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1. Knowing in Algorithmic Regimes: An Introduction

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Algorithms have risen to become one of the—if not *the*—central technology for creating, circulating, and evaluating knowledge in multiple societal arenas. In this volume, we argue that this shift has, and will continue to have, profound implications for how knowledge is produced and what and whose knowledge is valued and deemed valid. Ultimately, it will transform the epistemological, methodological, and political foundations of knowledge production, sense-making, and decision-making in contemporary societies. To attend to this fundamental change, we propose the concept of *algorithmic regimes*. It draws our attention to the transformation in today's "regime[s] of truth" (Foucault, 1977, p. 13), in particular to the socio-material "apparatuses" (Barad, 2007), cultures, and practices that configure and regulate how (valid) knowledge is produced and by which means truth claims can be made. Knowledge production in algorithmic regimes refers to the ways in which people as well as algorithms gain access to the world, how "reality" is made intelligible and subsequently constructed, and how power and agency are redistributed across human and non-human actors. In algorithmic regimes, the role of human subjects for knowledge production and circulation is decentred, because algorithmic systems are co-shaping ways of knowing and being in the world.

This knowledge transformation has fuelled—and been fuelled by—utopian visions of open and transparent societies and science that lend strength to democratic processes and grassroots movements. Algorithmic systems indeed allow for *new modes of participatory and collaborative knowledge-making and knowledge circulation*. As a result, new modes of knowledge creation and transparency are emerging that may counter official narratives, monitor policy-making, and allow for collective action by engaging civil society organizations or individuals (Milan, 2013; D'Ignazio & Klein, 2020;

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Rajão & Jarke, 2018). The participation of citizens in collaborative knowledge-making is also actively sought by governments and public administrations (e.g., civic tech, participatory urban planning, or participatory budgeting) and research institutions (e.g., citizen science).

However, knowledge production within algorithmic regimes has also proven to be "violent" (McQuillan, 2022) or "harmful" (Noble, 2018; Eubanks, 2018). Over the past two decades, we have witnessed increased surveillance and control through corporate- and government-run algorithmic systems, along with the reinforcement of structural inequalities and systemic discrimination (O'Neil, 2016; Noble, 2018; Gebru, 2019; Prietl, 2019; D'Ignazio & Klein, 2020; Weber & Prietl, 2022; Chun, 2021; on how the bias discourse unfolded around Twitter's cropping algorithm, see Lopez, in this volume; on how the notion of bias and possible solutions are negotiated "within" the computer science community, see Kinder-Kurlanda & Fahimi, in this volume; on empowering everyday users in understanding and detecting potentially harmful algorithmic behaviours, see Eslami & Heuer, in this volume). Vast amounts of online data, for example, have become an increasingly important source of information for state security and, in particular, intelligence services (Lyon, 2014, 2015; on how data use and non-use informs German police, see Büchner et al., in this volume). Economic systems worldwide have likewise become centred around the collection and exploitation of personal data, leading to what Shoshana Zuboff (2019) has termed "surveillance capitalism." Importantly, pervasive and integrated algorithmic systems not only allow state and corporate actors to produce increasingly detailed knowledge about individuals or groups of people, but these systems also afford unprecedented power and control over individuals and groups (Véliz, 2021; McQuillan, 2022; on knowledge requirements to shape recommendation algorithms and power redistribution, see Poechhacker et al., in this volume).

In this volume, we use the term "regime" to conceptualize this transformation of knowledge production as more or less stable socio-material assemblages which surface as coherent patterns of thinking and acting in the world (Deleuze & Guattari, 1987, pp. 503; Bröckling et al., 2011, p. 17; Dean, 1999, p. 21). Any discussion of such regimes must address questions of knowledge and power, in particular, the capacity of social actors to govern both others and themselves by controlling truth claims (Foucault, 1977, p. 13; Foucault, 1980, p. 93; on how predictive systems allow rendering the future governable, see Egbert, in this volume; on how fake news produce new trust regimes, see Wiengarn & Arnold, in this volume; on how sensitizing activities with everyday users subtly foregrounds algorithms and establishes a shared understanding, see Storms & Alvarado, in this volume; on how scientific truth claims are made within algorithmic regimes, see Gramelsberger et al., in this volume): "There can be no possible exercise of power without a certain economy of discourses of truth which operates through and on the basis of this association" (Foucault, 1980, p. 93).

In *algorithmic* regimes "the techniques and procedures which are valorized for obtaining truth" (ibid.) are transformed due to the widespread deployment of algorithms and algorithmic systems. Algorithmic truth claims neglect or even oppose concepts of situated or partial knowledge (Haraway, 1988). Rather, truth claims put forth by algorithmic systems suggest not only that the knowledge produced by and through these systems provides "optimal solution[s] but that other possibilities are suboptimal by definition" (McQuillan, 2022, p. 109; on the epistemic positioning of academic data science, see Prietl & Raible, in this volume).

