

The carbon footprint of Artificial Intelligence: More than just a retrospective paradigm shift

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Abstract: Since its inception through our shared discoveries of the natural world, recent technology has dramatically risen to the degree of supplanting itself in earlier iterations of technology in every major industry. Accruing a substantial following in its latest installments by means of artificial intelligence and its diverse application in daily living, it would seem that AI has a potential to coalesce human understanding with interdisciplinary fields of study that are crucial to tackling some of the world's most thought-provoking problems. However, we would be remiss in not mentioning the inherent damaging implications surrounding artificial intelligence. Whether that be the energy consumption associated with training these chat-bots, their effect on our individual autonomy, or the biomedical ethics side of things, our blissful ignorance does not negate the actual and factual surrounding the propagation of AI technologies. Understanding the cause and effect relationship between us and AI is necessary, among other areas of concern, we hope to mitigate its carbon footprint. When one ponders over AI and the significant contributions that it has made to humanity, there exist colossal consequences from its continued and probable misuse. In this paper, a narrative of hope will illuminate a pathway to discourse of addressing AI's carbon footprint. Since this topic of discussion prompts understanding of a new field, it is vital to explore it in depth with the hope of crafting a plan for remediation. If history is not to repeat itself, let us set the precedent of repeating worthwhile parts of human history wherein we were able to address relevant issues that endanger our collective home with public policies and proper resource management. Instead of the chasm of dismissal from our predecessors who offloaded problems to the next subsequent generation, there needs to be a spirit of inclusion with the public to combat these looming threats. By choosing to deliberately address the carbon footprint of artificial intelligence and the its implications in energy consumption, individual autonomy, and biomedical ethics there will be hope of better and hastier responses to the exact collateral damage AI gives to our earth and its inhabitants.

Keywords: Carbon footprint, Artificial Intelligence, Paradigm shift, Biomedical ethics, Autonomy, Environmental.

1. INTRODUCTION

What would you say is the most dangerous creature in our world? Well, the answer might surprise you. If you were to look in the mirror who might you see? The shocking revelation is humankind, plaguing the existence of countless innocent lives. Instead of being custodians to our earth, charged with the responsibility of preserving beauty to the greatest conceivable degree, we have, beyond any doubt, managed to threaten it instead. My experience as an educator has shown me the level of enslavement to technology that exist in and beyond the classroom. Being poised as “the next big thing” to aid students in their academic journey is a misconstrued understanding. Placing so much emphasis on allowing artificial intelligence to predict, plan, and lead our joint efforts was a constant theme. I remember vividly that when it came to lesson planning or any type of detail report writing, many of my colleagues would often seek out GPT-3 to do the work for them and then chastise the students in their classrooms when the latter used it for essays or homework. This level of hypocrisy was a breeding ground for double standards that elicited behavior problems throughout the year and were consistent with ethical values and morals being viewed as nothing more than gray areas.

When you think about the role of teachers, we are charged with leading by example. In effect instructing our students more than content and being exemplars of conduct and reputation. As a consequence of this reliance on technology and by direct association with artificial intelligence, many of these computers used by students became tarnished to the point that they could not be used anymore. Upon further inspection, a common thread became the physical mistreatment, lack of accountability, and the improper use of AI-centric platforms on these computers. Now when we consider the environmental implications of this situation and the possibility of it happening in similar settings, it really begs the question of the environmental and social impression on our planet. It would seem that by having those in positions of leadership condone actions that go in conflict with more sustainable efforts we inflate and deepen our carbon footprint. With the addition of chatbots that expend vast amounts of energy for training and computation this over taxes the hardware systems within computers and leads to their early obsolescence. All this in turn requires careful attention to the future brings, our growing commitment to more influential AI platforms serves as a preview to this unavoidable pathway, that humankind has found themselves in the middle of.

