Programmed Materials: An Archeology of Machinic Responsibility

Scott W. Schwartz

Abstract

The twenty-first century is programmed. From machinists who automate lathes to grind out the cogs of industry to the fleet of Experience Designers (UX) employed by Google to optimize digital interactions, the emphasis is on reproducible and predictable outcomes—programmed output. The valuation of mechanized and machinic output has a history intricately bound with the economics and social relations of capitalizing Europe, specifically the insurance industry. This paper investigates the privileging of programmable output in machinery and now data over the preceding centuries in a society that pursues the perpetual growth of wealth. I argue that shifts towards automation and programmability mark a significant transition in the concept of responsibility, both individual and social. Outsourcing responsibility to machines has engendered a dehumanized responsibility necessary to normalize detrimental and unjust socio-environmental conditions. To these ends, I examine encoded materials—the Jacquard loom, IBM's early punch cards, and today's object-oriented programming languages—for insights into the mass-produced responsibility of the industrialized world. I further show how the technology of programming (from punch cards to silicon) is entangled with insurance's need to value the future, which also structures our world.

This is a mass-produced sentence. This is a mass-produced sentence. This is a mass-produced sentence. This is a mass-produced sentence. This is a mass-produced sentence. This is a mass-produced sentence. This is a mass-produced sentence. This is a mass-produced sentence. This is a mass-produced sentence.

The above paragraph was composed utilizing the Ctrl + C and Ctrl + V commands on my keyboard. The developers of Microsoft Word, working within the parameters of the standardized QWERTY keyboard, programmed these commands to perfectly replicate highlighted text. Any sentiments captured on the "clipboard" (such digitalized physical metaphors abound in human-computer interaction) of a computer's operating system can be repeated perpetually using this programmed convention. Such is my faith in the precise reproducibility of this programmed output, that I need not bother proofreading the opening paragraph after its first sentence.

This article discusses the idea that responsibility (such as the responsibility for ensuring there are no typos in the opening paragraph) is a programmable function. Such an idea, it will be argued, is a prerequisite for the dehumanized social relations of capitalizing populations. That is, in order to organize a society around perpetually growing inequality (and the attendant suffering this induces), it is necessary to outsource responsibility (for this suffering) to non-human materials. This argument is pursued by weaving together the histories of the textile and insurance industries, investigating the overlapping media employed to produce the respective commodities of these two industries. The word "weave" is not used here arbitrarily. Rather, the tactile materiality of the textile industry serves as the warp and the relative intangibility of the insurance industry is the weft entwining the structure of automated mass-production (figure 1).

Scott W. Schwartz, "Programmed Materials: An Archeology of Machinic Responsibility," *IA: The Journal of the Society for Industrial Archeology* 43, nos. 1 and 2 (2017): 47–57.

Dept. of Anthropology, CUNY Graduate Center, New York, NY, sschwartz@gradcenter.cuny.edu.

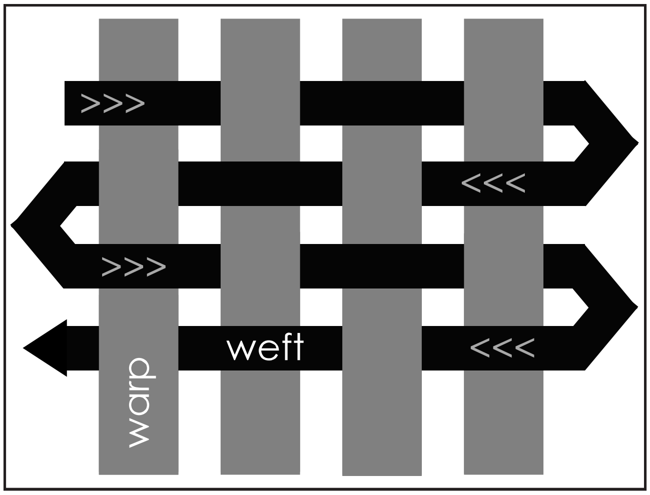

Figure 1. Illustration of warp and weft.

The artifacts of concern within are encoded materials: materials programmed to produce an expected output. Broadly, this could be understood as the concern of all archeology.[1] The Neolithic ceramic is an encoded material. It is imbued with significance and designed to be responded to in a certain manner. The industrial factory encodes materials at a larger and more replicable scale. While the prehistoric archeologist's interpretation of the ceramic's significance is often speculative, the meaning of the encoded materials excavated within is very much well-preserved. Indeed, this is precisely the characteristic of concern: materials designed to produce single unambiguous responses; materials designed to replicate the same outputs over and over and over; materials in which the coding is not subjective-social, but rather machinic-industrial. Individuals within a population (or archeologists studying that population retroactively) can disagree about what "justice" means or the significance of an artwork, but mass-produced machines do not disagree on what a line of code means.

The emergence of automated means of conveying signification has not been a linear progression of technological acumen over the preceding centuries. Rather, it evinces deeply embedded assumptions that justify and engender the growth of capital. Foremost among these assumptions is the privileging of predictability as the primary attribute of knowledge production. In unpacking this assertion, I will argue that machinic production was not adopted to improve efficiency, velocity, or even profitability (though it did do that), but rather to dissolve responsibility into the hypothetical subsequence epitomized by the ubiquitous computer programming phrase, "if . . . then."

This notion of a hypothetical subsequence (or futurity) is critical to theorizing industrial archeology. Industrial archeology studies capitalized production (the large-scale mobilization of machines and resources), and the concern of capital is to grow future wealth. As such, without the hypothetical construction of future profits, the resources needed for industrialization could not have coalesced. As will be shown below, insurance was and is indispensable in constructing the future in which wealth grows. To better articulate this notion of hypothetical subsequence, I supplement this argument with an experimental "excavation" of the Lloyds of London website from 1998 to 2016, assessing shifts in the coding that reflect larger social trends.

