AINA

AI and Analytics

Volume 2 • Edition 2020-21

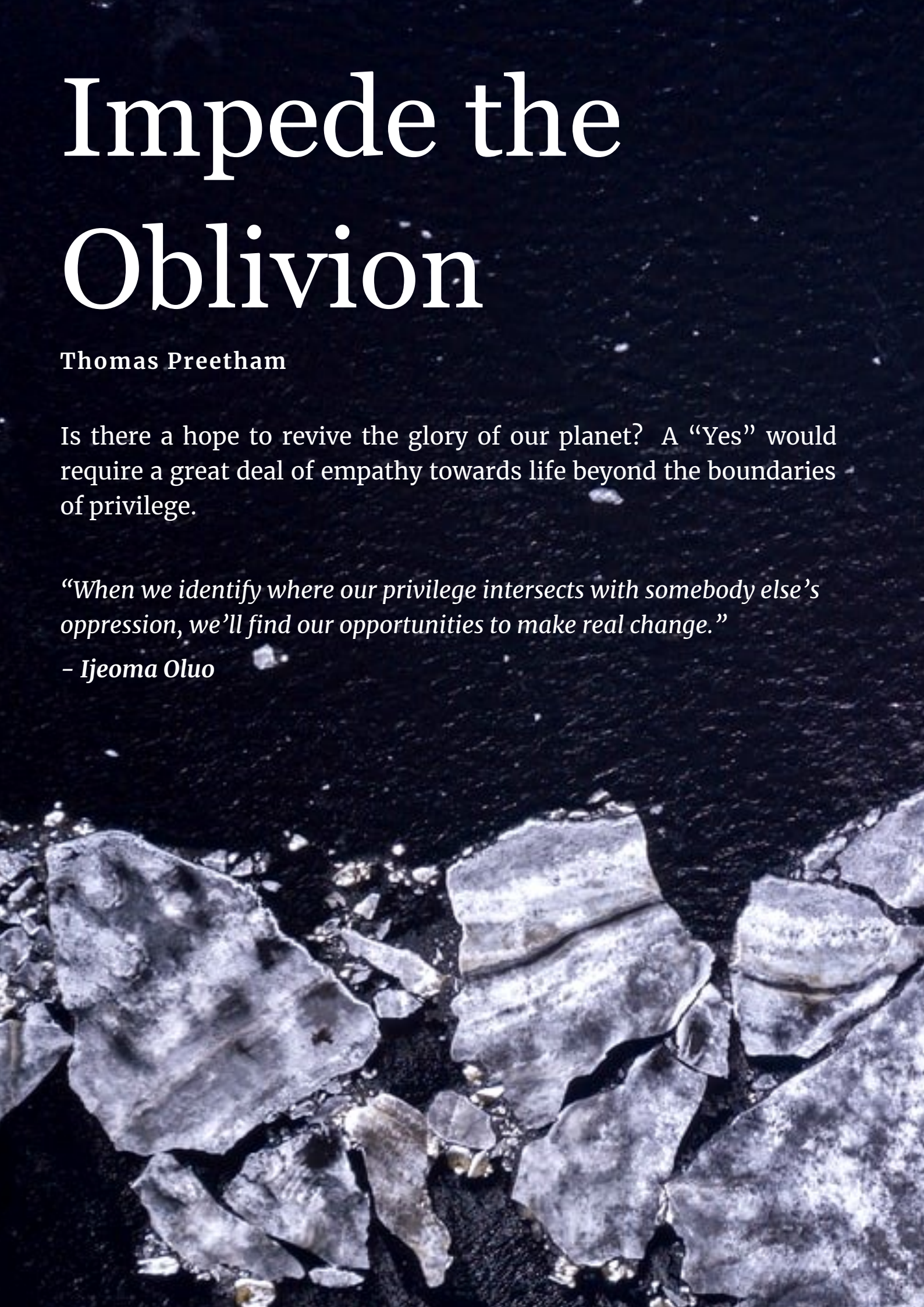Annual Analytics Magazine from the Students of PGDBA

Impede the Oblivion

Thomas Preetham

Is there a hope to revive the glory of our planet? A "Yes" would require a great deal of empathy towards life beyond the boundaries of privilege.

"When we identify where our privilege intersects with somebody else's oppression, we'll find our opportunities to make real change."

