Politicizing Algorithms by Other Means: Toward Inquiries for Affective Dissensions

Florian Jaton
STS Lab, Institute of Social Sciences, University of Lausanne (Switzerland)

Dominique Vinck
STS Lab, Institute of Social Sciences, University of Lausanne (Switzerland)

In this paper, we build upon Bruno Latour's political writings to address the current impasse regarding algorithms in public life. We assert that the increasing difficulties at governing algorithms—be they qualified as "machine learning," "big data," or "artificial intelligence"—can be related to their current ontological thinness: deriving from constricted views on theoretical practices, algorithms' standard definition as problem-solving computerized methods provides poor grips for affective dissensions. We then emphasize on the role historical and ethnographic studies of algorithms can potentially play in the politicization of algorithms. By both digging into the genealogy of algorithms' constricted definition and by making their contemporary constitutive relationships more visible, both historical and ethnographic studies can contribute to vascularizing algorithms and making them objects of enlarged disputes. We conclude by giving a flavor of the political potential of the vascularization efforts we call for, using materials from an ethnographic study conducted in a computer science laboratory.

A single aircraft does not fly, it is Air France that makes it fly, or, more precisely, Air France plus all the elements just listed (Callon 2000, p. 193. Our translation)

Algorithms have developed into somewhat of a modern myth (Ziewitz 2016)

Perspectives on Science 2023, vol. 31, no. 1
 https://doi.org/10.1162/posc_a_00582

1. Introduction

In an emphatic editorial essay for a special issue of the journal *Science, Technology, & Human Values*, Malte Ziewitz described the politicization of algorithms as trapped in a drama (Ziewitz 2016). This drama starts by introducing algorithms—loosely defined as computerized methods for solving problems—as entities producing important differences in the collective world.[1] This power attributed to algorithms raises, in turn, political desires for regulation that yet come up against the second act of the drama: algorithms are inscrutable, even, sometimes, to those who make them.[2] This constitutive opacity makes, in turn, the first act of the drama start over: Since they are not graspable, algorithms are even more powerful.[3] Hence reinforced desires for regulation that yet come up against the second act of the drama, which makes the first act start again, and so on, and so forth. The overall picture is one of a loop: algorithms are powerful (and we should do something about it), yet they are inscrutable, so they are powerful (and we should do something about it), yet they are inscrutable…

Though quite old, at least according to computer science's standards,[4] Ziewitz's proposition still holds on. Better still, with the latest advances in machine "deep" learning, we assume his remarks are more relevant than ever. Algorithms' increasing power[5] raises increasing desires for regulations[6] which are yet increasingly struggling against increasing opacity,[7] which makes algorithms increasingly powerful, and so on, and so forth.

1. See, for example, Hoffman and Novak (1998), Lawrence and Giles (1999), Introna and Nissenbaum (2000), Gandy (2002), Zureik and Hindle (2004), Introna and Wood (2002), Kraemer et al. (2010), Gillepsie (2013), Bucher (2012), Bozdag (2013), or Steiner (2012). We will come back to some of these papers in the following sections.

2. See, for example, Hill (2016) that emphasizes on the mathematical opacity of algorithms, Lessig (2000) that emphasizes on the complexity of their code, or Mittelstadt et al. (2016) that considers both mathematical and code-related complexities in the same ethical movement.

3. This is an argument formulated, in particular, by Pasquale (2016): the black-box aspect of algorithms makes them all the more powerful.

4. Ziewitz's 2016 paper, and the special issue of *Science, Technology, & Human Values* it introduces, derive from a conference on algorithmic governance held in 2013, an eternity when compared to computer science research's temporality rhythmed by conference papers published at a steady pace.

5. See, for example, Euchner (2019) and Stark and Hoffman (2019).

6. Notably the *Algorithmic Accountability Act*, a bill introduced in April 2019 to the US Congress, and the *Ethics guidelines for trustworthy AI*, a report published by an expert group mandated by the European Commission in April 2019. We will come back to these documents in the next sections.

7. See the recent *New York Times*'s article by Metz (2019) on which we will further comment.

The current discussions regarding the role of algorithms—be they qualified as "big data," "machine learning," or "artificial intelligence"—in public life are trapped in a thicker loop. The algorithmic drama is more dramatic than ever.

The problem seems inextricable: How to escape from this loop and effectively do something about the actual power of algorithms, these elusive entities that yet take active part to our courses of action? Building upon the political writings of Bruno Latour (himself building upon works of John Dewey, Carl Schmitt, Jürgen Habermas, and Michel Foucault, among others), we assume, first, that the current situation deserves to be further theorized. It is only by clarifying terms such as "politics," "political," and "politicization" that innovative propositions regarding the role of algorithms in public life may slowly start to be glimpsed. Second, taking stock of the (theorized) situation, we assume that historians and ethnographers of science and technology have a role to play in the politicization of algorithms. By providing new means for affective dissensions, historians and ethnographers of computer science and technology may contribute to vascularizing algorithms and make them objects of enlarged disputes.

The paper is organized as follows. We first summarize Latour's argument (Latour 2007, 2008) about the five meanings of the term "political"—consider five *moments* in the trajectory of an issue, here denoted political [1], [2], [3], [4], and [5]—as well as Eve Seguin's contribution to this argument for the case of science and technology (Seguin 2015; Seguin and Lord 2023). The aim of this first section is to make the following, trivial, point: New entities (political[1]) derive, sometimes, from naturalized habits (political[5]). These types of new entities—like the exoplanets analyzed by Seguin, or, as we will see, algorithms considered computerized problem-solving methods—are therefore more political than one might think at first. Building upon Latour and Seguin's combined argument, we then come back to algorithms and consider their standard, naturalized conception as problem-solving methods (political[5]), their recent multiplication within the collective world (political[1]), their analyses in terms of effects that have made them increasingly controversial (political[2]) as well as recent attempts to insert them in conventional governmental procedures (political[4]). The purpose of this section is to highlight the absence of a confrontational moment (political[3]) capable of drawing lines between allies and adversaries regarding the role of algorithms in the collective world. We then attribute the absence of such an adversarial moment to the algorithmic entities (political[1]) deriving from naturalized habits (political[5]): Whereas the multiplication of algorithms did somewhat succeed in constituting concerned publics (political[2]), the current ontological thinness of algorithms as derived from their institutional framing prevents us from drawing lines of confrontation (political[3]). We finally highlight the role of genealogical inquiries into algorithm-related naturalized habits—what we shall call "political activism[5]"—and of ethnographic inquiries into algorithms' empirical constitution—what we shall call "political activism[1]"—to get around this politicization impasse. The article concludes by giving a flavor of the politicization of algorithms by other means we call for using materials from an ethnographic study conducted in a computer science laboratory.

2. Turning Around Politics of Science and Technology (Augmented)

Among analysts, it is now trite to say that science and technology (S&T)—including computer-related ones—are impregnated with politics. What historians have documented over the past several decades (e.g., Shapin and Schaffer 1985; Hughes 1993) has only been confirmed, particularly with the issue of climate change and its challenges: Countless sociotechnical controversies involving power relations and conflicts over the validity of empirical evidence or theory, the relevance of instruments or standards, research agendas, and funding instruments undoubtedly attest to the presence of politics within S&T.

Yet, in recent writings,[8] Latour argues that this politicization of science suffers from a paradox that threatens to make the adjective "political" meaningless. On the one hand, the politics of S&T is not sufficiently circumscribed and does not address the non-political part of S&T. Sociotechnical controversies do involve many conflicts but, alone, they do not make S&T a site of politics as practitioners have established norms that often allow them to agree, at least temporarily. This disregard for the sometimes non-political moments of S&T may have, in turn, helped to support cynical discourses on S&T, recently popularized by the term "post-truth" (Kofman 2018). On the other hand, the acknowledged politics of S&T is not extended enough as it still struggles to address head on the political components of the new means by which S&T contribute to modifying the collective. As Latour argued: "science and technology are political yes, but by other means. The machinery of what is officially political is only the tip of the iceberg when compared to the many other activities generated by many more 'activists' than those who claim to do politics per se" (Latour 2007, p. 813). This difficulty in addressing the political part of an equation, a computer program, a new standard, or a digital

8. See especially Latour (2003, 2004, 2007, 2008). Early signs of his political arguments can also be found in *Laboratory Life* (with Woolgar [1979]1986), *The Pasteurization of France* (1984) and *Science in Action* (1987).

platform can, in turn, contribute to supporting scientific positivism—too happy to ignore the responsibilities inherent in S&T.

In order, then, to both extend and delimit—and thus redistribute—the politics of S&T, Latour builds upon contemporary interpretations of Dewey by Marres (2005a, b) which makes politics turn around issues according to the now famous slogan "no issue, no politics!" The overall maneuver—some of whose blind spots have recently been completed by Seguin (Seguin 2015; Seguin and Lord 2023)—is thus a fundamental change in the way politics should be considered: "The key move is to make all definitions of politics turn around the issues instead of having the issues enter into a ready-made political sphere to be dealt with" (Latour 2007, p. 815). In that sense, the five meanings Latour gives to the term "political"—which we will now briefly present—are to be considered attributes of concerns rather than substances existing all by themselves.[9] In order to become and develop, these political attributes also depend on particular activities we here call "activisms."

2.1. Political[1]: Which Disrupts the Collective

S&T can be said to be political since researchers, engineers and companies, among others, introduce new beings (e.g., scientific facts, technical artefacts, respected experts) into society, thus modifying its composition, relationships, and mindset. The concern is here cosmopolitical (Stengers 2005): New entities—also called actants (Latour 2005)—are forged that may disrupt common life. A canonical example is Pasteur's microbes that ended up supporting France's sovereignty, colonization, and wine exportation (Latour 1984).

