Chapter 3

Sociology of Artificial Intelligence: How AI Will Transform Work, Unemployment and Our Future

Ulaş Başar Gezgin[1]

Abstract

Artificial intelligence is one of the hot themes of the current public discussion with accounts associating it with transformations in especially manufacturing sectors which is usually expected to lead to massive unemployment. The public is keen on speculating about which jobs will be made redundant by the rise of AI and ultimately disappear. In addition to factories, the health sector is one of the sites of contestations as many medical tasks are getting automated. Some other scholars do not agree with this panic atmosphere. They claim that like any other industrial transformation, the rise of AI will also create new jobs. Although social implications of the rise of AI are under the spot, it is hard to come up with a single view among various views shared by scholars of various disciplines and strands of research. This article summarizes and elaborates on various positions on the topic, with a sociologically critical perspective, keeping an eye on AI's highly likely role in exacerbating the already biting social inequalities and injustice. The sociology of artificial intelligence is delineated along with the ethical issues raised by the expansion of artificial intelligence in our daily lives, keeping the possibility of a humane artificial intelligence in mind.

Introduction

The mainstream idea on social impact of AI is that it will lead to massive unemployment (e.g. Marwala, 2015). Another less common, but more realistic view with a twist is that although it will lead to massive unemployment, it will open up new job opportunities; humans will always be needed (Tse, Esposito & Goh, 2017). As stated by Fogel & Kvedar

1 Ulaş Başar Gezgin, Istanbul Galata University, Faculty of Arts and Social Sciences, Department of Psychology, ulas.gezgin@galata.edu.tr, ORCID ID: 0000-0002-6075-3501

https://doi.org/10.58830/ozgur.pub167.c749

(2018), "each generation for the last 100 years has had a visceral fear that automation would replace jobs. And yet, as it does so, new jobs emerge" (p.3). Thus, according to this account, machines (AI) and humans will not be in competition in the future, they will rather complement each other (Tse, Esposito & Goh, 2017). Thus, in this article, we present and discuss various scholars' views on how AI will influence our jobs, unemployment and in the most general sense, our future. We start our discussion with introductory explanations about what AI means. This is followed by a review of scholars' views.

Rigla et al. (2018) define AI as "the ability to make computers do things that would require intelligence if done by humans" (p.303). An earlier and shorter definition is "the intelligence exhibited by machines or software" (Pannu, 2015, p.79), but this begs the question. With such a definition, non-intelligent operations of machines or software cannot always be demarcated easily. Mahanty & Mahanti (2019) state that "artificial Intelligence deals with the study and development of software and machines that can imitate human-like intelligence" (p.2100). However, philosophically speaking, such a definition implies that AI cannot do more than just imitating human intelligence, and thus it can't be a substitute nor an equivalent to it.

A more elaborate definition which correctly stresses unpredictability and flexibility is the following:

"AI is a general term that currently refers to a cluster of technologies and approaches to computing focused on the ability of computers to make flexible rational decisions in response to often unpredictable environmental conditions" (Tredinnick, 2017, p.37).

Additionally, the way AI, machine learning and deep learning are connected can be summarized as follows:

"AI might be defined as a computer performing tasks in a rational human-like manner. Machine learning comprises a subset of AI, in which software algorithms attempt to predict future events, after being trained in rule-based logic, pattern recognition and reinforcement techniques. Deep learning, a sub-type of machine learning, utilizes artificial neural networks, loosely modeled after webs of neurons and synapses in the human brain" (Craft III, pp.406-407).

Finally, we need to briefly outline the notion of Industry 4.0 before our main discussion. Industry 1.0 was characterized by "mechanization, steam power and water power", 2.0 by "mass production, assembly line and

productivity", 3.0 by "computer and automation" and finally 4.0 by "cyber physical systems" (Stăncioiu, 2017, p.74).

