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Openings and Retrospectives



ALGORITHMS AND AUTOMATION: An Introduction

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Our world is densely populated by ubiquitous processors, capacious storage, and vigilant sensors. Networks of such machines are constantly measuring, packaging, storing, circulating, and operating on the world. They are busy assembling and being assembled, sharing information, and distributing their processing loads as they make decisions and enact plans. At the same time, they are refusing connections, maintaining their immune systems, performing network security, managing their boundaries, and controlling access. Human bodies move among this flexible, securitized meshwork of silicon, electricity, code, fiber optics, and data: building, maintaining, and restructuring. Their activity ensures that aesthetic, epistemological, economic, and political structures are thoroughly woven into these computational networks, tightly coupling the technical to the social as they experiment with new forms of work and life. Yet many of those who are building these systems do not seem particularly concerned with ensuring that our computational futures remain within the control, or even comprehension, of fleshy and cultural human beings. On the contrary: as they craft and maintain the

datascape, the technicians of global information capitalism are busily and happily laying the groundwork for the outsourcing of many social, cultural, and economic processes to computing machines.

I first met these technicians during my fieldwork in the Moscow data science community. The computer scientists, mathematicians, and electrical engineers with whom I spoke almost universally considered themselves minor players in the global knowledge economy, more interested in exploring what they called “scientific questions” about the nature of algorithms and their implementation than in building the bedrock for a qualitatively new form of the information economy (Lowrie 2017). If you take them at their word, their infrastructural work on the datascape was almost a by-product of their intellectual projects, simply an opportunity to find new data to explore and problem domains on which to unleash their algorithms. If you look at what they are actually building, however, you see the emergence of a profound new form of automation: one that not only does not merely rely on the *extension* of human capabilities and rationality in the form of assembly lines or Jacquard looms but that also actively works to *replicate* those capabilities and that rationality in extended sociotechnical systems. Not all automation is algorithmic, but all algorithms automate, and the extension of algorithmic automation from purely mathematical and computational terrains to extended sociotechnical infrastructures has produced profound, ongoing, and open-ended transformations in the organization and function of contemporary social worlds.

Humans have been automating their world for a long time. The first feedback-regulated device that replaced human labor was probably a water clock invented by Ctesibius circa 250 BCE, which obviated the need for manual replenishment of the outflowing water chamber, automatically keeping the ultimate inflow to the measuring chamber at a constant rate (Nocks 2008). The invention of the thermostat by Cornelius Drebbel in the seventeenth century is a better-known landmark, which was soon succeeded by an eighteenth-century explosion in the automation of mills, looms, and other industrial devices. These machines used analog programming in the form of gears, flywheels, linkages, cams, and followers to replace the human labor and cognition required in the performance of specific, regular, predictable tasks. Many modern instances of automation, especially of industrial functions, grow directly out of this mechanical lineage. Yet the quintessentially contemporary form of automation relies, instead, on the

computational command, control, and communication of information in what I call *algorithmic assemblages*.¹

Technical definitions of algorithms abound, although scholarly consensus remains elusive (see the debates in [Moschovakis 2001](#) and [Gurevich 2011](#)). The various synthetic definitions given by data and computer scientists themselves, however, might be boiled down to something like “a set of formal procedures for operating on a specific set of data in a finite amount of time to produce a specific range of outputs.” Algorithms are mathematical and computable procedures for doing things like routing traffic, diagnosing cancerous tumors from MRI images, or matching people on dating sites. These sets of procedures, though, cannot do a great deal on their own. As Grigori, a Muscovite data scientist, put it to me: “A recipe—even a really good one—isn’t a bakery.” An algorithm on its own is a flimsy thing: a few concepts, a heuristic approach, elaborated in some scant lines of code. Without being integrated into a broader sociotechnical system, an algorithm remains motionless, inert ([Gillespie 2014](#)). To make an algorithm work, you rather obviously need processing power, a storage-and-retrieval medium, and data; less obviously, you need to ensure that this computational architecture remains thoroughly integrated with *social* processes, with what my colleagues in Moscow frequently called “the world of applied tasks.” As Grigori explained it: “Without customers, a bakery will not [stay open]. Analogously, you need to find things for your algorithm to *do*! Problems to solve, data to digest.”

