produced by Watson into those actually used to prepare the dishes at the festival required the human talent of the highly trained ICE chefs.[5] This is the essence of cognitive computing: algorithmic support for human decision-making, and even human creativity.

Summarizing two centuries of the advance of code, from Jacquard-inspired punch-card (or "tabulated") machines to human-machine systems like the Watson Food Truck, including more than a century of IBM's own history, Abrams states, "Originally we had tabulated machines, then we went on to programmable systems, now we're in the era of cognitive systems." As I have emphasized throughout this book, the advance of code summarized by Abrams spans almost every domain of human creative activity.

As a further example, consider the fate of two films that premiered on the same night at the 2015 Sundance Film Festival, as recounted by Tim Wu of *The New Yorke*r in a January 2015 article. One of these films, *What Happened, Miss Simone?* was a documentary about singer and civil rights icon Nina Simone. That film was funded by Netflix, whose corporate decision to back the film was based in part on insights algorithmically gleaned from the vast trove of data it has collected on users of its streaming video and movie rental services. The second film was a comedy titled *The Bronze,* which featured television star Melissa Rauch as a vulgar gymnast. *The Bronze* was produced by Duplass Brothers Productions and privately financed by "a few wealthy individuals" whose decision to back the film was presumably not based on complex impersonal algorithms but rather, as has been the Hollywood norm, on business intuition. At the Sundance screening of *The Bronze,* the festival's director, John Cooper, indicated that it was a personal selection of his.

You can, of course, guess the outcome. "While not a formal competition in any sense," Wu recounts, "the night seemed to be a clear victory for algorithms over instincts. 'Miss Simone' gained a standing ovation at its screening and has earned critical respect. 'The Bronze,' while garnering some laughs, currently sits at ten per cent on Rotten Tomatoes, where critics have called it 'a grueling experience to sit through' and 'a mean-spirited and largely witless satire.' "

Granted, the use of data and even algorithms to inform film and television programming decisions is nothing new. Television executives for decades have had their decisions guided by the Nielsen ratings, as film industry executives have been guided by the dissection of box office receipts. However, ratings and receipts are both retrospective measures—and simple ones at that. In contrast, Netflix used its vast data resources and complex algorithms to make forward-looking predictions about audience reactions, like IBM Watson with the cognitive computing project.

This is just one anecdote, of course, but the code-focused approach Netflix has taken to movie-moguling and TV producing has yielded broadly impressive results, including breakout hits like *House* *of Cards, Orange Is the New Black,* and *Unbreakable Kimmy Schmidt.* Due in large part to its industry-leading focus on data and algorithms, Netflix has gone from a company that was widely judged to be on the brink of failure after a pricing mistake four years ago that sparked large-scale user defection to one that is to the business of streaming media what Alibaba and Amazon are to electronic commerce. In 2015, after years of steady growth, Netflix accounted for almost 37 percent of all downstream Internet traffic in North America during peak evening hours.[6]

Does this mean that Netflix is a company run entirely by algorithms in which human intuition and insight play no part? "It is important to know which data to ignore," Netflix chief content officer Ted Sarandos noted to Wu. "In practice, it's probably a seventy-thirty mix, [where] seventy is the data, and thirty is judgment. But the thirty needs to be on top, if that makes sense."

When it comes to various jobs' susceptibility to automation, movie mogul would still have to rank close to the bottom. The combination of cultural sensibility, financial acumen, negotiating savvy, and personal charisma required for success as a film industry executive would be difficult to duplicate. Yet anyone who has used a driving app such as Google Maps to guide the process of urban navigation knows what Sarandos is talking about. Augmenting human decision-making with automated input—the advent of Big Data or what IBM calls cognitive computing—is not a future possibility but a present reality. Furthermore, it is limited neither to experts nor to narrowly technical domains and is being applied in a broad range of human endeavors, from cooking and film production to public health, urban planning, disaster response, and environmental management.

