

The Democratization of Artificial Intelligence

Net Politics in the Era of Learning Algorithms

Andreas Sudmann

Diagnoses of time are naturally a difficult undertaking. Nevertheless, it is probably an adequate observation that, in our present historical situation, the concern for the stability and future of democracy is particularly profound (cf. Rapoza 2019). The objects of this concern are, on the one hand, developments which seem to have only a limited or indirect connection with questions of technology, such as the current rise of right-wing populism and authoritarianism, especially in Europe and in the US, or “the resurgence of confrontational geopolitics” (Valladão 2018). On the other hand, we witness an increasingly prevalent discourse that negotiates the latest developments in artificial intelligence (AI) as a potentially serious threat to democracy and democratic values, but which—with important exceptions—seems to be largely disconnected from the specific political conditions and developments of individual countries (cf. Webb 2019). Within this discourse, problematizing AI as jeopardizing democratic values and principles refers to different, but partly linked phenomena. Central reference points of these discussions are, for instance, the socio-political consequences of AI technologies for the future job market (catch phrase: “the disappearance of work”), the deployment of AI to manipulate visual information or to create ‘fake news’, the geo-political effects of autonomous weapon systems, or the application of AI methods through vast surveillance networks for producing sentencing guidelines and *recidivism risk* profiles in criminal justice systems, or for demographic and psychographic targeting of bodies for advertising, propaganda, and other forms of state intervention.¹

Prima facie, both forms of concern about the global state of democracy do not have much in common, but it is precisely for this reason that one needs to explore their deeper connections. For example, US President Donald Trump recently launched a so-called “American AI initiative”, whose explicit goal is to promote the development of smart technologies in a way that puts American interests first.

¹ It goes without saying that not all of those aspects that for some reason appear to be worthy of critique represent an immediate danger to the democratic order of a society. However, it is also obvious that government and society must find answers to all problems of AI.

At about the same time, Google/Alphabet announced that they had opened their first AI Lab in Ghana. Headquartered in Silicon Valley, the tech giant continues its strategy of establishing AI research centers all around the world: New York, Tokyo, Zurich, and now Ghana's capital Accra. According to the head of the laboratory, Moustapha Cisse, one of its goals will be to provide developers with the necessary research needed to build products that can solve some of the problems which Africa faces today. As an example of the successful implementation of such strategies, it is pointed out that with the help of Google's open source machine learning library TensorFlow an app for smartphones could be developed that makes it possible to detect plant diseases in Africa, even offline.

The 'humanistic' AI agenda of Google/Alphabet and other tech companies seems, at first glance, to be in sharp contrast to the "America First" AI policy by Donald Trump. However, the fact that the Silicon Valley corporations are increasingly striving to promote democratic values such as accessibility, participation, transparency, and diversity has nothing to do with a motivation to distance themselves from the course of the current US government. Rather, the number of critics who see Google, Facebook, and the other tech giants themselves as serious threats to democracy and/or acting in contrast to democratic values, in terms of their business strategies, data practices, and enormous economic and socio-cultural power, is growing.

Accordingly, these companies have been under considerable pressure to respond to this increasing criticism. Facebook in particular was involved in two major scandals, both concerning Trump's presidential campaign. First, in 2017, it gradually became known that Russian organizations and individuals, most of them linked to the Saint Petersburg based Internet Research Agency (an internet troll farm), had set up fake accounts on platforms such as Facebook, Twitter, and Instagram, and attempted to capitalize on controversies surrounding the 2016 US presidential election, partly by means of creating fake news. Another scandal involved the data analysis and political consulting company Cambridge Analytica. As it became public in March 2018, the company had access to and presumably analyzed the data of over 80 million Facebook users without their prior consent in order to support Trump's campaign.

As a consequence of these scandals, not only Zuckerberg but also Google's CEO Sundar Pichai recently testified to Congress in Washington. During those hearings, Zuckerberg in particular admitted several failures in the past and promised to intensify cooperation with government institutions and NGOs, as well as to investigate measures to improve data protection and finally to implement them accordingly. As far as Europe is concerned, the European General Data Protection Regulation ("GDPR") already contains legal requirements for improving and complying with data protection. In the congressional hearings, Zuckerberg declared that he is in principle willing to support similar measures of state regulation in the

US. At the same time, he expressed fears that Chinese competitors could technologically outperform his corporation because the country traditionally puts much less emphasis on data protection issues than Europe or the US (cf. Webb 2019). However, there are other reasons for Facebook's willingness to cooperate in terms of data protection policies: At least since the takeover of WhatsApp and Instagram, Facebook has achieved a *de facto* monopoly position in the social media sector. The situation is similar with Amazon in e-commerce and Google in search engines – and it is precisely this enormous hegemonic position which is increasingly subject of intense debates. Recently, even co-founder and former spokesman of Facebook, Chris Hughes (2019), criticized Zuckerberg's company as a threat to the US economy and democracy, and advocated for the company to be broken up in order to allow more competition in the social media sector. For various reasons, it is rather questionable whether such a scenario could occur in the near or distant future. Nevertheless, criticism of global "platform capitalism" (Srnicek 2016) or "surveillance capitalism" (Zuboff 2018) is growing, and this also concerns the role of AI in what recently has sometimes been called the new "data economy" (cf. for instance Bubbies 2017).

Not least with regard to the problems and phenomena mentioned so far, the aim of this volume is to explore the political dimension of AI, with a critical focus on current initiatives, discourses, and concepts of its so-called 'democratization'. One of the special characteristics of the latter term is that it is vague and concrete at the same time. As the current AI discourse reveals, the concept can refer to many different phenomena and yet evokes an ensemble of more or less corresponding or coherent conceptions of its meaning. Accordingly, democratization can be understood as the realization of an ethic, aiming at political information, a willingness to critique, social responsibility and activity, as well as of a political culture that is critical of authority, participative, and inclusive in its general orientation. Democratization can thus be conceived as a political, interventionist practice, which in principle might be (and of course has been) applied to society in general as well as to several of its subsystems or individual areas (like technology).²

One central question to be critically examined in this volume is to what extent network politics (and particular those related to ideas and activities of democratization) have been placed under new conditions with a view to the broad establishment and industrial implementation of AI technologies. The concept of network politics is understood here as a heuristic umbrella term for a broad spectrum of

² Of course, in political theory, the term also signifies a transition to a more democratic regime, or describes the historical processes of how democracies have developed. For a discussion of the term democracy and democratization cf. Birch (1993), for discussing on the relationship of democracy and technology, cf. for instance the contributions in Mensch/Schmidt (2003), Diamond/Plattner (2012) or Rockhill (2017).

critical research, to shed light on the different forms of how networks and politics are intertwined and related, both as socio-technical discourses and practices. As such, it addresses the network dimension of politics as well as the political conditions, implications, and effects of different types of social, cultural, or technological networks, including but not limited to the Internet or so-called social media.³ Accordingly, the volume does not only aim at exploring the political aspects of the relationship between AI and Internet technologies in the narrower sense (e.g. legal frameworks, political content on social media etc.). Rather, the critical focus involves looking at the networked and mediated dimension of *all* entities involved in the production and formation of current and historical AI technologies.