The efficacy of an algorithmic assemblage consists not only in its ability to process and identify patterns in vast amounts of data but also in its ability to manipulate adjacent computational routines, material infrastructures, and human beings. Depending on its domain of application, assembling a functioning algorithm requires the integration not only of hardware and digital flows but also of the organizational structures, analog infrastructure, and socioeconomic processes from which it draws its problems and on which it operates.² The algorithms at the core of an application such as Lyft or Uber, for example, analyze customer, driver, and mapping data, as well as producing and monitoring actual changes in extended flows of automobiles, human bodies, and money. The logistical algorithms at the core of an Amazon shipping center not only make predictions based on the analysis of past transactions, shipping events, and worker performance but also use those predictions to actively manage product inventories, control the position and performance of human workers, govern the flow of packages through the physical space of the warehouse, and interact with external organizations such as FedEx or the postal service.

Algorithmic automation represents a genuinely novel break with previous forms of automation primarily because of its ability to bring together and operate on a huge range of digital and analog processes at once. As [Hamid Ekbia and Bonnie Nardi \(2018\)](#) suggest in their contribution to this collection, in an algorithmic assemblage, the distinction between formal-mathematical procedures and the actual manipulation of objects in the world breaks down. It does not seem entirely hyperbolic to say that what we are encountering here is a collapse of the barrier between computational *res cogitans* and social-infrastructureal *res extensa*.³ The power unleashed by this collapse—the ability to directly supervise, intervene into, and operate extended material systems by mathematical fiat—is the basis for a truly epochal metastasis of algorithmic control.

Whereas earlier forms of analog engineering mostly automated repetitive, low-creativity human labor, the speed and sophistication of algorithmic information processing has enabled the automation of ever more “human” domains of activity. (Of course, our inclination to treat repetitive, low-creativity work as somehow less human than creative work is not a neutral claim, but rather a culturally specific response to our having automated such work to begin with.) The financial system is probably the most thoroughly computationally automated terrain in contemporary society ([MacKenzie 2006](#)), a field in which algorithms are more or less free to intervene into the cacophonous maelstrom of accelerating vector and quantity typical of late capitalism, often without a human on the loop. The political system is also being colonized by algorithms, with many quotidian functions of governance in metropolitan centers becoming mechanized ([Agar 2003](#)), although the actual electoral organs of the political system have remained relatively resistant to automation. Security functions such as policing ([Joh 2016](#)), targeted killing ([Franz 2017](#)), and war fighting ([Suchman and Weber 2016](#)) have been becoming automated since the Second World War (see [De Landa 1991](#)). Algorithms are also taking responsibility for other putatively cultural social functions, with the curation of taste ([Seaver, forthcoming](#)), the production of news media ([Carlson 2015](#)), medical diagnosis ([Soni et al. 2011](#)), scientific discovery ([Leonelli 2016](#)), and pedagogical supervision ([Williamson 2015](#)) also all undergoing various forms of automation. Certainly, many of these systems keep humans in the loop, leading [Ekbia and Nardi \(2017\)](#) to argue elsewhere that the current trend ought to be labeled *heteromation*, rather than automation proper (cf. [La-Flamme 2018](#)). Others, however, have argued that work and circulation generally are on their inevitable way to becoming automatic social functions ([Srnicek and Williams 2015](#); [Stiegler 2016](#)): science-fiction shades of Marx.

In the face of all of this posthuman automation, the viral expansion of algorithmic control and the concomitant conrescence of computational and human agency, it has proven difficult for anthropology to find its theoretical footing and ethnographic scope. Despite our long history of engaging humans as tool users and more recent enthusiasms for new forms of materialism that push social analysis into posthuman and multispecies terrains, there seems to be something profoundly heterodox—a whiff of the heretical—about an anthropology that would approach automatic processes on their own terms (but see [Fisch 2013](#)). As much as any specific empirical challenges to conducting an ethnography of automatic systems, ongoing research programs appear haunted by an unspecified and unacknowledged malaise, an epistemologically unjustifiable but deeply felt hunger for humanity.

One response has been simply to continue to do what we ethnographers have, historically, done best: follow the people, focusing on the new forms of labor emerging adjacent to algorithmic assemblages. Some scholars working in this vein have suggested that these new forms of automation will not or cannot *replace* human labor, but can merely *displace* it ([Irani 2015](#)). Certainly, building and maintaining most types of algorithmic assemblages still requires human labor—for now. This suggestion is, in part, empirically justified, as automation seems to have an ambiguous, or even positive, overall effect on employment (e.g., [Deloitte 2015](#)). Yet I see no theoretical reason for us to assume that this will continue to be the case, especially as algorithmic processes assume more and more responsibility for their own development, evolution, and maintenance, while drone control becomes more thoroughly integrated with logistics and management software. Optimism about the future necessity of human labor should not blind us to the emergent potentials for a drastic reconfiguration of the role such labor plays in the socioeconomy. The insistence that algorithmic assemblages *cannot* replace the human seems to me to speak more to contemporary disciplinary and political anxieties than to any objective analysis of those assemblages' capabilities and limitations.