Though sciences (including human and social ones) and technologies are particularly good at modifying the cosmos, disruptions may also come from outside of them. Laws, rules, institutions or artistic productions also participate in changing dynamics, desires, and expectations. Science-fiction series "Star Trek" inspired, for example, the Trekker community whose members campaigned for space exploration within the NASA and guided important S&T developments (Seguin and Lord 2023). However, all in all, it seems fair to say that S&T, by their ability to make new things visible, provide reproductible know-how and methods to both produce and master huge varieties of nonhumans, are inclined to produce, sometimes, drastic cosmopolitical disruptions.

9. However, as Seguin noted (2015), this Latourian redefinition of the political shares surprising characteristics with Lasswell's seven stages of polity processes, also inspired by American pragmatism (Lasswell 1971).

2.2. Political[2]: Which Poses the Problem of the Public

The irruption of new actants among the collective world sometimes leads to perplexity and discontent. And when worries, disagreements, or resistances spread out and accumulate, disruptive entities may become the focus of issues that are political[2] in the more classical sense of a controversy to be closed. Politics thus does not only concern the disruption of the collective world but also—at some different point—the emergence of new affected collectivities (e.g., new concerned citizens, orphans of an eliminated technology, emerging networks of users and activists).

It is important to precise, however, that the public on such issues is not already constituted. As John Dewey, responding to Walter Lippmann, showed a long time ago (1954), using a somewhat different terminology, a public may start to emerge when existing knowledge, institutions, and representation have previously failed to stand new political[1] agencies. In that sense, the activity of framing an issue as well as its public (often by means of S&T investigations and experimentations) is here the core of political[2] activism, a demanding, affective, and often unsuccessful endeavor since the vast majority of disruptive new political[1] entities—including those emanating from S&T—do not lead to political[2] issues.

2.3. Political[3]: Which Poses the Question of Sovereignty

The advent of new political[1] entities and the often tedious emergence of political[2] issues and their corresponding publics sometimes challenge collectivities to the point of becoming an existential threat. This may, in turn, raise the question of sovereignty, in the sense of power prevailing on others: Who should, and how, define rights and duties and distinguish between friends and enemies (Schmitt 1996, 2006), or, at least, between allies and adversaries (Mouffe 1999)? In these agonistic political[3] moment of great uncertainty, the prevailing issue is the renegotiation of autonomy and independence.

Through their ability to redefine power relations, for example by facilitating actions at a distance, S&T were, and still are, at the core of political [3] sovereignty issues. If we think for example of nuclear weapons or, currently, of course, climate change and the Covid crisis, the share of responsibility of S&T in collective survival issues is extremely important. The corresponding political[3] activism is all the more delicate as it is about mobilizing, convincing, deciding and enforcing, while at the same time never being able to completely mobilize, convince, decide, and enforce (Latour 2003). Importantly, it should also be noted that this transformation of political[2] public issues into political[3] conflicts to be pacified is extremely rare and requires important material and conceptual bases on which to build (more on this in the section 3).

2.4. Political[4]: Which Poses the Question of Procedures

When the public of a new issue is identified and when sovereignty's prerogatives are clarified, deliberative democracy may take over and manage the issue. In other words, building upon procedures considered legitimate, acknowledged ways to process problems (the ability and legitimacy to speak and to discuss together, the ability to search, to asses, to calculate and to compromise), as well as the prior acceptance by the minority of the overall respect of the final decision (in sum, everything that is missing in the previous political stages), assemblies of clerks and administrators can conduct public affairs to manage now-clearly-defined problems (Latour 2007, p. 817). Rather than pragmatists authors such as Dewey and Lippmann or agonistic authors such as Schmitt and Mouffe, communicative ethics writers such as Jurgen Habermass (1991, 1998) and Karl-Otto Apel (1984) were certainly the best at pinpointing the subtleties of these political[4] processes.

Here, at this stage of the politicization process, problems are considered manageable by conventional, though potentially innovative, rules, procedures, and administrators based on legitimate forms of representation of the various concerned audiences, interests and expertise, including lay knowledge. Political[4] moments are still uncertain but the uncertainty is now mainly about the final, often judicial, decisions. The underestimated, yet crucial, corresponding political[4] activism can be linked to all the professions and practices involved in smoothing out administrative procedures capable of black-boxing previously contested issues. This set of activities is nowadays more and more called "governance."

2.5. Political[5]: Which Raises the Question of Institutions

When problems are embedded in daily routine expertise and administration as well as they often seem to have nothing to do with politics. Yet, as famously shown by Foucault, it may be in such dormant inconspicuous states that forms of power are exercised in the most efficient way. And it is through thorough historical investigations on the genesis, crystallization, and sedimentation of these naturalized habits that mundane political[5] forms of power can eventually be unveiled. The administrative and cognitive devices (including those emanating from S&T) that operate as socio-material grounds for contemporary systems of action and thought were often, at some point, disruptions, issues, existential threats, or thoughtful debates. It is only through their progressive institutionalization that these devices ended up, sometimes, being part of normality.

Moreover, beyond their origins, established institutions are also political [5] through their implications; they constitute infrastructural supports, habits of thought and action that also contribute to orienting the formation of new entities. As Seguin (2015, pp. 295–302) has importantly shown for the case of interstellar proximization subtending the discovery/shaping of exoplanets, the novelty of the political[1] disruptions mentioned above must be put into perspective: It is not uncommon for what Foucault called the governmentality of power-knowledge (Foucault 1994, p. 642) to subtend the constitution of new entities, issues, publics, threats, and laws. Hence the importance of remaining attentive to underground devices and dispositions by engaging in political[5] activism through, for example, infrastructural inversions (Bowker 1994; Bowker and Star 2000) and genealogical studies (Foucault 1977). In order to consider this fifth meaning of the political not only as an outcome but also as a potential starting point of politicization processes, we have positioned it at the very top of summary table 1.

Before moving on to the next section and coming back to algorithms, it is important to note that Latour's redefinition of politization processes, augmented by Seguin's, is not intended to be understood in a linear way. As he noted:

> "The same case, the same cause, the same "issue" can go through all the different meanings. Its movement will not necessarily be linear, but it can skip steps, go up or down in the table, stay still in one or the other of the cells before becoming frantically agitated. If we consider appropriate to take as a typical example of a political[5] subject the shape of the seawalls chosen by the engineers of the Ponts et Chaussées, we will not be surprised to see, after the passage of Hurricane Katrina, that the question of technical choices for the seawalls that must protect New Orleans has suddenly become political[2] and even, because of President Bush's catastrophic management, political[3]: Since he was unable to ensure the protection of his fellow citizens, suddenly there is the obscure question of dikes attached to the great question of sovereignty" (Latour 2008, p. 669; our translation).

3. A Deleterious Shortcut: From Public Issues Straight to Deliberation

Let us now come back to algorithms. How can the above elements of Latourian political theory be linked to the current situation of looping algorithmic drama outlined in the introduction? May Latour's political propositions, augmented by Seguin's, help to address the current impasse with regards to the role of algorithms in public life? Let us begin with naturalized habits (political[5]) which, as we have seen, underlie sometimes the appearance of new entities (political[1]). How are algorithms historically defined? What is their own governmentality?

Table 1. Summary of Latour's five meanings of the political, augmented by Seguin (2015)

	Meanings of the term "political" / Moments in the trajectory of an issue	Loci classici	Potential activisms
Political[5]	Cognitive substratum; institutionalized standards; naturalized habits and conceptions; governmentality; embedded procedures and devices	Foucault (1972, 1977, 1994) Bowker (1994) Bowker and Star (2000)	Genealogical inquiries; infrastructural inversions
Political[1]	Definition, design, and introduction of "new" entities, associations and networks modifying the collective	Latour (1979, 1983, 1984, 1987) Shapin & Schaffer (1985) Hughes (1993)	Technoscientific practices; human and social scientific descriptions; in-depth journalistic investigations
Political[2]	Emergence of issues, controversies, and debates; constitution of new concerned publics	Dewey (1954) Lippmann (1993) Marres (2005a, b)	Promotion of, and participation in, social protests; writing of pamphlets
Political[3]	Demarcation between allies and adversaries; confrontations; re-enactments of sovereignty	Schmitt (1996, 2006) Mouffe (1992, 1999) Latour (2003)	Confrontation of values and perspectives; agonistic pluralism
Political[4]	Procedures; deliberations; communication; regulations; judicialization	Habermas (1991, 1998) Apel (1984)	Ethical communication; governance

In the absence of many sociohistorical works on the subject—a situation it may be wise to change, for reasons that will be developed later in the text—it is nevertheless possible to consult the numerous manuals dealing explicitly with algorithms. Distinguished computer scientists have indeed dedicated their lives to the study of algorithms, gradually forming a specific and highly esteemed subfield called "algorithmic study" whose framing of algorithms now constitutes, we believe, their standard, conventional definition (whose historical formation remains unclear, though).[10]

When browsing through the numerous computer science manuals on algorithmic study, one notices algorithms are defined in quite a homogeneous way. Authors typically start with a short history of the term[11] before quickly shifting to its general contemporary acceptation as a systematic method composed of different steps.[12] Authors then specify that the rules of algorithms' steps should be univocal enough to be implemented in computing devices, thus differentiating algorithms from other a priori systematic methods such as cooking recipes or installation guides. In the same movement, it is also specified that these step-by-step computer-implementable methods always refer to a problem they are designed to solve.[13] This second definitional element assigns algorithms a function: allowing computers to provide answers that are correct relative to specific problems at hand.