First of all, such a task needs some clarifications regarding the concept of AI because the term encompasses various approaches which are not always precisely differentiated, particularly in public discourse. When people talk about AI these days, their focus is mostly on so-called machine learning techniques and especially artificial neural networks (ANN). In fact, one can even say that these accounts are at the very center of the current AI renaissance. Sometimes, both terms are used synonymously, but that is simply wrong. Machine learning is an umbrella term for different forms of algorithms in AI that allow computer systems to analyze and learn statistical patterns in complex data structures in order to predict for a certain input x the corresponding outcome y , without being explicitly programmed for this task (cf. Samuel 1959, Mitchell 1997). ANN, in turn, are a specific, but very effective approach of machine learning, loosely inspired by biological neural networks and essentially characterized by the following features (cf. Goodfellow/Bengio/Courville 2016):

1. the massive parallelism of how information is processed/simulated through the network of artificial neurons
2. the hierarchical division of the information processing, structured in learning simple patterns to increasingly complex ones, related to a flexible number of so-called hidden layers of a network
3. the ability of the systems to achieve a defined learning goal quasi-automatically by successive self-optimization (by means of a learning algorithm called “backpropagation”)

Indeed one can claim that the current boom of ANN and machine learning in general is quite a surprise, given that the technological foundations of this so-called connectionist approach in AI have already been researched since the early days of computer science and cybernetics (cf. e.g. McCulloch/Pitts 1943, Hebb 1949, Rosenblatt 1958). However, with the notable exception of some shorter periods,

³ For an overview on the long tradition of research on net politics, cf. for example Lovink (2002).

ANN have been considered more or less a dead-end in the history of AI research (Sudmann 2016, 2018a). This assessment is likely to be radically different today, even if a considerable number of commentators are pointing to (still) fundamental limitations of ANN or continue to uphold the importance of other approaches in AI research, for instance symbolic and rule-based forms (cf. Pasquinelli 2017, Marcus 2018).

There is some dispute concerning when exactly the current AI boom started. Some experts stress certain development leaps around 2009 in the field of natural language processing (NLP) and speech recognition. However, progress in the field of computer vision (CV) was of particular importance. In 2012, a research team at the University of Toronto won a competition for image recognition called ImageNet, reducing the error rate of previous approaches by more than half. This leap in performance became possible because so-called convolutional neural networks (CNN), i.e. networks optimized for the task of computer vision, were, for the first time, consistently and effectively trained on the basis of GPUs, i.e. fast, parallel-organized computer hardware, as they have been typically implemented in modern game consoles (Sudmann 2016).

In any case, the major IT corporations also quickly registered progress in the field of computer vision and ANN, which led to a veritable boom in the acquisition and financing of start-ups. One of these start-ups was DeepMind, which was acquired by Google in 2013 for 650 million US dollars. Three years later DeepMind's AI system AlphaGo was able to beat the human world champion in the board game Go. With the success of AlphaGo, the AI boom had arrived in the mainstream, i.e. AI quickly became a dominant discourse in many areas of culture and society, including most fields of sciences (Sudmann 2018a, 2018b).

The latter does not mean that ANN were completely unknown in the fields of humanities and social sciences in the years before 2016. Especially around the early 1990s, interest in ANN grew considerably in areas like cognitive science and the philosophy of mind, shortly after the first industrial implementations of ANN took place and thanks to the establishment of the backpropagation learning algorithms in the 1980s (Sudmann 2018a, cf. also the interview with *Alexander Waibel* in this anthology). However, it can hardly be denied that in many disciplines the overall attention for ANN was rather limited even back then. In the end, the upswing of ANN in the 1980s turned out to be quite short, which is why some observers feel validated in their belief that the next AI winter will come – it is just a question of time. Of course, such an event could happen again, but currently there is no indication for this, rather the contrary seems to be the case.

Nevertheless, the ubiquitous talk of an “AI revolution” and the rhetoric of progress by Silicon Valley techno-utopists alone is a massive provocation for many critics, not only in the field of humanities, but also outside the academic world. Undeniably, since the very beginning, the debate on AI has typically been char-

acterized by either skeptical, utopian or dystopian narratives (cf. Sudmann 2016, 2018b).⁴ And even today, careful mediations between these positions are still rare. As such, many discussions on AI are geared towards the speculative horizon of a near and distant future. And it is also no coincidence that AI has been described ironically as the very field of research that is concerned with exploring what computers *cannot yet do* (cf. Michie 1971). In other words: As soon as a computer masters certain abilities, such a system is no longer considered to be AI. Hence, AI is permanently shifted into the realm of utopia (or dystopia).

At the same time, we have only recently entered a historical stage in which the gap between AI as science fiction or technical utopia and AI as existing technology of the empirical world seems to be closing. Of course, one may rightly point out here that, for example, self-driving cars were already being tested on roads during and even before the 1980s,⁵ or that first machine translation systems for languages were actually being developed in the 1950s (cf. Booth/ Locke 1955), but this does not change the fact that both technologies have only recently acquired or come close to the potential of applicability that the global economy expects of them.

AI's industrial usability and its increasingly outperforming human capabilities in various fields of applications seem to be new phenomena. However, computers have been a form of 'AI' from the very first day and were as such able to do things humans (alone) were not equally capable of, for example cracking the code of the German encryption machine Enigma (cf. Kittler 2013, cf. Dotzler 2006).

Given the rapid speed of new innovations and the expansion of fields of application, it is by no means an easy task to determine how AI reconfigures the relation between humans, technology, and society these days and impacts how we might be able to grasp the political and historical dimension of this shift in an adequate manner.

Finding an answer to this question implies a reflection of problems that have been discussed in the AI debate since the very beginning, for example the transferability of traditionally anthropocentric concepts such as perception, thinking, logic, creativity, or learning to the discussion of 'smart machines'. Indeed, it is still important to critically address the anthropological difference between humans and machines, to deconstruct the attributions and self-descriptive practices of AI, as *Anne Dippel* and *VN Alexander* demonstrate in their respective contributions. In her essay, *Anne Dippel* combines three stand-alone commentaries, each dealing with a different facet of AI, and each revolving around a different underly-

⁴ Already back in the late 1980s, the German media scholar Bernhard Dotzler wrote that all known forecasts of AI could already be found in Turing's writings (1989).