Hence, the ongoing transformation of society through algorithmic systems is not a mere technology-induced shift in social and scientific knowledge production, but instead leads to an "epistemic colonization" (Gillespie, 2014; see also Beer, 2018; Kitchin, 2014, 2022) and *new knowledge regimes*. To grasp the complexity and momentousness of this shift, it is necessary to look beyond the technical nature of algorithms to acknowledge the wider social, political, cultural, economic, and material entanglements of algorithmic systems as they apply to the generation, accumulation, storage, and connection of (big) data (Seaver, 2017, 2019; on how different framings of machine learning as black boxes produce different socio-technical boundaries within and of algorithmic regimes, see Jarke & Heuer, in this volume; on how algorithmic interactions are constantly reconfigured by different socio-technical, economic, and political drivers, see Boeva & Kropp, in this volume). Powerful discourses purport that algorithms are not only the key to objective and universal knowledge production but also "fixes" for social problems. These discourses are just as relevant to understanding current shifts in society's truth regime as the multiple economic and political drivers that are pushing to integrate algorithms across civic, social, economic, industrial, administrative, and academic arenas of knowledge production.

Three interconnected aspects are crucial for understanding algorithmic regimes and their importance to how people produce knowledge and thus make sense of the world: (1) the *methods* of designing and researching algorithmic systems; (2) *interactions* and how algorithmic systems reconfigure them; and (3) the *politics* and power relations engrained in algorithmic regimes. Although we discuss these three perspectives on algorithmic regimes separately, they are closely related to one another in reality, making their distinction foremost an analytical one. For example, the question of which methods to use for studying and designing algorithmic systems is a highly political one, because different methods allow us to attend to different aspects of algorithmic systems. Interactions within algorithmic regimes take different forms depending on the power relations underpinning specific interactional settings.

To shed light on algorithmic regimes as proposed above, this volume brings together interdisciplinary perspectives that explore each aspect in a dedicated section. Contributions in Section I, "Methods," review and *propose methods for algorithmic systems research and design*. We start with a general review of how algorithms and algorithmic systems have been conceptualized and understood in critical algorithm studies and wider social science and humanities discourses, followed by methodological implications for researching and designing algorithmic systems. Section II, "Interactions," offers insights into *how algorithmic regimes reconfigure interactions*. Multiple ways of interacting with data, algorithms, and algorithmic systems are discussed, illustrating how these interactions not only produce personal, interpersonal, or public knowledge, but also generate trust in algorithmic truth claims. Further complicating the matter, interactions with algorithmic regimes are not consistently obvious to actors, an insight that suggests a variation in issues that may emerge depending on individual algorithmic understandings. Contributions in Section III, "Politics," consider *how power relations are engrained in algorithmic regimes*. By viewing questions of knowledge (production) as inextricably intertwined with questions of power, this section starts by reviewing the literature on algorithmic bias, considers research into the capitalist, sexist, as well as (post)colonial structuring of algorithmic regimes, and then turns to approaches to tackling these problems through artificial intelligence (AI) ethics and initiatives for fair and trustworthy algorithmic systems.

Each section consists of four chapters followed by a commentary. We introduce each section in greater detail and summarize the chapters and commentaries below. Finally, we close this introduction with a reflection on what it means to know (and come to know) in algorithmic regimes.

Methods: What Are Algorithmic Systems and How Can We Study Them?

Considering the literature on critical algorithm studies and the wider discourse on algorithms and algorithmic systems in the social sciences and humanities, a central question that repeatedly arises is what scholars

```python
def bubble_sort(seq):
    changed = True
    while changed:
        changed = False
        for i in range(len(seq) - 1):
            if seq[i] > seq[i+1]:
                seq[i], seq[i+1] = seq[i+1], seq[i]
                changed = True
    return seq
```

Figure 1.1. Bubble sort algorithm in Python. Source: Rosetta Code (2023).

mean when referring to "algorithms" or "algorithmic systems." The concept of algorithms, it seems, has travelled far and wide from its technical roots in computer science and mathematics to encompass a broad variety of phenomena that now captivate critical social science and humanity scholars. All "[t]his talk about algorithms" in the social sciences has been criticized, though, as not speaking about "*actual* algorithm[s]" (Seaver, 2017, p. 1, emphasis in original) but rather about algorithms as ephemeral and intangible phenomena (Burke, 2019; Dourish, 2016). Many social science studies about algorithmic systems tend to explore spatiotemporal processes of their design, use, and application (Dahlman et al., 2021). So the question remains: What exactly do we mean when we talk about algorithms and algorithmic systems?

In computing, an algorithm is a finite, definite, effective procedure that applies a computational rule to transform an input into an output (Knuth, 1968–2022). Cormen et al. (2000) define an algorithm as any clearly circumscribed computational procedure that takes some value, or set of values, as an input and produces some other value, or set of values, as the output. Canonical examples of algorithms include search algorithms or sorting algorithms such as bubble sort (Figure 1.1) or quicksort. A classic example of an algorithm is Euclid's algorithm, which is used to find the greatest common divisor of two integers. Dijkstra's algorithm, a famous algorithm used to determine the shortest path between two nodes in a graph, is applied in some form today by Google Maps and other geo-services.