Artificial Intelligence models and applications are put in practice in diverse settings such as production management (e.g. Burggräf, Wagner & Koke, 2018), medicine (e.g. Adhikari, 2018; Buch, Varughese & Maruthappu, 2018; Mamoshina et al., 2018; Pacis, Subido Jr & Bugtai, 2018; Shrestha & Sengupta, 2018; Tajmir et al., 2018; Tang et al., 2018; Tian, 2018), pharmacy (Vyas et al., 2018), law (e.g. Alarie, Niblett & Yoon, 2018), environmental sciences (e.g. Vieira et al., 2018), energy efficiency (Poola, 2017), urban planning (e.g. Chui, Lytras & Visvizi, 2018; Khan et al., 2018), journalism (Broussard, 2014; Latar, 2015), education (Alberola et al., 2016; Belpaeme et al., 2018; Edwards & Cheok, 2017; Popenici & Kerr, 2017; Sora & Sora, 2012; Timms, 2016) etc.. These give the misleading impression that AI can do anything that our species can do. Despite of the exaggerated accounts common in media, so far we don't have successful general AI applications, but specific ones (Tredinnick, 2017). The latter are called as weak AI or narrow AI, while general ones that are yet to exist are called as strong AI or artificial general intelligence (Yadav et al., 2017).

Automation and Unemployment

To proceed further, we need to distinguish AI and automation. Mehta & Devarakonda (2018) state that

"the invention of the printing press and the development of the conveyor belt assembly line are good examples of how humans break down complex mechanical tasks into simpler well-defined steps that can then be automated. However, automating cognitive tasks has been a bigger challenge because it is not known precisely how human brains work. But is it necessary for humans to decode cognitive tasks for automation to work? Recent advances in artificial intelligence (AI) suggest otherwise, and the implications for health care are tantalizing" (p.2019).

That is a key point often missed in popular discussions of AI. In fact, what the public discusses is not really AI, but automation. Automation is the imitation of repetitive tasks that do not require intelligence. In that sense, even the pessimistic view on AI as to unemployment is misplaced from the very beginning. It is not AI which is expected to make workers in some tasks redundant, but automation. On the other hand, there are cases in the intersection of both AI and automation. Hengstler, Enkel & Duelli (2016) uses the term 'intelligent automation' to refer to a combination of both. A common example for this is driverless cars as will be discussed

later. They involve both repetitive and well-defined tasks that don't involve higher cognitive processing and unpredictable and risky tasks that involve intelligence. However, these combination of both automation and intelligence is uncommon. In many other examples, it is easy to differentiate automation and AI. For instance, the chess programs beating human masters are considered to exhibit AI, however a search engine or the manufacturing system in a factory are considered to be a matter of automation.

The confusion about AI and automation has parallels in robotics. To exemplify, Chand et al. (2018) point out that

"'Robotic Surgery' is increasingly debated in surgical circles. The reality is, however, that we are nowhere near the era of true robotic surgery, and what we are actually debating are advanced laparoscopic devices or 'tele-manipulators'. Whichever English definition one chooses for the term 'robot', the consistent qualification is a machine that is able to undertake tasks 'automatically', whether this be programmed or independently. The current iterations are robotic platforms which do not fulfil this most basic of criteria to be called robots" (p.645).

After mentioning the distinction between AI and automation, we can move to the unemployment discussions. The way mainstream thinkers approach the expected unemployment due to AI is in the mode of a crisis. They claim that with extremely high unemployment rates, the system will collapse (cf. Harari, 2016). However, they don't think about the possibility that we can have shorter work weeks (even 2 work days per week for instance), so that people can have more time to enjoy with their family and social connections. With such a wonderful free time, they can develop their personality through art, sports, philosophy and other humane activities. Others proposed a universal wage for these unemployed, but they forget that this (i.e. enormous transfer payments, in other words payments not based on production) may lead to hyper-inflation. With wrong assumptions firmly believed, these mainstream thinkers don't see any way other than collapse. In fact there are many other possibilities.

As to the economic discussions of the effects of AI on work and employment, a key point is which school of economic thought the debaters belong to. For instance, Acemoglu and his colleagues assume the self-correcting power of the markets (cf. Acemoglu & Restrepo, 2018a, 2018b) which is obviously a mainstream neo-liberal understanding of economics not necessarily shared by other economists such as Stiglitz, and many other Keynesian and Marxist thinkers. The truth is that economics is not a rocket science; it is mostly ideological than scientific, confusing basic facts and

opinions, and sometimes even distorting historical facts. For example, these mainstream neo-liberal thinkers are fond of linking economic development with the so-called 'democracy' which is not really a democracy in its true sense; often ignoring the economic success of 'neo-liberal' fascist dictatorships such Pinochet's Chile and that of non-Western powers such as China.