When we think about the earth's future a lot of it is predicated on the impact imposed by humans. Whether it is climate change, global warming, or the thinning of the ozone layer, our environment has been its playground. Often when talking about sustainability and land stewardship as a means for mitigating these determinants, there always seems to be a looming threat on the horizon. As we seek to expedite workflows and improve upon processes, artificial intelligence has been gaining support for its diverse applications. However, once those feelings of grandeur subside and reality sets in about its lingering effects there needs to be a call to action. Our insatiable curiosity has pushed the boundaries of technology and what we can hope to accomplish in pursuit of a better tomorrow. Because as the old adage goes, tomorrow is not promised and that should serve as a reminder that all of our efforts can be for not. Since the technology that we seek to push may eventually reach the general public, but at the cost of ourselves.

The role AI plays in our lives is not limited to the shock and awe narrative that is rolled out to the general public, its contributions towards our carbon footprint is the bigger story that needs to be examined. Its manner of training and computational power is necessitated by intricate AI models that are sapping our precious resources, which would better allocate effectively in a responsible and mindful manner, oppose to the pulpit of knowledge that is peddled of an AI-centered future. To dispute the fact that our lives and its countless interactions are not tempered with some sort of AI technology would be rash. However, our relationship with artificial intelligence is anything but casual. Meanwhile this relationship with AI relies on an overwhelming support of resources that very well may be taken away from underserved communities. If we were to liken AI's dependence to tally marks on a piece of paper, that paper would be filled out countless times over.

The training expended into these chatbots operate on next word predictions and bigger model sizes that suggest footing the metaphoric bill to us. In most cases in order to train these chatbots, developers will make use of datasets like in social media libraries to learn from conversations. Take for example the data efficiency of these intelligent machines, in order to generate coherent outputs a substantial amount of data or inputs are needed to facilitate its learning. The data that it is exposed to comes from a corpus of material to better identify patterns that will allow chatbots to imitate human-level intelligence across various disciplines. Endeavors to continue satisfying AI's preponderance of resources is coming from computational power derived from GPUs, memory storage, and processors. Which in time end up becoming taxed to the point where they often need to be replaced to keep abreast with the next iteration of GPT.

The pattern of predictability speaks for itself and the more that we seek to understand about the natural world will reveal that we have gone too far. So, here in lies the problem that as long as humanity seeks to push the boundaries of AI, we are going to continue to seek technology and in turn etch a carbon footprint that is going to leave a bigger impression than the dinosaurs. We do not have to look too far in history to see an example of that than crypto mining. At its height, digital currency became a popular commodity that saw an influx of operations known as crypto farms which involved some serious computer hardware. Due to this trend, consumers like me were left with remnants and much to figure out. Not too long after, many of those very same components used in farms were being sold after being used for their superfluous purpose. Unfortunately too many of these once sought after technological pieces found their way to the trash and consequently to our growing footprint.

2. CARBON FOOTPRINT

As we stop and think about how much AI has augmented the human experience, we need not look too far. Take for example, the very search engines that we use to gather data. There are already inclusions of chatbots ready to assist us in anticipation of questions searched. A large part of the applications associated with artificial intelligence requires an immense amount of

energy. According to AI's Growing Carbon Footprint – State of the Planet (2023), these data centers run 24/7 and most of that energy comes from fossil fuels. However, when compared to the aviation industry and its energy consumption, these data centers out consume. This large carbon footprint that is being left behind by AI and its 24/7 running of data centers is being driven by an exorbitant amount of training that goes into these models. Models, that again are engineered by imperfect man to solve mankind's problems seems like a contradiction.

From the same aforementioned article, researchers gleaned that the training alone for GPT-3 yielded carbon emissions equivalent to driving over a hundred gasoline powered vehicles for a year. (*AI's Growing Carbon Footprint – State of the Planet, 2023*). That is an extra five hundred metric tons of carbon that is being added to our shared home, now in the wake of the recent GPT-4 one could only imagine its environmental implications. AI's carbon footprint has been growing in size and our planet is reaching a point where it can significantly impact our carrying capacity. As we seek to inject more sophisticated parameters into training chatbots it inherently amplifies the downside of AI. No matter how hard we try to push that technological envelope artificial intelligence will never be able to attain consciousness. AI is a tool that should remain as a subset of prediction engines that should not be viewed as a one size fits all. The human experience is anything but predictable, so it would appear that having implicit trust in these prediction engines would be a recipe for disaster