In the above definitions, algorithms are characterized technically as being comprised of an input, an output, states of computation, and a computational rule. Specifically, an algorithm may be defined as consisting of a logical component (knowledge about the problem) and a control component (strategies for solving the problem) (Kowalski, 1979). Introna (2016) used those two components as the starting point to consider not what algorithms *are* but what constitutes their *doing*. There are multiple ways to characterize what algorithms "do." Considering the bubble sort algorithm or Google's page rank, we could say that they *sort* or *rank*. Following Introna, however, this definition is of limited utility, "as it conceals the implicit operations or assumptions that are necessary for such an answer to make sense" (2016, p. 21). What we could also say is that an algorithm such as bubble sort *compares* two values (Figure 1.1, line 6) in order to decide whether to *swap* them (Figure 1.1, line 7). Comparison serves the goal of sorting. This, Introna holds, is the action (or doing), the *temporal flow* of the code that enacts the sorting process. In these technical definitions of algorithms, the "programming subject" (Mackenzie, 2013) defines the *logical conditions* by rendering a problem in a particular way (e.g., that social entities need to be ranked) and the *structures of control* by implementing computational rules for solving the problem (e.g., specific sorting algorithms). Hence, those who program algorithmic systems inscribe certain understandings, assumptions, and ideas about the social world, including how (social) problems can or should be technically solved. This possibility to read and analyse what software code does is limited, however, to classic imperative programming. A programmer (or a team of programmers) explicitly programmes an algorithm in a programming language, meaning they write the instructions and computational rules that constitute said algorithm. But even in this case, the following should be acknowledged:

> The longer the system has been running, the greater the number of programmers who have worked on it, and the less any one person understands it. As years pass and untold numbers of programmers and analysts come and go, the system takes on a life of its own. It runs. That is its claim to existence: it does useful work. However badly, however buggy, however obsolete—it runs. And no one individual completely understands how. (Ullman, 1997, pp. 116–117, cited in Introna, 2016, pp. 25–26)

Circumscribing "the algorithm" can become nearly impossible, as it may not even exist within one computer, network, or organization (Dourish, 2016).

With the rise of machine learning (ML), we are witnessing a fundamental shift in how computational rules come to be. In ML, computational rules (the strategies for solving a problem) are not explicitly written in any programming language but inferred from data using an ML algorithm—a fact which makes ML-based systems fundamentally opaque. To illustrate: when applying the bubble sort algorithm, the specific computational rule is clear at each step. For an ML-based algorithmic system, the rule merely specifies how the input is transformed to infer the model, but not *how* the model is inferred. This is a crucial difference. On the one hand, it allows ML-based algorithmic systems to solve complex tasks like recognizing objects in images and translating languages. On the other hand, it increases the complexity and difficulty of studying ML-based algorithmic systems' logical conditions and structures of control (see Mackenzie, in this volume).

Hence, the methods for researching algorithmic systems depend on the programming paradigms used in their development. Algorithmic systems based on imperative programming can be explored through an analysis of their code, as has been shown by software studies or critical code studies (Mackenzie, 2017; Fuller, 2008). In contrast, algorithmic systems which are "trained" and based on ML escape these traditional methods. For such systems that infer rules from data, it is important to consider critically the data used to train them, the data providers, the practitioners who train and evaluate such systems, and the communities and collectives which use and (re)appropriate them (Costanza-Chock, 2020; D'Ignazio & Klein, 2020). Axel Meunier, Jonathan Gray, and Donato Ricci (2021) have suggested attending to "troublesome encounters" with algorithms, for example, "when things go wrong" or unexpected to attend to explore algorithms beyond computational processes.

The methods-related contributions in this volume provide interdisciplinary perspectives spanning the fields of computer science and human–computer interaction, philosophy, sociology, and science and technology studies (STS). They critically engage with ML in the interest of a deeper understanding and more transparent design of these systems. Taken together, the methods discussed empower researchers to explore the implicit and explicit assumptions "inscribed" into algorithmic systems (boyd & Crawford, 2012). As documented by Rieder (2017), algorithmic techniques travel between different scientific and non-scientific applications. Overall, contributions in this section consider how algorithmic systems may be evaluated, audited, and designed in ways that engender trust, fairness, and accountability.

Motahhare Eslami and Hendrik Heuer open Section I, "Methods," with their chapter, "Revisiting Transparency Efforts in Algorithmic Regimes," in which they discuss and evaluate existing human-computer interaction methods to study, research, and design algorithmic systems through the lens of transparency. Eslami and Heuer provide an overview of such approaches, point out where they fall short, and explore where new methodological designs are needed. Their review of folk theories and user beliefs suggests that when not designed carefully, interventions for algorithmic transparency can cause more harm than good. Based on these insights, the two authors call for widespread algorithmic literacy to help people make more informed decisions in their day-to-day encounters with algorithmic systems.

Chapter 3, "Understanding and Analysing Science's Algorithmic Regimes: A Primer in Computational Science Code Studies," by Gabriele Gramelsberger, Daniel Wenz, and Dawid Kasprowicz, provides a perspective from philosophy of science and technology. The authors propose computational science code studies (CSS) as a novel method for understanding the role of algorithmic systems in scientific knowledge production. In a case study involving computational astrophysics, they demonstrate how CSS can be used to analyse data structures, code layers, and code genealogies. The authors' method allows science studies scholars without a background in software development to study knowledge artefacts of scientific programming and reconstruct how scientific concepts and models are integrated into computational science models.