Whereas for Harari (2016, 2015), another best-selling debater, the markets are not self-correcting, but his economic understanding is mainstream and neo-liberal in other ways. These popular figures often propose their ideas as scientific facts rather than opinions, not allowing questioning of their quite subjective and ideological assumptions (cf. Gezgin, in press). Let us also note that Nobel Prizes in economics are awarded to economists that are both pro- and anti-government in their economic models which one more time shows that economics is not a science, or not a tough science that it pretends to be. Furthermore, if economics would not have been ideological, if it would have been as tough as rocket science, economists would be the wealthiest, which is obviously not the case. To sum up, economic discussions of AI needs further analysis due to the ideological nature of economics as a research area and a profession.

Let us also note another theme in economic discussions of AI which views AI as a cure for market inefficiency: If market inefficiency would be attributed to lack of or insufficient information of the market actors, then the expansion of AI would be considered as a cure for this efficiency as proposed by Marwala (2015). However this is a neo-liberal position open to criticism. In fact, market inefficiency has a number of other factors such as the profit motive itself which leads to overproduction of profitable products and services on the one hand, and underproduction of goods and services that are for public benefit rather than private profit by the private sector, the role of the state, the priorities of the government policies and relevant laws and regulations. Thus, AI can't fix capitalism's problems, as these problems are inherent to capitalism itself.

Artificial Intelligence, Automation and New Jobs

Our next topic is how AI (in fact, automation) is expected to transform our careers. Baldassari & Roux (2017) remind us that new jobs have been popularized that were not very well known 10 years ago such as app developers, data scientists, cloud computing experts etc., and brand new jobs appeared such as driverless car engineers, drone operators etc.. They believe that the rise of Industry 4.0 will not lead to fewer jobs or massive unemployment. As the jobs based on repetitive tasks will disappear, new

jobs to maintain the Industry 4.0 systems will emerge. They disagree with Industry 4.0 fanatics who claim that the human factor will disappear in factory production just like the case for driverless cars:

"An automated factory left alone cannot stay competitive for long. Just as we have seen dramatic improvement in the functionality of smartphones over the past decade, it is expected that factory hardware will continue to improve. This still requires skilled labor to assess, install, and maintain the hardware. The software that powers a factory will also continue to improve as today's algorithm will not meet tomorrow's needs. Therefore, an increasing supply of skilled labor is needed to develop software, improve it, and monitor the information. A single factory may need fewer people to run it; however, as with past industrial revolutions, the increases in productivity should create new markets, new businesses, and new factories that increase demand for skilled labor" (Baldassari & Roux, 2017, p.21).

Herzfeld (2017) is in the opinion that "AI has begun to shake the foundation of Western capitalism" (p.3); in contrast to this opinion, in fact, AI will reinforce capitalism as explained above. Sikdar (2018) is among the scholars who don't expect massive unemployment converging with Baldassari & Roux (2017): "In the past we saw the effects of vanishing horse-drawn carriages, and computers doing our accounting and finances, etc. Instead of massive unemployment widely predicted, many more new jobs were created than jobs that disappeared" (p.2). Wilson, Daugherty & Bianzino (2017), another group of scholars proposing that AI will create new jobs, presents and discusses three new job categories that are not replacing the old ones. The first category is that of trainers which refers to people who are tasked with training AI systems. The second category is that of explainers. Explainers will serve as bridges between technologically savvy experts and non-technical people including business leaders and politicians. This task is expected to be even more vital, as AI systems get more complicated. With more complications, it will be hard for non-experts to grasp the inner workings of AI. These explainers will also be central for the cases where algorithms appear to be wrong or counter-intuitive. They will be the ones to judge whether it is a system error or not. Finally the sustainers will ensure that the AI systems will continue their operations smoothly (Wilson, Daugherty & Bianzino, 2017).

For the medical settings, Fogel & Kvedar (2018) state that "while many fear that AI will disrupt jobs and the physician - patient relationship, we believe that AI can eliminate many repetitive tasks to clear the way for human-to-human bonding and the application of emotional intelligence and

judgment" (p.1). Naylor (2018) agrees with Fogel & Kvedar (2018) in case of deep learning:

"Deep learning shows promise for streamlining routine work by health care professionals and empowering patients, thereby promoting a safer, more humane, and participatory paradigm for health care. Different sources offer varying estimates of the amount of time wasted by health care professionals on tasks amenable to some automation (e.g., high-quality image screening) that could then be rededicated to more or better care" (Naylor, 2018, p. 1100). In this context, Jarrahi (2018) proposes 'the idea of intelligence augmentation' that means "AI systems should be designed with the intention of augmenting, not replacing, human contributions" (p.1).