Artificial Intelligence has become much more than a fleeting partnership, the countless interactions we have with technology in our day-to-day activities is nothing short of noteworthy. So when you ponder about what the potential downside may be when using it, a common sentiment would be why didn't I use it sooner? Instead of a more thought-provoking response to its energy consumption, consumption needed to keep up with its demand for information and fluid workflows and processes, that sheds light to AI's consumption of energy being anything but a transient action, because these deep neural networks crave substantial computational power. Specifically hardware, for long durations of time the amount of electricity that is required to power this endeavor continues to grow. Due to the immense amount of training that is invested in these intelligent models. In the case of the GPT-3 training, it required 1287 MWh of electricity (*AI's Growing Carbon Footprint – State of the Planet, 2023*). That number is just staggering because of the investment of resources, which are being made for the sake of a belief in fickle technology like AI. That is a pretender to the throne of human intelligence and continues to sap the very essence of being human, our personal autonomy.

Again, these infractions help to illustrate a foot hole that AI has already established in our lives. In addition to this uptick in reliance on intelligent machine learning, considerations about its hardware becoming obsolete as we are ushered into a technology based era. Human proclivity creates waste, in this case extends to electronic waste that is a foregleam for the future. This is tantamount to going in direct contradiction to a more sustainable future that promotes leaving our home better than we found it. Unfortunately, lack of safeguards prove to reveal a growing tendency in pushing this problem to the next generation. Cascading effects are going to widen and deepen a footprint that will be greater than that of prehistoric times. Which begs the question of who merits the responsibility for these consequences that are set to unfold? As we reach closer to these uncertain times, it become pragmatic to appeal to one's moral duty, and the motivations behind confidence in an artificial source. As the parent cell of AI, there are just some things that parents cannot allow their children to bear, in this case it would be our growing carbon footprint.

3. HUMANITY'S RESPONSIBILITY

To mitigate this in the near future it becomes necessary to be cognizant of sustainability which will prompt practices like recycling and adequate disposal of computer components to lessen the impact on our collective environment. Currently there are talks of "Green Initiatives that are indicative of algorithms and hardware to operate in more energy efficient ways. However, there is an ethical issue at play when it comes to the great lengths that are taken for the sake of AI. A prominent ethical question that is often asked is, just because we can, does that mean we should? In our current stream of time, we may be able afford and to a degree entertain these taxing measures imposed by artificial intelligence. But again, is that enough reason to validate its continual use? The verdict is still out about the implicit need for AI to be supplanted in various aspects of our interactions. Additionally, our human autonomy is at risk of being a shell of its former self. Since the addition of artificial intelligence there has been a greater emphasis on innovation and productivity, but at what cost? Choosing to give up our free will can potentially lead to concessions made on behalf of an inability to act with fidelity.

The inherent constraining that are being placed on our planet are giving rise to gaps in our infrastructures and our own individual autonomy. An interesting nugget regarding autonomy is further developed by DeGrazia and Brand-Ballard (2011) who state, "First, autonomy may be conceived of in terms of a threshold: One acts autonomously if one acts intentionally,

with sufficient understanding of what is at stake and one's action is sufficiently free of external and internal constraints (p.44).” The part that stands out and has relevance to our day is that collectively we do not have sufficient understanding of what is at stake when we place so much trust and confidence in AI. Instead it would be prudent to consider how we can be free of external and internal constraints that can inhibit our decision making processes when it comes to that threshold that artificial intelligence seems to bog down with its depletion of resources and human inhibition.