Right after these opening statements, computer science manuals typically organize these functional step-by-step computer-implementable problem-solving methods around "inputs" and "outputs." The functional activity of algorithms is thus further specified: The way algorithms may provide right answers to defined problems is by transforming inputs into outputs. This third definitional movement leads to the standard well-accepted conception

10. The next three paragraphs derive from Jaton (2021a, pp. 48–50).

11. This is, for example, the case in (Knuth 1997) where the author starts by recalling that "algorithm" is a late transformation of the term "algorism," that itself derives from the name of famous Persian mathematician Abū ʻAbd Allāh Muhammad ibn Mūsa al-Khwārizmi, literally "Father of Abdullah, Mohammed, son of Moses, native of Khwārizm," Khwārizm referring in this case to a region south of the Aral Sea (Zemanek 1979). Knuth then specifies that from its initial acceptation as the process of doing arithmetic with Arabic numerals, the term algorism gradually became corrupted: "as explained by the *Oxford English Dictionary*, the word 'passed through many pseudo-etymological perversions, including a recent *algorithm*, in which it is learnedly confused' with the Greek root of the word arithmetic" (Knuth 1997, p. 2).

12. See, for example, the (very) temporary definition of algorithms by Knuth: "The modern meaning for algorithm is quite similar to that of recipe, process, method, technique, procedure, routine, rigmarole" (Knuth 1997, p. 4; emphasis in the original).

13. See, for example, Sedgewick and Wade's definition of algorithms as "methods for solving problems that are suited for computer implementation" (Sedgewick and Wade 2011, p. 3).

of algorithm as "a procedure that takes any of the possible input instances and transforms it to the desired output" (Skiena 2008, p. 3).[14]

These a priori all-too-basic elements are, in fact, not trivial as they push ahead with an evaluation stance and frame algorithms in quite an oriented way. Indeed, by endowing itself with problems-inputs and solutions-outputs, this take on algorithms can emphasize on the adequacy relation between these two poles. The study of algorithms becomes, then, the study of their effectiveness. This surveying position is fundamental and penetrates the entire field of algorithmic study whose scientific agenda is explicitly summarized by Knuth: "We often are faced with several algorithms for the same problem, and we must decide *which is best*" (Knuth 1997, p. 7; our emphasis).[15] From this point, algorithmic analyses can focus on the elaboration of meta-methods allowing to systematize the formal evaluation of algorithms.

Borrowing from mathematical branches such as set theory or complexity theory, techniques for analyzing algorithms as proposed by algorithmic students can be extremely elegant and powerful. Moreover, in the light of the significant advances in terms of implementation, data structuration, optimization, and formal understanding, this standard conception of algorithms as more or less functional interfaces between inputs and outputs—themselves defined by specific problems—certainly deserves its high respectability

Notably through the academic and industrial efforts of important authors such as Donald Knuth, Edsger Dijkstra, and Christos Papadimitriou—who have also worked to establish computer science as a full-fledged academic field—this contemporary conception of algorithms has gradually formed a genealogical, routine, and easily mobilizable stratum. What is an algorithm? Answer: It is a problem-solving computerized method transforming inputs into outputs in the best possible way. And despite several identifiable limits to this definition—to which we will return in the following section—it remains true that such thus-defined entities have multiplied over the past several decades, to the point of making important, daily contributions to our common lives (MacCormick

14. See also Cormen et al.'s definition: "A well-defined computational procedure that takes some value, or set of values, as *input* and produces some value, or set of values, as *output* [being] thus a sequence of computational steps that transform the input into the output" (2009, p. 5; emphasis in the original).

15. See also Dasgupta et al.'s phrasing: "Whenever we have an algorithm, there are three questions we always ask about it: 1. Is it correct? 2. How much time does it take, as a function of *n*? 3. And can we do better?" (2006, p. 12), and "There are three desirable properties for a good algorithm. We seek algorithms that are correct and efficient, while being easy to implement" (Skiena 2008, p. 4)

and Bishop 2013); entities that can be defined (at least partially) as problem-solving computerized methods transforming inputs into outputs in the best possible way have effectively contributed to the computerization of the collective world (Kling 1996) as well as its extension—notably with the rise of mobile computing—to our most intimate spheres (Mazzotti 2017). Better still, such methods have also participated in the upsurging of today's most valorized companies such as Facebook, Oracle, and Google, among many others. It is, in that sense, not risky to assert that the collective world is now more than ever interacting, directly or indirectly, with algorithms, thus making these entities—deriving from a political[5] stratum—important new political[1] actors.

However, in parallel with their irresistible step up, algorithms have also been increasingly criticized, at least since the late 1990s (Jaton 2021a, pp. 10–11). Targeted and consequent efforts were first deployed by New Media scholars who criticized the discourse on empowerment and accessibility of information put forward by early Web technology promoters. Hoffman and Novak (1998), for example, have shown that the accessibility and use of Web technologies in the United States was highly dependent on racial differences. Lawrence and Giles (1999) showed that, contrary to many promotional discourses reporting almost unlimited access, the search engines available in the late 1990s were able to index only a small fraction of the Web. In a similar vein, Introna and Nissenbaum (2000) have highlighted the underground—and potentially harmful—influence of the heuristics used for URL classification by these same late 1990s search engines. The post-9/11 period that followed focused on criticisms of biases in programs and algorithms—the term appeared at that time in the critical literature[16]—for surveillance and preventive detection. In his study of the social implications of data mining technologies, Gandy (2002) warned, for example, that they are the gateway to rational discrimination potentially strengthening correlative habits between social status and group membership. From a political economy perspective, Zureik and Hindle (2004) discussed biometric algorithms' propensity to trivialize social profiling, categorization, and exclusion of national groups. Another example of this line of research in Surveillance Studies is the work of Introna and Wood (2002)—their analysis of facial recognition algorithms highlighted the potential biases of these devices, which were often presented as impartial.

16. While the terms "software," "code," or "software-algorithm" were initially preferred, the single term "algorithm" has become more and more common in Surveillance Studies from the 2000s. It would be interesting to better know the channels through which the term "algorithm"—along with its standard definition of problem-solving computerized method transforming inputs into outputs—has become established in the Anglo-Saxon critical literature.

The congruence and exchanges between these two lines of research—New Media Studies and Surveillance Studies—led, at the beginning of the 2010's, to numerous investigations on discriminations and invisibilities induced by the use of algorithms (still considered problem-solving computerized method transforming inputs into outputs, though).[17]

The importance of these critical studies of the social effects of algorithms should not be underestimated, for as they have acted, at their own level, as backfires to the commercial and seductive rhetoric of new information technologies' promoters.[18] Moreover, this critical position has now been extended to the press, which almost daily denounces the biases in machine learning and artificial intelligence algorithms as well as their opacity.[19] Timid yet identifiable publics have emerged around issues, which, to date, primarily concern the lack of accountability of algorithmically supported decisions as well as the harms these decisions may cause to vulnerable populations. This progressive publicization has gradually transformed algorithms from political[1] entities (derived from political[5] habits) into political[2] topics.

More recently came regulation attempts aiming to better govern algorithms and reduce their deleterious effects, as forged by their related issues and publics. Among the latest—at the time of writing—are the US Algorithmic Accountability Act (AAA) and the UE Artificial Intelligence Act (AIA), two virtuous attempts that yet seem to have little chance of drastically changing the situation. The AAA is a bill—a formal statement that needs to be voted on in the US Parliament to become a law—proposed by three congressional Democrats in April 2019[20]. It seeks to constrain large businesses[21] using a "high-risk automated decision system"—a system

17. On discriminations induced by algorithms, see, for example, Kraemer et al. (2011); Gillepsie (2013). On the issue of invisibilization, see, for example, Bucher (2012); Bozdag (2013). A widely consulted monograph was also that of Steiner (2012).

18. See for example O'Neil (2016).

19. For nice reviews of these critiques, see Crawford's article in the *New York Times* (2016) as well as Levin's article in *The Guardian* (2019).

20. https://www.congress.gov/bill/116th-congress/house-bill/2231.

21. A large business here means "any person, partnership, or corporation [that] (A) had greater than $50,000,000 in average annual gross receipts for the 3-taxable-year period preceding the most recent fiscal year [or] (B) possesses or controls personal information on more than (i) 1,000,000 consumers; or (ii) 1,000,000 consumer devices; or (C) is substantially owned, operated, or controlled by a person, partnership, or corporation that meets the requirements under subparagraph (A) or (B); or (D) is a data broker or other commercial entity that, as a substantial part of its business, collects, assembles, or maintains personal information concerning an individual who is not a customer or an employee of that entity in order to sell or trade the information or provide third-party access to the information" (AAA, p. 5, https://www.congress.gov/bill/116th-congress/house-bill/2231).

that, for example, "makes decisions, or facilitates human decision making, based on systematic and extensive evaluations of consumers" [AAA 2019, p. 6B][22])—to conduct an "algorithmic impact assessments," that is a study "evaluating an automated decision system and the automated decision system's development process." [AAA 2019, p. 2][23]). Yet, as noticed by Kaminski and Selbst (2019), the AAA's grand ambitions suffer from the institutional relays used to carry out its injunctions. The AAA indeed relies heavily on the Federal Trade Commission—the US agency responsible for consumer protection—that does not, in effect, have the necessary influence to enforce high-level settlements with large companies. More problematically, as of Spring 2021, the bill has not progressed past the committee level, and the Senators behind the initiative are having a hard time trying to reintroduce it (Johnson 2021).