A similar view is pronounced by Jha & Topol (2016):

"Jobs are not lost; rather, roles are redefined; humans are displaced to tasks needing a human element. Radiologists and pathologists need not fear artificial intelligence but rather must adapt incrementally to artificial intelligence, retaining their own services for cognitively challenging tasks" (p. 2354).

Fogel & Kvedar (2018) add the following:

"Given the time limitations of a physician's, as the time demands for rote tasks increase, the time for physicians to apply truly human skills decreases. By embracing AI, we believe that humans in healthcare can increase time spent on uniquely human skills: building relationships, exercising empathy, and using human judgment to guide and advice" (p.1).

In other words, automation, rather than making doctors redundant, is expected to assist them to save time with routine, tedious tasks that don't require creativity, empathy or care. This accordingly will pave the way for more space for humane tasks that doctors don't have time to perform in the current situation. Obviously, as common in popular discussions, AI and automation are confused here. Nevertheless, Fogel & Kvedar (2018) are clear about the most likely consequences: "Rather than take over, we believe that these systems may take on much of the unpleasant work of healthcare" (p.2).

Sociology of Artificial Intelligence

From a human rights perspective, it is clear that there will be winners and losers of the rise and expansion of AI (Raso et al., 2018). With the current capitalist thinking over the future, AI will worsen the current economic and social unfairness. Health applications of AI can worsen the social and

economic gaps due to the costs (Russell et al., 2015). Raso et al. (2018) note that privacy will be the most affected, but with regard to other human rights, we will see differentiated effects rather than overall impact over everybody. For Lloyd (2018), the biggest threat of AI is not about unemployment, but amplification of social biases to the detriment of already marginalized populations. E.g. "many algorithms learn from and perpetuate treatments that are best suited to white males' but may not be the best remedy for other groups" (Lloyd, 2018, p.3). The alternative would be a socially inclusive AI or discrimination-aware machine learning.

Likewise, for Crawford (2016), there is a more serious problem than the panic atmosphere that is due to the possibility of a future AI being smarter than human beings and getting out of control:

"Sexism, racism and other forms of discrimination are being built into the machine-learning algorithms that underlie the technology behind many "intelligent" systems that shape how we are categorized and advertised to" (p.1).

(...)

"Like all technologies before it, artificial intelligence will reflect the values of its creators. So inclusivity matters — from who designs it to who sits on the company boards and which ethical perspectives are included. Otherwise, we risk constructing machine intelligence that mirrors a narrow and privileged vision of society, with its old, familiar biases and stereotypes" (p.3).

In the same vein, Brundage (2015) predicts that

"The accessibility, transparency, affordability, and usability of AI innovations may influence the extent to which they tend to empower disenfranchised people or to entrench existing inequalities. If AI innovations are largely patented and fiercely protected by corporate interests, incomprehensible to non-experts, and draw on data or other resources that are only in private hands, different social consequences may result than if all AI innovations are immediately available to everyone (...)" (p.29).

Hamaguchi & Kondo (2018) identify sociologically differentiated effects of automation as a result of the more widespread mobilization of AI models in work settings: There are regional differences in the rate automation causes unemployment, and secondly, female workers are the most affected (Hamaguchi & Kondo, 2018). We can explain the basis of this finding and expand it sociologically: Under capitalism, the most oppressed are usually engaged in the most repetitive, boring tasks. Patriarchy oppresses females

and young workers (both girls and boys). Capitalism is usually characterized by racial and cultural discrimination despite of progressive policies in various countries. That means racial and cultural minorities along with females and youth will be the most affected by automation, losing their jobs. On the other hand, not all repetitive jobs are replaceable by AI. For instance, tasks involving care such as nursing is not expected to be affected by automation negatively. In contrast, they may rise as islands in the seas of automation. As patriarchy associates care with women, women at care professions can be the winners of the rise of AI. Of course, this is just one of the possible futures.

Ethics of Artificial Intelligence and Humane AI

A humane use of AI for industry would be in areas where workplace deaths are common such as mining (Nadimpalli, 2017) or shipyards. In fact, what is usually called as 'workplace accidents' (which are alternatively called as 'workplace murders' by labor activists) are endemic to capitalism. Labor safety has no universally accepted standard. Nevertheless, it is true that some of the work areas are more lethal than others, as a comparison of working as a miner vs. as a waiter would reveal.