To remedy this foreseeable threat, it is necessary to evaluate the work that others have done to combat this looming threat. An interesting line of reasoning is provided by Stahl (2021) which goes on to say, “In order to render the discussion more accessible, I have proposed a new categorization of the AI debate. My suggestion is that we distinguish between three perspectives on AI: machine learning or narrow AI, general AI, and converging socio-technical systems (p.118).” The key to this partnership with artificial intelligence lies in a clear delineation in its applications to be able to allow for human flourishing and prompt that very thing for our earth. It becomes paramount to verily understand the role AI plays and how it may subjugate our earth to greater concerns about global climate change. Because when we stop and think about the myths associated with AI, there is none bigger than artificial intelligence being a cheat code and all those associated with it partake in unethical behavior. Of course, like anything else it boils down to the intended use and for what it leveraged. In my own experience, I have seen it leveraged to avoid doing one’s work and continue to shirk any form of responsibility.

Look for instance at its inception and early development, artificial intelligence centered on increasing human thinking by coalescing our understanding with an artificial entity. This line of inquiry has illustrated a narrative that for far too long did not offer many considerations towards the ramifications from continued use of AI. Cowl’s make an interesting observation et al. (2021), which states, “Leveraging the opportunities offered by AI for global climate change is both feasible and desirable, but it involves a sacrifice (ethical risks and potentially an increased carbon footprint) in view of a significant gain (a more effective response to climate change). p.284.” So it would seem that in order to remedy global climate change, a gambit is needed that would require us to forgo a smaller carbon footprint and ethical beliefs being compromised in the hopes of solving one of mankind’s age old problems.

4. ETHICAL CONSIDERATIONS

Our belief systems are responsible for countless decisions making processes that we make on a daily basis. Now when we think about the ethical implications of those same processes being under the influence of AI, it really does raise the following questions. If we allow concessions for the sake of this AI gambit where does it end? Will this be the start of a cycle that gives credence to a malformation of ethical tenets that shape future generations to come? As we have seen throughout the course of time, history often repeats itself and in most cases a cruel reminder of humanities arrogance. Thinking that we know better and can govern in a way that is free of consequences, inject artificial intelligence in that conversation and have a call to action. That will merit considerations and best practices to encourage change for our environment that will be done morally.

It is interesting what was mentioned in Cowl’s study, observations that were made about AI. Specifically in the gambit that was alluded earlier. An aspect of interest that stood out was artificial intelligence, not being a silver bullet or our only means of dealing with climate change. Because when we think about societal norms that have been commonplace as of late, our relationship with technology has skyrocketed to the top. Instead of having conversations with actual people in line at the store, doctors’ offices, or elsewhere many are choosing to engage with AI that has no semblance of that human connection. Despite how poignant it may sound, many would like to place stock in a future that is built on machines, but it is necessary to take pause and understand the biomedical side of things. Since advancements are being made to systems and workflows within the healthcare industry is being propelled by AI and its counterparts.

Even though the connection between AI’s carbon footprint and biomedical ethics may not be readily apparent, their interactions are important to delve into. Since they deal with long term consequences, allocation of resources, and sustainability of our environment. In order to answer these ethical quandaries there needs to be a collaboration of efforts between cross disciplines from the vantage point of ethical, environmental, and social standards. For instance, when pondering over biomedical areas of research is often concerned with sustainability and equity of resources and how our actions now does not jeopardize those in the future. When we think about the future, creating it with genetic engineering in mind is a prevalent thought. Adding artificial intelligence to the equation makes not only a more complex issue but pressing a stoichiometry balance in nature. That if done incorrectly, can lead to a reaction that has lingering effects, much like in unbalanced chemical reactions.

From a micro to macro level, artificial intelligence's growing carbon footprint is revealing that ethical decisions now more than ever should be incorporating the longevity of environmental implications. Principles like stewardship should be an outline for a plan of action that needs to be hatched in more than just a positional good. The fallacy of AI being an innovative technology has lulled many in a false sense of security that any of these adverse reactions would be felt in our lifetime. Since the inception and development of AI in the mid-20th century interest has been shown in favor of intelligence machines imitating human intelligence. Bearing in mind the manner in which these intelligent machines will be able to diffuse challenges in climate change and dilapidation of our environment, there should be no substitute for the real thing, in this case human intelligence that is grounded in an actual consciousness. That is able to demonstrate the free will that is derived from our shared experiences of this world.