The AIA, for its part, is a would-be regulation released in April 2021 by the European Commission that builds upon reports previously compiled by a group of experts (mainly from the industry)—the High-Level Expert Group on AI (European Commission 2021)[24]. This proposal classifies AI systems according to four types of risk: minimal risk (e.g., video games, spam filters); limited risk (e.g., chat bots, emotion recognition); high risk (e.g., justice, immigration, schools); and unacceptable risk (e.g., manipulation, social scoring). For minimal and limited risk systems, little will change and the rules will remain broadly similar to those that already exist in the European Union. The same goes for systems involving unacceptable risks, for these will be banned, as they are generally already within the European common market.[25] But the core of the regulation concerns systems considered as high risk, which will be obliged to comply with five requirements related to data governance, transparency for users, human oversight, accuracy and traceability. Manufacturers of these high-risk systems will have to fill out a declaration of compliance with these five requirements in order for their product to acquire the CE mark of quality and enter the European market. Though honorable in many respects, this guideline seems to suffer from an excess of compromise: As recently commented by investigative journalists who have closely analyzed the industrial lobbies involved in the formulation of this proposal, the European Commission ended up with a document potentially initiating an industry-dominated "ethics washing" (Yanchur et al. 2021; see also Benkler 2019; Metzinger

22. https://www.congress.gov/bill/116th-congress/house-bill/2231.
23. https://www.congress.gov/bill/116th-congress/house-bill/2231.
24. https://digital-strategy.ec.europa.eu/en/policies/expert-group-ai.
25. The official ban of unacceptable risk AI system seems merely symbolic and addressed to China and its system of surveillance and generalized scoring. On this topic, see Gaumond (2021).

2019). Moreover, most of this would-be regulation is based on self-assessment by the industry, prompting members of the EU expert group to already consider it a resounding failure (Smuha et al. 2021).

Though different in many respects, it seems to us that these two recent regulation attempts share two fundamental characteristics. The first one is that even though they dig as far as possible toward the source of the power of algorithms, they fail to locate its origin and impact on it. Either the regulation is too vague and the actors concerned can go around it (as in the case of the AAA), or it is too specific and may therefore no longer become prescriptive (as in the case of the AIA). In both cases, algorithms appear like soaps that slide between the hands of the regulators, thereby contributing to algorithms' unfathomable aspect and reinforcing, in turn, the overall recursive drama.

In parallel with the limits on their prerogatives' enforcement, the two regulation attempts meet in tone and manner: Both rely on rational discussion, deliberation, and existing institutions to counterbalance the growing power of algorithms. A salient contrast thus appears between, on the one hand, the unprecedented highlighted by political[2] issues and, on the other hand, the way this unprecedented is captured by political[4] procedures: While the political[2] issues induced by algorithms seem to call into question our whole living together, institutions, protocols, and habits inherited from a pre-algorithmic moment—in the sense of defined before issues about the power of algorithms broke out—appear to be the best suited to grasp and regulate the issues. On the one hand, the warmth of the issues, on the other hand, the coldness of the administration and experts who hit—not surprisingly, to be fair—a dramatic wall. Something seems to be missing in this delirious process Ziewitz managed to detect, quite admirably. Can Latour's political propositions help address this missing political mass?

It is surprising to note the difference between the claimant aspect of political[2] issues and the pacified aspect of regulatory political[4] propositions for the case of algorithms. The *extra*ordinary of the issues on the one side, the *ultra*-ordinary of deliberation on the other: How could the latter confront the former without stalling? While the political[2] issues induced by the political[1] multiplication of algorithms have succeeded in creating concerns, they have not succeeded in forming the political[3] antagonisms that can be expected from them. Who, indeed, are the adversaries? Biases? But these seem to be consubstantial with the very notion of algorithms.[26]

26. This is at least the position of computer scientist Tom Mitchell who, in an influential 1980 report, explained that the computational process of learning involves an inductive leap that has to be biased in order to choose one generalization over another (Mitchell, 1980). On this topic, see also Jaton (2021b).

Figure 1. Schematics of the algorithmic drama under the lens of Latour's and Seguin's arguments.

The big tech companies? But they are the guarantors of contemporary capitalism in which we daily participate.[27] Equity? But this notion appears to be quite relative as it depends on a third term to put two or more positions into equivalence.[28] Who/what is—or should be—this supreme judge? Who are we arguing with, exactly? The toughest and wildest notion of the political, the one authors like Carl Schmitt or Chantal Mouffe consider the purest, seems to be missing. Under the lens of Latour's reading of political processes, political[3] confrontations capable of drawing lines between allies and adversaries are lacking in the algorithmic drama, making it suffer from recursivity. This, in our opinion, may be the current problem of the politicization of algorithms: it fudges the agonistic moments (Mouffe 1999) capable of redefining sovereignties as well as the regulations deriving from them (see Figure 1).

4. A Quite Empty Set

Why is it so difficult to engage agonistic processes when it comes to algorithms? Why do the usual procedures of deliberative democracy appear the best suited to address the unprecedented issues emerging in the wake of algorithms? It seems to us that there is a problem of means: The current ecology of algorithmic entities offers only few takes for the expression of enlarged political[3] dissensions; the ontological soil of algorithms is currently not rich enough to feed disruptive affections. To fully understand this argument, we need to start by considering, once again, the institutional political[5] definition of algorithms as computerized methods that transform inputs into outputs to solve problems in the best possible way. What does this naturalized definition highlight and evoke? And inversely, what does it play down and dismiss?

A first set of attributes can be found in the term "method" indicating a step-by-step list. Under this lens, algorithms are lists of successive

27. For a negative version of this argument, see Zuboff (2019). For a positive one, see Mackey and Sisodia (2012).

28. Verma and Rubin (2018) have identified more than twenty different, and competing, statistical notions of fairness. Before considering a specific algorithm as fair or unfair, prior agreement on a definition of equity seems, then, to be necessary.

operations. They are, in that sense, originally procedural; they have a beginning, an end, as well as more or less intermediate steps. An important computational aspect is combined with this; as these procedures are expressed through electronic computing environments, their language is that of computation. This is where the notion of code comes in, operating as a lexical material governing these sets of computational actions. From this *collateral* political[1] entity—code—concerns have gradually arisen about inscrutability and opacity, with some algorithms expressing themselves in computer codes that are long and complex enough to be no longer amendable by those who shaped them. This political[2] issue has recently drawn the attention of executives of large companies and state agencies who seek ways to gain the trust of users of algorithm-supported decision-making tools (James 2019; Schmelzer 2019; Towers-Clark 2018).

A second set of attributes emanating from the institutional political[5] definition of algorithms can be found in the transformation of inputs into outputs. Algorithms are operative in the sense that they obtain, by means of coded computational steps, something new from known elements. An important resolutive and competitive connotation is combined with this: algorithmic operations solve problematic issues and these resolutions are more or less good, efficient, or optimal. Because algorithms solve problems in different ways, a number of qualifiers, emanating from more or less academic spheres, have progressively emerged: big data, artificial intelligence, and machine learning are recent popular examples of such qualifiers. Also, the operative, resolutive, and competitive attributes of algorithms has made the sets of data (datasets) they use as "raw" materials increasingly visible. Together with several scandals affecting highly visible companies,[29] the "data deluge" and its enrolment in calculation procedures have been widely publicized from the 2010s onwards (Cukier 2013). These collateral political[1] entities—big data, machine learning, artificial intelligence, datasets—have recently converged to fuel political[2] issues over the quality of these datasets. For more and more ethical (mostly from the academia) and technical (mostly from the industry) experts, biased sets of data lead to biased results, though these results may emanate from the most efficient big data, machine learning, or artificial intelligence algorithms (Crawford 2013, among many others).

As mentioned above, it would be unfair to consider these two sets of attributes—"coded, computational, methodical"; "resolutive, operative,

29. The affair surrounding Facebook and the data-analysis firm Cambridge Analytica regarding psychographic targeting during Donald Trump's presidential campaign is a recent example of such scandals. On the Cambridge Analytica affair, see Rosenberg et al. (2018).

Figure 2. Augmented schematics of the algorithmic drama under the lens of Latour's and Seguin's arguments.

competitive"—as completely erroneous. At some point, algorithms can legitimately be considered computerized methods that transform inputs into outputs to solve problems in the best possible way. However, a brief examination suffices to show that these attributes only address a particular moment in the career of algorithms, career that goes well beyond their restrictive, institutional definition. And it is precisely this political[5] constriction, as well as the few political[1] entities it allows to exist, that, perhaps, prevents the expression of political[2] issues capable of suggesting broader political[3] antagonisms and innovative political[4] regulations (see Figure 2).

But what are the limits of the institutional political[5] conception of algorithms? What does it prevent from making visible and, therefore, from making exist? Let us begin with the first set of attributes: "coded, computational, methodical." While the standard conception of algorithms rightly insists on the centrality of computer code for the methodic expression of algorithms, this insistence does not take into account the actions of writing these lines of code at computer terminals. According to the naturalized conception of algorithms, writing numbered lists of instructions capable of triggering electric pulses in desired ways is mainly considered a means to an end. Yet, as for example shown by Button and Sharrock (1995) and Jaton (2021a, 2022), programming practices—by virtue of the collective processes they require in order to unfold—also sometimes influence the way algorithms come into existence and produce differences in the collective world.

Regarding the second set of attributes—resolutive, operative, competitive—while the standard definition emphasizes the resolutive aspect of algorithms, it completely overlooks the definition of the problems algorithms are intended to solve. According to this view, problems and their potential solutions are already made; the role of algorithmic studies being to evaluate the effectiveness, or very possibility, of the steps leading to the transformation of inputs into outputs. Yet it is fair to assume that problems and the terms that define them do not exist by themselves. As it is for example shown in Jaton (2017, 2019, 2021b) and Bechmann and Bowker (2019), problems are delicately irrigated products of problematization processes engaging habits, desires, skills, and values that altogether participate in the way algorithms—considered problem-solving devices—will further be designed. Moreover, if one considers problematization processes as part of algorithmic design, the nature of the competition between algorithms changes: the best algorithms are not only the ones whose formal characteristics certify their superiority but also the ones that managed to associate to their problems' definitions the procedures capable of evaluating their results. By concentrating on formal criterions without taking into account how these formalisms participated in the initial shaping of the problems at hand, the standard conception of algorithms covers up the evaluation infrastructure of algorithms, thus refusing any political[1] visibility to its various—yet, for now, little known—components.