<P>erverse Engineering

The performance of capitalism relies on the construction of a world that permits the perpetually accelerating asymmetrical growth of wealth. If capitalizing populations did not believe they occupied a world in which wealth could grow forever, it is difficult to imagine why they would design their economy, politics, and social relations around this pursuit. This nature (ontology) of capital, I argue, is facilitated by an intellectual (epistemological) privileging of output over experience. (Here I am following the idea developed in Henare *et al.* that ontology is built out of epistemology).[2] That is, ways of knowing and ways of producing knowledge are the practices that build the operative reality (ways of being) a population inhabits, regardless of how closely that world accords with actual conditions.

Chandler has connected the privileging of projected outcomes with notions of responsibility, arguing that "the management of effects . . . evades the question of responsibility or accountability for problems or the need to intervene."[3] Agamben has described this concentration on effects as the purview of governance developed out of deregulated neoliberalism.[4] However, the origins of this central focus on outputs can in fact be traced much earlier than the onset of digitalized neoliberalism. For this article, I follow the emphasis on projected output over experience to the late-eighteenth-century textile industry.

To illustrate this shift from experience to output as the basis for operable reality, suppose you feel hot (this is an experience) then see a thermometer reading 50°F (this is the output of a mechanized device). Most populations familiar with the Fahrenheit scale and the expected briskness of 50°F would conclude that in reality it is not hot. Your experience of hotness is induced by delusion, illness, or non-normative nervous system. Your experience of hotness is unquantifiable, thus unpredictable, thus aberrant and incorrect. Fifty degrees is "reality"; being hot, "just" your perception.

This emphasis on dehumanized output is historically situated in specific events that occurred in Europe over the past several centuries. Many have identified shifts in approaches to knowledge production in Europe following the Middle Ages.[5] This scholarship describes with various nuances how the timeless ecclesiastical truths of a Church-based power structure were superseded by the quantified dynamic observations of enlightenment and industrial science.[6] This process has variously been identified as modernization, industrialization, globalization, colonization, or capitalization. This string of "-zations" are often lumped together as common manifestations of a European compulsion for spatial, political, and economic domination. All are inter-related, but the history of immediate concern is that of capitalization, as it is the mechanics and valuation of capital that underwrites the compulsion for perpetual growth.

The belief in the possibility or reality of perpetual growth was unfamiliar (or at least not dominant) within the earlier ecclesiastical ontology of Christian Europe.[7] The notion of perpetually growing wealth, population, or territory is incompatible with material experience, and for many populations would seem absurd or terrifying. If however, experience is delegitimized as an inaccurate representation of reality in favor of calculated effects, this incompatibility and absurdity withers away. The idea of perpetual growth became accepted and normalized through an increasing reliance upon quantification in the production of knowledge.[8]

While the scholars cited above have observed an increased emphasis upon quantification, less attention has been given to the temporal aspect of quantification and its implications for the notion of growth. Quantified knowledge can be processed through discrete or probabilistic reasoning, transforming reality into a trend, forecast, model, or hypothetical output which presupposes a subsequence. The experience of the present becomes a source of data within a trend. As Daston alludes, privileging quantified standardization in knowledge production is less about producing "better" knowledge than increasing predict-ability (the hyphen denotes that the concern is not the accuracy of the prediction, but the framing of the future as a probabilistic outcome).[9] This is not to say that command over subsequence was not valued before a capitalized epistemology (portents and divination have long been valued). However, probabilistic knowledge (formalized in the seventeenth century) is valued because it opens up a dynamic future; it makes the present incomplete. Quantified time is incompletable. Numbers never end.[10]

Insuring the Future

Prior to the Napoleonic Code of 1804, it was illegal for most people to charge, collect, or disburse interest within European Christendom. To charge more than the principal in the repayment of a loan was both a criminal offense and damnable sin.[11] However, this injunction was circumvented (notably by the Medici in the fifteenth century and the Fuggers in the sixteenth) by using the language of insurance. Using negotiable instruments such as bills of exchange, bankers were able to dissemble their use of the future as a source of wealth.[12] Rather than charging a fee for lending money in the present that was to be repaid in the future (the interest rate of a loan), which was illegal, they deployed a linguistic twist to insist that they were insuring that the value of money today would not be diminished at a future time. A traveling aristocrat may buy a bill of exchange to insure that over the course of two or three months travel their ten florins today would still carry the same purchasing power in the future.

In the eyes of the Church this transaction constituted a risk to the lender, thus eliding bans on usury. As the invention of monetizable risk allowed usury to be unleashed and capitalism to be legally practiced, the control of risk via predictive acumen became increasingly prioritized. The actuarial valuations employed by insurance houses drove an increased pursuit of probabilistic calculations. Porter argues that the tools of insurance can be directly "connected with the founding of mathematical probability in the seventeenth century."[13] Appadurai suggests, "insurance is the major site for the central technique of modern finance which is probabilistic calculation."[14] The value that interest and insurance attached to the subsequent conditions drove a metrological notion of risk derived from the mathematics of probability, which needed numbers (data) to be calculated. Ayache writes, "Money and finance are key in the definition of probability. If anything, money is the ground, not probability."[15] By this Ayache means that the formulation of probability is derived from monetary valuation. Predictive acumen and an appreciation for trends and trajectories did not develop as a result of mathematical or scientific advances. Rather, mathematical and scientific breakthroughs were the result of privileging predict-ability and the need to justify perpetual economic growth.

The introduction and acceptance of interest transformed the future into a commodity and made wealth kinetic—as I have argued elsewhere: "if wealth is not growing it is diminishing."[16] Growth demands a subsequent, a next, an around-the-bend. An ontology of timeless truth such as works for religion does not work for capital. Whether it is ceremonial destruction, gift exchange, or usury prohibitions, non-capitalizing populations develop taboos and restrictions against activating the gears of compound interest. Some populations destroy or redistribute their excess. Capitalized populations employ their excess to pursue perpetual, accelerating, asymmetrical growth.

The history of one of the most prominent names in insurance, Lloyds of London, maps well over the naturalization of exponential economic growth. Lloyds is not an insurance company proper, but rather an insurance market or clearinghouse backed by multiple financial syndicates and sanctioned by acts of Parliament (the Lloyds Act of 1871). The company dates to 1688 and was originally concerned with maritime shipping insurance, notably that of joint-stock outfits like the East India Company.[17] These shipping companies traded in a variety of commodities. As such their primary business was no business in particular, it was simply the growth of wealth through the movement of commodities around the world. Its business was to provide a vehicle for investment.