⁵ For example, the so-called Navlab group at Carnegie Mellon University has been building robot vehicles since 1984. Carnegie Mellon was also the first university to use ANN for developing self-driving cars.

ing metaphor: intelligence, evolution, and play. Her first commentary constitutes an auto-ethnographic vignette which provides a framework for the reflection on artificial ‘intelligence’ and the alleged capacity of machines to ‘think’; both—as Dippel argues—very problematic metaphors from a feminist perspective with regard to the (predominantly) female labor of bearing and rearing intelligent human beings. The second one is an insight into her current ethnographic fieldwork amongst high-energy physicists, who use machine-learning methods in their daily work and succumb to a Darwinist metaphor in imagining the significance of evolutionary algorithms for the future of humanity. The third commentary looks into ‘playing’ algorithms and discusses the category of an ‘alien’, which, albeit controversial in the field of anthropology, she considers much more suitable in order to understand AI than a direct personification, bringing a non-human entity to life. VN Alexander in turn stresses in her text that there is no evidence that AI systems are really capable of making ‘evidence-based’ decisions about human behavior. AI might use advanced statistics to fine-tune generalizations; but AI is a glorified actuary table, not an intelligent agent. On the basis of this skeptical account, she examines how Alan Turing, at the time of his death in 1952, was exploring the differences between biological intelligence and his initial conception of AI. Accordingly, her paper focuses on those differences and sets limits on the uses to which current AI can legitimately be put.

In addition to a critical analysis of current AI discourses and its central concepts, it is equally important to understand the assemblages of media, infrastructures, and technologies that enable and shape the use of AI in the first place. To meet this challenge, it is necessary to take due account of the specific characteristics and historical emergence of the heterogeneous technologies and applications involved (cf. Mckenzie 2017). Axel Volmar’s contribution “Productive Sounds: Touch-Tone Dialing, the Rise of the Call Center Industry and the Politics of Voice Assistants”, for example, reflects on the growing dissemination of voice assistants and smart speakers, such as Amazon’s Alexa, Apple’s Siri, Google’s Assistant, Microsoft’s Cortana, or Samsung’s Viv, which represent, in his words, a “democratization of artificial intelligence by sheer mass exposure”. He engages with the politics of voice assistants, or more specifically, of conversational AI technologies by relating them to a larger history of voice-based human-machine interaction in remote systems based on the workings of “productive sounds”—from Touch-Tone signaling through on-hold music and prerecorded messages to interactive voice response (IVR) systems. In this history, Volmar focuses on changing forms of phone- and voice-related work and labor practices and different forms of value extraction from the automatization and analysis of telephonic or otherwise mediated speech. He argues that while domestic and potentially professional office end users embrace voice assistants for their convenience and efficiency with respect to web searches and daily routines; businesses, tech corporations, surveillance

states, and other actors aim to gain access to the users' voice itself, which is seen as a highly valuable data source—a 'goldmine'—for AI-based analytics.

Another interesting field in which AI and in particular machine learning techniques are increasingly deployed is the financial market and its various forms of algorithmic trading. As *Armin Beverungen* shows in his article, financial trading has long been dominated by highly sophisticated forms of data processing and computation in the dominance of the "quants". Yet over the last two decades high-frequency trading (HFT), as a form of automated, algorithmic trading focused on speed and volume rather than smartness, has dominated the arms race in financial markets. Beverungen suggests that machine learning and AI are changing the cognitive parameters of this arms race today, shifting the boundaries between 'dumb' algorithms in HFT and 'smart' algorithms in other forms of algorithmic trading. Whereas HFT is largely focused on data and dynamics endemic to financial markets, new forms of algorithmic trading enabled by AI are expanding the ecology of financial markets through ways in which automated trading draws on a wider set of data (such as social data) for analytics such as sentiment analysis. According to Beverungen, in order to understand the politics of these shifts it is insightful to focus on cognition as a battleground in financial markets, with AI and machine learning leading to a further redistribution and new temporalities of cognition. A politics of cognition must grapple with the opacities and temporalities of algorithmic trading in financial markets, which constitute limits to the democratization of finance as well as its social regulation.

In order to shed light on the political dimension of global AI infrastructures, we should not only examine how AI is used in the private sector by the tech giants, but also take into account that the public sector is more and more on a quest to become data-driven, promising to provide better and more personalized services and to increase the efficiency of bureaucracy and empower citizens. For example, taking Norway as a case study, *Lisa Reutter* and *Hendrik Storstein Spilker* discuss early challenges connected to the production of AI-based services in the public sector and examine how these challenges reflect uncertainties that lie behind the hype of AI in public service. Through an ethnographic encounter with the Norwegian Labor and Welfare Administration's data science environment, their chapter focuses on the mundane work of doing machine learning and the processes by which data is collected and organized. As they show, decisions on which data to feed into machine learning models are rarely straightforward, but involve dealing with access restrictions, context dependencies, and insufficient legal frameworks. As Reutter and Spilker demonstrate, the data-driven Norwegian public sector is thus in many ways a future imaginary without practical present guidelines.

For the task of critically addressing the specifics of different AI phenomena, it is crucial to explore appropriate paths, concepts, and levels of critique. Since Kant, critique has meant questioning phenomena with regard to their function-

ing and their conditions of possibility. According to Foucault, critique can also be understood as the effort or even art to find ways “not to be governed like that and at that cost” (Foucault 1997 [1978]: 45). In turn, a further concept of critique seeks to examine the idealistic imaginations of society in comparison with its real conditions and to explore why and to what extent these social ideals may (necessarily) be missed (or not). For Marx, this form of critique entailed analyzing why one is confronted with the necessary production of illusion and false consciousness, a focus to which Adorno and Horkheimer felt equally committed in their critical analysis of the *Dialectic of Enlightenment* (1944/1972).

Of course, these are only some of many possible trajectories of critical thinking useful for a profound investigation of an increasingly AI-driven world. Furthermore, we should bear in mind that AI provides new constellations and configurations of socio-technological assemblages, which might not be investigated adequately through the lenses of old concepts of critique, as Geert Lovink has argued with regard to internet and social media technologies (2011: 88).

Hence, it is important to question the very concepts of critical analysis we mobilize for our understanding of digital culture. For instance, *Tobias Matzner*'s text engages with some prominent critical positions regarding current applications of AI. In particular, he discusses approaches that focus on changes in subjectivity as an inroad for critique, namely *Wendy Chun* and *Antoinette Rouvroy*. While Rouvroy forms a general verdict against what she calls “algorithmic governance”, Chun suggests to ‘inhabit’ the configurations of subjectivity through digital technology. Matzner’s text aims at a middle ground between these positions by highlighting the concrete situation of the concerned subjects. To that aim, *Linda Martin Alcoff*'s work on habitualization as situated subjectivity is connected with reflections from media theory. In concluding, this perspective on situated subjects is connected to the question of a democratic configuration of AI technologies.