Chapter 4, by Elias Storms, a cultural sociologist, and Oscar Alvarado, a human–computer interaction scholar, is entitled "Sensitizing for Algorithms: Foregrounding Experience in the Interpretive Study of Algorithmic Regimes." In it, the authors address the question of how to involve people without technical expertise in participatory algorithmic systems research and design. Motivated by the complexity of the term "algorithm" and the low awareness of algorithms among most people, they propose and evaluate sensitizing activities that subtly foreground the presence of algorithms, thus raising algorithmic awareness and establishing a shared understanding without influencing the experiences or expectations of research participants.

In Chapter 5, "Reassembling the Black Box of Machine Learning: Of Monsters and the Reversibility of Foldings," Juliane Jarke and Hendrik Heuer explore the different ways in which we encounter machine learning as a black box. The contribution offers a critical reflection on machine learning grounded in STS. Jarke and Heuer identify three different understandings of ML-based systems as black boxes and demonstrate how the metaphor of the black box as a mode of inquiry permits the construction of different understandings as to what is considered a legitimate and constitutive element of an algorithmic system and what is not. In so doing, they draw attention to the ways in which black boxing serves as specific knowledge- and boundary-making practices in the emergence and stabilization of algorithmic regimes.

Chapter 6, "Commentary: Methods in Algorithmic Regimes," by Adrian Mackenzie, is a comment on this section. Mackenzie reflects on the four contributions and his own ways of knowing and coming to know algorithms and algorithmic systems. He wonders "whether all interest in algorithms stems from the deep unease occasioned by technical action" and asks whether living in an algorithmic regime produces (inevitably) methodological ambivalence. In highlighting that many things become infrastructural in algorithmic regimes, Mackenzie also offers advice for investigating algorithms and their effects. The author encourages fellow scholars to attend to breakdowns, follow the detours, and find "paths around corners and ways of opening doors." The difficulties inherent in embarking on these new and untrodden paths are demonstrated in how these four contributions wrestle with questions of knowing in algorithmic regimes.

Overall, this section demonstrates that calls for transparency, fairness, and accountability are only of limited utility (see also Lopez and Kinder-Kurlanda & Fahimi, in this volume). Algorithmic literacy is needed both to empower users in their everyday experience and to enable designers and researchers to critically question how such systems come to be configured. This includes awareness as to how algorithmic systems "solve" or address (social) problems, for example, about *logical conditions* that render a (social) problem in a particular way and *structures of control* that implement computational rules for solving it. Hence, in line with feminist STS and new materialism, algorithmic systems are best understood not as technologies that respond to existing problems, but rather as "apparatuses" (Barad, 2007) that produce reality through specific ways of configuring and framing problems in the first place. The knowledge produced through these systems therefore does not merely depict reality but produces it. In other words, how people engage with and come to know about algorithmic systems matters (Zakharova, 2022).

Interactions: How Do Algorithmic Regimes Reconfigure Interactions?

Section II, "Interactions," attends to some of the intended as well as unintended reconfigurations of social relations and trust in truth claims brought forth by algorithmic regimes. The chapters highlight how different forms of interactions, whether human–algorithm, human–human, or more-than-human, simultaneously configure and are configured by algorithmic systems. As illustrated by the burgeoning research in critical algorithm studies, data studies, and software studies, interactions with algorithmic systems happen both implicitly and explicitly.

First, human–algorithm interactions *transform everyday knowledge-making practices*, as has been exemplified by studies on self-tracking devices (Duttweiler et al., 2016; Lupton, 2016; Neff, 2016). People interact purposefully with algorithmic systems built into wearables like fitness trackers and apps, as well as with their physical data, to produce new empirical self-knowledge (Lupton, 2018), thereby creating an "algorithmic self" (Pasquale, 2015) and developing new forms of human–algorithm communication (Hepp, 2020). For example, Katrin Amelang (2022) considers how period-tracking apps produce forms of self-knowledge that go beyond traditional pen-and-paper practices. Now, though, tools previously viewed as enabling women to gain control over their bodies have become a source of increasing insecurity due to changing abortion legislation and fears of third-party access by the state or health insurance providers.

Algorithmic regimes also *transform how professionals come to know about key aspects of their work*. One social domain in which this currently applies is crowd work and platform labour. When platform users understand how their interactions with apps, platforms, and technologies affect them, typically in an unfavourable manner, they attempt to "game" these algorithmic systems (Irani, 2015; Rosenblat & Stark, 2016; Schaupp, 2021). Another example is education: algorithmic systems have also become central to how educators produce and implement knowledge about schooling and learning (Jarke & Breiter, 2019; Hartong & Förschler, 2019; Grant, 2022). In educational algorithmic regimes, teachers learn about students and their performance through algorithmic systems (Jarke & Macgilchrist, 2021). This leads to what Alice Bradbury (2019) has described as "data-driven subjectivities" and Neil Selwyn, Luci Pangrazio, and Bronwyn Cumbo (2022) termed "knowing the (datafied) student": both teachers and children make sense of learning successes and failures based on how they are computed and displayed in algorithmic systems.