In lock-step with the expansion of investment and global trading companies, the insurance industry developed to commoditize vulnerability. Various potential dangers threatened returns on investment promised by successful trading missions, from pirates to inclement weather. Each of these potential threats could be quantified and packaged as risk—commoditized exposure to future harm. Thus, "being responsible" became conceived of as being prepared for *future* vulnerabilities, as opposed to being able to respond to present conditions. Being responsible became the output of an actuarial valuation. Today, it is popularly considered irresponsible not to have life or health insurance. That is, it is irresponsible not to pay an insurance company to insure one's capacity to grow wealth should an injury or death occur. This has not always been the case. Until the nineteenth century efforts to rebrand life insurance as protection for widows and children, buying insurance was seen as irresponsible and unchristian gambling.[18]

Carpets & Coding

In the eighteenth and nineteenth centuries, textiles served as the perfect commodities to produce through automated repetition. That is, they normalized machinic responsibility. Indeed, just as historians of technology (and labor) look to eighteenth-century textile manufacture as the key site of revolution in mechanical industry, computational historians pinpoint the Jacquard Loom as the key pivot in computational history.[19] Invented in 1804 and spread rapidly through France and Britain, Joseph Marie Jacquard's loom relied on binary punch cards that could be mechanically "read" in order to perform programmable functions. For Jacquard this function wove ornate textile patterns. Machines cannot be programmed in the language of human syntax (not yet anyway, and certainly not in the early 1800s). Jacquard's principle innovation, then, was the development of a language for machines—a bridge between the material and the discursive that found a way of communicating human sentiments to non-human materials. When combined with the automating power of steam engines, the Jacquard Loom was able to encode behaviors into the material world with a velocity and reproducibility never before seen.

Famously, Charles Babbage and Ada Lovelace conceived of something akin to modern computing in 1837 in a device Babbage dubbed the Analytical Engine.[20] This engine would carry out its functions based on the same programming as the Jacquard punch card system. Lovelace, perhaps more than Babbage, saw the long-term implications of the device. Noting the capacity of algorithms, she suggested the Analytical Engine could "do whatever we know how to order it [program it] to perform . . . It is likely to exert an indirect and reciprocal influence on science itself . . . In so distributing and combining the truths and the formula of analysis, they may become most easily and rapidly amenable to the mechanical combinations of the engine."[21]

While this role of technological innovations in the textile industry upon automation and computation has been widely noted, few have investigated why exactly it happened to be the textile industry.[22] Are there specific attributes and characteristics of textile production that make it more amenable to this sort of automated, machinic, mass-production? Why not an agricultural product? Why not metal, glass, ceramic products, clocks, or shoes?

As the epistemological preference for predict-ability germinated, patterns and pattern detection became highly useful epistemological tools, which could serve as the basis for projecting hypothetical futures. Patterns are, among other things, information that repeats. Textiles, such as blankets, carpets, dresses, or jackets were constructed out of patterns—repeated shapes, colors, and angles. There is, of course, repetition in the production of many other commodities, but textiles are most explicitly patterned materiality (cloth, wool, silk, etc.). A carpet or sheet is materialized repetition. A textile is a material conduit of pattern. The Jacquard punch cards were the discursive materiality employed to translate this pattern to non-sentient machines. The loom could read the coding in the cards and actionably respond to this code in order to imprint the pattern into a fabric. Jacquard's Loom made the responsibility for outcomes mechanical.

In the case of the loom and textile industry, two other infrastructural technologies were necessary to facilitate their commercial explosion—steam power and slavery. While many prolific manufacturers began adopting steam engines in the early 1800s, it was not because the steam engine provided a significant advantage in the generation of power or the velocity of output. Rather, as manufacturer John Makin of the Bolton company testified in 1834, "the real advantage of the power-loom was that it enabled a manufacturer to predict with greater confidence when an order could be completed, and that it gave him greater control over the materials of manufacture."[23] Malm adds that, as opposed to any benefits to quality, quantity, or efficiency, the two primary drivers of the adoption of fossil-fueled steam automation are predictability and control: "Weaving by power would still be more costly than weaving by hand, but the former had the winning benefit of securing a quantity of work under more immediate control and management."[24]

Industry's adoption of mechanized repetition has far more to do with generating confidence in the composition of the output than the quality or quantity of output. Ada Lovelace's father, Lord Byron, agreed. "The superfluous laborers were thrown out of employment. Yet it is to be observed that the work thus executed was inferior in quality; not marketable at home, and merely buried over with a view to exportation."[25] Like the Medici Bank, profits of the textile industry were a function of hypothetical subsequence.

Byron's testimony alludes to the globalized aspect of textile production. The finished products were sold to India, produced in English factories, using cotton grown in America by humans stolen from Africa. The capitalized planet was woven together by mass-produced fabrics under a common conception of deferred responsibility and hypothetical value. The automated output of textiles globalized the economy under a single ontology of value that became normalized in Europe after the unleashing of interest and insurance.

Are textiles morally objectionable products, given their reliance on slave labor and CO_2 emitting power? Are punch cards morally objectionable artifacts for facilitating textile production? Are they, by definition, irresponsible? Flusser argues: "Many industrial processes are carried out by automated machines, and it would be absurd to hold robots [automated machines] responsible for the use to which products are put . . . The lack of moral responsibility that follows logically from the production process must inevitably also come up with morally objectionable products."[26]

Flusser (along with many others, no doubt) finds it absurd to presume that composites of metal, steam, grease, and other non-sentient parts can bear responsibility for social matters such as poverty (though some have challenged this assumption).[27] By incorporating material mechanisms into the discursive universe, though, outsourcing responsibility to materials is precisely what programming does. Rather than a technological trajectory toward "artificial intelligence" (programming materials to reflect—and thus replace—human intelligence), the technological arc of the past 200 years has pursued an "artificial responsibility" (programming materials to reflect—and again replace—human responsibility).