Further, even if there is something structural about algorithmic automation that requires the production of new, adjacent spaces for necessarily human labor, studying that labor does not obviate the need to understand automation on its own terms. Although perhaps less avidly than practitioners in the other social sciences, communications, and information science, ethnographers have been turning their attention to the construction and operation of algorithmic assemblages as extended sociotechnical systems (e.g., [Gates 2011](#); [Schüll 2012](#)). Unfortunately, however, rather than delivering a detailed ethnographic examination

of how algorithmic systems are built and function, our primary disciplinary focus has been on the *effect* of algorithmic automation on existing social structures. While this certainly constitutes crucial work, our stubbornly all-too-human discipline has frequently used this research as the basis for what is probably an overly hasty critique of algorithms both per se and as agents of automation.

Algorithmic processes, according to the dominant storylines across the human sciences, replicate and can in fact exacerbate existing forms of inequality, while removing putatively humane human judgment from the decision loop on critical social functions. Though most of these criticisms focus on specific algorithmic implementations, there is a pervasive sense in the literature that the problem lies with automation itself, that algorithmic processes somehow necessarily and generally fail to capture the nuance and specificity of human and social processes. The preferred solution, more often gestural and inchoate than concrete and programmatic, is the *contextualization* of algorithmic knowledge and the *re-introduction* of humans to the development, implementation, and maintenance of algorithmic assemblages. I do not consider this a particularly felicitous way forward for anthropological knowledge in the age of algorithmic automation.

Quite the contrary: I think that we should be suspicious of the deeply ingrained, professional-intellectual satisfaction that comes from a thorough contextualization of an algorithm qua technical object. Certainly, understanding the social forces shaping the construction and deployment of an algorithmic assemblage, or charting how they integrate with broader social structures and processes, constitutes a crucial step in the analysis of algorithmic automation. But as [Nick Seaver \(2013, 10\)](#) argues elsewhere, allowing this to remain the *horizon* of that analysis tends to leave “algorithms themselves untouched, objective stones tossed about in a roily social stream.” I am similarly skeptical of calls to “humanize” contemporary automation processes by providing nonengineer stakeholders or kibitzing anthropologists a seat at the table of algorithm development. As [Dawn Nafus \(2018\)](#) convincingly argues in her essay, this may actually give away the farm, insofar as it forecloses arguments about the propriety of the algorithmic colonization of infrastructural and intellectual ground that perhaps might be better occupied by more human forms of analysis and control. More broadly, it seems to me simply unlikely that any Luddite insistence on humanizing algorithmic systems, especially by a community as peripheral as ours, will have any profound effects on the automation processes unleashed by algorithmic innovations and ubiquitous computing. Still more vexingly, such refusals to engage seriously with emergent technologies may have the unfortunate side effect of assuring engineers

and policymakers that ethnographic critique has little to offer them besides nostalgia and wishful thinking.

So what is to be done? Certainly, neither I nor the other contributors to this collection would be happy with an anthropology of algorithms that writes humans out of social analysis altogether. This would be, at best, premature: as the contributions collected here amply demonstrate, algorithmic assemblages remain thoroughly integrated with and reliant on myriad forms of human labor for their function, despite my insistence on the genuine novelty and power of algorithmic automation. To borrow a term from [Nafus's \(2018\)](#) essay, an exclusive focus on algorithmic assemblages as technical objects would leave a great deal of social science “undone.” Rather, it seems to me that the best way forward is to carefully and thoughtfully separate our roles as ethnographers of algorithmic assemblages and as anthropologists of the contemporary.

What does it mean to approach an instance of algorithmic automation ethnographically? To sum up [Seaver's \(2018\)](#) recommendations: we must begin with a realistic assessment of an algorithmic assemblage's capabilities, functions, limitations, goals, drives, resources, and meanings, charting its internal distribution of agency and affects across humans and machines, placing it within extended social terrains and networks of relationships with both humans and other assemblages. That is to say, in the same way that we begin to understand any of the *other* things that we study, be they moieties or swidden plots or migration patterns or persons or masks or cattle or automobiles or jaguars. Certainly, the *anthropological* opening that this introduction proposes has focused on contemporary forms of automation and computation in a structural and theoretical mode, treating algorithmic assemblages as an emerging type. The work of *ethnography*, however, must proceed in an altogether more nominal fashion, confirming or disconfirming these claims in particular situations of assembly and feeding empirical material back into theoretical conversations. Anthropological theories must, ultimately, be *synthetic* if they are to be either anthropological or theoretical.