"Never before has it been possible to self-consciously design and test at scale new forms of social technologies with rapid iterations and innovation," John Clippinger wrote in his contribution to the informatively titled *From Bitcoin to Burning Man and Beyond: The Quest for Identity and Autonomy in a Digital Society,* a 2014 book he coedited with author/activist David Bollier.[7] "The convergence of open platforms, social networking, Big Data and encryption innovations allows us to address many social and economic problems that simply could not be seen or addressed under the regnant system of authoritative institutions."[8]

Clippinger has been thinking and writing about human societies as cybernetic systems for 40 years. Most recently he started the Institute for Innovation & Data Driven Design, a nonprofit organization formed to develop, and to field test, legal- and software-based "trust frameworks" for data-driven services, infrastructures, and enterprises. Core to this work is the use of an authentication and verification system known as the Blockchain, which allows for the irreversible and open documentation of verified transactions of any type.

The era of cognitive computing is clearly upon us. Social systems are already man-machine systems. Whether this next stage in the advance of code is desirable is a less interesting question than how to make it as broadly beneficial as possible. Who does the work in the era of cognitive computing? Who gets the credit? Who earns the reward? Who owns the data . . .

. . . and, when all is said and done, who gets to decide if computer-generated poutine is *real* poutine?

THE COMITÉ INTERPROFESSIONNEL du vin de Champagne is an organization dedicated exclusively to ensuring the authenticity of wines sold under the name "champagne." For a bottle of sparkling wine to be so branded, it must be produced not only in the Champagne region of France but also according to a specific set of processes, including the choice of grape varietals, care of vines, and actual production of the champagne. Like Swiss watchmakers in their market, the producers of authentic champagnes comprise a relatively small share, about 13 percent, of the sparkling wines sold globally. However, with $2.4 billion in export sales in 2014, they constitute more than 50 percent of the global export market for sparkling wine.

Most French wines and an array of other agricultural products are produced in accordance with regulations established by the Institut National de l'Origine et de la Qualité, a government organization formed in 1935 that functions as a sort of modern-day guild.[9] The Institut National ensures quality and restricts output in order to maintain the integrity of brands and protect producers' livelihoods.

Many other countries have similar entities, each with its own methods of authenticating culinary products by ensuring compliance with production standards. In Thailand, the government has recently taken such work to a new level with its introduction of a tasting robot designed for a single task: authenticating Thai dishes. A box the size of an old-style television set, the "e-delicious" machine scans samples of supposed "Thai food" and compares the chemical composition of the samples against the known chemical signatures of authentic dishes. The government entity that created the machine, the Thai Delicious Committee, is taking additional action to ensure the authenticity of Thai food, including offering a logo that restaurants can affix to their menus if they use government-sanctioned recipes.

Given that sales of food and beverages constitute between one-sixth and one-fifth of global economic exchange, these attempts to ensure the authenticity of culinary code are of inherent importance in understanding the code economy in past, present, and (likely) future forms. However, they also underscore the fundamental relationship between algorithms of production and protocols for authentication and verification, such as Blockchain.

The analogy between monetary and culinary protocols for authentication and verification is illustrated further by considering the personal history of one of history's greatest creators of new concoctions: Sir Isaac Newton.

What do I mean by this? Well, Isaac Newton is renowned for his invention of calculus (simultaneously with Gottfried Leibniz). And, as I noted in chapter 12, Newton served for more than two decades as the Master of the Royal Mint, during which time he oversaw the introduction of common currency for the new Kingdom of Great Britain. However, during the course of Newton's lifetime, he also wrote over a million words of notes on alchemy, of which he published none. These notes detailed his extensive and exhaustive attempts to find a recipe for gold, using base metals as inputs. Newton's mentors and peers who shared his passion for alchemy included the great natural scientist Robert Boyle (known to chemistry students everywhere via Boyle's Law) and philosopher John Locke, whose essays on cognition and political freedom inspired Jean-Jacques Rousseau and helped spark the American Revolution.[10]

Acting like human versions of Watson in their search for a recipe for gold, Newton, Boyle, Locke, and a vast pan-European guild of alchemists tried thousands of different combinations of ingredients, subjected to a panoply of preparations, all the while taking scrupulous notes on the conjectured composition of the base metals they used as ingredients and the results they observed. Lacking any real understanding of chemistry, they could only observe raw correlations and seek patterns that seemed to promise a solution in machine-learning fashion.