For Fogel & Kvedar (2018), in discussions of health applications of AI, the most important criterion should be the patient care. If a new technology will add to patient welfare, making his/her life healthier and longer, it should be adopted. This is another way to formulate a humane AI. Although AI outperforms human doctors by a computational brute force approach in certain cases, what they lack is an understanding of the ethical and moral dimensions of human decision making (Brush, 2018).

One of the most serious ethical problem associated with AI would concern the AI weapons (Russell et al., 2015). Their destructive capacity is feared to be out of control in the future. It is risky to leave life and death decisions as such to machines. Aside from the weapons, for all AI systems we have the legal and ethical liability problem, in other words who will be responsible for AI's acts that violate the norms (Asaro, 2016), as exemplified by the case of driverless cars.

Driverless cars are expected to be more efficient than human drivers, as they are immune to road rage, distractions, and driving under the influence of alcohol and drugs. Furthermore, they are hoped to provide assistance to old-aged and handicapped people that are physically unable to drive (Arkin, 2016) and reduce traffic-related pollution (Zhao et al., 2016). However they pose ethical and legal problems, in case of accidents involving dilemmas (Deng, 2015) and human drivers' frustration as a result of the driverless cars'

exact compliance to the traffic law (Arkin, 2016). Human drivers sometimes break the laws on reasonable grounds (let us remember the notion of flexibility in the AI definition above), and that is not the case for driverless cars. Another example that involves ethics concerns the robots that remind the patients to take medicine. What if the patient refuses to take it? In this case, patient's well-being and autonomy will be in conflict (Deng, 2015).

It is usually claimed that radiology will be one of the first areas to go extinct by the rise and expansion of AI. However, Tridandapani (2018) thinks otherwise: "Current AI efforts have achieved limited success in narrowly focused image interpretation problems, and there is no indication that an AI system can practice general radiology" (p.965). Kahn Jr (2017) agrees with Tridandapani (2018) from another direction: "Although radiology is ready to benefit from AI technologies, the specialty entails more than identifying findings on images" (p.719). For Yasaka & Abe (2018), radiologists will still be needed for rare diseases, incidental findings and multimorbidity common among the elderly.

Thus, it appears that public opinion and celebrity figures with science backgrounds (such as TV futurists and pop scientists) exaggerate the success in narrow fields, but ignoring the failure in more general stuff. Furthermore, Tridandapani (2018) adds, medical professions require care with empathy which can't be imitated and replaced by AI. Another researcher, Zhang (2016), converges with this position stating that doctor's role is not only healing the body, but comforting the soul which involves emotions. In other words, doctors have another role which is to make the patient feel better, in addition to make him/her healthier. Thus, it is better to view AI not as a threat or substitute to human doctors, but as assistants to support patient welfare. Likewise, Sharma & Carter (2017) claim that AI can't replace human pathologists. They propose that in these discussions, activities involving high-level cognition and high-level computation are mistaken. They are not identical. For them the question is no longer about human versus computer, but "human versus human with the computer" (p.623), a view shared by Chen & Asch (2017) in different words. The best health performance according to Chen & Asch (2017) can't be achieved by neither alone, but by both. Ultimately the decision maker will be the human based on the findings and suggestions provided by the machines (Albu & Stanciu, 2015).

Conclusion

In this article, we first presented various definitions of artificial intelligence before proceeding to our main discussion on the social impacts of the rise of AI. We inferred that flexibility and unpredictability are the keys to both human and artificial intelligence. We proposed that public discussions on AI and unemployment are based on a theoretical misconception as AI and automation are not identical. Our next topic was the mainstream thinking on the link between automation and unemployment. We identified two major positions: The first one viewed the rise of AI as a social crisis due to the expected massive unemployment, while the second one argued that just like the similar historical cases, the rise of AI will also open up new jobs. In both accounts, mostly repetitive, routine work tasks are expected to be automated and accordingly disappear. As the last issue of our article, we reflected on the future of AI and its social impacts with a sociological perspective. It is highly likely that AI in its current forms will aggravate the already existing social inequalities and unfairness. Instead, a humane AI hugging not only advantaged but also disadvantaged social groups is necessary. Finally, it is proposed that at least in the short term and mid-term, AI and automation would be unable to substitute human empathy, care and related emotions, which will boost the significance of what is humane about our species. To conclude, rather than replacing human beings, AI and automation will assist our species to open more space for higher cognitive tasks. But ethical and sociological dimensions of AI should be kept in mind. A fanatic admiration for the rise of AI is out of touch with the social realities.