The healthcare sector in collaboration with biomedical research depend on the novel technologies that result from artificial intelligence. By expediting tasks and workflows helps to alleviate undue pressure that exist in an everchanging field. However, if a substantial number of computational resources are funneled to biomedical research that is led by AI that this can cause an uptick in environmental deprivation and potential social inequities. If led unchecked can be tantamount competing to limited resources and increased energy costs. An approach in sustainability is required to preserve our resources and navigate responsible endeavors of biomedical research in the healthcare field. Because when it comes to the ethical considerations in light of emerging technologies and the concessions that may be made, should they be in spite of AI or because of it? When we ponder over the motive behind our actions they should not be ingrained deeply with a fleeting technology that will outgrow its purpose.

5. BIOMEDICAL ETHICS

Within the scope and purview of biomedical ethics, healthcare systems become more reliant on tasks done by AI. Despite its propensity to fast track the field regarding patient outcomes, treatment diagnosis, and drug discovery there still needs to be a measure of restraint. This intersection between AI's carbon footprint and social responsibility in healthcare gives credence to mitigation strategies in support of sustainable efforts. An interesting sentiment is shared by Stahl (2021), who shares, "The current state of the AI ethics debate can be described as a cacophony of voices where those who shout loudest are most likely to be heard, but the volume of the contribution does not always offer an assurance of its quality (p.2)." This sad truth reveals the dichotomy regarding the AI gambit and its pursuit of an ethical framework that may be diluted in place of AI-centric healthcare. Our decision making processes should instead be tempered with a balancing act of environmental impact against the inherent benefits of artificial intelligence.

Understanding the difficulties with AI's implementation is important, as it conveyed by Weerarathna et al. (2023), that mention, "AI applications in biomedical cancer research offer significant potential, but they also come with several challenges such as validation and clinical adoption, bias and fairness, data privacy and security, data quality and quantity, and interpretability (p.8)." Is the promise of something being able to do so much for us worth the inherent risk associated? Take for example our medicines, more often than not they help us with our ailment but causes a subsequent side effect that warrants attention. What should deserve our focus in this case, are the challenges listed above like data privacy, quality, and quantity. Those are the beginning of additional areas of concern to rise to the forefront in research. Which serves a preview for another area of concern, that of a medical paradigm shift. Which can distract us from the greater issue at hand, AIs continued use at the expense of our environment.

The introduction of AI applications and its relationship to biomedical ethics is still a new facet of research. Further supplanting the need for additional vantage points that merit converging ideas. Because the motivation that there is to use AI in Biomedical sciences is strong since it has been used for close to two decades in dealing with cancer research. Due to its ability to not only offer speed and accuracy in diagnosis, but also provide recommendations and suggestions for a more promising prognosis. However, awareness is vital and according to Bhardwaj et al. (2019), who reveal, "In addition to the impediments identified in the previous section pertaining to development of an appropriate medical paradigm to resolve black boxing in biomedical systems, another major difficulty identified was in management of medical records (p.163)." Upon reading this quote cemented the truth in this paradigm shift that coalesces principles and methods of networks in science and biological systems. That are being tempered with more a holistic type of care in respects to the future of health care and beyond.

6. OUR FUTURE

When we think about the future that we are creating, and in turn encouraging it, becomes tethered to technology and its subsidiaries. It is interesting what Jonathan Anomaly discusses in his book, *Creating Future People: The Ethics of Genetic Enhancement* because his insight into emerging genetic technologies as a means for influencing our futures gives credence to this paper. Because it now seems that more than ever, there is a crossroads in not only the future of people, but in how technology will shape our environment. A thought from Anomaly's book that I found to be sobering was, "Our capacities do not give us license to abuse the less able and may give us special responsibilities to take care of them (Anomaly, 2020, p.14)." Here what I appreciated is that just because we are able to operate in capacities that others are not able to, does not give us that license. Instead, we should be prompted to help those because it is our moral duty. In effect, revealing our character extends well into how we are taking care of our collective home.