True, Newton and his contemporaries failed utterly in their quest to create gold. However, they did contribute significantly to what has turned out to be a far greater project: the discovery of the algorithms of structured inquiry into the nature of the world that they termed "natural philosophy," which we refer to today simply as "science."[11]

ON OCTOBER 31, 2008, Satoshi Nakamoto—who may or may not exist—posted a nine-page paper to the "metzdowd.com" cryptography mailing list, which was titled "Bitcoin: A Peer-to-Peer Electronic Cash System." The paper proposed "a system for electronic transactions without relying on trust." Its publication was timely. Six weeks earlier, Lehman Brothers Holdings, Inc., the fourth-largest U.S. investment bank, had sought Chapter 11 protection, thus initiating the single biggest bankruptcy proceeding in U.S. history. Trust in the financial system was as low as it had been for decades, as experts and members of the general public alike asked, "How can the global financial system be made more transparent and less subject to systemic distortions?" By offering an architecture for the issuance of currency and the documentation of transactions that is based on code rather than individual discretion, Bitcoin provided at least one possibility.

Is Bitcoin really money? The best approach to answering this question begins with insights from William Stanley Jevons, cofounder of the neoclassical school in economics and pioneering inventor in the field of artificial intelligence, to whom I referred in chapter six. Jevons set forth the basic parameters for contemporary understanding of money in a monograph published in 1875, titled *Money and the Mechanism of Exchange*.

"To decide upon the best material for money is thus a problem of great complexity," Jevons wrote, "because we must take into account at once the relative importance of the several functions of money, the degree in which money is employed for each function, and the importance of each of the physical qualities of the substance with respect to each function."[12] Jevons organized the desirable properties of a material functioning as money along seven dimensions: "(1) Utility and value;

(2) Portability; (3) Indestructibility; (4) Homogeneity; (5) Divisibility; (6) Stability of value; (7) Cognizability." To validate his framework, Jevons used it to explain the historical dominance of gold as a medium of exchange. Gold has intrinsic appeal, Jevons noted; it is permanently lustrous and possesses "a rich and brilliant yellow colour, which can only be adequately described as golden." It is easy to carry, it can be subdivided without difficulty, it is scarce and thus relatively stable in value, and, perhaps most importantly, it can be readily recognized due to its exceptional density. Jevons stated that, for these reasons, when it comes to money gold is, well, the gold standard.

Given the supremacy of gold as a medium of exchange, it was only natural that, when national governments began to issue paper currency in the nineteenth century, they sought to tie the value of their currency to gold. The emergence of a gold standard—first in the Commonwealth countries and then in the United States and other leading European nations—contributed to the dramatic growth in global trade that occurred toward the end of the nineteenth and the beginning of the twentieth century. The outbreak of World War I brought that first era of globalization to a sudden halt, and with it the beginning of the end of the gold standard. For the past 40 years the world's currencies have been untethered from gold or any other metal. National "fiat" currencies are nothing more or less than tradable trust, whose function as currency is based entirely on government-enforced scarcity and verifiability not tethered to its intrinsic usefulness.