References

Acemoglu, D., & Restrepo, P. (2018a). Artificial Intelligence, Automation and Work (No. w24196). National Bureau of Economic Research. http://www.nber.org/papers/w24196.pdf

Acemoglu, D., & Restrepo, P. (2018b). The Race between Man and Machine: Implications of Technology for Growth, Factor Shares, and Employment. American Economic Review, 108(6), 1488-1542.

Adhikari, N. C. D. (2018). Prevention of Heart Problem Using Artificial Intelligence. International Journal of Artificial Intelligence and Applications (IJAIA), 9(2), 21-35.

Alarie, B., Niblett, A., & Yoon, A. H. (2018). How artificial intelligence will affect the practice of law. University of Toronto Law Journal, 68(supplement 1), 106-124.

Alberola, J. M., Del Val, E., Sanchez-Anguix, V., Palomares, A., & Teruel, M. D. (2016). An artificial intelligence tool for heterogeneous team formation in the classroom. Knowledge-Based Systems, 101, 1-14.

Albu, A., & Stanciu, L. (2015, November). Benefits of using artificial intelligence in medical predictions. In E-Health and Bioengineering Conference (EHB), 2015 (pp. 1-4). IEEE.

Arkin, R. C. (2016). Ethics and Autonomous Systems: Perils and Promises [Point of View]. Proceedings of the IEEE, 104(10), 1779-1781.

Asaro, P. M. (2016, March). The liability problem for autonomous artificial agents. In Ethical and Moral Considerations in Non-Human Agents, 2016 AAAI Spring Symposium Series.

Baldassari, P., & Roux, J. D. (2017). Industry 4.0: preparing for the future of work. People & Strategy, 40(3), 20-24.

Belpaeme, T., Kennedy, J., Ramachandran, A., Scassellati, B., & Tanaka, F. (2018). Social robots for education: A review. Science Robotics, 3(21), eaat5954.

Broussard, M. (2015). Artificial intelligence for investigative reporting: Using an expert system to enhance journalists' ability to discover original public affairs stories. Digital Journalism, 3(6), 814-831.

Brundage, M. (2015, April). Economic Possibilities for Our Children: Artificial Intelligence and the Future of Work, Education, and Leisure. In AAAI Workshop: AI and Ethics.

http://www.aaai.org/ocs/index.php/WS/AAAIW15/paper/download/10155/10128

Brush, J. E. (2018). Is the Cognitive Cardiologist Obsolete?. JAMA Cardiology, E1-E2.

Buch, V., Varughese, G., & Maruthappu, M. (2018). Artificial intelligence in diabetes care. Diabetic Medicine, 35(4), 495-497.

Burggräf, P., Wagner, J., & Koke, B. (2018, January). Artificial intelligence in production management: A review of the current state of affairs and research trends in academia. In Information Management and Processing (ICIMP), 2018 International Conference on (pp. 82-88). IEEE.

Chand, M., Ramachandran, N., Stoyanov, D., & Lovat, L. (2018). Robotics, artificial intelligence and distributed ledgers in surgery: data is key!. Techniques in Coloproctology, 22, 645-648.

Chen, J. H., & Asch, S. M. (2017). Machine learning and prediction in medicine—beyond the peak of inflated expectations. The New England journal of medicine, 376(26), 2507-2509.

Chui, K., Lytras, M., & Visvizi, A. (2018). Energy Sustainability in Smart Cities: Artificial Intelligence, Smart Monitoring, and Optimization of Energy Consumption. Energies, 11(11), 2869.

Craft III, J. A. (2018). Artificial Intelligence and the Softer Side of Medicine. Missouri medicine, 115(5), 406-407.

Crawford, K. (2016). Artificial intelligence's white guy problem. The New York Times, 26.06.2016.

https://www.nytimes.com/2016/06/26/opinion/sunday/artificial-intelligences-white-guy-problem.html

Deng, B. (2015). Machine ethics: The robot's dilemma. Nature News, 523, 24-26.

Edwards, B. I., & Cheok, A. D. (2018). Why Not Robot Teachers: Artificial Intelligence for Addressing Teacher Shortage. Applied Artificial Intelligence, 1-16.