– Ijeoma Oluo

Earth

is the only planet in our Solar System that is remarkably conducive to life, making it an ideal home for a diversity of life forms. Interpreting the formation of such a habitable planet, after enduring phases of magmatic hellish and a frozen snowball through billions of years, is nearly obscure. No wonder the details of abiogenesis are yet, fuzzy. Researchers believe that life could be possible where there is water, and its origin has been one of the greatest mysteries to humans. In August 2020, researchers at the *Centre de Recherches Pétrographique et Géochimiques*, *France* suggested that Enstatite Chondrite (EC) meteorites may have been responsible for water formation on Earth. EC's isotopic composition resembles that of the Earth's and contains enough Hydrogen and Oxygen that could have supplied a gargantuan amount of water. Ergo, Earth has been blessed with approximately 326 million trillion gallons of water but ironically just 1% of it is relied upon for survival which can quench our needs only for so long.

Over the centuries, owing to the significance of water for the sustenance of life on Earth, the transition from utilizing to exploiting it escalated rather quickly. We are in an era that's facing the worst water crisis across the globe and just a few decades away from reaching an inflection point where most of the world will be confronting its "Day Zero" due to lack of water.

The rate of consumption of water has been increasing exponentially over time and eventually depleting the freshwater reserves. According to a 2016 research article published by Mesfin M. Mekonnen and Arjen Y. Hoekstra, 4 billion people face water scarcity at least one month a year with half a billion facing severe water scarcity throughout the year.

Besides irresponsible exploitation, water scarcity is an unfortunate consequence of changing climatic conditions. With the rising global temperatures, the melting glacial water returns to the dynamic water cycle. The increased rate of evaporation leads to an increased amount of water vapour, a potent greenhouse gas, in the atmosphere. These gasses trap the heat of the Earth within its atmosphere, leading to further increase in temperature & this vicious cycle continues.

How bad is Climate Change? According to a report published on 19 April 2021 by the World Meteorological Organization, 2020 has been recorded as one of the three warmest years on record and the temperature is increasing mainly due to the rising concentration levels of the major greenhouse gases. Even if humanity stopped releasing greenhouse gases today, NASA claims that global warming will continue for at least several decades, if not millennia. Carbon dioxide is responsible for two-thirds of the present global warming induced by human activities, largely the combustion of fossil fuels. CO_2 is known to be a "long-lived greenhouse gas" as it can remain for decades to centuries in the atmosphere.

Every year, over half of the carbon generated by anthropogenic activities stays in the atmosphere. It settles as black soot, called Black Carbon, on the glaciers and thus reduces their sunlight reflectivity from 70% to 20%. It leads to the ice absorbing more heat from the Sun, which increases the rate of melting of the glaciers by five times the global average. Consequently, the global mean sea level continues to rise at a higher rate through 2020, increasing the risk of quite a few cities getting submerged soon.

Terrestrial ecosystems remove the other half from the atmosphere. The oceans absorb approximately 23% of annual anthropogenic CO_2 emissions and act as a climate change buffer. However, the CO_2 reacts with seawater, lowering its pH and turning the marine ecosystems acidic at such a rate that the marine organism might not be able to adapt. According to an article published by the Scripps Institution Of Oceanography, "Acidification trends might begin to cause net erosion of coral reefs in this century." and if this happens, many coastal lines will be vulnerable to deeper waters and violent storms.

It will require a book to explain how bad climate change is affecting the Earth, and hence, this is just the tip of the iceberg. It has reached a point where over the past decade, researchers found strong evidence of climate change's relationship with the increase in unprecedented extreme events like cyclones, wildfires, hurricanes, floods, etc.

"The current scenario insinuates the urgency of every individual becoming mindful of the impending adverse effects of climate change and act responsibly towards building a better future."

Generation AI

You must be wondering why I have taken a detour towards Artificial Intelligence all of a sudden but bear with me while I connect the dots. AI has been a buzzword for quite some time now. With the advent of newer technologies, AI has become an integral part of our daily lives. We often hear news about how AI has helped increase the revenues of companies, saved lives through smart gadgets and defeated the world champion of "Go" in his own game, just to name a few. What if the tool that has such high potential to completely change the dynamics of technology be leveraged to tackle climate change? According to a 2020 Forbes report, approximately 84% of global energy demand is supplied by burning fossil fuels. Industries and buildings account for 27%, Electricity and Heat Production accounts for 35%, Transportation accounts for 14% and Agriculture accounts for 24% of global greenhouse gas emissions.

Energy: Industrial Energy consumption has recently seen a revolutionary optimization with the support of AI. DeepMind and Google teamed up in 2016 to create an AI-powered recommendation engine to help Google's data centers save energy. They announced their next stage of this work in 2018: a safety-first AI system that would automatically regulate cooling in Google's data centers while still being supervised by the data center operators. This ground-breaking technology has uncovered various novel cooling strategies, several of which have now been included in data centers operators' rules and heuristics. Despite only being in existence for a few months, the system has already shown to save roughly 30% on average in energy, with further expected improvements.