As suggested above, capitalism is not compatible with human responsibility. No human or group of humans takes responsibility for the destructive environmental and social consequences of perpetual economic growth. Hopefully, no human would pursue the perpetual growth of wealth if forced to take responsibility for the exploitation of labor and extinction of ecosystems that facilitate such growth. Fortunately (from the perspective of wealth), responsibility has been programmed into machines, obviating the need for any human to carry such burdens.

Codes & Cards

Following their propagation in the textile industry, the next prominent use of binary punch cards was in tabulating the results of the 1890 U.S. Census.[28] By the end of the nineteenth century, computational tabulating machines (soon known as "calculators") became commercially available utilizing punch card technology. Much of the early use of punch cards was for simple counting or information storage. Eventually, IBM dominated the market for encodable cards and the machines that read them, but the core concept behind programming had not changed from the time of Jacquard.

One of the first commercial sectors to use punch card computation technology was the life insurance industry.[29] Life insurance companies utilized punch cards for storing the copious amounts of data that must be kept on individuals throughout their lives, pertaining to health, vocation, marital status, and family size. Actuaries within the insurance industry also used punch card technology as aids in crunching and calculating this data into normative statistical tendencies and probabilities regarding the performance of human bodies, then translating this output into a monetary value that could be attached to subsequent human bodies.

Here the auto-replication of the future underwritten by insurance begins to emerge. Insurance was used as the concept for legally practicing usury in fifteenth-century Europe. This inspired a valuation of knowledge production that privileged subsequence and output. This engendered a focus on quantification, pattern recognition, and replicability that led to the development of probability mathematics, which has come to fuel the profits of the insurance industry. A replicating technology was invented (the punch card) that produced more reliable output (than hand-weaving). This technology enabled textiles to be shipped around the world on vessels insured by the now legitimized commercial insurance sector. A century later, this replicating technology (encoded punch cards) was adopted by the insurance industry to carry out actuarial calculations to more precisely valuate the future. This punch card technology led to the development of computer programming, from which the greatest data collection experiment ever imagined has been built: the Internet. This massive accumulation of data has been able to model and pattern human behavior through user actions on programmed interfaces such as websites and mobile platforms. In this account of textiles, coding, and insurance, epistemology and ontology consume each other over and over again perpetually in order to open up the hypothetical space into which wealth must grow.

Excavating the Internet

To study changes in encoded experience and shed light on how we interact with programmed outputs today, I conducted an excavation of the Lloyds of London website. Lloyds has been the most durable name in insurance over the last 300 years, famously insuring Cindy Crawford's face and Tina Turner's legs. While there is perhaps nothing special about Lloyds of London's website (relative to that of any financial institution), the choice of www.lloyds.com stands as a poignant representation of the circuitous history outlined above.

For this study I have followed rather straightforward archeological methodology for recording and documenting artifacts and contexts in an effort to excavate the Lloyds' website. Utilizing the Wayback Machine section of the Internet Archive (www.archive.org/web; archives of Lloyds' site exist from 1998 to the present), I have been able to reconstruct a stratigraphic deposition of how the coding of this particular experience of insurance has changed over the short life of the company's Internet presence.

I "sieved" the html (hyper-text markup language) source code of the site for command artifacts using the filtered search operation activated by the Ctrl + F keyboard function in my word processor. I recorded thirteen distinct contexts, one for every major renovation of the site discernable since 1998. Each aesthetic change to the site is treated as a new depositional context (*e.g.*, a floor layer) in the vein of the Harris Matrix in archeology. I have treated each html command tag as an independent artifact class. That is, tags like <img>, <table>, <script>, or <div> are treated as artifacts. By tracing the relative occurrence and abundance of these commands over time, it is possible to analyze different ideas and priorities that have developed in the programming of experiences and outputs.

Clear trends emerge when the data are sorted (Table 1). Not surprisingly the sheer quantity of code has an upward trajectory (figure 2), but of more interest is the type of tags (artifacts) being used at different times (contexts). One could draw the analogy that the earlier iterations of the site were primarily mechanical. That is, they are mostly concerned with structure and positioning, putting the mechanical parts in the right place and order so that a fixed, finished product is presented to the consumer. This approach to the site's programming expands from 1998 until peaking in 2004 (context [009]). This emphasis is evident in the abundance of <table>, <tr>, and <td> commands, which control the positioning and alignment of the screen interaction. (Note a brief anomaly in context [012] (1999) in which the programming experimented with the short-lived aesthetic convention of frames.)

The earlier iterations of the site presented a finished product in which all possible experiences of the site had been pre-programmed, that is, they existed prior to the user's interaction with the product. The trend in the 2000s, as demonstrated by the changes in coding, reflects a movement toward a more dynamic user experience of the site, that is, a site in which more possible subsequence is programmed into the product. Having