The question of AI critique concerns hardly less the problem of its appropriate scaling. In the chapter by *Jonathan Roberge*, *Kevin Morin*, and *Marius Senneville*, the authors contend that in order to connect the macro-level issues related to the culture of AI and the micro-level of inscrutability within deep learning techniques, a third analytical level is required. They call this mezzo-level “governmentality”, i.e. they discuss how power relations and the distribution of authority within the field are specifically shaped by the structure of its organizations and institutions. Taking the Montréal hub as a case study—and based on their 2016-2018 ethnographical work—they focus on two interrelated matters: a) the redefinition of the private-public partnership implied in deep learning, and b) the consequences of the “open science model” currently in vogue.

Furthermore, we should take into account that recent developments of smart machines may reflect some general shifts and continuities in shaping the infrastructures and environments of human-machine relations. The essay “Reduction

and Participation" by *Stefan Rieger*, for example, deals with a noteworthy strategy in media environment. It is a movement towards a holistic conception of the body and an approach to include all senses—even the lower ones. Above all, according to Rieger, these senses play a crucial role in the course of a ubiquitous naturalization. The consequence is a story of technological evolution and its irresistible success which follows a storyline diverging from the well-known topoi of augmentation and expansion. The intentional reduction of a technically possible high complexity is conspicuous. It is affected by aspects of internet politics, democratization, and the question of who should have access to media environments at all (and in what way). "Reduction and Participation" meets the demands to include other species and forms of existence. The aim of such demands is to expand the circle of those who gain agency and epistemic relevance, which also affects the algorithms themselves, as Rieger argues.

The question of agency and epistemic relevance reminds us that the project of AI critique itself also has an important history that needs to be considered. In fact, the development of AI has always been accompanied by a critical reflection in terms of its political, social, or economic dimensions and contradictions. And oftentimes, the computer scientists and engineers themselves were the ones to articulate these different forms of critique.

For example, already the cyberneticist Norbert Wiener noted in 1950:

Let us remember that the automatic machine, whatever we think of any feelings it may have or may not have, is the precise economic equivalent of slave labor. Any labor which competes with slave labor must accept the economic consequences of slave labor. It is perfectly clear that this will produce an unemployment situation, in comparison with which the present recession and even the depression of the thirties will seem a pleasant joke. This depression will ruin many industries—possibly even the industries which have taken advantage of the new potentialities. (Wiener 1988 [1950]: 162)

Indeed, one of the most intensively discussed AI topics today revolves around the speculative question of how far automation driven by robots and smart machines leads to a turmoil on the labor market and may cause extensive job loss. For example, AI experts like Kai Fu Lee believe that 40% of the world's jobs could be replaced by AI and robots within the next 15 years (Reisinger 2019; cf. also Frey/Osborne 2017). Such forecasts, however numerous they may be in circulation these days, are above all one thing: sometimes more, sometimes less well-derived or well-founded speculations. How the world will be in 15 years is not predictable, neither by clever scientists nor by intelligent machines. Nevertheless, Norbert Wiener's quote at least illustrates that critique and speculation go hand in hand, both then and now.

Similarly, many critical points made by Joseph Weizenbaum in his seminal work *Computer Power and Human Reason* (1976) enjoy a renaissance in current discussions on AI. In case of Weizenbaum's book, his critical intervention was twofold: On the one hand, he was also motivated to emphasize the fundamental differences between man and machine and/or between thinking/judging and calculating, including highlighting certain fundamental limits of what AI can be capable of; on the other hand, Weizenbaum warned that there are tasks that a computer might be able to accomplish but that it should not do. Many subjects discussed and arguments proposed by Weizenbaum are specifically echoed and further developed in current debates on "AI ethics" (cf. Cowls/Floridi 2018; Taddeo/Floridi 2018). But unlike Weizenbaum, whose critical reflections were essentially based on classic symbolic AI, today's AI ethics debate faces the challenge to adequately understand the media, technology, and infrastructures of machine learning systems and artificial neural networks, whose logic of operations are significantly different from what has sometimes been called "good old fashioned AI" (Sudmann 2018b). And this is a particularly difficult task, since due to the marginal status of ANN there is no profound tradition of expertise in this particular field of AI, neither in many disciplines of the humanities and social sciences, nor even in the natural and technical sciences (cf. also the interview with Alexander Waibel in this volume).

In addition, since the beginning of the AI boom, many of the leading researchers have given up their jobs as professors or employees at universities or taken leaves of absence to set up start-ups or work for the big tech giants. On the one hand, the enormous salary opportunities (whether as an employee or as the founder of a start-up) are tempting; on the other hand, many scientists also accept jobs with the major tech companies because they assume that the conditions for their research are significantly better in business than at university (for instance, in terms of access to learning data or powerful computers, access to funds for research).

Most companies and especially the countless start-ups that have been founded in recent years in the wake of the AI boom are also constantly complaining about the lack of experts in the field, which they perceive as a major brake for further innovations. Many institutions have recognized this problem and are investing billions in training, research, and development of AI. Nevertheless, the question arises according to which criteria, with which goals, and under which conditions this funding takes place. Against this background, it is imperative that private and public funding of AI also includes support for critical research. Certainly, the latter is above all a task for the humanities and social sciences. But in order to master this task adequately, they depend on dialogue and cooperation with the 'hard sciences'.

However, there is another reason why research on and with current AI technologies, especially with regard to their political dimension, poses a major challenge, which even experts cannot easily overcome. As has been extensively discussed in recent years, ANN in particular are regarded as a fundamentally opaque technology of AI. While computer scientists are in fact able to observe and measure the activity of each individual neuron and of their connections independent of their number, they cannot or only to a limited extent understand or explain the activities of ANN (cf. also my contribution to this volume). It is obvious that this specific black box problem has serious political-ethical implications and effects. For example, it is one thing whether AI technologies are used, say, for the recognition of medieval handwritings or for recommending certain products to consumers. However, when AI technologies are used to evaluate a person's creditworthiness or to decide whether a particular person might commit a particular crime based on their appearance and behavior, the situation is obviously a different one.

