The Effect of Artificial Intelligence on Employment in the Engineering Industry

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Abstract

This project aims to cover how the rapidly improving and evolving technology of Artificial Intelligence (hereon referenced as AI) has been and will continue to affect the job market. It is not too hard to consider how many consequences this technology has—in fact, the possibilities are quite endless. It seems that nearly each month a new progression comes out regarding AI, and as such, it is only a matter of time until each profession has become at least remotely affected by the developments.

While positive implications can be reached quite easily, such as how AI saves time and labor, these positives can often be grouped with one or more negatives. Just as how AI can serve as a "Copilot" and aid in writing, the technology can also entirely do the job alone. This technology is still new and very much so in development, but as it continues to be perfected, we may analyze its significance in the job market. Considering how we three are all CSEN majors, we have a strong interest in examining how this technology could affect our future workforce and careers.

Letter of Transmittal

We have prepared this essay in an effort to educate those unaware of the developing technology of AI, as well as its potential implications on employment in the engineering industry. Targeted toward future engineers, we aim to provide ample information regarding the potential risk and aid that AI may offer or pose in the future. Our goal is not to worry students with this information but to educate them so that they may be better prepared for a future working alongside this revolutionary tool.

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Introduction

Context

AI has been of high interest recently, with new developments being released on a near monthly basis; innovations of which we are all incredibly familiar—OpenAI's ChatGPT and Sora, Github's Copilot, and even Grammarly. While all similar in their neural network design, these technologies offer different values and skills to be utilized by humans. The main question, however, is if this new technology poses a threat to employment (we will focus only on engineering here, as that question is far too vast to answer in this short essay). Considering that AI is able to churn out answers at an incredibly rapid rate with seemingly near-perfect accuracy, this technology most certainly threatens jobs in engineering fields. However, we must ponder the question of to which extent this threat exists, and how it will continue to develop over the upcoming years.

It should be noted that AI still remains in a very infantile state, often hallucinating or failing to properly address a question. After all, AI is not conscious—it is rather the product of hundreds of thousands of hours matching similar prompts to likely answers (this is the concept of a neural network). Provided this, it cannot think, and thus cannot ever tell if the answer it has produced is truly right. The technology will always do its best to fabricate an answer that is similar to a problem it has seen in the past, but since not every question has ever been asked (or answered correctly), this poses an obstacle to the accuracy of answers delivered.

How AI Works

To obtain a proper grasp of the potential threat that AI brings upon employment in the engineering industry, we must first understand how the technology works. This will allow us to have a better understanding of why AI is both threatening—and not—to certain jobs. After all, artificial intelligence is just that, artificial. It cannot think for itself, nor is it self-aware. However, it can mimic "learning" through repetitive iterative processes and algorithmic training. This leads machines to analyze patterns and create ties between prompts and answers.

A Metaphor—The 'Teacher" & The "Class"

You could think of AI as both a teacher and a class full of thousands of students. The teacher provides varying images of an image to identify; in our example, we will use a bird. However, there are other photos mixed in, containing buildings, humans, and other animals. The students then, using their individual unique algorithms, react to the images and decide which image is a bird, and which is not. As the analysis concludes, the teacher (alongside humans) can select which student performed the best, with that "student" becoming the new "teacher." New students are then created based on the teacher's algorithms and pattern detection. The cycle then repeats, leading the AI to improve accuracy with each new wave.

The Technology Behind Machine Learning

In reality, AI functions very similarly to the human brain, being composed of several *artificial neural networks*. These are comparable to the interweaving neuron webs within our own brains, which fire in specific patterns to trigger an output. In simple terms, artificial neural networks process data from an "input layer," which then generates a response at an "output layer," depending on the path to which the signal travels between the two (Boucher, 2020).

Depending on the input, the signal may choose a different path, thus arriving at a different output. This is tuned over time by training the machine in a process similar to the metaphor depicted above, which is a process that is highly power-intensive and time-consuming (p. 5). The aspect of such training being resource-consuming is notable and should be kept in mind for later discussion.