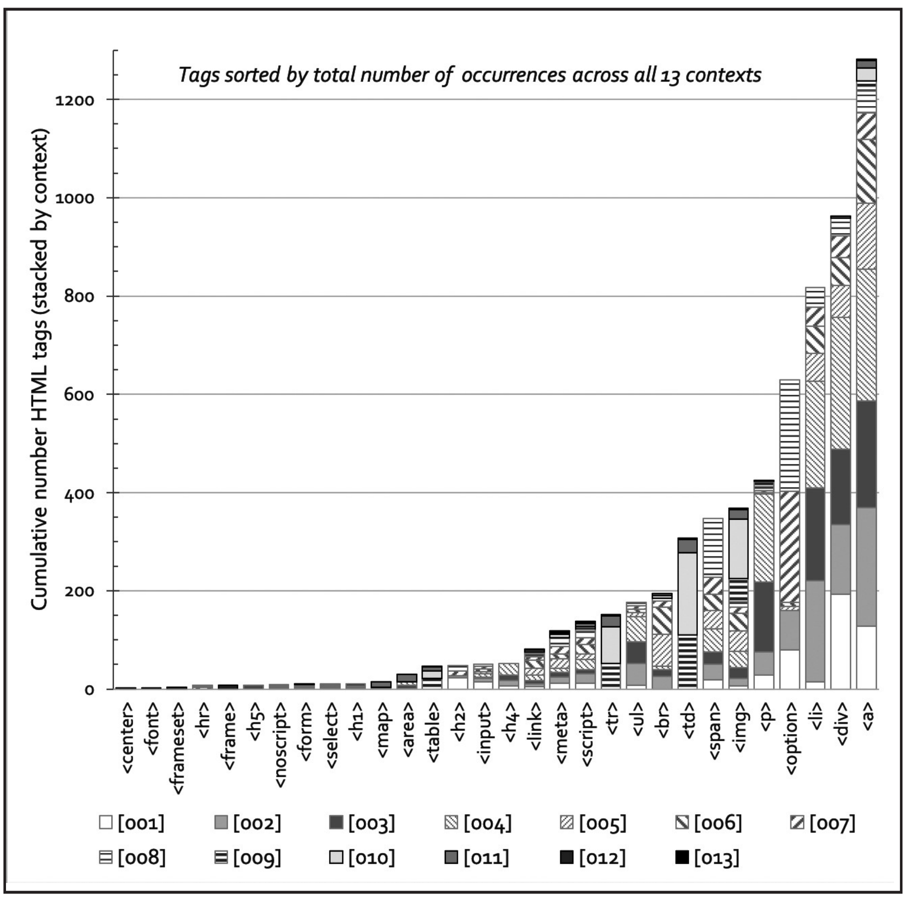

Figure 2. Growth of the html tags on Lloyds.com homepage over time.

Table 1.
Illustration of change in programming priorities for lloyds.com in the manner of a Harris Matrix.

Context no.	[013]	[012]	[011]	[010]	[009]	[008]	[007]	[006]	[005]	[004]	[003]	[002]	[001]
Page Date	Dec. 6, 1998	Feb. 20, 1999	Feb. 1, 2001	Apr. 2 2002	Feb. 12, 2004	Feb. 3, 2006	Feb. 2, 2007	Jan. 2, 2008	Apr. 21, 2010	Oct. 9, 2010	Nov. 1, 2012	Nov. 4, 2015	Jan. 25, 2017
<script>	0	0	5	2	2	12	12	16	10	18	7	17	12
<meta>	3	2	2	7	1	16	15	10	20	8	10	12	12
<link>	1	1	3	1	2	7	7	17	14	10	7	6	5
<center>	1	0	0	1	0	0	0	0	0	0	0	0	0
<table>	1	0	8	16	21	0	0	0	0	0	0	0	0
<tr>	2	0	22	75	52	0	0	0	0	0	0	0	0
<td>	3	0	28	167	110	0	0	0	0	0	0	0	0
<frameset>	0	4	0	0	0	0	0	0	0	0	0	0	0
<frame>	0	8	0	0	0	0	0	0	0	0	0	0	0
<p>	0	1	0	0	10	9	4	1	2	179	143	47	28
<map>	0	0	12	0	0	0	0	0	0	1	1	1	0
<area>	0	0	15	0	0	0	0	0	0	7	7	1	0
<img>	3	0	20	121	47	12	12	36	41	34	22	14	7
<font>	0	0	1	0	1	0	0	0	0	0	0	0	0
<a>	3	0	15	26	22	43	54	130	134	269	216	242	128
 	0	0	4	6	0	5	13	54	65	8	13	26	0
<div>	0	0	4	0	0	35	45	57	64	269	153	142	193
<form>	0	0	0	1	1	1	1	1	1	1	1	1	1
<hr>	0	0	0	0	1	3	3	0	0	0	0	0	0
<h2>	0	0	0	0	0	11	10	0	0	0	0	4	23
<h1>	0	0	0	0	4	1	1	1	1	1	1	1	0
	0	0	0	0	0	7	7	8	8	51	44	44	8
	0	0	0	0	0	41	39	54	57	217	189	207	14
<input>	0	0	0	0	0	5	5	5	5	6	4	7	14
<span>	0	0	0	0	0	120	34	33	38	46	26	31	19
<option>	0	0	0	0	0	226	227	8	8	0	0	80	80
<select>	0	0	0	0	0	2	2	1	1	0	0	2	2
<noscript>	0	0	0	0	0	1	1	1	1	1	1	1	2
<h4>	0	0	0	0	0	0	0	0	0	24	11	10	7
<h5>	0	0	0	0	0	0	0	0	0	0	8	0	0
Total	**17**	**16**	**139**	**423**	**274**	**557**	**492**	**433**	**470**	**1150**	**864**	**896**	**555**
Word count	141	183	800	2310	1032	2241	2327	2740	2386	4819	3655	4702	4451
Characters	1,596	2,022	9,928	29,846	11,858	51,829	50,762	49,308	48,830	94,432	71,473	87,218	79,551
Tag char.	0	0	536	2555	11	8241	8267	11333	4110	414	347	8385	9333
Script (%)	*0%*	*0%*	*5.4%*	*8.6%*	*0.09%*	*15.9%*	*16.3%*	*23.0%*	*8.4%*	*0.44%*	*0.49%*	*9.6%*	*11.7%*

a site with more possible outcomes allows the product to be more accommodating to potential eventualities.

To this end, within web development, the vocation of Experience Designer (UX) has emerged over the past decades.[30] The idea of a programmed or designed experience is rather oxymoronic. As will be expanded on below, experience is the anomaly, the malfunction. A programmed experience is no experience at all, but a mechanized output. That is, Experience Design is an effort to further corral experiences into the parameters of a projectable output.

The first evidence of this shift on the Lloyds' site appears in 2006 (context [008]) with the explosion of <option> commands. This command produces the now-familiar drop down menu with an array of options (in this case the options are countries, from Afghanistan to Zimbabwe). This trend dissipates in context [006] (2008) in favor of an increasing occurrence of programming within <script> commands and an increase in anchor, <a>, commands which are used to link within one page and to other pages (this latter trend may also be a result of Google's search algorithms favoring certain link configurations).

