Data Scientists
Heroes or Villains?

Foundations of Data Science 2024/2025

Helton Mendonça, Nº56870

Introduction

In the past years, the amount of data being generated has increased massively. When searching “How much data is being generated everyday in 2024?” on Google, we get different numbers. If we took an average of these numbers based on the top 3 pages that appear when you search this[1], you would approximately get 357 million of terabytes being created every day. When put in perspective, most PC’s today, still don't come with 1 TB of storage out of the box, let alone smartphones. It's practically impossible to imagine this amount of information in our heads.

So with this immense necessity of dealing with this data, the Data Scientist work is increasingly more important. They are a bridge between the raw data, and the valuable knowledge they can provide, whether it is by transforming it, analyzing it or even automating complex tasks.

However, as a popular phrase, from comic books, says: “With great power, comes great responsibility”, this parallels perfectly with the assignment of these individuals in today's world. This power can serve great good for society, but if not used correctly, even if not on purpose, it may cause more harm.

So, in this essay, I will be exploring the philosophical question of: “Are Data Scientists Heroes or Villains?”. Through recent examples of how Data Science can be used for positive, but also some negative outcomes, I want to highlight ethical responsibilities that come with our future profession and encourage critical thinking on this topic.

Are we Heroes?

In classical literature, a Hero is considered an individual that performs great deeds by performing selfless acts for the greater good. Now, in reality this definition can be more broad, but we could still find some similarities to the classical literature hero. So in this section I will be discussing a few recent examples on how Data Science is used for good, and that could interpret as actions of a “Hero”, in my opinion.

The first example takes us back to the recent past, in the Covid-19 Pandemic, focusing on a Bayesian extension of the Suscetible-Infected-Removed(e-SIR) model[2], tailored for intervention prediction. This was used to analyze the 21-day lockdown against more mild interventions, and predict on the outcome of even harder policies. The study found that if the lockdown was correctly implemented, it could reduce the total amount of cases in the short time, alleviating health services work load. They also used the model to infer that an even longer lockdown, of at least 42 days, would be even more beneficial to the objective mentioned above. Since the pandemic affected the whole world, including us in Portugal, studies like these proved to extremely valuable in dealing with pandemic, possibly saving millions of lives.
We continue with climate change, an extremely hot topic in today's world. Here[3] we have an example on how Data Science can be used to expand the understanding of the environmental crisis by facilitating the explanation of large multidimensional climate datasets, alongside with the forecasting of future trends and outcomes. However, this paper brings up an interesting paradox. Even though AI can have great contribution to solving the problem, it also contributes to it, because the training of massive AI models in huge data centers, also increase the carbon footprint. They recommend a balanced approach in the use of AI in general, not only considering climate change. Here again, we have an example of how Data Science fields like AI can save millions of lives. If and only if they are used properly, they could help reduce the expected 250000 lives lost each year to this global battle[4].
We finalize with an example of Data Science in poverty alleviation[5], where they use a multidimensional model using big data and random forests to accurately identify poor households, analyze poverty factors and support poverty alleviation efforts. This last example of “heroic” application of Data Science, is a concern that affects nearly 10% of the global population, according to the United Nations[6]. But with the support of our field along with many others, we seek to reduce it as much as possible.
These are just a few examples, and many more could be also explored in other areas such as education, technology, etc.

Are we Villains?

A Villain is an antonym to the Hero persona in the classical literature. In real life, villains might be less obvious, and sometimes it's not even consensual whether they are bad or not. A contemporary example, in my eyes, would be someone like Donald Trump, hated but also loved by many. Us Data Scientists could possibly fit this same category in today's world.
The following examples, are cases where Data Science is used in a way that could cause much damage to millions of people, where if done with malicious intent, could categorize themselves as villainous.
The first case regards COMPAS (Correctional Offender Management Profiling for Alternative Sanctions)[7], an algorithm, used in the USA judicial system to access the likelihood of an individual recommitting a crime. However, this application has risen a lot of controversy due to his results showing a bias in misclassifying black defendants in a greater magnitude to

that of a white defendant, as the original study found[8]. The provider of this model, Equivant, defends the tool's calibration and accuracy, across all racial groups. The more recent study, seeks to counterargument this statement by saying that calibration alone does not address broader and more complex ethical situations, such as the potential unequal harsher punishments, black people, may receive. This example highlights a critical line in Data Science, of balancing technical correctness with ethical responsibility. The company may have followed strict practices, but could be oversimplifying the actual impact its product may have in society. The case, shows how it's not enough to have theoretical and technical expertise in Data Science but also responsibility and foresight, as the author also suggests to providers. These ethical debates ensure the correct implementation of these tools without increasing issues, such as inequality.