Bitcoin—a digital currency created and exchanged on the Blockchain platform—satisfies all the criteria for being "money" that William Stanley Jevons set forth more than a century ago, with one exception: intrinsic utility and value. That does not mean that that Bitcoin will grow in significance as a means of exchange, much less achieve any position of dominance. But with digital transactions via mobile phones—Apple Pay and the like—becoming ever more common and the concept of a digital currency not backed by any government gaining rapid acceptance, the prospect of one or another digital currency competing successfully with fiat currencies is not nearly as far-fetched today as it was even three years ago.

Sixty-four days after publication of the Bitcoin protocol, the system was operational. The first solution to the progressively more difficult algorithm described in Nakamoto's paper was discovered, which is the same as saying that Bitcoin number 1 had been "mined." In the six years that followed the creation of Bitcoin, it traced out the full trajectory of the Gartner Hype Cycle: from early obscurity to "the peak of inflated expectations" as the price of Bitcoin surged in 2011 and again in 2013, and subsequently to "the trough of disillusionment" as adoption remained slow.

Through these stages, some bullish pundits proclaimed Bitcoin's ascendancy as a global currency imminent and the displacement of the world's central banks correspondingly inevitable. Others decried Bitcoin as being suited only to money laundering and the facilitation of illicit transactions and argued that it would never develop into a viable commercial platform. Yet while the volatile public discussion of Bitcoin has focused on the viability and desirability of a digital currency not backed by any government, a bigger story has been hidden in plain sight all along: the creation of "a system for electronic transactions without relying on trust" that the person (or persons) named Satoshi Nakamoto described in a technical note published one Halloween night more than seven years ago. That system is the Blockchain.

TO UNDERSTAND THE Blockchain, consider anew the image of Bob Cratchit laboring over his desk in *A Christmas Carol,* making calculations and entering them into a ledger. That ledger constituted the authoritative record of the business of Ebenezer Scrooge and Company. Each transaction fit into a horizontal block—a row in the ledger—and the entire ledger thus constituted a chain of such blocks, each one dependent on the accuracy of the one before. In other words, a ledger is a block chain.

The Blockchain that underlies Bitcoin is also a ledger. However, it is a ledger with two special properties. First, it is a "distributed" ledger. Rather than being validated by a lone "Bob Cratchit" working in obscurity—or, in more contemporary form, an army of auditors from PriceWaterhouseCoopers—the Blockchain is a ledger that is validated by thousands of strangers, all of whom perform their own calculations to ensure that a given block in the chain is accurate and authentic. What Wikipedia has accomplished for knowledge, Blockchain thus promises to accomplish for transactions: returning validation authority to users. And just as Wikipedia put an end to the dominance of *Encyclopaedia*

Brittanica, Blockchain has the potential to put an end to the dominance of central banks, university registrars, land title companies, and any other third-party validators of transactions, credentials, or claims.

The second special property of the Blockchain, which follows directly from the first, is that once a block in the Blockchain has been validated, it stays validated forever. In other words, unlike physical ledgers that can be doctored or altered, the Blockchain is immutable. How? Simply because—due to its digital rather than paper-based nature—the Blockchain exists in many places at once. Any attempt to tamper with one copy of the Blockchain would be invalidated by the abundance of copies that collectively affirmed the authoritative version. To attempt to tamper with blocks in the Blockchain is a task of comparable (or, for technical reasons, even greater) difficulty than trying to get the world to accept as legitimate a new version of *Hamlet* or a modified version of the Beatles song "Yesterday." So many authoritative copies exist that a fraud is easily unmasked.

Thus the Blockchain is not just any ledger. It is an example of a distributed, immutable ledger.

The very existence of the Blockchain brings to the foreground an essential dimension of code economics that I have only briefly alluded to: authenticity and verification. We judge the authenticity of a coin from the imprint it bears, from its weight, and (with some work) from its physical composition. We judge the authenticity of paper currency from the engraving it bears, including difficult-to-reproduce watermarks and microprinted characters. But how do we judge the authenticity of a digital payment—be it a digital dollar bill or a Bitcoin? Or, in a complex anonymized world, of a bottle of wine? A work of art? Even an experience?