Potential Applications of Machine Learning

As has been seen heavily over the last year, AI has been one of the most, if not the most, influential tools of our time. Capable of generating text, media, and solving problems in minute amounts of time, machine learning has changed the way we work. This has also changed how industries function as well.

AI is capable of filling out entire spreadsheets and conducting analysis on them, easing the workload for data scientists. Copilot-esque chatbots have also been created for software engineers, being able to read over scripts in an entire directory to offer helpful advice for what to write or implement next. While AI can be applied in nearly every field of work, it is the extent to which we must ask ourselves.

How Artificial Intelligence Will Harm Engineers

Reducing Work

The rise of automation and computerization, particularly driven by artificial intelligence, poses an inherent risk to the employment of engineers. Acemoglu and Restrepo (2020) highlighted that automation, especially when propelled by AI, could lead to a significant reduction in employment and wages within the U.S. labor market. Their research estimated that AI-driven automation could result in a reduction of about 0.18% to 0.34% in employment and 0.25% to 0.5% in wages across various sectors. This reduction in employment opportunities and wages could directly impact engineers, as AI increasingly automates tasks traditionally performed by humans. As AI technologies continue to advance, engineers may face increasing pressure as certain job functions become automated, leading to a decrease in demand for engineering roles. According to Frey and Osborne (2022), 47% of U.S. employment was at risk of automation, which can be foreseen by observing the direct negative impact Germany's employment experienced as the country increased its usage of robots. Unlike technological advances of the past, AI poses a threat to not only low-skill jobs but also cognitive tasks and high-skill jobs. Additionally, the rapid advancement and scalability enable AI to incrementally expand capabilities, resulting in a constant threat that a new skill could be replaced at any moment.

Job Displacement

The adoption of artificial intelligence is expected to significantly impact the career opportunities of current and future engineers. AI-driven automation is likely to lead to the displacement of engineers involved in repetitive or routine tasks, such as data analysis, drafting, and design. This displacement could result in a mismatch between the skills required in the job market and those possessed by engineers, as AI increasingly automates tasks traditionally

performed by humans. Engineers will need to adapt and upskill to work with AI and focus on tasks that require creativity, critical thinking, and problem-solving. As AI increasingly automates routine tasks traditionally performed by humans, job displacement could disproportionately affect certain groups within the engineering workforce, such as those with lower levels of education or fewer specialized skills (Peetz, 2019). Additionally, the demand for engineers with expertise in AI-related fields, such as data science and machine learning, is expected to increase, leading to higher wages and greater job security for those with the requisite skills. This could widen the gap between engineers with specialized AI skills and those without, further exacerbating inequality within the engineering profession. Engineers who possess these specialized skills will be in high demand, while those who do not may face increased competition and job insecurity. Moreso, this reduction in low-skill positions could correlate to entry-level engineers struggling to find jobs to jumpstart their careers. However, having advantages in cognitive or creative positions does not guarantee job security either, with programs such as OpenAI's Sora claiming the ability to generate realistic videos from text instructions, proving AI's functionality in creative careers has only begun. Therefore, engineers will need to continuously update their skills and adapt to the changing technological landscape to remain relevant in the industry.