As *Dan Mcquillan* argues in his essay, AI is a political technology and is as such being used to sustain austerity, but its politics are obscured by its technical opacity and by a narrative of ethics. The concrete operations of AI, acting through statistical regression and optimization, produce thoughtlessness and epistemic injustice. Meanwhile, AI's predictive classifications extend bureaucratic governmentality into the future, which it seeks to preempt. However, AI is fragile and only solves what Bergson called "ready-made problems". According to Mcquillan, we need to approach AI in a way that enables us to take sides with the possible against statistical probabilities. His article sets out both a feminist and situated approach to developing non-oppressive AI, and the forms of collective community and workplace structures necessary to achieve it. Similarly, *Yvonne Förster* problematizes that especially current AI applications are a black box and operate without being able to give an account of the underlying reasons, and the underlying causal processes themselves also remain opaque. In her essay, she discusses the concept of invisibility and opacity from a phenomenological perspective and explores the relation of experience and perception to technology.

Democratizing AI

Compared to the long tradition of AI critique, the discourse of "democratizing AI" is a relatively new one. Basically, the discourse has emerged since it has become widely known that AI is now intervening in all areas of global culture and society. The following aspects, among others, have contributed to the emergence and dissemination of this discourse:

1. the extensive critique of AI technologies with regard to their social, economic, and political implications, manifestations, and effects
2. the long tradition of dystopian imaginations of AI
3. the practices of datafication and data analytics of the big tech companies and their hegemonic role in the current and future development of AI
4. the assessment of ANN as a fundamentally opaque technology of information processing and data analytics

Terms such as democratization and democracy are sometimes used as if one could always refer to them positively or affirmatively. At the same time, theories of democracy constantly remind us that the idea of democracy meaning the “rule of the people” presupposed significant exclusions at all times. In the ancient polis of Greece only free citizens—but not women, slaves, or someone who did not own land—were allowed to vote and act politically. This tradition of exclusion was bound to continue for a long time. According to John Locke’s conception, which was decisive for the development of English parliamentarism, the right to vote was still given only to the property owners, and of course we should not forget that well into the 20th century, women were not allowed to take part in elections in democratic societies. Even today, people who have lived in a particular country for many years, although in principle subject to all of its laws, are excluded from national elections unless they have the necessary citizenship.

As we have recalled at the beginning, AI technology already has helped politicians to get elected. Against this background, it is obvious to ask whether and when machines themselves will be allowed to vote, or more generally to speculate whether and when they will be perceived as entities that possess certain rights, like a human being. And it is quite remarkable that even though machines are not allowed to vote (yet), they already can be elected—as it happened in 2018, when an AI system in Japan (Tama City, Tokyo) was running for mayor. The AI system in question promised that thanks to its statistical methods it could effectively evaluate the advantages and disadvantages of requests by citizens; it claimed to make fair decisions, to strive for consensus in conflicts of interest, and also to focus on absolute transparency with regard to the use of taxes. When the votes were counted, it turned out that the AI system came in last of all candidates. The outcome is perhaps unsurprising, even in technology-obsessed Japan. People there, as well as in other countries, might accept AI-systems and robots as tools, servants, or toys, but it seems difficult to imagine a political representation by machines other than in terms of very dystopian scenarios.⁶

6 Even though not only in Japan, but also in Europe or the US, the presence of machine is a normality in governments (also cf. Agar 2003).

Indeed, the very fact that the cultural imaginary of AI has been shaped so extensively by dystopian narratives probably still causes people to fear the coexistence with intelligent machines, or at least to feel profound discomfort. Against this background, recent efforts of democratizing AI, as described in the following, can indeed be understood as working against such a dystopian view of the common future of humans and machines, as people imagine it.

However, it is important to note here that the demand for a democratization of AI inevitably implies that such technologies are in themselves undemocratic, or at least have the strong tendency or potential to be incompatible with democratic values and practices. And there are good reasons for this conceptualization of AI. If the development of intelligent machines is aimed at replacing or surpassing humans, or if AI is seen as a driving force for economic growth and a condition for securing hegemonic geopolitical power, in all these instances, the technology has *prima facie* nothing to do with the establishment and protection of democratic values such as equality in the emphatic sense. Similarly, the current discussions about algorithmic biases point to fundamental problems of inequality and difference associated with the large-scale implementation of AI systems in all areas of society.

For instance, *Alexander Monea*'s chapter examines how attempts to make computer vision systems accessible to users with darker skin tones has led to either the hypervisibility of phenotypic racial traits, particularly morphological features like hair texture and lip size, or the invisibility of race. Drawing on critical race theory and the problematic history of racial representation in photographic media, he demonstrates how racial biases are prevalent in the visual datasets that many contemporary computer vision algorithms are trained on, essentially hard-coding these biases into our computer vision technologies, like Google Photos. The most frequent industry reaction to these hardcoded racial biases is to render race invisible in the system, as was done with Google Photos. He further shows how the invisibility of race in computer vision leads to the familiar problems of 'color blindness', only expressed in new media. The author argues that these constitute fundamental problems for the potential democratization of AI and outlines some concrete steps that we might take to more strongly demand egalitarian computer vision systems.

Nevertheless, at least some people believe that AI might have the potential in itself to open up a new utopian horizon of freedom, equality, fraternity, and could furthermore even be used productively to secure world peace (cf. Valladão 2018). In Thomas Hobbes' theory of state, the Leviathan (as the embodiment of a fictive social and governing contract) is conceptualized as the necessary condition of possibility for a peaceful coexistence among people. Without it, mankind would fall back into the state of nature, into the war of all against all. However, as history since Hobbes has shown, the modern state is an extremely precarious, fragile en-

ity, incapable of providing lasting protection for *all its members*. More importantly, the sad truth is that there has never been a state or democracy since, say, the French Revolution that was fully able to meet the demands of freedom, equality, or solidarity in their emphatic sense.

Against this background, the utopian vision (and for some certainly dystopian imagination) of delegating responsibility for the political and the control of society entirely to machines does not seem completely absurd. But if one can envisage mankind deciding to better put their fate in the hands of superior machines, then it is also still conceivable that people at some point also might or will stand up for the realization of a truly better global society—without any help of AI as a political entity or “peace machine” (Honkela 2017).

Current concepts of democratizing AI, however, have little in common with a critique aiming at a fundamental transformation of society. Nevertheless, the concept of a democratic AI, as a project of the present, still remains very closely related to utopian visions and motivations inasmuch as it resembles ever so many strategies and concepts of democratization that have been developed throughout history in relation to taste, art, media, technology, or society as a whole.

Current ideas of democratizing AI share strong similarities with utopian-political ideas of the cyberspace, virtual reality, and of course the Internet, as they have been especially prevalent since the early 1990s (cf. Egloff 2002). The idea that cyberspace and/or the Internet (the concepts are not identical, yet often used as synonyms) are in themselves an emancipatory space that used to be called “cyber-utopianism” and has been the subject of criticism since 1995 at the latest, for example by the Critical Art Ensemble. Conversely, even today many scientists, artists, and net activists adhere to the idea that either the Internet and/or cyberspace actually mark a space of freedom, subversion, and resistance that must be defended, despite all its heterogeneous contradictions and problems.