If we drill below the gross number and typology of command artifacts into the ratio of code that falls within the <script> commands, there is a clear trend toward opening up more possible trajectories for the use of the llyods.com site—more outcomes have been programmed. Programming within <script> tags is more conditional, allowing the ultimate expression of the hypothetical "if. . . then" statements. While the ratio of <script> language tails off nearer the present, this is because the html files I am excavating begin to reference totally separate script files that are vastly more encoded than the html file that comprises lloyds.com. For example, the ".js" (JavaScript) file (taken from [002]) contains 323,932 characters (compared to the 87,218 characters that comprise the html file), and there are multiple such referenced JavaScript files within this context. The site employs probably nearer to one million characters of coding (closely approximating the character count of *Moby Dick*) to make it more pliable to contingent hypothetical experiences.

The Lloyds' site is not unique in the shifting basis of its coding strategy and largely reflects broader trends in aesthetic programming preferences. This trajectory in coding can be interpreted as a shift toward an increased reflexivity of programming to absorb diverse experiences, that is, to more seamlessly compress the difference between an experience and an output. The surge in <script> tags and the use of object-oriented programming languages like Java, Python, or Ruby indicates an increased perception of algorithmic output as operative reality. Parisi notes that "algorithmic sequences tend to become bigger in volume than programmed instruction and to take over."[31]

The Internet is often preceived of as a technological innovation, but it may just be a medium for programming and for generating novel algorithmic outputs. Similarly, Jeffery et al. explain that it is not metabolism that serves as the basis of life, but rather life that serves as a vessel for continued entropy-inducing metabolism.[32] That is, perhaps it is not computer programming that serves to enable the Internet, but rather the Internet that serves the manifestation and spread of a language capable of imbuing materials with responsibility.

Early optimistic visions of the Internet as a liberating space free from hierarchical domination of governments or corporate media have clearly not panned out. This raises the prospect that perhaps the content is rather meaningless. Data accumulation platforms care little about what is posted or "Liked" as long as this information can be counted, parsed, packaged, and sold. Like early modern commercial shipping, the significance is not in the content nor the commodity, but in the production of a hypothetical subsequence into which wealth can grow. It does not matter what is on the Internet; it is the further reduction of experience to encoded output that drives the medium.

Archaeological Considerations

While some have questioned the relevance of contemporary archeology (ever since Rathje's excavations into household waste), this line of research has much to add to the appreciation of social organization.[33] Precisely that which is taken-for-granted is most dangerous in perpetuating social injustice, and the present is frequently taken-for-granted.[34] The point of investigating such a seemingly mundane subject as distribution of html code is to illustrate how deeply embedded are certain modes of thought which structure a society that is based on capital. By reframing the quotidian, the atrocities of the status quo become visible. At present, a billion people on this planet are malnourished.[35] That is, the contemporary manner of social organization accepts this mass impoverishment as part of its normal functioning—not an injustice to be remedied. The status quo of capitalized social organization fails to perceive systematic starvation as a failing. Studying contemporary materials via the methodology of archeology makes the contemporary world weird, denormalizes it, allows it to be reassessed, and perhaps changed. As Lucas writes: "Explorations of the role of material culture in the development of capitalism and global expansion—the very processes connected to the rise of modernity—have formed a core part of some of the most exciting archeology being done in the United States."[36]

While the foregoing could be considered an archeology of the Internet, my goal is more precisely to conduct an archeology of responsibility (specifically, capitalized or automated responsibility). Certainly, an archeology of the Internet has merits and such efforts have been enlightening, but this excavation of code ultimately pursues different aims.[37] By examining changes in the html programming of a single website, I hope to illustrate how capitalized societies interact with and perceive programmed materials not as mere tools for furthering social reproduction or attaining ends, but rather as sources of authoritative knowledge, determinative prerogatives, arbiters of reality, and ultimately decision-makers. In short, programmed materials are viewed as responsible in a manner that fallible human subjectivity is increasingly not.

Undertaking an excavation of html code aims to examine and challenge a perceived schism between the material and the discursive, as it is along this historically situated fault line that responsibility teeters. Within the epistemology of capital, discursive notions of suffering or justice are less reliable evidence than materials like coal and electrons, resulting in an increasing deferral of responsibility from humans to materials. Computer programming simultaneously exposes and normalizes this schism. Code appears as semiotic instructions to be read (or performed) by machines, yet must also operate on a material strata, be it punch cards or silicon. In the vein of Barad, my aim is to flatten the sense of ontological "beforeness" of materiality that Lucas discusses and argue that the material and discursive are engaged in a mutually co-constitutive respiratory relationship.[38]

Anomalous Experience

"Algorithmic automation involves the breaking down of continuous processes into discrete components, whose functions can be constantly reiterated without error."[39] However, this algorithmic encoding must be housed on some material, and any material is subject to senescence. No matter how strong the composite materials, after enough use both material artifacts and discursive artifacts will begin to wear and tear. Machines operating on the same encoded program may replicate outputs more consistently and precisely than fallible humans, but they are not immune to the contingencies of duration. Of course, the particular wood and metal parts used from one Jacquard Loom to the next will have different affordances and histories, thus wearing down at different rates.

Here we see the *responses* available to the materials which have been imbued with responsibility by capitalizing populations that practice captialism. Encoded materials are not limited to the programming which animates them. Mass-produced machines can interpret code deviantly. While the mechanical meaning inaugurated by Jacquard punch cards is designed to create a signal that has only one possible interpretation, even mechanized meaning is contextual. The punch card program that outputs a nineteenth-century tapestry still needs the context of an automated loom. If some part of the loom is not performing perfectly (either from wear or poor construction), it will offer a different interpretation of its program, such as a dropped loop of thread in the pattern. Such incidents are seen as aberrations or anomalies. That is, they are seen as not real representations of the code, but rather as "glitches" and not merely (or positively) as alternate interpretations of the code. Something is usually done to "fix" aberrant machines—either reprogramming the software or servicing the hardware. Such anomalous machinic behavior constitutes an experience, in that it short-circuits the expected output (regardless of whether the machine intends this malfunction). When malfunctioning, machines are performing unprogrammed experiences. The ellipsis that connects "if" to "then" is hijacked by contingency. This is what is meant by machines taking responsibility. When the material components of a machine resist their role in the perpetual growth of the economy they are demonstrating responsibility for the present by forsaking the hypothetical programmed world they are supposed to be manifesting. Malfunctions are real.