In other more explicit instances of human–machine interactions such as coding, approaches such as visual programming languages aim to democratize computer programming and make it more accessible to a broader public (Alt, 2011; Noone & Mooney, 2018; Vee, 2017). Such accessible forms of programming that aim to improve coding literacy can be quickly learned and digested through online tutorials and the reuse of code, thereby propagating an algorithmic regime that retains a near-to-black box state (Heuer et al., 2021). Users mainly interact with inputs and outputs by reusing and recombining modularized algorithmic components in a graphical user interface (Chun, 2005; Eischen, 2003). The modularization and segmentation of algorithms as reusable and distributed components as part of the epistemic culture of computer science and software engineering drives an algorithmic regime of ignorance with unforeseeable consequences (Burke, 2019; Malazita & Resetar, 2019).

Second, and concerning human–human interaction, *algorithmic systems and their role in producing knowledge* relevant to these interactions *often remain inaccessible, or even invisible, to human understanding*. This applies, for example, to presumptive human-to-human interactions such as hiring, school admissions processes, or credit scoring. In these situations, algorithmic systems such as automated decision-making systems produce (discriminatory) truth claims that are often inaccessible to humans (Chiusi et al., 2020; Eubanks, 2018; Noble, 2018; O'Neil, 2016; see also the "Politics" section in this volume). Looking beyond such relatively privileged situations, attending to such epistemic transformations is particularly relevant in social arenas that are supposed to serve and support marginalized and minoritized populations. For example, Virginia Eubanks (2018) explored how algorithmic systems surveil, control, and disproportionately disadvantage families receiving social benefits. Paola Lopez (2019, 2021), Stefanie Büchner and Henrik Dosdall (2021), as well as Doris Allhutter and colleagues (2020), researched the algorithmic system employed by the Austrian Job Centre to determine the likelihood of a jobseeker finding a new job and receiving further job training. These case studies question the agency afforded to civil servants to challenge knowledge produced by algorithmic systems while simultaneously warning against the risks of algorithmic regimes.

Third, algorithmic systems reconfigure *relations and interactions on more-than-human and planetary scales* (Crawford, 2021; Gabrys, 2020). Using the visual and analytical metaphor of the atlas for their study of voice assistants such as Amazon Echo and others, Kate Crawford and Vladan Joler (2018) argue that personal interactions with these algorithmic devices are always also interactions between data, human labour, and earthly resources. Rarely do these interactions happen in real time, as human and planetary time differ in their pace. Instead, they serve to connect the digital and the physical, the natural and the artificial, humans and environments, to support computational power. For the various human actors involved, interactions with AI-based virtual assistants are increasingly becoming instantaneous acts. Furthermore, users and micro-workers are prompted to perform tasks such as data cleaning and labelling, thereby "impersonating" AI to overcome technology's shortcomings (Burrell & Fourcade, 2021; Shestakofsky, 2017; Tubaro & Casilli, 2022). By doing so, not only the algorithmic systems but also the human knowledge practices behind them become opaque in order to increase trust in their truth claims.

In sum, it is important to consider how and through which interfaces different users as well as producers and developers interact with algorithmic systems. This section asks which kinds of knowledge are produced through these practices, and which forms of interactions emerge in and through algorithmic regimes.

The first contribution to this section is Chapter 7, "Buildings in the Algorithmic Regime: Infrastructuring Processes in Computational Design," by Yana Boeva and Cordula Kropp. In it they present an empirical case study of human–algorithmic interactions in architectural practice from an STS, infrastructure, and software studies perspective. They examine ongoing changes in the production of buildings and built environments as algorithms, coding, and AI reconfigure design practice and knowledge. The chapter illustrates how the integration of algorithms into design software becomes a continuous "infrastructuring" process that happens through multiple social, technological, and politico-economic decisions. Infrastructuring, they argue, not only conceals algorithms and automation in software systems, thus making them unintelligible to architects, engineers, and urban developers even as they interact with them in design work, but it also reconfigures knowledge about and the design of the built environment.

In Chapter 8, "The Organization in the Loop: Exploring Organizations as Complex Elements of Algorithmic Assemblages," Stefanie Büchner, Henrik Dosdall, and Ioanna Constantiou introduce the role of organizations in shaping algorithmic regimes. Through interactions with different algorithmic assemblages, they argue that algorithmic regimes emerge within organizations—for knowledge production and integration. Presenting a cross-case comparison between predictive policing in Germany and algorithmic decision support systems in healthcare, the chapter foregrounds the role of organizations in producing algorithmic regimes, taking the conversation beyond the more broadly discussed roles of users and developers and into the field of organization studies.