The problem the Blockchain solves is as old as monetized exchange: how to verify that that a person, an object, or a claim is what it represents itself to be. Without such verification, it is impossible to establish rights over property and rules over contracts; without rights over property and rules over contracts, it is impossible to structure a market system of exchange.

Nearly all economic analysis takes the existence of rights over property and rules over contracts as a given and focuses on the nature and consequences of market exchange. The advent of the Blockchain (subsuming within it the applications of Blockchain code such as Bitcoin) surfaces the fact that markets depend on platforms for exchange, which in turn rely on protocols of authentication and verification.

It turns out that the immutability of the Blockchain makes it a powerful tool for authentication and verification—and, potentially, a next phase in the advance of code.

SO FAR, THE Blockchain applications that have drawn the greatest attention have been in financial services—taking a cue from, though going well beyond, the precedent set by Bitcoin. However, the applications of Blockchain that ultimately may have the greatest direct impact on the human experience are likely to be those related to the (self-)governance of peer-to-peer networks.

By their very structure, peer-to-peer platforms start out being distributed. The challenge is how to organize all of the energy contained in such networks so that people are rewarded fairly for their contributions. This is a problem that in the past has been solved either by impersonal markets (which do a bad job of keeping track of reputation) and centralized administrative authority (which does a bad job of rewarding contribution). Blockchain-based systems for governing peer-to-peer networks hold the promise—so far unrealized—of incorporating the best features of markets when it comes to rewarding contributions, and of organizations when it comes to keeping track of reputations.

If designed as Robin Chase, Lisa Gansky, John Clippinger, and others believe they can be, peer-to-peer systems have the potential to scale-out the value created on peer-to-peer platforms to reach the tens of thousands, even hundreds of thousands, of people who contribute to them. Moreover, they will create new and enticing invitations to latent producers within the economy to employ their individual assets and talents to create new economic value. Dynamically negotiated "smart contracts" on the Blockchain and other peer-to-peer innovations hold the promise of realizing Jevons' long-ago articulated vision of "a more useful and beneficial form of organization" based on profit-sharing, which I discussed in chapter 6.

The significance of peer-to-peer business models thus is not effectively measured by adding up the current share of GDP they represent in terms of monetized transactions. These innovations in work are rushing in at the fringes of the advanced economies to fill the void left behind as large corporations continue to "lean up"—that is, to shrink their payrolls by employing algorithms and machines to perform routine tasks previously performed by people. Steven Straus, former managing director of the Center for Economic Transformation at the New York City Economic Development Corporation, looks at the same phenomenon from the standpoint of job seekers: "We currently have about three job seekers for every available job and 11 million people looking for work—so the growth of the sharing economy isn't surprising."[13]

In the coming decades, the United States and other advanced industrialized economies will no sooner return to the routinized manufacturing-centric economy of the twentieth century than to the agrarian economy that preceded it. The issue is not whether new livelihoods based on peer-to-peer business models are better or worse than the Industrial Age jobs that are disappearing from large corporations, but whether, when jobs are eliminated in the process of digital disruption, they will be coming back in their old form—or not. As that happens, we humans have no choice but to fall back on our most fundamental social skills: creating and sharing with one another. There is, however, one big difference: unlike our isolated ancestors of millennia past, Americans and people everywhere in this century are empowered by architectures of collaboration that allow for the creation of new and diverse livelihoods at an unprecedented rate.

In her book *Peers Inc.,* Robin Chase draws from well-considered analysis, as well as her own personal experience as the cofounder of the car-sharing company Zipcar, to differentiate between the "Peers" and "Inc."—the crowd that creates value, and the platforms on which that value creation takes place. In a chapter fitingly titled "Who Has the Gold?" she makes the following observation: "Peers Inc. thrives when peers are motivated to contribute. Platforms that do not adequately reward peers, value their contribution, and invest in their potential, will fail in the long term."[14]

Therein lies the potential of today's peer-to-peer economy. However, the existence of peer-to-peer networks alone is not sufficient to ensure inclusion and equity. Because "he who enrolls, controls," another requirement for inclusion and equity may be that the networks are based on systems of trust and verification that are not wholly owned by disinterested third parties.