Bias In AI

The increased usage of AI poses harm to minority groups that are disproportionately affected by biased algorithms. AI utilizes data to determine conclusions, which can often be misleading or unconsciously manipulated by the view of the developers. An example was COMPAS, a predictive ML model that was created for US courts to assess defendants. The model, using historical data containing potentially prejudiced trials, determined black individuals to be at a "high risk" of committing a crime at double the rate of white defendants (Belenguer, 2022). Additionally, Amazon developed an algorithm to select the top resumes from hundreds of applications. However, a bias heavily favoring men was almost immediately detected, presumably because female programmers in IT account for less than 20% of the workforce and thus were not valued by the model. Through these examples, it is clear that AI lacks the capacity to discover the context of data and question its integrity, instead using past trends as the main factor for decision-making. Meanwhile, engineering as an industry has historically had limited diversity, with the US Bureau of Labor and Statistics stating around 84% male and 76% white (2023). Thus, an introduction of a biased AI to this field could result in further discrimination and a continuation of unequal representation of the industry. The result of this includes AI racial profiling similar to the Amazon model and collaboration with the AI being difficult/unfavorable for women and people of color. Furthermore, as AI expands, it will establish policies and projects that could shape the engineering industry and society as a whole in this discriminatory, flawed image. Overall, biased AI within the engineering industry can harm minorities by perpetuating social injustice, reinforcing stereotypes, and excluding underrepresented groups from job opportunities and technological advancements.

How Artificial Intelligence Will Aid Engineers Beyond Software Engineering

Artificial intelligence serves to benefit multiple industries beyond just software engineers. In our research, we learned that Artificial Intelligence can be used in industries that use any form of current technology, from driverless cars to doing our taxes. It is to be known and to be clear that artificial intelligence is a tool. Like any tool if used correctly, it can improve efficiency, time, and in some cases safety.

AI is put on a pedestal when it comes to being able to enhance and improve the possibilities of engineers in different fields. In researching it has been discovered that this ranges from petroleum engineering to software development. According to Sandha, Agha, and Islam, AI addresses some of the complex and difficult challenges in the oil and gas industry. These challenges include determining formation permeability from well logs or forecasting post-fracture well performance in the absence of engineering data (Sandha, 2005). This ability comes from the AI being able to process these new data sets and information at a much faster rate than our human minds. With this efficiency, it still manages to excel in complex tasks that require it to understand certain speech and recognition patterns as well.

Additionally, Meziane and Vadera illustrate how Artificial Intelligence strategies using knowledge-based systems, data mining, and neural networks can offer great benefits and advantages in software development. These strategies help break down lasting issues in developing software that stem from cost/budget and time management issues ("Artificial Intelligence Applications for Improved Software Engineering Development: New Prospects," 2009). AI's potential to help improve software development is attributed to its speed, performance, versatility, and overall impact across different industries.

Thus illustrating the different benefits Artificial intelligence brings to the engineering field regardless of practice. There is no doubt that artificial intelligence can be a valuable tool that can revolutionize traditional engineering processes and tedious tasks performed by engineers. It enhances security, efficiency, and accuracy, for many different applications regardless of the field. If used correctly Artificial intelligence can rid of false biases and reinforce the positive impacts it so strongly has the potential for.

Conclusion

In conclusion, the effects of Artificial Intelligence on specifically the engineering job market are complex and significant, it blends the promise of positive results while overcoming its negative challenges. Throughout this report, we have observed that Artificial Intelligence is not just another innovation in tech, not just another product. It is the transforming force that will ultimately change and reshape many processes for engineers thought to be set in stone. It will create new job opportunities and require new skills to remain successful in the industry.

On one side of things, Artificial Intelligence showcases an important opportunity for growth in the field of engineering specifically software engineering. It handles incredible amounts of data quickly and with high precision and accuracy. This allows for quicker problem-solving, productivity, and solutions. Just like with any other engineer, software engineers have tools as well. Whether it is a keyboard or Artificial intelligence both tools serve different purposes when it comes to a given task. Engineers equipped with AI tools can be more efficient when it comes to handling complex data and be more accurate as well. The development of AI will also lead to the creation of new jobs and focus on engineering, maintenance, prompt engineering, and most importantly ethics.

Conversely, the growth of Artificial Intelligence introduces new challenges as well. One of the most feared of which is job displacement and the growth of inequalities already prevalent in the engineering field today. As AI begins to automate daily and tedious tasks there is a clear and prevalent risk of reduced demand and needs for current and beginner software engineering roles. This possibly results in job loss or the devaluation of current possessed skills. This shift requires engineers to adapt and grow their current skill sets to keep up with new technology but also simultaneously outperform current challenges set by Artificial Intelligence.