Jörn Wiengarn and Maike Arnold's philosophical perspective focuses on the social-epistemic effects of the algorithmic regime of fake news. In Chapter 9, "Algorithm-Driven Reconfigurations of Trust Regimes: An Analysis of the Potentiality of Fake News," they present a taxonomy of potentially disrupting and far-reaching effects of interacting with—or, as they write, confronting—fake news. In their analysis of the impact of fake news on a person's trust network, they introduce three scenarios: a person interacting with fake news remaining robust towards a disinformation's source, a person becoming disoriented by it, or beginning to fully trust fake news and mistrust any other news sources. Given these findings, the growing and increasingly opaque presence of ML-based algorithmic systems in news and information creation and our everyday interactions with them call for closer examination.

Chapter 10, "Recommender Systems beyond the Filter Bubble: Algorithmic Media and the Fabrication of Publics," by Nikolaus Poechhacker, Marcus Burkhardt, and Jan-Hendrik Passoth, examines different algorithmic systems for information recommendation and how interactions with them construct publics. Following Bernhard Rieder (2017), the authors analyse two ideal-typical recommender systems used in well-known digital media systems, particularly by public broadcasters, and how those systems mediate between databases, interfaces, and practices in the formation of digital publics. Publics, they argue, drawing upon Dewey's pragmatist concept of "issue publics" (Dewey, 2006), are reconfigured by different algorithmic recommender systems by mediating between different practices within a wider algorithmic regime. How democratic societies are informed and develop knowledge depends on the recommendation approach employed and, more specifically, the interactions with it defined by those empowered to shape it.

Finally, Chapter 11, "Commentary: Taking to Machines: Knowledge Production and Social Relations in the Age of Governance *by* Data Infrastructure," by Stefania Milan, rounds off the section by reflecting on the four contributions and how algorithmic regimes affect social interactions. As algorithmic developments take over critical social decisions, for Milan, a continuous activity of "taking to machines," algorithmic regimes manifest modes of "governance *by* data infrastructure." These modes of governance transform our social interactions, which she encourages us to consider carefully as they increasingly begin to dominate knowledge production and publicly relevant decisions. The opaque state of algorithmic regimes and their data infrastructures has the potential to shift "agency, control, and sovereignty away" from the public to algorithmic agents (and the tech industry), depending on interests and also on interactions, as the four contributions emphasize.

Overall, this section and its contributions highlight how existing forms of knowledge are reconfigured while new ones are created as people interact with algorithmic systems and take part in algorithmic regimes. Algorithmic interactions, as the contributions illustrate, can impact individuals even in situations where they might not be deploying an algorithmic system directly, as in the case of public servants using automated decision-making systems. When users have to rely on these systems, such as public servants, professionals, and news producers and the multiple organizations they belong to, the result is a reshaping, not only of the practices and structures of knowledge legitimation but also the grounds upon which current and future societies exist. Accordingly, turning our attention to interactions with algorithmic systems allows us to see how algorithmic regimes emerge.

Politics: How Are Power Relations Engrained in Algorithmic Regimes?

Studying the politics of algorithmic regimes often reveals the strong linkage of regulatory, technological, and economic issues within knowledge production and the opaque ways in which institutions and companies distribute and standardize knowledge. Section III, "Politics," largely follows the Foucauldian understanding of the term politics, thus, looking at the ways that knowledge and power are co-constitutive. The chapters in this section, therefore, zero in on this claim by focusing on different dimensions of the power/knowledge nexus in algorithmic regimes.

In recent years, the politics of algorithmic systems have gained increasing attention, especially when it comes to instances of bias in AI and algorithmic discrimination (Noble, 2018; Gebru, 2019; Prietl, 2019; D'Ignazio & Klein, 2020; Weber & Prietl, 2022; Chun, 2021). This research argues that discriminatory results should be considered less as "bugs"—implying a quick-fix mentality—but instead should be seen as pervasive to algorithmic systems' design and execution, starting with the epistemological assumptions that inform them. One important gateway for discrimination is the (training) data sets upon which ML algorithms are based. These often mirror historically established asymmetries of in/visibility, for instance, under-representing already marginalized social groups (with regards to a gender data gap Criado-Perez, 2019; see also Lopez, 2021). Data, however, are only one aspect of the problem. Other aspects include epistemological and/or ontological assumptions such as the belief that data can speak for itself (termed "data fundamentalism" by Crawford, 2013), an attitude of "technosolutionism" according to which all (social) problems can ultimately be solved through technologies (Morozov, 2013), or the premise that knowledge derived from historical data can be used to predict and *nota bene* even shape the future (cf. Rona-Tas, 2020; Esposito, 2021; Eyert & Lopez, 2023). Given the growing awareness of algorithmic discrimination, the politics of digital technologies are also increasingly being acknowledged as a serious societal challenge.

Current efforts to tackle connected problems predominantly either take the form of calls for ethics (Floridi et al., 2018; Dignum, 2018; Hagendorff, 2020; Prietl, 2021) or organizing workshops and conferences under the headings FAccT and FAT/ML to debate how fairness, accountability, and transparency in machine learning can be achieved.