We proceed with social media, where the discussion of the use of Data Science expertises such as AI, for example, have been increasing in the past few years. In this paper[9], we follow the application of ML techniques in the manipulation of people's decisions, through the personalized selection of advertisements and contents. Big tech companies, such as Google or Meta, to name a few, collect, track and analyze their users' data, and then use it to profile consumers and recommend pieces of information to specific target groups. All of this comes with a catch. The propagation of misinformation in digital platforms, which in return can possibly influence the opinions of such users in matters like elections, for example. By 2024, this evolved to Generative AI, and the epidemic of Deepfakes, where we could have a non-real, but photorealistic content of a political figure giving a fake speech. Coming back to the study, it proposes more responsibility from this social media platforms, based on the Guidelines for Trustworthy AI from the EU. From a personal stand of view, I think we've all experienced this before. I agree that these apps need to be more open and rigorous to solve the problem. However, we can only solve the core issue, if everyone who uses them takes responsibility for what they post and watch. If we expect just for these companies to filter all of this misinformation, we are doing a disservice to ourselves, possibly harming many others.

To conclude, the final example is war. My impression is that Data Science, and most specifically AI, is playing a role almost to the same degree that tanks and planes played in World War I. Before that event, when a man used to go to battle he knew he was fighting another man on equal ground. Then he had to fight a metal titan such as a tank, or get blown by a plane, kilometers above, not knowing what even killed him…nowadays, a soldier might even be killed by a non-human controlled weapon.

Today, in 2024, as wars such as Russia-Ukraine or Israel-Palestine and Lebanon rage on, we see the natural evolution of warfare, thanks to the advancement in technology such as AI. In this recent paper[10] , the author goes on explaining the uses of AI in modern warfare, such as the one mentioned above. Now we have Autonomous Weapon Systems(AWS), that operate independent of human oversight in real time. We also have wars in the digital world, with cyberattacks and defense that also use advanced AI models to implement and predict these. This technology also bleeds into intelligence, surveillance, reconnaissance, and logistics domains of militarized conflicts. The paper affirms this a trend that will only keep on growing, as the technology evolves. It also discusses the ethical and moral considerations of this evolution, such as responsibility and accountability in AI driven actions. Who can we keep accountable, in the case of deaths by AWS? The operators or even the commanders? The developers or providers of that model? The manufactures of the missiles? This dispersion of responsibility is one of the biggest challenges for legal and ethic debates in modern warfare. The author finishes by recommending policymakers and technologists a

few points: such as the development of regulatory frameworks on the use of AI in warfare; Promoting transparency and accountability in AI application in these militarized conflicts; Better integration of this technology with human oversight, with robust training programs for the operators; A longer foresight in ethical issues that may arise in the development of new AI advancements. He reinforces the upmost cooperation of all parts involved in this issue.
These were a few cases on how Data Science can be used for the bad. There are many more examples, and I encourage the reader to reflect if these could really be considered bad.

Maybe we're something else…

As being discussed, the Data Scientist often finds himself navigating between both sides of the ethical spectrum, even unintentionally. There are times when we might fit better in the Hero category, and other times we might assimilate a Villain role.
My take on this is that frequently, we are what are called Anti-Heroes. The definition of one, is when a character might have intentions of a Hero, but their actions can sometimes be morally questionable or ambiguous. This analogy, reflects the complexity of our work.
I expect that most practitioners want to do the right thing, but sometimes, the lack of rigor, responsibility, self accountability and even foresight that a task demands, results in negative effects on society. Additionally, our work may even be misused intentionally, by people with harmful objectives.
Throughout history, there have been many examples where a group or an individual had good intentions in their discovery or breakthrough, but unfortunately, it was either misused or was morally perverse. An event that comes to mind, is the creation of the Atomic Bomb, in the Manhattan Project, led by Oppenheimer. His creation was meant to put an end to World War II, but at the cost of hundreds of thousands of lives. Were Oppenheimer and his coworkers, heroes or villains, in your opinion? In my view, they could also fit the anti-hero category.
The previous analogy and comparison are subjective, and I encourage the readers to explore many more.

Can the Data Scientist be trusted?