Fogel, A. L., & Kvedar, J. C. (2018). Artificial intelligence powers digital medicine. NPJ Digital Medicine, 5, 1-4.

Gezgin, U. B. (in press). Eleştirel Bilim: İnsan ve Toplum Bilimlerine Yönelik Eleştirel Yazılar

[Critical Science: Critical Essays for Humanities and Social Sciences] [book to be published].

Harari, Y.N. (2016). Homo Deus: A Brief History of Tomorrow. London: Harvill Secker.

Harari, Y.N. (2015). Sapiens: A Brief History of Mankind. London: Harvill Secker.

Hamaguchi, N., & Kondo, K. (2018). Regional Employment and Artificial Intelligence in Japan. Research Institute of Economy, Trade and Industry (RIETI).

https://www.rieti.go.jp/jp/publications/dp/18e032.pdf

Hengstler, M., Enkel, E., & Duelli, S. (2016). Applied artificial intelligence and trust—The case of autonomous vehicles and medical assistance devices. Technological Forecasting and Social Change, 105, 105-120.

Herzfeld, N. L. (2017). Artifical Intelligence: An Existential Risk?

https://digitalcommons.csbsju.edu/cgi/viewcontent.cgi?article=1071&context=theology_pubs

Jarrahi, M. H. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. Business Horizons.

https://fardapaper.ir/mohavaha/uploads/2018/05/Fardapaper-Artificial-intelligence-and-the-future-of-work-Human-AI-symbiosis-in-organizational-decision-making.pdf

Jha, S., & Topol, E. J. (2016). Adapting to artificial intelligence: radiologists and pathologists as information specialists. Jama, 316(22), 2353-2354.

Khan, S., Paul, D., Momtahan, P., & Aloqaily, M. (2018, April). Artificial intelligence framework for smart city microgrids: State of the art, challenges, and opportunities. In Fog and Mobile Edge Computing (FMEC), 2018 Third International Conference on (pp. 283-288). IEEE.

Kahn Jr, C. E. (2017). From images to actions: opportunities for artificial intelligence in radiology. Radiology, 285(3), 719-720.

Latar, N. L. (2015). The robot journalist in the age of social physics: The end of human journalism?. In The new world of transitioned media (pp. 65-80). Springer, Cham.

Lloyd, K. (2018). Bias Amplification in Artificial Intelligence Systems. arXiv preprint arXiv:1809.07842.

Mahanty, R., & Mahanti, P. K. (2019). Unleashing artificial intelligence onto big data: A review. In Web Services: Concepts, Methodologies, Tools, and Applications (pp. 2099-2114). IGI Global.

Mamoshina, P., Ojomoko, L., Yanovich, Y., Ostrovski, A., Botezatu, A., Prikhodko, P., ... & Ogu, I. O. (2018). Converging blockchain and next-generation artificial intelligence technologies to decentralize and accelerate biomedical research and healthcare. Oncotarget, 9(5), 5665.

Marwala, T. (2015). Impact of Artificial Intelligence on Economic Theory. arXiv preprint arXiv:1509.01213.

Mehta, N., & Devarakonda, M. V. (2018). Machine learning, natural language programming, and electronic health records: The next step in the artificial intelligence journey?. The Journal of Allergy and Clinical Immunology, 141, 2019-2021.

Nadimpalli, M. (2017). Artificial intelligence risks and benefits. International Journal of Innovative Research in Science, Engineering and Technology, 6(6), 1-4.

Naylor, C. D. (2018). On the prospects for a (deep) learning health care system. Jama, 320(11), 1099-1100.

Pacis, D. M. M., Subido Jr, E. D., & Bugtai, N. T. (2018, February). Trends in telemedicine utilizing artificial intelligence. In AIP Conference Proceedings (Vol. 1933, No. 1, p. 040009). AIP Publishing.

Pannu, A. (2015). Artificial intelligence and its application in different areas. Artificial Intelligence, 4(10), 79-84.

Poola, I. (2017). Artificial Intelligence and the Future of Renewable Energy. International Advanced Research Journal in Science, Engineering and Technology, 4(11), 216-219.

Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. Research and Practice in Technology Enhanced Learning, 12(1), 22.

Rigla, M., García-Sáez, G., Pons, B., & Hernando, M. E. (2018). Artificial intelligence methodologies and their application to diabetes. Journal of Diabetes Science and Technology, 12(2), 303-310.