In grappling with the question of how the new modes of algorithmic knowledge production and decision-making are connected to social relations of power, scholars have also problematized the structuring of AI and digital platforms more fundamentally, pointing to the political economy of digitalization and datafication. Some have stressed their capitalist nature (Zuboff, 2019; Srnicek, 2016, 2018), pointing out that a handful of private corporations seek to dominate the development of AI and other algorithmic technologies by controlling vast amounts of data plus the technological infrastructure for generating, storing, and processing these data (boyd & Crawford, 2012; Lyon, 2004). Others have highlighted the military background and governmental use of AI for surveillance and warfare technologies (Lyon, 2004; Weber, 2016; Eubanks, 2018). Considering that most influential (corporate and government) actors are located in the Global North, algorithmic regimes are also described as situated within (post)colonial structures (Hagerty & Rubinov, 2019). This is especially visible when it comes to the workforce required for developing algorithmic systems. Whereas those responsible for conceptualizing, designing, and developing algorithmic technologies constitute a rather homogenous group of predominantly "white," well-educated, and socio-economically privileged men, the largely invisible, less glamorous, low-skilled, and low-paying work of content moderation or simple data handling is done by a mostly anonymous (online) crowd of workers located in the Global South (Qiu, 2022; Gray & Suri, 2019).

Focusing on the socio-material effects of algorithmic systems, Stefania Milan and Emiliano Treré (2019) have further argued against "universalist" interpretations of the increasing importance of algorithmic systems and digital data, thus challenging predominant narratives of algorithmic systems in the sciences. Rather, scholars need to consider how communities and people live with and experience algorithmic regimes differently depending on where they are situated. These experiences take many different forms: from the border control of migrant bodies that are detected and governed differently through algorithmic systems (Gundhus, 2021) to the ways in which knowledge about algorithmic systems enables or disables social and economic advancement in underprivileged communities (Rangaswamy & Narasimhan, 2022).

As these works demonstrate, studying the political nature and impact of algorithmic regimes is not limited to questions of algorithmic bias. It is also about who configures and shapes algorithmic regimes, to what ends and for whose benefit, what are the dominant ideas and imaginaries underpinning this development, how are they negotiated, institutionalized, and materialized, and which realities do algorithmic regimes enact. Put differently, and as feminist and other critical perspectives in STS have long argued, technical artefacts and the epistemological and methodological premises of knowledge production are inextricably linked to questions of politics and power; they are neither neutral nor objective (Haraway, 1988; Barad, 2003; Weber, 2016; Beer, 2018).

Chapter 12, "The Politics of Data Science: Institutionalizing Algorithmic Regimes of Knowledge Production," by Bianca Prietl and Stefanie Raible, presents an empirical study of the academic institutionalization of data science in Germany, Austria, and Switzerland that draws on the tradition of Foucauldian discourse analysis as power analysis. By analysing how data science is structurally implemented, epistemologically positioned, and discursively legitimized, the authors aim to capture the power dynamics incorporated in the establishment of a specific regime of knowledge production, one that is based on algorithmic big data analysis. The chapter offers a critical engagement with data science as a crucial actor in professionalizing, promoting, and legitimizing algorithmic modes of knowledge production.

In Chapter 13, "Algorithmic Futures: Governmentality and Prediction Regimes," Simon Egbert proposes to analyse predictive analytics and the corresponding applications as "prediction regimes," understood as a subtype of algorithmic regimes. Drawing on the Foucauldian notion of truth regimes and the close nexus of power and knowledge, he highlights the important role of predictive algorithms when it comes to deciding in the present based on algorithmically produced knowledge about the future. Drawing on works from governmentality studies, he argues that (predictive) algorithms are "rendering devices," making the future calculable and, hence, governable in the present, ultimately demonstrating the inherently political character of algorithmic regimes.

In Chapter 14, "Power and Resistance in the Twitter Bias Discourse," Paola Lopez discusses the case of the cropping algorithm from the microblogging and social networking service Twitter, which was heavily criticized in the autumn of 2020, as users observed that the machine learning-based cropping tool for preview pictures discriminated against Black people, systematically cutting their faces from preview pictures more often than for White people.

Combining a Foucauldian perspective on the power/knowledge nexus with a mathematical perspective that examines the mathematics of algorithmic systems, Lopez discusses the problems and underlying questions of machine bias, fairness, and transparency that become salient in Twitter's "biased" cropping tool and the company's reaction to this critique.

Chapter 15, "Making Algorithms Fair: Ethnographic Insights from Machine Learning Interventions," by Katharina Kinder-Kurlanda and Miriam Fahimi, offers an (auto)ethnographic analysis of how an interdisciplinary project consortium (NoBIAS) grapples with making algorithms less biased and, hence, fairer. Bringing a cultural anthropology approach to STS, they focus on the importance of computer science experts as key "intellectuals" in algorithmic regimes and reconstruct the negotiation of different understandings of algorithms, on the one hand, and fairness and bias, on the other. In doing so, they point to the fact that, all technical complexities aside, actually making an algorithm fair is often not a straightforward undertaking.

The section concludes with Chapter 16, "Commentary: The Entanglements, Experiments, and Uncertainties of Algorithmic Regimes," a comment by Nanna Bonde Thylstrup that reflects upon the chapters of this section, arguing that in engaging with the politics of algorithmic systems it is necessary not only to attend to the ways in which they generate new modes of control, organization, and knowledge production, but also to how these new modes of knowledge production are constituted by messes, failures, and uncertainties.