The utopian-idealistic dimension of democratization is also visible in the current use of the concept by the large tech corporations in connection with AI. They present the concept of a “democratic AI” first and foremost as a great promise of universal, all-inclusive accessibility, participation, and transparency. For example, for Microsoft the democratization of AI essentially means putting the technology into the hands of “every person and every organization” (cf. Microsoft News Center 2016; cf. Johnson 2017a).

As far as the official agendas of tech giants are concerned, various strategies are currently being pursued to achieve this goal: First, a general idea is to advance the simplification, standardization, and automation of AI, so that even non-experts inside and outside companies and universities can increasingly use the corresponding technologies (such as ANN) for their purposes and applications. Second, the large IT companies want to grant users, scholars, and companies open access to various cloud services, from computational resources (such as Google’s

Tensor Processing Units, i.e. specific chips to accelerate machine learning operations), to program libraries and frameworks like Scikit, PyTorch, Keras, or TensorFlow, training data sets like MNIST or ImageNet, to various other software tools that are helpful for the broader dissemination and improvement of AI.

Unsurprisingly, the corporations do not provide their services without individual interests or the expectation of anything in return: For example, Google requires researchers who use their resources to make their own research results and perhaps also their code available open source (Johnson 2017b). In addition, they speculate that open-sourcing their tools might also have the effect that independent developers contribute to their improvement without incurring significant costs (cf. Lomonaco/Ziosi 2018). Moreover, big companies like Microsoft benefit from the fact that the open source idea itself enjoys a high reputation in the tech research community and that researchers have an interest in their work being highly visible and widely recognized (cf. Bostrom 2017).

Critically engaging with the promise to provide developers access to emerging machine learning technologies and to enable them to infuse their applications with smartness or intelligence, *Marcus Burkhardt*'s text asks how machine learning and AI as fields of technological development and innovation are structured in themselves. By providing an initial mapping of the coding cultures of machine learning and AI on GitHub, he argues that it is important to attend more closely to the hitherto largely neglected infrastructural layers of code libraries and programming frameworks for developing critical perspectives on the social and cultural implications of machine learning technologies to come.

Beyond certain advantages connected to different actions of opening AI, many researchers, institutions, and companies tend to stress that solving problems in this field is a collective endeavor that cannot be achieved individually, which is why it is necessary to share ideas and methods as widely and as openly as possible.

Problems and contradictions of economic and scientific competition, however, are rarely discussed. On the surface, it seems like AI research is essentially driven by an unbound idealism. The reality, however, is that the field is indeed characterized by fierce international competition for talent, capital, and other 'resources'. And at the heart of the big tech companies' agenda is the tenacious struggle for being the first to overcome the unsolved problems of AI and/or to achieve the ultimate goal of a *general artificial intelligence*, a so-called strong AI, i.e. a machine capable to master or learn any task similar to or better than a human being.

This also applies to the so-called non-profit organization that even has integrated the "openness" idea in its brand name: OpenAI. As I demonstrate in my own contribution for this volume, OpenAI has somehow been the avant-garde of the current "AI democratization" hype, also by foregrounding its commitment to democratic values like access, participation, and transparency. But if one examines the activities of the organization hitherto, the investment of OpenAI is

more about making progress to solve the foundational technological problems in AI, rather than focusing on how the concept of an open, democratic AI could be further developed in a technologically and conceptually meaningful way.

For the moment, if one critically examines the rhetoric of companies like Google or Microsoft, it looks as if the promise of a democratic AI has already been fulfilled by its accessibility. Especially in the case of technology, however, democratization not only means access to its use, but also the possibility of its control (cf. Lomonaco/Ziosi 2018). If and how such a process can be organized and shaped in a reasonable way, for example through state supervision or other measures, is still an open question, and maybe it cannot be answered in general. But the crucial point here is that those companies who advocate the “democratization of AI” must *at least in principle* be willing to restrict their sovereignty and/or to accept interventions by other external entities.

The latter, however, is unlikely to be in the interests of the large tech corporations. Indeed, the simple fact that the tech giants so fully embrace the idea of a “democratic AI” strongly indicates how little the concept threatens their economic or cultural power, quite to the contrary.

Nevertheless, the democratization of AI, as advocated by the large tech groups, is not only about controversial concepts of access, transparency, and participation. Furthermore, the concept also entails the goal to serve ‘good purposes’, i.e. solving the world’s small and large problems. Microsoft’s “AI for Earth” initiative, for example, aims at fighting climate change or eliminating inequalities in the health care system. Given such an agenda, it is, of course, awkward that Microsoft was recently accused of working with researchers from China’s National University of Defense Technology, controlled by the country’s Central Military Commission, collaborating on AI problems that commentators thought to be usable for state surveillance technologies. Microsoft dismissed these accusations by pointing out that the research papers in question had as much or little to do with surveillance as WiFi or a Windows operating system would have. In addition, the company pointed out that such forms of international cooperation are very typical in the field of AI research.

However the situation may be in this specific case, it is clear that especially in the field of AI, it has always been difficult to distinguish between a military and civilian use.⁷ For example, similarly as with other AI application fields, a large part of research in the field of machine translation and natural language processing (for the political discussion of this field of AI, cf. the interview with Alexander

⁷ Sometimes it is also a matter of disputes within a company whether orders from the military should be accepted. Cf. the recent protests by Google employees against the so-called “Maven project” (cf. vgl. Shane/Wakabayashi 2018). For a recent discussion on the miliary use of AI see also Ernst/Schröter/Sudmann (2019).

Waibel in this volume), has been funded by the military, specifically by programs supported by DARPA. This commitment is no coincidence. Especially during the Cold War, there was a high demand for translations from Russian into English (and vice versa on the side of the Soviets for translations from English to Russian). Furthermore, global military operations and disaster management efforts have always stimulated a general interest in the rapid translation of large quantities of foreign-language texts. Finally, one should note that the field of machine translation had been based on basic mathematical and cryptologic knowledge from the start—developed during the Second World War by researchers in the military and secret services.

As the use of AI for military goals shows, “openness” and “transparency” cannot count as positive values per se. According to Nick Bostrom (2017), openness to security measures or openness about goals can be good, but openness about source code does not necessarily have to be. Accordingly, Bostrom advocates a differentiated approach to “open AI”: When it comes to developing technologies that have the potential to cause considerable damage, they should naturally not be disclosed.