Raso, F. A., Hilligoss, H., Krishnamurthy, V., Bavitz, C., & Kim, L. (2018). Artificial Intelligence & Human Rights: Opportunities & Risks. Berkman Klein Center Research Publication, (2018-6). https://cyber.harvard.edu/sites/default/files/2018-09/2018-09_AIHumanRightsSmall.pdf

Russell, S., Hauert, S., Altman, R., & Veloso, M. (2015). Take a stand on AI weapons. Nature, 521, 415-418.

Sharma, G., & Carter, A. (2017). Artificial intelligence and the pathologist: future frenemies?. Archives of Pathology & Laboratory Medicine, 141(5), 622-623.

Shrestha, S., & Sengupta, P. P. (2018). Imaging Heart Failure With Artificial Intelligence. Circulation: Cardiovascular Imaging, 11, e007723.

Sikdar, S. (2018). Artificial intelligence, its impact on innovation, and the Google effect. Clean Technologies and Environmental Policy, 20, 1-2.

Sora, J. C., & Sora, S. A. (2018). Artificial Education: Expert systems used to assist and support 21st century education. GSTF Journal on Computing (JoC), 2(3), 1-3.

Stăncioiu, A. (2017). The Fourth Industrial Revolution „Industry 4.0". Fiability & Durability/Fiabilitate si Durabilitate, (1), 74-78.

Tajmir, S. H., Lee, H., Shailam, R., Gale, H. I., Nguyen, J. C., Westra, S. J., ... & Do, S. (2018). Artificial intelligence-assisted interpretation of bone age radiographs improves accuracy and decreases variability. Skeletal Radiology, 1-9.

Tang, A., Tam, R., Cadrin-Chênevert, A., Guest, W., Chong, J., Barfett, J., ... & Poudrette, M. G. (2018). Canadian Association of Radiologists white

paper on artificial intelligence in radiology. Canadian Association of Radiologists Journal, 69, 120-135.

Tian, B. (2018). Building Artificial Intelligence for Dermatological Practice. Open Access Library Journal, 5, e4541.

Timms, M. J. (2016). Letting artificial intelligence in education out of the box: educational cobots and smart classrooms. International Journal of Artificial Intelligence in Education, 26(2), 701-712.

Tredinnick, L. (2017). Artificial intelligence and professional roles. Business Information Review, 34(1), 37-41.

Tridandapani, S. (2018). Radiology "Hits Refresh" with Artificial Intelligence. 25, Academic Radiology, 965-966.

Tse, T., Esposito, M., & Goh, D. (2017). Humans and artificial intelligence: Rivalry or romance?. LSE Business Review. http://eprints.lse.ac.uk/85490/1/businessreview-2017-10-24-humans-and-artificial-intelligence-rivalry.pdf

Vieira, G. C., de Mendonça, A. R., da Silva, G. F., Zanetti, S. S., da Silva, M. M., & dos Santos, A. R. (2018). Prognoses of diameter and height of trees of eucalyptus using artificial intelligence. Science of The Total Environment, 619, 1473-1481.

Vyas, M., Thakur, S., Riyaz, B., Bansal, K. K., Tomar, B., & Mishra, V. (2018). Artificial Intelligence: The Beginning of a New Era in Pharmacy Profession. Asian Journal of Pharmaceutics, 12(2), 72-76.

Wilson, H. J., Daugherty, P., & Bianzino, N. (2017). The jobs that artificial intelligence will create. MIT Sloan Management Review, 58(4), 14-16.

Yadav, A., Gupta, V., Sahu, H., & Shrimal, S. (2017). Artificial Intelligence-New Era. International Journal of New Technology and Research, 3(3), 30-33.

Yasaka, K., & Abe, O. (2018). Deep learning and artificial intelligence in radiology: Current applications and future directions. PLoS medicine, 15(11), e1002707.

Zhang, Z. (2016). When doctors meet with AlphaGo: potential application of machine learning to clinical medicine. Annals of translational medicine, 4(6), 125-126.

Zhao, H., Dimovitz, K., Staveland, B., & Medsker, L. (2016, September). Responding to challenges in the design of moral autonomous vehicles. In The 2016 AAAI Fall Symposium Series: Cognitive Assistance in Government and Public Sector Applications, Technical Report FS-16-02 (pp. 169-173).