The fidelity of computer commands such as Copy + Paste is greater than Henry Ford could ever have dreamt for his assembly lines. This could be attributed to the distinct types of automation involved—mechanical versus computational. Both practices entail encoding materials to maximize the predictability of output. However, computational programming can produce outputs in excess of the capacity of reality to contain them. That is, there are millions of outputs that computational programming does not produce, but could. Computational programming is designed to accommodate outputs in surplus of conceivable reality. For example, no computer programmer coded my computer with the ability to replicate the sentence: "This is a mass-produced sentence" as opened this essay. . . Or the word: "deconostratigalitosismexocation." Yet: deconostratigalitosismexocation.

The difference between mechanized and computational automation is well-articulated by Negarestani's formulation of a Turingian revolution (after computer scientist Alan Turing). As opposed to Copernican, Darwinian, Newtonian, and Einsteinian revolutions, "The Turingian revolution suggests that the future will not be a varied extension of the present condition. It will not be continuous with the present. Whatever arrives from the future. . . will be discontinuous to our historical anticipations."[40] This perpetual novelty makes the future always predict-able, but never predictable—the precise conditions under which capital has thrived since the unleashing of interest, indeed the very conditions by which interest became legalized. The future needs to be simultaneously predict-able and unpredictable. Change and novelty must constantly occur. Expectations can never be met or satisfied, but the possibility or probability of meeting and satisfying them must be constantly calculable. While there are many socio-historical factors involved, the "Great Acceleration" in the production of just about every measurable quantity (except biodiversity) from 1945 to today has been at least partly enabled by this conceptual opening of the present to a spectrum of trajectories not beholden to material finitude.[41]

Coda

I would argue that rather than dissolving responsibility, materializing it in the machine forces us to question why and to what ends capital abdicates responsibility to non-sentient composites. If the complete biography of a nineteenth-century textile requires the labor of ten slaves in Georgia and the displacement of three silk weavers in China, who or what is responsible for this? One of the reasons that capitalism produces so much suffering is that it allows for the inequitable distribution of resources without the attribution of responsibility. Under capitalized conceptions of reality, no one is responsible for the present. Responsibility only exists as the output of a function, in the realm of subsequence (epitomized by the insurance premium). Unfortunately, suffering occurs in the present, not in the abstract hypothetical future.

Hans Vaihinger neatly outlined the projective epistemology of capital in his philosophy of "as if. . ." in which he describes "how knowledge is produced based on hypothetical outputs."[42] Using Adam Smith's *Wealth of Nations,* Vaihinger postulates that "Smith didn't regard himself as dealing with more than a fiction. Smith intended his assumption merely provisional . . . These assumptions don't correspond to reality and deliberately substitute a fraction of reality for the complete range of causes and facts."[43] Perhaps Vaihinger's thermodynamic philosophy of "as if . . . " is in need of rebooting as an algorithmic philosophy of "if . . . then." A lot happens in the ellipsis of programming's if . . . then statements. This dot, dot, dot is the experience of the present that is subordinated to the "then" of capital's subsequent profit aggregation. Encoded materials are responsible for delivering us into the "then," but who (or what) is responsible for life in the voided ellipsis?

Notes

1. Gavin Lucas, "Modern Disturbances: On the Ambiguities of Archaeology," *Modernism/Modernity* 11, no. 1 (2004): 109–120.
2, Amiria J.M. Henare, Martin Holbraad, and Sari Wastell, *Thinking Through Things* (London: UCL, 2005).
3. David Chandler, "Digital Governance in the Anthropocene: The Rise of the Correlational Machine," in *Digital Objects, Digital Subjects,* ed. David Chandler and Christopher Fuchs (London: Univ. of Westminster Press, 2019), 23–42.
4. Giorgio Agamben, "What is a Destituent Power?" *Environment and Planning D: Society and Space* 32, no. 1 (2014): 65–74.
5. Fernand Braudel, Civilization and Capitalism, 15th-18th Century (New York: Harper & Row Publishers, 1982); Alfred W. Crosby, *The Measure of Reality: Quantification and Western Society,* 1250–1600 (Cambridge: Cambridge Univ. Press, 1997); Eric Hobsbawm, *The Age of Revolution,* 1789–1848 (Cleveland: World Pub. Co. 1962); Matthew Johnson, *An Archaeology of Capitalism* (Oxford: Blackwell Publishers, 1996).
6. The popular religion-science dichotomy has been thoroughly rewired by Peter Harrison, *The Territories of Science and Religion* (Chicago: Univ. of Chicago Press, 2015).