Considering the label of an Anti-Hero, the trustworthiness of a Data Scientist is a relevant question. How can we trust individuals that sometimes might be “good” and others times the opposite, even if not intentionally.
The EU has also questioned this and took action to it, by implementing across its territory, the AI Act [11], this year. This legislative framework, proposes not only recommendations but also prohibitions and obligations, AI technology, must commit. Some of them are that developers must provide technical documentation and relevant information of their products. Also, they must respect Copyright Laws and publish a descriptive summary of the content used in the training of the model, ensuring transparency. The document also categorizes some uses of AI as unacceptable. This includes systems that deploy manipulative or deceptive techniques onto users. Others are models that exploit vulnerabilities such as age

or socioeconomic status, or even architectures that asses the risk of an individual committing criminal offenses solely based on profiling. There are various other examples that the Act also touches upon, and I encourage the readers to inspect it and draw conclusions on if you agree or not with what was suggested in it.
Even though this legislation is recent and will be updated as more concerns arise, it serves as a solid baseline on the regularization of Data Science, not only applied to the field of AI. Considering it, I believe a Data Scientist that actively tries to commit to these rules, is a more trustworthy one, even if occasionally crosses red lines established in the document.
After all, trust is earned, not only trough adherence to the norms, but also a strict sense of self accountability and responsibility.

Conclusion

In this report, we analyzed both ends of the ethical spectrum of Data Science.
We explored applications that could be considered good, possibly fitting the definition of a Hero. On the other hand, we also discussed uses of Data Science domains, for more ethically ambiguous applications. We also addressed the question of trustworthiness of the Data Scientist, and we concluded based on the EU AI Act that he could be trusted only if he respected the rules, but also if he had a strong sense of self accountability, responsibility, and even foresight of how his work may end up used. These conclusions were parallel to some suggestions made to tackle the issues found in the “Are we Villains?” section. This correlates, with a question I asked Professor Cátia on the first class, of what makes an exceptional Data Scientist. I believe these are all qualities, one should have.
Even though this discussion was brief, and did not permit much more expanding or more examples on the ethical limbo of Data Science, I hope it sparked deep thoughts and critical thinking on our role, in the world.
As for the main question of this discussion, “Are Data Scientists Heroes or Villains?”, we argued that there is no simple answer to it, due to the complexity of the real world. Nonetheless, we defined a category of an Anti-Hero, that seeks to join both labels, possibly illustrating the difficulty of defining what is a Data Scientist.

References

[1] GilPress, “How Much Data is Generated Every Day (2024),” *Whats the Big Data*, May 09, 2024. Accessed: Dec. 05, 2024. [Online]. Available: https://whatsthebigdata.com/data-generated-every-day/

F. Duarte, “Amount of Data Created Daily (2024),” Exploding Topics. Accessed: Dec. 05, 2024. [Online]. Available: https://explodingtopics.com/blog/data-generated-per-day

O. Unlu, “Breaking Down The Numbers: How Much Data Does The World Create Daily in 2024?,” Edge Delta. Accessed: Dec. 05, 2024. [Online]. Available: https://edgedelta.com/company/blog/how-much-data-is-created-per-day

[2] “Predictions, Role of Interventions and Effects of a Historic National Lockdown in India’s Response to the the COVID-19 Pandemic: Data Science Call to Arms,” *Harvard Data Science Review*, May 2020, doi: 10.1162/99608f92.60e08ed5.

[3] J. Cowls, A. Tsamados, M. Taddeo, and L. Floridi, “The AI Gambit — Leveraging Artificial Intelligence to Combat Climate Change: Opportunities, Challenges, and Recommendations,” *SSRN Electronic Journal*, 2021, doi: 10.2139/ssrn.3804983.

[4] World Health Organization: WHO, “Climate change,” *World Health Organization: WHO*, Oct. 12, 2023. Accessed: Nov. 30, 2024. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

[5] T. Liang and X. Wang, “A Statistical Analysis Model of Big Data for Precise Poverty Alleviation Based on Multisource Data Fusion,” *Scientific Programming*, vol. 2022, pp. 1–10, Mar. 2022, doi: 10.1155/2022/5298988.

[6] “Sustainable Development Goals,” UNDP. Accessed: Nov. 30, 2024. [Online]. Available: https://www.undp.org/sustainable-development-goals/no-poverty

[7] K. Lippert-Rasmussen, “Algorithmic and Non-Algorithmic Fairness: Should We Revise our View of the Latter Given Our View of the Former?,” *Law and Philosophy*, Oct.

2024, doi: 10.1007/s10982-024-09505-4.

[8] “Machine Bias,” ProPublica. Accessed: Dec. 01, 2024. [Online]. Available: https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

[9] U. Reisach, “The responsibility of social media in times of societal and political manipulation,” *European Journal of Operational Research*, vol. 291, no. 3, pp. 906–917, Jun. 2021, doi: 10.1016/j.ejor.2020.09.020.

[10] I. Chalagashvili, “AI Era in Modern Warfare,” *SSRN Electronic Journal*, 2024, doi: 10.2139/ssrn.4813807.

[11]“EU Artificial Intelligence Act,” Up-to-date developments and analyses of the EU AI Act. Accessed: Dec. 05, 2024. [Online]. Available: https://artificialintelligenceact.eu/