To boost the predictability and value of wind power, DeepMind and Google applied machine learning to 700 megawatts of wind generating capacity in the central United States in 2018. They built a system that could anticipate wind power output about 36 hours prior to the actual production employing a neural network trained on historical turbine data and promptly available weather

forecasts. The model then suggests making optimal hourly delivery commitments to the power system a full day ahead of time based on these estimates. This genre of machine learning approach can encourage more adoption of carbon-free energy on electric grids and enhance the business case for wind power globally.

Water: There are plenty of techniques that help with Water Recycling and Waste Water Management but considering the environmental conditions a mere repair will not suffice. We need more efficient ways to leverage the most abundant resource on our planet, not only cater to our needs but also bring back the glory of Mother Earth. Fortunately, the technology of Desalinating Ocean Water using Reverse Osmosis has been a ray of light and has more than doubled over the last decade but the amount of treated water made in a year still adds up to less than 1% of the water we use. Currently, there are over 20,000 Desalination Plants across the world that produce 25,000 million gallons of water per day.

However, the efficiency of ultrafiltration depends on various external factors like weather, temperature, change in the quality of water collected, etc. To overcome these uncertainties, the process of ultrafiltration can be optimized using Reinforcement Learning which is already being implemented since October 2020 by the researchers of the University of Alberta's AI4Society in Drayton Valley. The reinforcement learning algorithm collects data from the environment, takes decisions, learns from it and further improves the filtration process resulting in an efficient usage of energy, chemicals and manpower. With the help of AI, desalinating ocean water could not only quench the thirst of many but also replenish the aquifers if done at a large scale by every country.

AI is also being leveraged to cultivate low-carbon materials, improve transportation systems, advanced battery technologies, and a slew of other cutting-edge technologies that promise to make considerable progress toward a more sustainable economy. It can aid researchers in examining spatial data to detect deforestation, tropical cyclones, weather fronts, and atmospheric rivers with an accuracy of 89 to 99 percent, the latter of which can bring heavy precipitation and is frequently difficult for humans to spot on their own. Building better models help people stay safe by improving weather forecasts. It can also help optimize the orientation of solar panels to get the maximum out of solar energy, only to name a few.

Isn't it too nice to be true?

Implementing AI solutions requires high energy and lots of data. Machine Learning

"It is predicted that by 2025, 20% of the global electricity could be consumed by the devices that store data."

produces significantly more carbon emissions than we can imagine. AI systems, from speech recognition to self-driving automobiles, require a lot of energy and produce high amounts of carbon emissions. Research done at Stanford suggests that an off-the-shelf language-processing AI system produces approximately 635 kgs of emissions, which is almost the same as flying a person on a roundtrip between San Francisco and New York. Depending on the source of power, the whole suite of experiments required to create and train an AI language system from square one can yield up to 35,380 kgs. That's more than twice what an average American exhales in a lifetime. Machine Learning systems will almost certainly require more energy during

production than during training. So, what is the use of the state-of-the-art AI solutions to optimize energy consumption by powerhouses, data centers and desalination centers if it is compensating for the carbon emissions, if not worse, that it is designed to reduce in the first place?

The key is to keep a check on the emissions and choose the right location for the data centers. A team at Stanford built a tool to measure both the energy consumed and the amount of carbon emission by a machine learning project. Consequently, it leads to a movement known as Green AI where the developer is compelled to identify ways to make machine learning cleaner and greener. Research has been going on to explore the plausible ways to make machine learning algorithms more energy efficient whilst preserving their performance. Furthermore, moving the training and production activities to a site that is mostly powered by renewable energy sources can significantly reduce carbon emissions.

The Verdict

AI irrefutably exhibits prodigious potential to combat climate change; however, there are still some intricacies of the energy sources that need to be taken care of for it to serve the purpose. The scientific studies done by the prestigious British Medical Journal – Lancet suggests that nuclear power is the safest and cleanest source of energy and requires the minimum amount of raw materials. Top countries, according to the Environmental Performance Index of 2020 reveal a paradigm of relying more on the combination of nuclear and renewable energy over fossil fuels. The faster we migrate to a harmonious mix of all the cleaner energy sources available, the greener our technologies develop and the better control we can gain over climate change. All the aforementioned technological advancements will aid us only as long as we don't repeat the mistakes committed in the past.

The repercussions of climate change are probably the most exorbitant price we might have to pay in the near future unless we put conscious efforts on a systemic and an individual level to mitigate them. It's high time we take stern measures before it's too late for any contingency to rescue the living beings from the wrath. We need to educate ourselves on its gravity and let go of selfish motives for the greater good of life on Earth. Every time we decide not to act against nature, we add a few pages for our future. We might not have fallen behind in time to change our lifestyle that is detrimental to this planet. Climate change is palpable and is drastically affecting the Earth. Although we are the ones to blame, we can make sure to be the solution too.