7. Jacques Le Goff, *Time, Work & Culture in the Middle Ages* (Chicago: Univ. Of Chicago Press, 1980); Kathryn Tanner, *Christianity and the New Spirit of Capitalism* (New Haven: Yale Univ. Press, 2019).
8. Mary Poovey, *A History of the Modern Fact: Problems of Knowledge in the Sciences of Wealth and Society* (Chicago: Univ. of Chicago Press, 1998).
9. Lorraine Daston, *Classical Probability in the Enlightenment* (Princeton: Princeton Univ. Press, 1988).
10. Nick Land, "Mechanomics," *Pli - Warwick Journal of Philosophy* 7 (1998): 55–66.
11. Raymond de Roover, "The Scholastics, Usury, and Foreign Exchange," *The Business History Review* 41, no. 3 (1967): 257–271; Marjorie Grice-Hutchinson, *The School of Salamanca: Readings in Spanish Monetary Theory,* 1544–1605 (Auburn: Ludwig von Mises Institute, 2009); Adrian Walsh and Tony Lynch, *The Morality of Money: An Exploration in Analytic Philosophy* (New York: Palgrave Macmillan, 2008).
12. Raymond de Roover, *The Rise and Decline of the Medici Bank, 1397–1494* (Cambridge, MA: Harvard Univ. Press, 1963).
13. Theodore Porter, "Life Insurance, Medical Testing, and the Management of Mortality," in *Biographies of Scientific Objects,* ed. Lorraine Daston (Chicago: Univ. of Chicago Press, 2000), 227.
14. Arjun Appadurai, *Banking on Words: The Failure of Language in the Age of Derivative Finance* (Chicago: Univ. of Chicago Press, 2017), 62.
15. Elie Ayache, "Time and Black-Scholes-Merton," *Wilmott* 88 (2017): 33.
16. Scott W. Schwartz, "Temperature and Capital: Measuring the Future with Quantified Heat," *Environment and Society* 8, no. 1 (2017): 186.
17. Christopher Evans, "'Power on Silt': Towards an Archaeology of the East India Company," *Antiquity* 64, no. 244 (1990): 643–661.
18. Timothy Alborn, *Regulated Lives: Life Insurance and British Society, 1800–1914* (Toronto: Univ. of Toronto Press, 2009).
19. David Mather, "Extended Memory: Early Calculating Engines and Historical Computer Simulations," *Leonardo* 39, no. 3 (2006): 236–243; Sadie Plant, *Zeros and Ones: Digital Women and the New Technoculture* (London: Fourth Estate, 1998).
20. James Essinger, *Ada's Algorithm: How Lord Byron's Daughter Ada Lovelace Launched the Digital Age* (Brooklyn: Melville House, 2014).
21. Luigi Menabrea, "The Analytical Engine Invented by Charles Babbage," trans. Ada Augusta Lovelace, *Bibliothèque Universelle de Genève* 82 (1842), repr. Scientific Memoirs, ed. Richard Taylor (London: Richard and John E. Taylor), 3: 666–731.
22. J. David Bolter, *Turing's Man: Western Culture in the Computer Age* (Durham: Univ. of North Carolina Press, 1984); Nathan Ensmenger, *The Computer Boys Take Over: Computers, Programmers, and the Politics of Technical Expertise* (Cambridge, MA: MIT Press, 2010); Nick Montfort, Patsy Baudoin, John Bell, Ian Bogost, Jeremy Douglass, Mark Marino, Michael Mateas, Casey Reas, Mark Sample, and Noah Vawter, *10 PRINT CHR$(205.5+RND(1)); : GOTO 10* (Cambridge, MA: MIT Press, 2013).
23. Duncan Bythell, *The Handloom Weavers: A Study in the English Cotton Industry During the Industrial Revolution* (London: Cambridge Univ. Press, 1969), 72.
24. Andreas Malm, *Fossil Capital: The Rise of Steam-Power and the Roots of Global Warming* (Brooklyn: Verso, 2016), 73.
25. Lord Byron, *The Works of Lord Byron: Including the Suppressed Poems* (Philadelphia: J.B. Lippincott & Co., 1855), 554.
26. Vilém Flusser, *The Shape of Things: A Philosophy of Design* (London: Reaktion, 1999), 67.
27. Pierre Lemonnier, *Technological Choices: Transformation in Material Cultures Since the Neolithic* (London and New York: Routledge, 1993); Langdon Winner, *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: Univ. of Chicago Press, 1989).
28. Herman Goldstine, "A Brief History of the Computer," *Proceedings of the American Philosophical Society* 121, no. 5 (1977): 339–345.
29. N.E. Coe, K.J. Hedley, and L. Longley-Cook, "Punched-Card Equipment," *Journal of the Institute of Actuaries* 74, no. 2 (1948): 246–287.
30. Elizabeth B.-N. Sanders, "A New Design Space," *Proceedings of ICSID 2001 Seoul: Exploring Emerging Design Paradigm* (October 2001): 317–324.
31. Luciana Parisi, "Instrumental Reason, Algorithmic Capitalism, and the Incomputable," in *Alleys of your mind: Augmented intelligence and its traumas,* ed. Matteo Pasquinelli (Lüneburg: Meson Press, 2015): 133.
32. Kate Jeffery, Robert Pollack, and Carlo Rovelli, "On the Statistical Mechanics of Life: Schrödinger Revisited," 2019, https://arxiv.org/abs/1908.08374v1.
33. William Rathje, "The Garbàge Decade," *American Behavioral Scientist* 28, no. 1 (1984): 9–29.
34. Hannah Arendt, *The Origins of Totalitarianism* (Cleveland: World Publishing Co., 1963); Nancy Scheper-Hughes, *Death Without Weeping: The Violence of Everyday Life in Brazil* (Berkeley: Univ. of California Press, 1993).
35. Liam Downey, *Inequality, Democracy, and the Environment* (New York: NYU Press, 2015); Lynne Phillips, "Food and Globalization," *Annual Review of Anthropology* 35 (2006): 37–57.
36. Lucas, "Modern Disturbances," 114 (see n. 1).
37. Rodney Harrison, "Excavating Second Life: Cyber-Archaeologies, Heritage and Virtual Communities," *Journal of Material Culture* 14, no. 1 (2009): 75–106; Jussi Parikka, *What is Media Archaeology?* (Cambridge: Polity Press, 2012).
38. Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham: Duke Univ. Press, 2007).
39. Parisi, "Instrumental Reason," 130 (see n. 31).
40. Reza Negarestani, "Revolution Backwards: Functional Realization and Computational Implementation," in *Alleys of Your Mind: Augmented Intelligence and its Traumas,* ed. Matteo Pasquinelli (Lüneburg: Meson Press, 2015), 149.
41. John R. McNeill, *The Great Acceleration: An Environmental History of the Anthropocene since 1945* (Cambridge, MA: Harvard Univ. Press, 2014).
42. Schwartz, "Temperature and Capital," 188 (see n. 16).
43. Hans Vaihinger, *The Philosophy of "As If": A System of the Theoretical, Practical and Religious Fictions of Mankind* (New York: Harcourt Brace & Co., 1924), 20.