As the chapters in this section demonstrate, there are no easy answers to questions of power and politics in algorithmic regimes. This is especially true when taking bias, discrimination, and fairness as starting points that remain properties of algorithmic systems and hence often seen as in need of a techno-fix (for a critique of such supposedly ready to implement "solutions," and the proposition of an "ethics of doubt," see Amoore, 2020). Throughout the contributions in this section, the power/knowledge nexus reveals itself to be closely connected to forms and practices of in/visibility. Whenever there is opaqueness in an algorithmic regime, those obscured issues are not likely to become part of discourses or practices—whatever is kept in the dark will probably not join the ranks of public knowledge. This insight underlines the importance of taking a (self-)reflexive stance towards algorithms, considering them from an inside-out perspective by researching key actors but also by establishing a broad, open, and participatory societal discussion about algorithmic regimes, their relationship to power, and their practical limits. This means, as McQuillan (2022) argues, that we not only need algorithmic literacy but also feminist literacy that allows us to uncover systemic and structural power imbalances and inequalities in our contemporary algorithmic regimes.

Conclusion: Re-imagining Algorithmic Futures

How different social actors come to know about and make sense of the world has been transformed profoundly through the deployment of algorithms and algorithmic systems of knowledge production. This volume explores how the epistemological, methodological, and political foundations of knowledge production, sense-making, and decision-making change in contemporary societies by focusing on three distinct but highly interrelated aspects of what we propose to analyse as *algorithmic regimes*: (1) the *methods* to research and design algorithmic regimes; (2) how algorithmic regimes reconfigure *interactions*; and (3) the *politics* engrained in algorithmic regimes. The contributions in this volume demonstrate that algorithmic systems now operate as constitutive parts of knowledge creation about social processes and social interactions as well as constitutive parts of knowledge circulation within them. The related applications are highly diverse: algorithmic decision-making systems decide on eligibility for social welfare, (pre)select job applicants, or even establish new research paradigms based on so-called data science methods. Concluding this introduction, we would like to take a step back and consider the implications of our endeavour on a broader scale and what it might mean for re-imagining algorithmic futures.

This volume and other critical works serve as a warning against algorithmic systems that claim to provide universal answers to complex social problems and simple truths about social reality based on the claim of "optimization" (McQuillan, 2022; D'Ignazio & Klein, 2020; Hepp et al., 2022). In algorithmic regimes, validation is emphasized over verification processes and scientific concepts of truth and probability are replaced with trust and reliability (e.g., Weber & Prietl, 2022). As a result, an "ontology of association" (Amoore, 2011) starts to dominate, which privileges correlation over causation. In many instances, complex social and structural problems (such as equal access to education) come to be configured as individual. This framing shifts our attention and scope of action from structural barriers to educational equity to a responsibilization of individuals (Macgilchrist, 2019). Hence, knowledge produced by and through algorithmic systems is in many instances reductionist and even harmful.

In light of increasing uncertainty about humanity's future and questions about the basic values on which our societies stand, it seems more important than ever to consider which kinds of knowledge we value and which knowledge regimes we look to for answers to multiple collective uncertainties and challenges—including climate disaster, racial injustice, the care crisis, war, or displacement. Feminist scholars have long argued that all knowledge is situated and partial (e.g., Haraway, 1988). This also holds for algorithmic systems. Even though they strive to appear otherwise, algorithmic systems are not value-neutral. They configure algorithmic regimes through optimization, exclusion, colonization, and a positivist reproduction of existing social orders. In so doing,

> [c]urrent AI overlooks the work of care that underpins the world, and replaces it with datafied models of reality that are disconnected and domineering.... Adopting AI as our prosthetic, as our extended means of knowing the world, brings certain consequences in how the world becomes objectified.... If we are aiming instead for an alternative based on care and repair, it matters what we ground our knowledge on. (McQuillan, 2022, pp. 107–110)

Algorithmic regimes devalue and invisibilize the work and knowledge practices of caregivers (D'Ignazio & Klein, 2020; Zakharova & Jarke, 2022). It is our collective responsibility (and hope) to consider how algorithmic systems can be (re)configured to serve the common good. This requires, as many of the contributions in this volume show, algorithmic literacy and transparency into how algorithmic systems define (social) problems and come to be configured as sites of knowledge production (and truth claims) about social processes and relations. This is not merely a technical challenge that might involve "ethics checklists" being applied by software engineers, but instead requires a broader dialogue about the algorithmic future(s) we want to live in. Considering new modes of knowledge production as algorithmic regimes provides a critical lens through which it is possible to question the objectivity and validity of algorithmic truth claims and connect them to how power becomes manifest.

Ultimately, this leads to the question of what kind of society we want to live in. Which socio-technical futures do we desire? How can we imagine futures of social justice, social cohesion, and caring communities in (opposition to) algorithmic regimes? At the core of these questions lies the realization that algorithmic systems do not operate separately from the social world, but as part of its ongoing becoming.

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