"MAN IS BORN FREE and everywhere he is in chains." This powerful opening sentence from Jean-Jacques Rousseau's *The Social Contract* encapsulates the fundamental paradox of the advance of code, and the progress of human society.

Echoing Rousseau, I noted at the outset of this book that the advance of code over the past four or five centuries has involved the collective willingness of human beings to cede to other people, and to code itself, authority and autonomy that we for millennia kept unto ourselves and our immediate tribal groups. This individual autonomy has allowed humanity's greatest inventions to emerge and propagate: cities, global trade, the rule of law, science, and democracy. That these greatest inventions are all social inventions is not surprising, for humans are deeply social beings. Progress in human society can be thought of as the evolution of chains, from those of subjugation and servitude to those of collaboration and interconnection. At every stage, the process has been enabled by the advance of code.

Earlier in the book I alluded to the significant advances in democracy, science, and financial systems that occurred simultaneously during the interval of history during which Rousseau, the Genevan watchmaker's son, wrote his great works of political and natural philosophy: the Age of Enlightenment. That systems of governance, inquiry, and economics should have advanced all at the same time—fueled by coffeehouse discussions in just a handful of cities—is no coincidence at all. Each of these foundational developments in human social evolution is, at its core, an algorithm for authentication and verification. The scientific method, democratic processes, and financial system protocols all serve to reduce the arbitrary power of single individuals—whether to rule, to establish facts, or to validate transactions—while simultaneously enhancing the collective capacity of groups. Each is an instance of an underlying phenomenon, which is the advance of code.

That political, scientific, and economic manifestations of the advance of code are fundamentally linked is reflected in the simple historical fact that many of the same people were responsible for parallel and linked advances in modern democratic forms of government, scientific methods, and the architecture of modern financial systems. As I mentioned, Newton, Leibniz, Locke, Boyle, Rousseau, and an array of colleagues whose names are now mostly lost to history, each contributed substantially to the conceptualization and in some cases the implementation of some of the institutional innovations that have shaped the modern world.

The patterns connecting systems of authentication and verification in politics, science, and economics continued into the nineteenth century, as embodied in figures as diverse as David Ricardo, Lord Byron, Charles Babbage, Ada Lovelace, Henry George, and William Jevons.

It is only because of the disciplinary fragmentation of inquiry that has occurred in the past century that we do not immediately perceive in the evolved historical record the patterns connecting systems of authentication and verification in politics, science, and economics as they have jointly evolved. Those patterns exist, but it takes some work to find them. Illuminating those patterns has been the point of this book.

The underlying unity of the advance of code along multiple frontiers is evident today in the work and writings of Jim Bessen, Robin Chase, John Clippinger, Vint Cerf, Lisa Gansky, Jaron Lanier, Tim O'Reilly, David Nordfors, and many others whose perspectives on the code economy I have shared in this book, or who have in other ways informed the patterns I have sought to illuminate. A significant number in this group considers self-governing protocols for authentication and verification to be an essential element of an inclusive and democratic digital future. The conviction these well-informed observers share regarding the importance of building self-governance into the architecture of the code economy is based in part on their concern about the potentially negative consequences of the concentration of data and the centralization of third-party powers of authentication and verification.

However, the development of new institutional mechanisms for ensuring authenticity does not preclude the use of old ones. If 40,000 years of the history of code is any indication, algorithmic improvements will shift the domains in which human judgment will be valuable but will not diminish its importance. What each of us believes to be authentic will determine what each of us believes to be valuable. These decentralized, individual determinations of value will shape the evolution of the economy and, to a significant extent, the development of human society.[15]