5. Toward Vascularization Efforts

If we accept the convoluted elements presented so far, a legitimate question could be: How did we get there? How did we end up with a political [5] conception of algorithms that inhibits the proliferation of collateral political[1] entities and, in turn, constrains the formation of political[2] issues and publics capable of suggesting political[3] confrontational moments and innovative political[4] regulations?

For now, alas, the question remains largely open. Edwards (1996) did propose valuable historical elements regarding the parallel development of electronic computing and the politics of discourse during the Cold War in the United States. In this important work, he showed how what he calls cyborg discourse has gradually contributed to reducing a priori irreducible subjectivities to one single computer-inspired human mind. Akera (2008) also participated in this line of research by finely reporting on the entangled dynamics of military, industrial, and academic research on computer science during the 1940s and 1950s in the United States that further promoted cyborg discourse, now operating as dominant mindset. The works of Dupuy (2009) and Pickering (2011) on the history of cybernetics also provided important insights about this fragmented and interdisciplinary research group and its progressive homogenization and re-appropriation by contemporary promoters of cognitive science and artificial intelligence. For the case of economics as an academic discipline, Mirowski's impressive work (2002) on the cybernetic roots of today's dominant neoclassical economics is a priceless reference as well. Yet, as far as we know, no intellectual endeavor has yet tried to build upon this literature to assemble a genealogical panorama of the institutionalization of the notion of algorithm and its corollaries.

Yet again, if we accept the elements presented in the previous sections, a further politicization of algorithms should go along with an ontological enrichment capable of making visible—and thus making exist—algorithms' contemporary ecology. Though this political[1] activism has not really taken off yet, results of ethnographic investigations slowly start to get published, hence providing small yet meaningful insights into the richness obtruded by the single term "algorithm".[30] And so that readers of *Perspectives on Science* can get a quick flavor of the heuristic and political potential of such studies for the ontological thickening of algorithms, we will now draw on materials taken from an inquiry conducted in a computer science laboratory from 2013 to 2016.[31] These field notes will be presented chronologically and some of their content—a fraction of the [*entities*] set off with square brackets—will be considered at the end of the paper in the light of our (wild) Latourian political argument.

> October 28, 2013
> Second day in this [computer science laboratory] that is specialized in digital image processing: My observations remain hopelessly dull. I can count how many computer scientists there are in the laboratory, find out where they come from, and somewhat describe their architectural environment. But as far as their practices are concerned, I have it all wrong. No laboratory gown, mice, or bench; no effervescence that could serve as a cover. I am visible, too visible... The place is often silent and the researchers most of the time wisely sit in front of their monitors. They are certainly busy, but their business remains far from me. How could I be part of their arrangements and account for the practical constitution of their algorithms?
>
> November 3, 2013
> I am assigned to a project on a new [paper]. Will I finally be able to account for the work of these computer scientists? I was right to ask the director of the Lab not to give me any more idle privileges: I will now have to contribute to the productions of her Lab. But will I be up to the task? She knows that my knowledge is very limited (although I take classes to become more competent) and must therefore have an idea in mind. But is it reasonable for an ethnographer to participate in a draft paper on signal processing?

30. See, for example, the work of Bechmann and Bowker (2019), Grosman and Reigeluth (2019), Henriksen and Bechmann (2020), Jaton (2017, 2019, 2021a) and Neyland (2019).

31. The following elements are taken from an investigation summarized in Jaton (2017, 2019, 2021a).

November 7, 2013
The first working session with my new colleagues is over. The team is quite nice, although BJ, GY, and CL are certainly wondering why I insist on helping them with this draft article. By the way, what is the object of this article? Is this a new {algorithm}? Maybe. My colleagues are more willing to talk about a new {model}, but they also have no objection calling it an algorithm. Is it {big data} or {artificial intelligence}, then? They're laughing: "{Buzzwords}" CL tells me. "I'd stick to algorithm." And this would-be algorithm, could it ever be included in a broader system and thus irrigate the daily lives of hundreds of thousands of users? This is what the team dreams of, while knowing that this type of successful {application} of an algorithm published in the {*Proceedings* of a conference} is extremely rare. But it happens sometimes: Don't we talk about the Viola and Jones algorithm? These hopes are all the more pervasive as our project flirts with digital image compression: "This is where the beef is," GY even tells me. And are the main {sponsors} of the targeted conference not Google, Facebook and Microsoft? At any rate, for now, such hopes are very distant, the immediate problem being the absence of something my colleagues call "{ground truth}." I now understand that it was mainly to help them remedy this absence that the director affiliated me with the project. So be it. It is still too early to understand what a ground truth really is. For now, I will simply do what BJ, GY and CL have asked me to do, that is to identify Web platforms with royalty-free images and download on the Lab's server contents that echo, directly or indirectly, what our algorithm-model will have to detect (in this case, differentials in saliency). These initial operations are not very exciting, but they still make me glimpse the backstage of the shaping of an algorithm bearing great hopes.

November 15, 2013
Ground truths are everywhere. How blind I was: From the beginning of the inquiry, everything was there, before my eyes! Not a single day goes by without a member of the Lab complaining or being enthusiastic about a ground truth anymore: "Our results are promising: look at these {performances}!," says MS at the weekly Lab meeting. Except that I now realize that the very existence of her beautiful results depends on a ground truth accepted and used by a whole research community to evaluate the performances of her shadow detection models. "It's difficult to really know if the model works because for this topic, the {evaluation metrics} are actually

quite bad," says RK—still at the same lab meeting—about his new super-voxel segmentation model. It makes sense to me now: If there is no consensus on how a ground-truth database defines the terms of a problem to be solved, it becomes complicated to compare the performances of algorithms that are supposed to solve that problem... This is well in line with what NK tells me during the coffee break: "You don't know people in the Faculty of Arts by any chance? Because I need experts to set up my handwritten recognition model." "You mean, to make a ground truth?," I try. "Yes exactly. I could do it myself, but since I'm not from the field, can get short for that one."

December 12, 2013
The article project continues, not without discussions. We now have 800 high-resolution images that grid well, at least potentially, what the algorithm will be supposed to detect. But is that enough? Do the {datasets} used for the formation of algorithms in image processing not need to be huge? Not necessarily, apparently. At least not for this type of project where the main goal is to see whether a new detection concept takes up in the research community (and potentially also in the industry). And anyway, time is already running out: It is essential to launch the {crowdsourcing experiment} before the Christmas break, in order to be able to process the results in January. And how to design this {web questionnaire} the {crowdsourcing company} *ClickWorker* will distribute to English-speaking workers from who knows where? It is important not to screw it up because the signals produced by these workers will constitute the material basis for training the model—the {training set}—but also for evaluating it—the {evaluation set}. Not to mention that we will also have to pay the participants in this crowdsourcing experiment. {Not much}, sure enough, but since our budget is around 1000 EUR and we will have to ask the opinion of around 300 workers—this is the current standard—the tasks we can ask them must not be too time-consuming. And anyway, if the tasks are too convoluted, the participants won't do them properly. "{Never trust a user}," as the saying goes (at least, in applied computer science). All these issues impact on the design of the Web application that will collect the logs and store them on our servers with the help of the crowdsourcing company's {Application Programming Interface} (API). Or rather, more precisely, all these questions impact on GY who is responsible for coding this Web application in PHP and Javascript, two {programming languages} to which computer scientists specializing in signal processing are not necessarily accustomed.

February 2, 2014
The project is a little behind [schedule]. Nothing alarming but the completion of the web application questionnaire by GY took him longer than expected (he is also working on other papers). This delay had an impact on CL who had to write, in hurry, the Matlab scripts to database the hundreds of thousands of geometric coordinates x1, y1; x2, y2 soon extracted from the operations of the crowdworkers (thanks, precisely, to GY's Web application). Fortunately, she could rely upon [communities of Matlab programmers] on [StackOverflow] who were eager to answer her requests. Anyway, we now have a well-organized database allowing us to visualize the result of the on-demand work of 300 individuals (actually a little less than that as I learn that GY has also developed a system to identify bots, set aside their results, and not pay their actions). And that's where the tedious work begins for good, at least for us in the Lab. CL and GY have already done a lot for the project: It will therefore be up to BJ—first year PhD student—and me—first year PhD student *in social sciences*—to work on these results for each image. We knew what this data post-processing work should lead to: We discussed it at the beginning of the project, and the results of our discussions even guided the design of the web application. But now we are discovering the daunting workload it represents. Segmenting complex forms in natural images to obtain grayscale matrices representing the relative saliency values as expressed by the 300 crowdworkers: It will take us weeks! No wonder nobody in the image-processing research community framed the saliency problem in these terms. When will ground truths be subcontracted? BJ tells me some universities already do it in-house, and that it is not pretty to see: With crowdsourcing at least, [casualized labor] remains out of sight.

March 4, 2014
It took us one month to finish [post-processing] all the crowdsourced data; this was hard and menial. But here we are, officially: We have at our disposal a new ground-truth database containing untransformed data—input-images—and their transformed corollaries—output-targets. And the terms of the problem our algorithm will have to solve are thus defined as follows: It will have to be able to transform input-images into output-targets in the best possible way. As is often the practice in signal processing, we have also randomly divided the ground truth into two sets: the training set which will be used to set up the algorithm, and the evaluation set—also sometimes called "test

set"—which will be used to test the algorithm's performance and [compare] it with other algorithms already published by other laboratories. Does the serious business now begin? The thousands of lines of computer code and the complex mathematics? More or less. We will try to reuse models that BJ, GY, and CL have already developed: The date of submission of the manuscript is indeed March 31, and we must hurry up.

