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Working and organizing in the age of the learning algorithm

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A B S T R A C T

Learning algorithms, technologies that generate responses, classifications, or dynamic predictions that resemble those of a knowledge worker, raise important research questions for organizational scholars related to work and organizing. We suggest that such algorithms are distinguished by four consequential aspects: black-boxed performance, comprehensive digitization, anticipatory quantification, and hidden politics. These aspects are likely to alter work and organizing in qualitatively different ways beyond simply signaling an acceleration of long-term technology trends. Our analysis indicates that learning algorithms will transform expertise in organizations, reshape work and occupational boundaries, and offer novel forms of coordination and control. Thus, learning algorithms can be considered performative due to the extent to which their use can shape and alter work and organizational realities. Their rapid deployment requires scholarly attention to societal issues such as the extent to which the algorithm is authorized to make decisions, the need to incorporate morality in the technology, and their digital iron-cage potential.

1. Introduction

Recent technological developments have given rise to algorithms that are capable of learning from data to undertake tasks that previously required human judgement. Such a development could be the most consequential to work and organizing since the beginning of the digital age sixty years ago. Algorithms have historically been understood as a program containing a fixed sequence of instructions executed until a solution is reached (Hopcroft & Ullman, 1983). Algorithms function by taking in data that has been restructured, formatted, and prepared for processing. With continuous advances in programming science, coupled with Moore's law (the continuous increase in hardware computing power), algorithms are becoming more predominant and performant, reaching a crucial stage of evolution. With the digitization of most economic and social interactions, algorithmic technologies are now being used on a hitherto unforeseen and unknown scale. Driving the change is the emergent set of learning technologies that were developed in the field of artificial intelligence. For the first time since the rise of the field of artificial intelligence half a century ago, learning algorithms are able to perform reliably, and potentially exceed, an increasing array of tasks that historically had been the domain of humans. We use the term learning algorithms to refer to an emergent family of technologies that build on machine learning, computation, and statistical techniques, as well as rely on large data sets to generate responses, classifications, or dynamic predictions that resemble those of a knowledge worker.

Beyond the recognition that a growing part of humanity now collaborates and communicates digitally, it is important to recognize that such technologies are increasingly impacting broader aspects of society. For example, algorithms change newsroom culture by providing a measure of the readership of online newspaper articles, to emphasize stories likely to be popular (Christin, 2014). They

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alter legal procedure and judicial discretion by introducing statistical models of crime prediction in legal proceedings and identifying perpetrators (Christin, 2016). Algorithms that manage engine functioning have been used by car manufacturers to defeat engine pollution tests (Ramsey, 2015) or by Uber to avoid city inspections (Krisher, 2017). Algorithms are also constitutive for the modern electoral campaigns, as they help sway votes by targeting individual citizens with customized cross-platform communications that emphasize select memes, images, keywords, hashtags, analyses and stories, based on an analysis of the content of a person's corpus of online communication (Cadwalladr, 2016; Shaffer, Carey, & Starling, 2017).

For many scholars, learning algorithms do not seem to qualitatively differ from previous developments of the digital age (e.g., the personal computer, the Internet, Web 2.0) that have each heralded novel ways of organizing or new business models. Algorithm developments enable digital platforms and the shift to short-term employment. They positively increase economic output by broadly increasing consumption (Brynjolfsson & McAfee, 2014). For firms, they increase economic gain via improved targeting capacities, reduced costs, and enhanced productivity (Newell & Marabelli, 2015). Beyond economic value, however, predictions of future consequences are mixed. Some analyses emphasize that learning algorithms are likely to take over major aspects of the knowledge economy, threatening to extinguish up to half of full-time jobs in the United States within two decades (Frey & Osborne, 2017). Despite the increasing prevalence of learning algorithms in every facet of work and life, and the multitude of associated predictions surrounding the future of work, scholars and practitioners alike are only now beginning to understand their transformative effects on work and organizing. The debate centers on the extent to which algorithms can take over many aspects of human work. What will matter is the capacity of contemporary workers to adapt their ways of knowing and working and embrace novel technologies, with augmentative effects (Brynjolfsson & Mitchell, 2017; Nelson & Irwin, 2014). In the balance of the paper, we examine emerging characteristics of algorithmic technologies and discuss how they might transform work and organizing, with implications for future research.

2. Consequential aspects of learning algorithms

In this section we examine certain emergent aspects of learning algorithms that make them highly consequential for work and organizing. More specifically, we distinguish four consequential aspects: black-boxed performance, comprehensive digitization, anticipatory quantification, and hidden politics.

2.1. Black-boxed performance

In today's digital era, users of web technologies are constantly presented with search results, ads, or personalized recommendations that cannot be easily explained, redressed, or adjusted because the algorithms behind them are opaque, inaccessible, and unmodifiable. For one, sophisticated algorithms such as Google's search, Facebook's newsfeed, or Amazon's recommendation algorithm constitute the "secret sauce" that is crucial to business success. They are worth billions of dollars and are tightly protected as intellectual property (O'Neil, 2017). Design choices are internal to the firm and unavailable for public scrutiny for both commercial and competitive reasons. As a result, unknown design choices that reflect social assumptions and economic valuation become inscribed into the software. Different people putting in the same search term are likely to generate different recommendations because the algorithm takes into account additional individual and contextual factors. Even if auditing were to be applied to such algorithms, understanding them would be limited only to a select professional class of knowledge workers with highly specialized skills and technical training for comprehending code of immense size and logical complexity (Dourish, 2016).

While the above sources of inscrutability could be said to apply to other more traditional types of algorithms as well, learning algorithms are even more opaque because they do not rely on pre-specified instructions, but on evolving weights and networks of connections that get refined with each additional data point (Burrell, 2016; Michalski, Carbonell, & Mitchell, 2013). As a matter of fact, even if a learning algorithm is coded in a very simple and comprehensible way, understanding how it arrived at its result can still be unclear, even to its developers, due to the quantity and complex interaction of the data fed into the algorithm. For example, when activists in the Occupy Wall Street movement accused Twitter of censoring their activities from becoming a trending topic, the engineers at Twitter insisted that no censorship had taken place, and while they could explain the code that they had written, they were unable to explain why the Occupy Wall Street activities did not become a trending topic (Dourish, 2016).

To some extent, the inscrutability of learning algorithms could prove to be a positive aspect because the less people understand how the learning algorithm comes to a certain outcome, the less they will try to "game" the system (O'Neil, 2016). This could result in decreasing corruption in various instances such as credit scoring in loan application processes, competitive tendering, or evaluation of work performance. From that perspective, learning algorithms can function as panopticons, imposing discipline that is often desired in the workplace (Burton-Jones, 2014; Zuboff, 1988). However, black-boxed performance may also result in various problematic situations. For legal learning algorithms that apply high legal standards to the judgement of civil or criminal cases, if defendants ask why they were convicted, it would not be fair to get a response from the system's developers that 'the system trained on tons of data and thus came to this decision' (Tegmark, 2017). Similarly, in an accident with a self-driving car, it could be difficult to identify the specific reasons that led the self-driving car to act in the way it did, so as to allocate legal responsibility accordingly (Knight, 2017). Overall, learning algorithms increasingly produce unknown and unexpected outcomes that cannot be explained by humans in a straightforward manner (Dourish, 2016). As we discuss later in greater detail, this poses significant consequences for various facets of work and organizing.

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