Ultimately the double-edged characteristics of AI and its impact on engineering bolden the need for a fair and balanced approach to its integration into the current world of technology. It is important for educational institutions, corporations, and policymakers to work together in preparing the current workforce to adhere to set boundaries and standards for AI. This preparation must include training, ethical guidelines for AI use and methods to dissolve and minimize possible job displacement impacts produced as a result of the growth of AI.

As we stand at the divide of this technological advancement the decisions we make today will determine the decisions AI will shape for us in the future of engineering. It is our responsibility to navigate this powerful tool towards results that will improve the profession of engineering while maintaining ethical and fair boundaries for all. By noting the challenges and benefits and embracing both we can harness the full potential of AI not only to transform the world of engineering but also to positively contribute to the engineering job market and society overall.

References

Araz, Z., Syed, A., & Nazrul I. (2023). Worker and Workplace Artificial Intelligence (AI) Coexistence: Emerging Themes and Research Agenda. Technovation 124 (June): 102747–47. https://doi.org/10.1016/j.technovation.2023.102747

Belenguer, L. (2022, February 10). AI bias: exploring discriminatory algorithmic decision-making models and the application of possible machine-centric solutions adapted from the pharmaceutical industry. SpringerLink. https://doi.org/10.1007

Boucher, P. (2020, June). Artificial intelligence: How does it work, why does it matter, and what can we do about it?. European Parliament. https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641547/EPRS_STU(2020)641547_EN.pdf

Chen, M., TWOREK, J., Sutskever, I., Zaremba, W., Jun, H., & Ponde de Oliveira Pinto, H. (n.d.). Systems and methods for generating code using language models trained on computer code.

Chen, N., Li, Z., & Tang, B. (2022, November 8). Can digital skill protect against job displacement risk caused by artificial intelligence? empirical evidence from 701 detailed occupations. PLOS ONE. https://doi.org/10.1371/journal.pone.0277280

Fischer, J. E. (2023). Generative AI considered harmful. Proceedings of the 5th International Conference on Conversational User Interfaces. https://doi.org/10.1145/3571884.3603756

Peetz, D. (2019). Digitalisation and the jobs of the future. In *The Realities and Futures of Work* (pp. 83–112). ANU Press. http://www.jstor.org/stable/j.ctvq4c16w.9

F. Meziane, and S. Vadera. 2014. "Artificial Intelligence Applications for Improved Software Engineering Development: New Prospects." 2014. https://www.semanticscholar.org/paper/Artificial-Intelligence-Applications-for-Improved-Meziane-Vadera/9e61f7767e43315855b667bd7da418eefaf665d5.

Mpinga, E. K., Bukonda, N. K. Z., Qailouli, S., & Chastonay, P. (2022). Artificial Intelligence and Human Rights: Are There Signs of an Emerging Discipline? A Systematic Review. Journal of multidisciplinary healthcare, 15, 235–246. https://doi.org/10.2147/JMDH.S315314

Sandha, K R Agha, and R Islam. 2024. "Artificial Intelligence…as a Decision Support System for Petroleum Engineers." Petroleum Science and Technology. 2024. https://www.semanticscholar.org/paper/Artificial-Intelligence%E2%80%A6as-a-Decision-Support-for-Sandha-Agha/64b0d636e97a027443efe3a9a1e6e1b24dec512d.

Tyson, L. D., & Zysman, J. (2022). Automation, AI & Work. *Daedalus*, *151*(2), 256–271. https://www.jstor.org/stable/48662040

U.S. Bureau of Labor Statistics. (n.d.). *Employed persons by detailed occupation, sex, race, and Hispanic or Latino ethnicity*. U.S. Bureau of Labor Statistics. https://www.bls.gov/cps/cpsaat11.html