March 28, 2014
The latest tests carried out on the evaluation set are rather conclusive. By virtue of the common [statistical measures] in terms of accuracy and recall, the performances of our algorithm are better than those of algorithms already published by other laboratories. That's the least our algorithm could do as it is native to the ground truth we used to evaluate its performances! Everyone agrees: A different result would have been extremely surprising. And anyway, is it not the development of our new ground truth that really matters? Because thanks to this new ground truth, the research community in image processing will have at its disposal a subtle [problem to work on] and, eventually, solve. But also, more strategically, if our paper—which GY is finishing writing, in a hurry—is retained, all those who will want to beat the performances of our algorithm will have to refer to our paper as it introduces the new ground truth: [guaranteed quotations]! As long as the paper is retained, of course. And for this kind of important conference, the average is about 80% refusal.
In any case, it is there, before my eyes, in the form of five Matlab files containing thousands of lines of code: our algorithm. I now understand one of the advantages of [mathematical formalism]: infinitely easier to read and talk about. Here, even [pseudocode] wouldn't do the trick.

June 19, 2014
We got informed of the decision a week ago: The paper is not accepted. Sad. BJ sent me the reviewers' report and we meet to discuss it. The paper is mathematically flawless, which is good news for GY who took care of the analysis. But the three [reviewers] agree that the point of the article—that our algorithm surpasses the performance of previously published algorithms—does not hold water. This is due to our performance evaluations which tested already-published algorithms only on our new ground truth, thus giving a definite advantage to our algorithm. It is true that the paper's argument may have been awkwardly constructed. Was it really important to focus on the performances of our algorithm when

> these performances were not really commensurable with other algorithms? As our algorithm was based on the training set of a new ground truth, it was designed to solve a new problem. But many other authors have done this before us, and have been published, to such an extent that this "logical error" could legitimately be taken as a kind of obligation. Especially since in these days of the rise of machine-learning techniques, [selection criteria] increasingly focus on algorithms' [statistical performances]. It remains nonetheless true that, on this point, the reviewers were right. But couldn't they at least welcome our attempt to redefine an image-recognition problem? Couldn't they admit that the image-processing research community cannot continue to work forever with dusty ground truths? Because—at least for BJ—it is not very complicated to beat the performance of existing algorithms: If you give him the appropriate [computing infrastructure] (which is quite [expensive] and [polluting]), he will manage to design a powerful machine learning algorithm. His carbon footprint will explode for the sake of algorithmic research on image processing. This is often what those who are selected for major conferences do. What a beautiful performance! But for what problem? The one poorly defined by this ground truth from 2009? Good algorithms that solve bad problems defined by bad ground truths. Bad algorithms, in short. Have these reviewers not yet understood that to have *better algorithms*, we need *better ground truths*? They too quickly forgot their doctoral years where all these questions were daily problems. By mainly valuating statistical performances, they lock themselves into insipid problems. And this may also be true in the industry. How to avoid succumbing to the sirens of [easy-made money] and do [good computer science]? Anyway, according to BJ, all is not lost. The paper will be redesigned and resubmitted. Because it is true that, as it stands, the document is not easy to follow.

Despite its primarily illustrative vocation, this brief dive into computer science in the making gives a flavor of the ontological thickness of these problem-solving computerized methods of calculation called "models" or "algorithms." The algorithm of CL, GY, and BJ exists indeed from the very beginning of the project, in November 2013, in the form of hopes and desires. But as of March 28, 2014, does it not exist a little more? Yes, because, on that date, it was indeed assembled and could therefore effectively detect relative saliency maps within digital images. But on June 19, did the non-publication of the paper describing its components and performance not reduce its existence? Certainly, because at this stage, the algorithm is limited to five Matlab files stored in the Lab's internal server, whereas if associated with its article, it could have become interesting to one of these Big Tech employees visiting the major conferences in signal processing in search of new ideas and talents. It seems thus difficult to reduce the existence of this algorithm to its institutional problem-solving skeleton; it is wrapped in a multitude of documents, events, objects, and desires that the reality of this entity gains—or loses—in intensity.

This element points, in turn, to the most curious entities of this brief ethnographic incursion: the ground truths, these material referential databases that link input-data and output-targets. While these databases appear to define the terms of problems that can be solved computationally, they are not always given. In our case, GY, CL, BJ, and the ethnographer had to shape a new ground truth during a complex process involving habits, skills, resources, and values. And it seems that this venture could not have been completely avoided; the new ground truth appeared as a prerequisite for the development of the new algorithm. This was even the main interest of the project (at least in June, 2014, for BJ): proposing a surprising ground truth from which surprising algorithms could be derived. For the ethnographer, but also maybe—why not?—for computer scientists, a fascinating yet largely unexplored continent seems then to emerge: the study of the whys and wherefores of these ground-truth databases, genuine fundamental-yet-contingent matrices of many algorithms. And here, precisely, also lies a politization potential, impossible to anticipate without getting sensitive to the manufacture of algorithms. If many algorithms derive from those assignable objects called ground truths—that cannot, obviously, be reduced to datasets—seizing those assignable ground truths and the practices underlying their constitution also amounts, to a certain extent, to seizing algorithms. Especially, as these types of databases seem to concern different groups of people who have, a priori, little in common. In our case, the construction of a new ground truth has connected—though loosely—doctoral students in signal processing eager to propose innovative algorithms, contingent workers enrolled by new forms of precariousness crowdsourcing companies are not reluctant to exploit and maintain, well-established professors who are responsible for selecting papers for the smooth running of a conference sponsored by the giants of the tech industry, and an ethnographer willing to report on the constitution of algorithmic processes. And it is, potentially, through the identification of such cross-cutting affections that discussions on algorithms could lead to new issues and passions.

This affective potential is all the more apparent as avenues for engagement are suggested at the end of the project, notably by BJ. Dissatisfied with the rejection of the article, he complains about the lack of discernment of reviewers who, blinded by their increasing emphasis on the performances of image-processing algorithms, do not question their overall relevance. Priority seems to be given, at least for major conferences, to algorithms that solve problems the most effectively, not to the definition of the effectively-solved problems. And this drives, in turn, more and more Ph.D. students and postdocs to focus on the results of performance evaluations and to design costly machine learning models in an instrumental way. Critical debates on algorithms could then also develop around a nucleus proper to algorithmic research; instead of only concerning outside positions (e.g., users, consumers, clients), the critique of algorithms could also build upon internal levers at the very heart of research and innovation (e.g., precarious Ph.D. students and postdocs in signal processing).

Yet, according to the above small ethnographic excerpts, the constriction of solvable problems and the correlated increasing instrumental use of costly machine learning techniques seem not to be the only (potential) issues affecting algorithmic research. Underpaid precarious work could also operate as a lever to affect algorithmic processes and contribute to its further politicization. Indeed, who benefits, in the end, from the products of

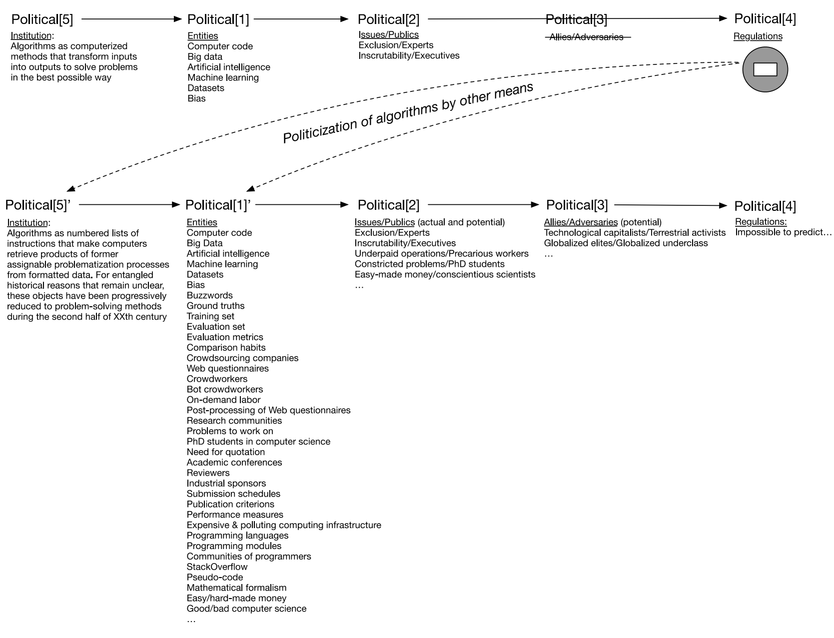

Figure 3. Schematics of a potential politicization of algorithms by other means.

crowdworkers who more and more participate in the design of ground truths? Certainly, in part, the researchers who design the derived algorithm and who are credited with a publication (if selected by the reviewers) and with the status of innovator (Irani 2015). But also, in a more insidious way, to tech companies; some of them having the means to sponsor academic conferences, involve their in-house research teams in them, and also, sometimes, reuse for their own businesses algorithms published by others. The situation is rather clear; underpaid click workers contribute to the development of the algorithmic infrastructure of tech firms, especially the now hegemonic ones. This is not a new proposition: important authors have also pointed out this alarming aspect of the so-called platform economy (Casilli 2019). But in complement to these important works, the above excerpts make it possible to suggest new places and actors likely to take part in the criticism of on-demand casualized labor and to augment the public on these potential issues. Here again, the ontological thickness of algorithms as deployed by an ethnographic investigation points at new places and actors potentially eager to participate in modifying what negatively affects them. It is then, perhaps, by making visible what links a priori differentiated populations to algorithmic networks that algorithms will begin, progressively, to be thoroughly politicized (see Figure 3). This, we believe, calls for further inquiries.

References

Akera, Atsushi. 2008. *Calculating a Natural World: Scientists, Engineers, and Computers During the Rise of U.S. Cold War Research*. Cambridge, Mass.: MIT Press.