In like fashion just because we have the means to advance society at the cost of our home, should not be reason enough to push that carbon filled envelope. So many of our transactions in life are filled with technology that is learning how to assist us. But would it not be better for us as a species to learn how to first, properly take care of our home? The logic in practicing land stewardship seems like an elementary thought, but it is filled with an illuminating path forward in how we can dig ourselves out of this chasm of uncertainty. Understandably, a solution such as this would appear to be easier said than done. Since we all have our own type of ethics and that in turn makes it more difficult to reach a consensus that would seem agreeable to all. An alternative thought for consideration that was alluded earlier in this paper was to allow AI to find a way out for us. If we were to follow suit with that idea, what will that say about our capacity to govern and take care of ourselves for the near future? Having to be bailed out by a form of intelligence that is anything, but human should be a wakeup call to how critical things are.

Coincidentally along the same lines of Anomaly in terms of this perceived future of ours, Michael Sandel's book, *The Case Against Perfection: Ethics in the Age of Genetic Engineering* is a sobering read, explicitly, his outlook towards the type of ethics in genetic engineering. He made a poignant assertion, "If it is permissible, even admirable, for parents to help their children in these ways, why isn't it equally admirable for parents to use whatever genetic technologies may emerge (provided they are safe) to enhance their child's intelligence, musical ability, or athletic skill? (Sandel, 2009, p.51)." Which is a fair question to ask given our current standing in the stream of time, we are on the precipice of understanding things a little too much for our own good. That gives weight to finding ourselves in the middle of ethical dilemmas. Whether or not this resonates with us becomes part of a larger issue in the technological gradient that keeps eliciting decadent behavior in society. Developments in the technological sector are geared to making life easier, by giving us back time. The time that is given back to us, sadly, is allocated for indulgent pleasures that inch some towards a moral gray area of independence.

7. CONCLUSION

Areas of consideration that were not able to be fully explored in this paper include: the role of autonomy in the context of advancing AI developments, AI's influence on genetic engineering. While many of the implications surrounding AI is again, a new field. However it is necessary to maintain candid conversations that look to further explore the depth of artificial intelligence as a pretext for shortcuts in everyday life. Sadly, the uncertainty that lies in the byproducts of human creativity leaves us with what to choose to place our confidence in. It would seem that technology is a double edge sword that has as many benefits as consequences preempting more than just idle talk. In order to evoke real change, there needs to be more research into the outer workings associated with Artificial Intelligence. This shock and awe narrative may work for the general public, but because of human nature, we are going to have ones push that envelope of understanding.

The more that we seek to understand, only proves to show how little we know, do not let that discourage us in getting to the truth of AI's role in society. In other words, to what end and purpose does it serve than our own, the reason for AI's influence stems from an improper estimation of its technological prowess. This paper sought to bring more awareness to the increased uptick in popularity circling artificial intelligence and its counterparts. A semblance of hope for the future may be shaped by being more invested in downsizing the carbon footprint that we are leaving, and the consequences that result from an excess in more marginal AI endeavors. More often than not, people are appropriately concerned with the legacy that they leave behind, wondering if they have lived a life free of regret. Along these same lines, the legacy that humankind will leave behind should not be predicated on a dependency on a technology that is as fickle as a forecaster's ability to predict the weather.

It may then become necessary to inspire the arrival of persons who will be paragons of hope, relying on the actual and factual to investigate with fidelity the actions, which should be taken in order to remediate our carbon footprint, in order to better take care of our collective home. The gravity of the situation is that we do not have the luxury of starting over, we cannot transplant humanity to another planet and repeat the same mistakes. We need to first find out where we went wrong, otherwise we run the risk of our carbon footprint becoming part of that legacy that we leave behind. A guiding principle that has had a reoccurring theme in my life, has been a commitment to enhance and improve every aspect of our environment, ensuring that it is left in better shape than it was originally found. I ponder over its application because it extends well into the very essence of this paper, which has been to bring awareness to a topic of conversation that few want to have. If we as a society, can push through that level of apprehension, there can be hope for our earth just yet.

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