I think, though, that our theories in this domain ought to be centered on algorithmic assemblages themselves, rather than on their contingent uses within specific social situations. Certainly, we should criticize those deployments of algorithmic control that produce and circulate bad affects, diminish human capabilities, damage the biotic world, and exacerbate (or create new) inequalities. However, I think that the existing theoretical preoccupations with such negative tendencies tells us more about our collective political imaginary than about the objective affordances and constraints of algorithmic assemblages. It seems to me

underwritten by an ultimately sterile form of technological determinism, reflecting an unfortunately prevalent inability to think expansively and imaginatively about the utopian lines of flight contained in our admittedly brutal present. Karl Marx, after all, was no critic of automation. Instead, our task should be to rigorously develop an architectural understanding of the conceptual, technological, and social problem spaces opened and explored by algorithmic innovation.

Algorithmic automation is a potent form of social engineering, capable of vastly expanding and accelerating our capabilities for interpretation, organization, and production. Like other world-historical innovations such as the division of labor, the electrical grid, double-entry bookkeeping, the assembly line, or flexible employment, it has the potential to dramatically restructure the field of human experience. Algorithmic assembly also brings to bear a potent form of domination and hierarchy, eroding as it does the barriers between computational *res cogitans* and concrete *res extensa* to orchestrate new forms of life and circulation, making bodies and numbers and commodities and knowledge dance to the austere tunes of algorithmic rationality. Precisely because of the vast forces unleashed by these new forms of action and control, however, it seems to me that our first task as anthropologists should be a modest witnessing, the production of a careful and resolutely untimely chronicle of our emerging contemporary (Rabinow 2011). Genuinely understanding how algorithms become assembled within social processes and the effect that they have—or could have—on social worlds should be our priority. The picture of the future may be an algorithmic boot stamping on a human face, forever—but this remains to be seen. There is no *technological* reason why the future could not, instead, be one where algorithmic automation radically liberates humans from the drudgery of work and the all-too-human domination that has heretofore structured industrialized life (Srnicek and Williams 2015).

Given that our present has seen its share of human boots stamping on human faces, however, and that humans remain the architects, builders, and maintainers of most algorithmic assemblages, it is easy to understand why ethnographically informed futurological speculation in this domain has proven almost uniformly pessimistic. Ethnography is obliged to cleave closely to the particulars under observation, and the sociological particulars have not been particularly inspiring, especially given the imbrication of algorithmic automation with platform capitalism (Srnicek 2017) and the precaritization of labor (Noble 2011; Srnicek and

Williams 2015). In its concrete engagements with worlds of human practice, ethnographic knowledge and critique should continue to militate against the damage caused by specific implementations of algorithmic automation, examine its place within global political economy, and strive to encourage the collaborative relationships with engineers, designers, and computer scientists that are necessary to build more humane assemblages of computational and social processes.

Ethnography is not coextensive with anthropology, however. While we disagree on the relative value of ethnography for anthropology, I am in absolute accord with Tim Ingold (2017, 24) in his insistence on the separation of the two forms or moments of thought and on his understanding of anthropological reason as a “fundamentally speculative” partner to the radically empirical—and indeed, nominalist—work of ethnography (see also Bialecki 2013). Ethnography is concerned with how things are, in specific places, for specific folks. Anthropology has the mandate to think expansively, imaginatively, and otherwise: it is the exploration of “the conditions and possibilities of human life in this world” (Ingold 2017, 24). In condemning the deleterious effects of specific algorithmic assemblages, we should not abandon automation conceptually or practically to the forces of hierarchy, domination, and inequality. The anthropology of algorithmic automation can be both militant and optimistic, dedicated to cultivating allies and building better worlds in the datascape—but only if it works, first, to understand how those worlds function.

NOTES

1. Mike Ananny (2016, 7) also uses the term *algorithmic assemblage*, but he restricts what is assembled to the relatively limited set of “institutionally situated computational code, human practices, and normative logics.”
2. Of course, some algorithms are directly focused on managing other computational flows, such as those that manage processing tasks or information retrieval and storage within a specific computational architecture. The idea that these are solipsistically digital functions, however, is a mistake: even these autonomic computing functions require the ability for information processing to feed back into the material world, manipulating actual storage and processing substrates.
3. René Descartes (1988) thought of the world as made up of *res extensa*, the extended corporeal substance occupying material space, and *res cogitans*, the immaterial mental substance that is the nonextended stuff of pure thought; these were joined together by the third substance, God. Here, these terms are used with some playfulness.

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