Apel, Karl-Otto. 1984. *Understanding and Explanation: A Transcendental-Pragmatic Perspective*. Cambridge, Mass.: MIT Press.

Bechmann, Anja, and Geoffrey C. Bowker. 2019. “Unsupervised by Any Other Name: Hidden Layers of Knowledge Production in Artificial Intelligence on Social Media.” *Big Data & Society* 6(1): 205395171881956. https://doi.org/10.1177/2053951718819569

Benkler, Yochai. 2019. “Don’t Let Industry Write the Rules for AI.” *Nature* 569: 161. https://doi.org/10.1038/d41586-019-01413-1, PubMed: 31043715

Bowker, Geoffrey C. 1994. *Science on the Run - Information Management & Industrial Geophysics at Schlumberger 1920–1940*. Cambridge, Mass.: MIT Press.

Bowker, Geoffrey C., and Susan Leigh Star. 2000. *Sorting Things Out: Classification and Its Consequences*. Cambridge, Mass.: MIT Press. https://doi.org/10.7551/mitpress/6352.001.0001

Bozdag, Engin. 2013. "Bias in Algorithmic Filtering and Personalization." *Ethics and Information Technology* 15(3): 209–227. https://doi.org/10.1007/s10676-013-9321-6

Bucher, Taina. 2012. "Want to Be on the Top? Algorithmic Power and the Threat of Invisibility on Facebook." *New Media & Society* 14(7). https://journals.sagepub.com/doi/10.1177/1461444812440159

Button, Graham, and Wes Sharrock. 1995. "The Mundane Work of Writing and Reading Computer Programs." Pp. 231–258 in *Situated Order: Studies in the Social Organization of Talk and Embodied Activities*. Edited by Paul T. Have and George Psathas. Washington, DC: University Press of America.

Callon, Michel. 2000. "Analyse des relations stratégiques entre laboratoires universitaires et entreprises." [Analysis of strategic relationships between university laboratories and companies] *Réseaux. Communication - Technologie - Société* 18(99): 171–217. https://doi.org/10.3406/reso.2000.2200

Casilli, Antonio. 2019. *En attendant les robots*. [Waiting for the Robots] Paris: Le Seuil.

Crawford, Kate. 2016. "Opinion | Artificial Intelligence's White Guy Problem." The New York Times, January 20, sec. Opinion. https://www.nytimes.com/2016/06/26/opinion/sunday/artificial-intelligences-white-guy-problem.html

Crawford, Kate. 2013. "The Hidden Biases in Big Data." *Harvard Business Review*, April 1. https://hbr.org/2013/04/the-hidden-biases-in-big-data

Cukier, K. 2013. "Data, Data Everywhere." *The Economist*, February 25.

Dasgupta, Sanjoy, Christos Papadimitriou, and Umesh Vazirani. 2006. *Algorithms*. 1st edition. Boston: McGraw-Hill Education.

Dewey, John. 1954. *The Public and Its Problems*. Athens: Swallow Press.

Dupuy, Jean-Pierre. 2009. *On the Origins of Cognitive Science: The Mechanization of the Mind*. Cambridge, Mass.: MIT Press.

Edwards, Paul N. 1996. *The Closed World: Computers and the Politics of Discourse in Cold War America*. Cambridge, Mass.: MIT Press. https://doi.org/10.7551/mitpress/1871.001.0001

Euchner, Jim. 2019. "Little Ai, Big AI—Good AI, Bad AI." *Research-Technology Management* 62(3): 10–12. https://doi.org/10.1080/08956308.2019.1587280

European Commission. 2021. *Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending certain Union Legislative Acts*, Brussels, European Union Law.

Foucault, Michel. 1972. *The Archaeology of Knowledge*. New York: Pantheon Books.

Foucault, Michel. 1977. *Discipline and Punish: The Birth of the Prison*. New York: Vintage Books.

Foucault, Michel. 1994. *Dits et écrits: 1954–1988. {Sayings and Writings: 1954–1988}* Volume 4. Paris: Editions Gallimard.

Gandy, Oscar H. 2002. "Data Mining and Surveillance in the Post-9.11 Environment." Pp. 113–137 in *The Intensification of Surveillance Crime, Terrorism and Warfare in the Information Age*. Edited by Kristie Ball and Frank Webster. London/Las Vegas: Pluto Press.

Gaumond, Eve. 2021. "Artificial Intelligence Act: What Is the European Approach for AI?" *Lawfare*, June 4. https://www.lawfareblog.com/artificial-intelligence-act-what-european-approach-ai

Gillepsie, Tarleton. 2013. "The Relevance of Algorithms." Pp. 167–194 in *Media Technologies*. Edited by Tarleton Gillepsie, Pablo Boczkowski, and Kirsten Foot. Cambridge, Mass.: MIT Press.

Grosman, Jérémy, and Tyler Reigeluth. 2019. "Perspectives on Algorithmic Normativities: Engineers, Objects, Activities." *Big Data & Society* 6(2): 2053951719858742. https://doi.org/10.1177/2053951719858742

Habermas, Jürgen. 1991. *The Structural Transformation of the Public Sphere: An Inquiry Into a Category of Bourgeois Society*. Cambridge, Mass.: MIT Press.

Habermas, Jürgen. 1998. *Between Facts and Norms: Contributions to a Discourse Theory of Law and Democracy*. Cambridge, Mass.: MIT Press.

Henriksen, Anne, and Anja Bechmann. 2020. "Building Truths in AI: Making Predictive Algorithms Doable in Healthcare." *Information, Communication & Society*, preprint version (April 29): 1–15. https://doi.org/10.1080/1369118X.2020.1751866

High-Level Expert Group on Artificial Intelligence. 2019. "*Ethics Guidelines for Trustworthy AI*." Text. Brussels: European Commission. April 8. https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai, https://doi.org/10.24920/003611

Hill, Robin K. 2016. "What an Algorithm Is." *Philosophy & Technology* 29(1): 35–59. https://doi.org/10.1007/s13347-014-0184-5

Hoffman, Donna L., and Thomas P. Novak. 1998. "Bridging the Racial Divide on the Internet." *Science* 280(5362): 390–391. https://doi.org/10.1126/science.280.5362.390

Hughes, Thomas Parke. 1993. *Networks of Power: Electrification in Western Society, 1880–1930*. Baltimore, MD: John Hopkins University Press.

Irani, Lilly. 2015. "The Cultural Work of Microwork." *New Media & Society* 17(5): 720–739. https://doi.org/10.1177/1461444813511926

Introna, Lucas D., and Helen Nissenbaum. 2000. "Shaping the Web: Why the Politics of Search Engines Matters." *The Information Society* 16(3): 169–185. https://doi.org/10.1080/01972240050133634

Introna, Lucas, and David Wood. 2002. "Picturing Algorithmic Surveillance: The Politics of Facial Recognition Systems." *Surveillance & Society* (2/3). https://ojs.library.queensu.ca/index.php/surveillance-and-society/article/view/3373, https://doi.org/10.24908/ss.v2i2/3.3373

James, S. 2019. "AI Regulation Is Critical, Says 54% of Tech Executives." *TechRepublic*, March 12. https://www.techrepublic.com/article/ai-regulation-is-critical-says-54-of-tech-executives/

Jaton, Florian. 2017. "We Get the Algorithms of Our Ground Truths: Designing Referential Databases in Digital Image Processing." *Social Studies of Science* 47(6): 811–840. https://doi.org/10.1177/0306312717730428, PubMed: 28950802

Jaton, Florian. 2019. "Pardonnez cette platitude: de l'intérêt des ethnographies de laboratoire pour l'étude des processus algorithmiques." ["Forgive the Platitude": Of the Value of Laboratory Ethnographies for the Study of Algorithmic Processes."] *Zilsel* 5(1): 315–339. https://doi.org/10.3917/zil.005.0315

Jaton, Florian. 2021a. *The Constitution of Algorithms: Ground-Truthing, Programming, Formulating*. Cambridge, Mass.: MIT Press. https://doi.org/10.7551/mitpress/12517.001.0001

Jaton, Florian. 2021b. "Assessing Biases, Relaxing Moralism: On Ground-Truthing Practices in Machine Learning Design and Application." *Big Data & Society* 8(1): 20539517211013570. https://doi.org/10.1177/20539517211013569

Jaton, Florian. 2022. "Éléments pour une sociologie de l'activité de programmation." [Elements for a Sociology of the Programming Activity.] *RESET, Recherche en sciences sociales sur internet* 11. https://doi.org/10.4000/reset.3829

Johnson, Khari. 2021. "The Fight to Define When AI Is 'High Risk'." *Wired*, September 2. https://www.wired.com/story/fight-to-define-when-ai-is-high-risk/, https://doi.org/10.1002/aic.17470

Kaminski, Margot E., and Andrew D. Selbst. 2019. "Opinion | The Legislation That Targets the Racist Impacts of Tech." *The New York Times*, May 7, sec. Opinion. https://www.nytimes.com/2019/05/07/opinion/tech-racism-algorithms.html, https://doi.org/10.1016/j.jece.2019.103140

Kling, Rob. 1996. *Computerization and Controversy: Value Conflicts and Social Choices*. San Diego, CA: Morgan Kaufmann.

Knuth, Donald E. 1997. *The Art of Computer Programming, Vol. 1: Fundamental Algorithms*, 3rd Edition. Reading, Mass.: Addison-Wesley Professional.

Kofman, Ava. 2018. "Bruno Latour, the Post-Truth Philosopher, Mounts a Defense of Science." *The New York Times*, October 25, sec. Magazine. https://www.nytimes.com/2018/10/25/magazine/bruno-latour-post

-truth-philosopher-science.html, https://doi.org/10.15585/mmwr.mm6741a7

Kraemer, Felicitas, Kees van Overveld, and Martin Peterson. 2011. "Is There an Ethics of Algorithms?" *Ethics and Information Technology* 13(3): 251–260. https://doi.org/10.1007/s10676-010-9233-7

Lasswell, Harold Dwight. 1971. *A Pre-View of Policy Sciences*. New York: American Elsevier Pub. Co.