Particularly with regard to ANN technology, the fundamental question arises as to which extent requirements of transparency and openness can be realized at all, given that specifically the connectionist approach of ANN has to be understood as being fundamentally opaque at its core (Sudmann 2017). Nevertheless, various approaches of a so-called “Explainable AI” at least try to reduce the opacity of current AI systems.

As Schieferdecker, Großmann, and Schneider stress in their contribution to this volume, software-based systems using AI methods for different tasks are essentially characterized by their “criticality”, by which they mean their usage in safety- and security-critical domains like transportation and automotive, banking and finance, healthcare, cyber-security or industrial automation. As the authors explain, this criticality of numerous AI-based systems demands rigorous and effective quality engineering in pre-deployment phases and at runtime. In their article, the authors review the state of the art in safeguarding AI-based systems by so-called “verification and validation methods”, taking a particular look at the principal function components of AI-based systems and their extended quality requirements. Since any AI is primarily developed in software, the principal approach to the quality engineering of software-based systems in general is reviewed. According to Schieferdecker, Großmann, and Schneider, testing is the best-known and most effective V&V method and will most probably also form the basis for dealing with AI-based systems: It can be used for confirming or witnessing outcomes of AI-based systems, it can become a digital common for their comparison and benchmarking, and thus contribute to a shared knowledge basis of AI.

Against the background of the phenomena outlined so far, it is quite obvious that the political economy of AI is a great challenge for policymakers. As *Frank Pasquale* shows in his essay, so-called centralizers encourage the accumulation of data in very large firms, while in contrast decentralizers want to see more dispersed innovation. Although both have very different visions for long-run economic development, each can help counter the untrammelled aspirations (and disappointing everyday reality) of stalwarts of digital capitalism. They also contribute to our understanding when giant firms try to solve what Friedrich Hayek has identified as the “knowledge problem”—which and when they exacerbate it via obscurity and obfuscation. If conglomeration and vertical mergers actually promote AI that solves real-world problems—of faster transport, better food, higher-quality health care, and more—authorities should let them proceed. According to Pasquale, industrial bigness helps us understand and control the natural world better. But at the time, he argues that states should block the mere accumulation of bargaining power and leverage, even if it is in the service of AI development. Policymakers need to find ways to address the contradictions and diverging perceptions regarding the regulation of technology. One important task here is to translate political decisions into laws that are appropriate in practice, but that also take into account the criticism of these technologies. But what role can laws play in the democratization of AI? This is the question the chapter by *Christian Djefall* addresses. His text highlights the dimensions of AI’s openness and shows that AI can be beneficial and detrimental to democracy. Constitutional law actually calls for a democratization of AI. Reliance on and delegation to AI systems requires a democratic rebalancing. The chapter then goes on to explore how AI can be democratized. It identifies three layers that describe a series of choices: the technical layer, the social layer, and the governance layer. On the technical layer, there are many choices to be made; a specific concept like designability could help to identify choices that enable democratic governance. The influence of AI systems is often not rooted in technology but attributed to AI through social choices. In administrative law, automated decisions are endowed with the power of the law. The governance layer shows how technologies can be influenced by overarching choices. This can be done for example by frames and organization. Taking all layers together, there is ample room for democratic determination of AI applications.

It is perhaps a question of debate to what extent machine learning algorithms as “cultural machines” (Finn 2017) already have an influence on our daily life and changed the sociocultural experiences we make in this world. The discussion on the cultural impact of machine learning and ANN has also recently intensified around the question of how AI can be considered creative and perhaps even changes our understanding of art (practices). The public discussions on this were fueled by an auction at Christie’s, where a painting ‘created’ with the help of an AI-system was sold for a high price. Interestingly enough, the art collective responsible for

this painting claimed that they want to “explain and democratize AI through art”. It was probably foreseeable that AI would also be coopted quickly by the art world. But recent discussions on “creative AI” tend to omit that the problem of machines’ supposed creativity is by no means new, as *Jens Schröter* shows in his article. In fact, already in the 1960s, in so-called “information aesthetics”, similar questions were discussed. In his essay, Schröter therefore historicizes the current debates and argues that the question of whether machine-creativity or machine-art is possible cannot be answered by abstractly contrasting ‘man’ and ‘machine’ (AI).

The relationship between art, creativity, and smart machines shows that the discussion about the politics and democratization of AI must not be restricted to certain areas (economy, military) or to certain groups of actors (e.g. “The Big Tech Giants”). Instead, we should consider that the critique of AI and the commitment to democratizing it is also supported by many NGOs, academic institutions, journalists, or politicians; actors whose efforts undoubtedly deserve their own portrayal. This book is therefore only a small contribution to a controversial field of discussion whose contours, relations, and conditions have yet to be explored.

References

Algar, Jon (2003): *The Government Machine. A Revolutionary History of the Computer*. Cambridge, MA: MIT Press.

Birch, Anthony H. (1993): *Concepts and Theories of Modern Democracy*. London et al. Routledge.

Bostrom, Nick (2017): “Strategic Implications of Openness in AI Development.” In: *Global Policy*, 1-12. (<https://nickbostrom.com/papers/openness.pdf>).

Bublies, Pia (2017): “Data is Giving Rise to a New Economy.” In: *The Economist*, May 6. (<https://www.economist.com/briefing/2017/05/06/data-is-giving-rise-to-a-new-economy>).

Cowls, Josh and Floridi, Luciano (2018): “Prolegomena to a White Paper on an Ethical Framework for a Good AI Society.” June 19. (<https://ssrn.com/abstract=3198732> or <http://dx.doi.org/10.2139/ssrn.3198732>).

Diamond, Larry Jay, and Plattner, Marc F., eds. (2012): *Liberation Technology: Social Media and the Struggle for Democracy*. Baltimore, MD: Johns Hopkins University Press.

Dotzler, Bernhard (1989): “Know/Ledge: Versuch über die Verortung der Künstlichen Intelligenz.” In: *MaschinenMenschen*. Katalog zur Ausstellung des Neuen Berliner Kunstvereins, 17.-23.07. Berlin: NBK: 127-132.

— (2006): *Diskurs und Medium. Zur Archäologie der Computerkultur*. Band 1. München: Fink.

Egloff, Daniel (2002): *Digitale Demokratie: Mythos oder Realität*. Wiesbaden: Westdeutscher Verlag.

Ernst, Christoph, Schröter, Jens, and Sudmann, Andreas (2019): "AI and the Imagination to Overcome Difference." *spheres – Journal for Digital Cultures* 6 (2019): forthcoming.

Finn, Ed (2017): *What Algorithms Want. Imagination in the Age of Computing*. Cambridge, MA: MIT Press.

Foucault, Michel (1997 [1978]): "What is critique?" In: *What is Critique? Semiotexte*: Los Angeles, CA, 41-81.