Latour, Bruno. 1983. "Give Me a Laboratory and I Will Raise the World." Pp. 141–170 in *Science Observed: Perspectives on the Social Study of Science*. Edited by Karin Knorr-Cetina and Michael Joseph Mulkay. London: SAGE. https://doi.org/10.1007/BF02176420

Latour, Bruno. 1984. *The Pasteurization of France*. Cambridge, Mass.: Harvard University Press.

Latour, Bruno. 1987. *Science in Action - How to Follow Scientists & Engineers Through Society*. Reprint. Cambridge, Mass.: Harvard University Press.

Latour, Bruno. 2003. "What If We Talked Politics a Little?" *Contemporary Political Theory* 2(2): 143–164. https://doi.org/10.1057/palgrave.cpt.9300092

Latour, Bruno. 2004. *Politics of Nature*. Cambridge, Mass.: Harvard University Press. https://doi.org/10.4159/9780674039964

Latour, Bruno. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. New York: Oxford University Press.

Latour, Bruno. 2007. "Turning around Politics: A Note on Gerard de Vries' Paper." *Social Studies of Science* 37(5): 811–820. https://doi.org/10.1177/0306312707081222

Latour, Bruno. 2008. "Pour un dialogue entre science politique et science studies." [For a Dialogue between Political Science and Science Studies.] *Revue francaise de science politique* 58(4): 657–678. https://doi.org/10.3917/rfsp.584.0657

Latour, Bruno, and Steve Woolgar. 1986. *Laboratory Life: The Construction of Scientific Facts*. Princeton, NJ: Princeton University Press. https://doi.org/10.1515/9781400820412

Lawrence, Steve, and Giles, C. Lee. 1999. "Accessibility of Information on the Web." *Nature* 400(6740): 107. https://doi.org/10.1038/21987

Lessig, Lawrence. 2000. "Code Is Law." *Harvard Magazine*, January 1. https://harvardmagazine.com/2000/01/code-is-law-html

Levin, Sam. 2019. "'Bias Deep inside the Code': The Problem with AI 'Ethics' in Silicon Valley." *The Guardian*, March 29, sec. Technology. https://www.theguardian.com/technology/2019/mar/28/big-tech-ai-ethics-boards-prejudice, https://doi.org/10.1089/ped.2019.1028

Lippmann, Walter. 1993. *The Phantom Public*. Reprint edition. New Brunswick, NJ: Transaction Publishers.

MacCormick, John, and Chris Bishop. 2013. *Nine Algorithms That Changed the Future: The Ingenious Ideas That Drive Today's Computers*. Princeton, N.J.: Princeton University Press. https://doi.org/10.1515/9781400839568

Mackey, John, and Rajendra Sisodia. 2012. *Conscious Capitalism: Liberating the Heroic Spirit of Business*. Boston, MA: Harvard Business Review Press.

Marres, Noortje. 2005a. "Issues Spark a Public Into Being: A Key but Often Forgotten Point of the Lippmann-Dewey Debate." Pp. 208–217 in *Making Things Public*. Edited by Bruno Latour and Peter Weibel. Cambridge, Mass.: MIT Press.

Marres, Noortje. 2005b. "*No Issue, No Public: Democratic Deficits after the Displacement of Politics*." University of Amsterdam.

Mazzotti, Massimo. 2017. "*Algorithmic Life*." Los Angeles Review of Books. https://lareviewofbooks.org/article/algorithmic-life/

Metz, Cade. 2019. "Is Ethical A.I. Even Possible?" *The New York Times*, March 5, sec. Business. https://www.nytimes.com/2019/03/01/business/ethics-artificial-intelligence.html, https://doi.org/10.3389/fped.2019.00478

Metzinger, Thomas. 2019. "Ethics Washing Made in Europe." *Der Tagesspeigel*, April 18. https://www.tagesspiegel.de/politik/eu-guidelines-ethics-washing-made-in-europe/24195496.html

Mirowski, Philip. 2002. *Machine Dreams*. Economics Becomes a Cyborg Science. Cambridge/New York: Cambridge University Press.

Mitchell, Tom M. 1980. "*The Need for Biases in Learning Generalizations*." New Brunswick, NJ: Rutgers University Press.

Mittelstadt, Brent Daniel, Patrick Allo, Mariarosaria Taddeo, Sandra Wachter, and Luciano Floridi. 2016. "The Ethics of Algorithms: Mapping the Debate." *Big Data & Society* 3(2): 2053951716679679. https://doi.org/10.1177/2053951716679679

Mouffe, Chantal (ed.). 1992. *Dimensions of Radical Democracy: Pluralism, Citizenship, Community*. London; New York: Verso.

Mouffe, Chantal. 1999. "Deliberative Democracy or Agonistic Pluralism?" *Social Research* 66(3): 745–758.

Neyland, Daniel. 2019. *The Everyday Life of an Algorithm*. London: Palgrave Pivot. https://doi.org/10.1007/978-3-030-00578-8

O'Neil, Cathy. 2016. *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. New York: Crown.

Pasquale, Frank. 2016. *The Black Box Society: The Secret Algorithms That Control Money and Information*. Reprint edition. Cambridge, Mass./London: Harvard University Press. https://doi.org/10.5500/wjt.v6.i4.736

Pickering, Andrew. 2011. *The Cybernetic Brain: Sketches of another Future*. Chicago: University of Chicago Press.

Rosenberg, Matthew, Nicholas Confessore, and Carole Cadwalladr. 2018. "How Trump Consultants Exploited the Facebook Data of Millions." *The New York Times*, March 17, sec. U.S. https://www.nytimes.com/2018/03/17/us/politics/cambridge-analytica-trump-campaign.html

Schmelzer, Ron. 2019. "Understanding Explainable AI." *Forbes*, July 23. https://www.forbes.com/sites/cognitiveworld/2019/07/23/understanding-explainable-ai/

Schmitt, Carl. 1996. *The Concept of the Political*. Chicago: University of Chicago Press.

Schmitt, Carl. 2006. *The Nomos of the Earth in the International Law of the Jus Publicum Europaeum*. Candor, NY: Telos Press.

Sedgewick, Robert, and Kevin Wayne. 2011. *Algorithms*, 4th ed. Upper Saddle River, NJ: Addison-Wesley Professional.

Seguin, Eve, and Laurent-Olivier Lord. 2023. "Bruno Latour's Science Is Politics by other Means: Between Politics and Ontology". *Perspective on Science* 31(1): 9–39. https://doi.org/10.1162/posc_a_00579

Seguin, Eve. 2015. "Pourquoi les exoplanètes sont-elles politiques?" [Why Are Exoplanets Political?] *Revue française de science politique* 65(2): 279–302. https://doi.org/10.3917/rfsp.652.0279

Shapin, Steven, and Simon Schaffer. 1985. *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*. Princeton: Princeton University Press.

Skiena, Steven S. 2008. *The Algorithm Design Manual*, 2nd ed. London: Springer. https://doi.org/10.1007/978-1-84800-070-4.

Smuha, Nathalie A., Ahmed-Rengers, Emma, Harkens, Adam, Li, Wenlong, MacLaren, James, Piselli, Riccardo and Karen Yeung. 2021. "How the EU Can Achieve Legally Trustworthy AI: A Response to the European Commission's Proposal for an Artificial Intelligence Act," *SSRN Scholarly Paper ID 3899991*. Rochester, NY: Social Science Research Network. https://doi.org/10.2139/ssrn.3899991

Stark, Luke, and Anna Lauren Hoffmann. 2019. "Data Is the New What? Popular Metaphors & Professional Ethics in Emerging Data Culture." *Journal of Cultural Analytics*, May 3. https://doi.org/10.31235/osf.io/2xguw

Steiner, Christopher. 2012. *Automate This: How Algorithms Came to Rule Our World*. New York: Portfolio Hardcover.

Stengers, Isabelle. 2005. "The Cosmopolitical Proposal." Pp. 994–1003 in *Making Things Public*. Edited by Bruno Latour and Peter Weibel. Cambridge, Mass.: MIT Press.

Towers-Clark, Charles. 2018. "Can We Make Artificial Intelligence Accountable?" *Forbes*, September 19. https://www.forbes.com/sites/charlestowersclark/2018/09/19/can-we-make-artificial-intelligence-accountable/

Verma, Sahil, and Julia Rubin. 2018. "Fairness Definitions Explained." *Proceedings of the International Workshop on Software Fairness, New York, NY, USA*, 2018, 1–7. FairWare '18. ACM. https://doi.org/10.1145/3194770.3194776

Yanchur, Alina, Schyns, Camille, Fondahn, Greta Rosén and Sarah Pilz. 2021. "Computer Says No: How the EU's AI Laws Cause New Injustice," *EUobserver* (blog), August 23. https://euobserver.com/investigations/152695

Zemanek, Heinz. 1979. "Dixit Algorizmi. His Background, His Personality, His Work, and His Influence." *Proceedings on Algorithms in Modern Mathematics and Computer Science 1–81*. Berlin: Springer.

Ziewitz, Malte. 2016. "Governing Algorithms Myth, Mess, and Methods." *Science, Technology & Human Values* 41(1): 3–16. https://doi.org/10.1177/0162243915608948

Zuboff, Shoshana. 2019. *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*. New York: PublicAffairs.

Zureik, Elia, and Karen Hindle. 2004. "Governance, Security and Technology: The Case of Biometrics." *Studies in Political Economy* 73(1): 113–137. https://doi.org/10.1080/19187033.2004.11675154