Frey, Carl Benedikt and Osborne, Michael A. (2017): "The future of employment: How susceptible are jobs to computerisation?", *Technological Forecasting and Social Change*, Elsevier, vol. 114(C): 254-280. (<https://ideas.repec.org/a/eee/tefo so/v114y2017icp254-280.html>).

Goodfellow, Ian, Bengio, Yoshua, and Courville, Aaron (2016): *Deep Learning*. Cambridge; London: MIT Press.

Hebb, Donald Olding (1949): *The Organization of Behavior. A Neuropsychological Approach*. New York: John Wiley & Sons.

Honkela, Timo (2017): *Rauhankone. Gaudeamus*.

Horkheimer, Max and Adorno, Theodor W. (1944/1972): *Dialectic of Enlightenment*. New York: Herder and Herder.

Hughes, Chris (2019): "It's Time to Break Up Facebook". In: *New York Times*, May 9. (<https://www.nytimes.com/2019/05/09/opinion/sunday/chris-hughes-facebook-zuckerberg.html>).

Johnson, Khari (2017a): "AI democratization depends on tech giants." In: *VentureBeat*. (<https://venturebeat.com/2017/12/28/ai-weekly-ai-democratization-depends-on-tech-giants/>).

Johnson, Khari (2017b): "Google unveils second-generation TPU chips to accelerate machine learning." In: *VentureBeat* (<https://venturebeat.com/2017/05/17/google-unveils-second-generation-tpu-chips-to-accelerate-machine-learning/>).

McCulloch, Warren S. and Pitts, Walter (1943): "A Logical Calculus of the Ideas Immanent in Nervous Activity". In: *The Bulletin of Mathematical Biophysics* 5.4: 115-133. DOI: <https://doi.org/10.1007/BF02478259>.

Locke, William N. and Booth, A. Donald, eds. (1955): *Machine Translation of Languages*. Cambridge, MA et al.: The Technology Press of The Massachusetts Institute of Technology, John Wiley & Sons, John Wiley & Sons, and Chapman & Hall.

Lomonaco, Vincenzo and Ziosi, Marta (2018): "On the Myth of AI Democratization." (<https://medium.com/ai-for-people/on-the-myth-of-ai-democratization-a472115cb5f1>).

Lovink, Geert (2003): *Dark Fiber—Tracking Critical Internet Culture*. Cambridge, MA: MIT Press.

Lovink, Geert (2011): *Networks Without a Cause. A Critique of Social Media*. London: Polity Press.

Marcus, Gary (2018): "Deep Learning. A Critical Appraisal." (<https://arxiv.org/abs/1801.00631>).

Mackenzie, Adrian (2017): *Machine Learners. Archeaology of Data Practice*. Cambridge, MA: MIT Press.

Mckenzie, Adrian (2017): *Machine Leaners. Archaeology of a Data Practice*. Cambridge, MA: MIT Press.

Mensch, Kirsten and Schmidt, Jan C., eds. (2003): *Technik und Demokratie. Zwischen Expertokratie, Parlament und Bürgerbeteiligung*. Opladen: Leske+Budrich.

Michie, Donald (1971): "Formation and Execution of Plans by Machine", in N.V. Findler & B. Meltzer, eds.: *Artificial Intelligence and Heuristic Programming*: New York: American Elsevier: 101-124.

Microsoft News Center (2016): (<https://news.microsoft.com/features/democratizing-ai/>)

Mitchell, Thomas (1997): *Machine Learning*. New York: McGraw-Hill.

Pasquinelli, Matteo (2017): "Machines that Morph Logic: Neural Networks and the Distorted Automation of Intelligence as Statistical Inference." In: *Glass Bead Journal*, Site 1, "Logic Gate: The Politics of the Artifical Mind".

Rapoza, Kenneth (2019): "Democracies In Crisis: Has The West Given Up On Democracy?" In: *Forbes*, January 9. (<https://www.forbes.com/sites/kenrapoza/2019/01/09/democracies-in-crisis-has-the-west-given-up-on-democracy/#425fb6db1242>).

Reisinger, Don (2019): "A.I. Expert Says Automation Could Replace 40% of Jobs in 15 Years." In: *Fortune*. (<http://fortune.com/2019/01/10/automation-replace-jobs/>).

Rockhill, Gabriel (2017): *Counter-History of the Present. Untimely Interrogations Into Globalization, Technology, Democracy*. Durham: Duke University Press.

Rosenblatt, Frank (1958): "The Perceptron. A Probabilistic Model for Information Storage and Organization in the Brain". In: *Psychological Review* 65.6: 386-408.

Samuel, Arthur (1959): "Some Studies in Machine Learning Using the Game of Checkers." In: *IBM Journal of Research and Development*, Vol. 3: 210-229.

Shane, Scott and Wakabayashi, Daisuke: "The Business of War: Google Employees Protest Work for the Pentagon." In: *The New York Times* April 4, 2018. (<https://www.nytimes.com/2018/04/04/technology/google-letter-ceo-pentagon-project.html>).

Srnicek, Nick (2016): *Platform Capitalism*. Cambridge, UK; Malden, MA/USA: Polity Press.

Sudmann, Andreas (2016): "Wenn die Maschinen mit der Sprache spielen." In: *Frankfurter Allgemeine Zeitung* No. 256, Nov. 2: N2.

Sudmann, Andreas (2018a): "Zur Einführung. Medien, Infrastrukturen und Technologien des maschinellen Lernens." In: *Machine Learning. Medien, Infrastruk*

turen und Technologien der Künstlichen Intelligenz. Ed. Christoph Engemann and Andreas Sudmann. Bielefeld: transcript: 9-23.

Sudmann, Andreas (2018b): "Szenarien des Postdigitalen. Deep Learning als MedienRevolution" In: Engemann/Sudmann, 55-73.

Taddeo, Mariarosaria and Floridi, Luciano (2018) "How AI can be a force for good", *Science* 361 (6404): 751-752.

Valladão, Alfredo Da Gama e Abreu (2018): "Artificial Intelligence and Political Science". *Policy Paper*, September, 1-29.

Webb, Amy (2019): *The Big Nine. How The Tech Titans & Their Thinking Machines Could Warp Humanity*. New York: Hachette Book Group.

Weizenbaum, Joseph (1976): *Computer Power and Human Reason. From Judgment to Calculation*. Oxford, England: W.H. Freeman & Co.

Wiener, Norbert (1988 [1950]): *The Human Use of Human Beings: Cybernetics and Society*. London. Free Association.

Zuboff, Shoshana (2018): *The Age of Surveillance Capitalism. The Fight for a Human Future at the New Frontier of Power*. New York et al.: Public Affairs.

