

# Data Mining Human Reasoning

*Mid Term Report*

*Project Author: Taha Kashaf*

*Advisor: John Lawrence*

## **Aims and Objectives:**

In today's world, a controversial talking point is one of vaccines. This is of course very topical right now, in the midst of the world's best-documented pandemic: COVID-19. However, while many of us see vaccinations and large-scale inoculation as the final solution to bring an end to 3 years of measures and restrictions, many also see vaccinations as a bad thing.

Anti-vaccination rhetoric has been around long before COVID-19<sup>[5]</sup>, however the visibility of the movement has grown dramatically, and its effects on the rest of us have become more tangible. As we see reports of hospital urgent care wards filled primarily with unvaccinated covid patients<sup>[1]</sup>.

The problem here is an obvious one: large groups of people carry a negative sentiment towards vaccinations. The goal of this project is simple. To use a data-driven approach, powered by machine learning and sentiment analysis to attempt to understand *why* people have the opinions they do regarding vaccines.

This is obviously not a solution to the problem, but with a topic as complex as human reasoning, and why people choose the things they do. First, you need a comprehensive understanding of why. Once that understanding has been built, only then can you begin to tackle the problem. This project is an attempt at understanding the reasoning behind the problem.

## **Background Research & Takeaways**

The area of big data is a rapidly growing one – and one that has come to the forefront of discussion in recent times. Recent large-scale political campaigns have been won and lost on data-centric approaches<sup>[2]</sup>. The success of these campaigns has even led to legislation being passed in the area, such as the General Data Protection Legislation (GDPR).

There is no question about the importance or research potential within big data, the ability to analyze and extract value from large-scale unsorted data is an ever-growing field. One of the many ways in which this is possible is sentiment analysis. Once again, an ever-growing field.

There are 3 main types of sentiment analysis<sup>[3]</sup>:

- Lexicon-based approaches.
  - These rely on corpora or dictionaries that contain terms classified by their sentiment. In my current plans, I am unlikely to use lexicon-based approaches.
- Machine-Learning approaches.
  - Supervised learning techniques
    - These use algorithms trained by pre-labeled data, and will be the type of sentiment-analysis I am aiming to use.
  - Unsupervised
  - Semi-Supervised
    - A combination of supervised and semi-supervised, in an attempt to design the most appropriate classification model.
    - A hybrid of lexicon-based, and machine-learning-based.

In recent times, similar studies have been carried out <sup>[3][6][7]</sup>, using social media and in particular twitter data to analyze vaccine sentiment. Much as I plan to do myself. However, these studies focus primarily on classifying the data and presenting the empirical evidence as the results.

The goal of my own project is both to classify the data as a first step, and then to look beyond that and use the results to search for further correlations that will aid in understanding *why* the sentiment is held in the first place.

Lastly, the final takeaway I have from the research and similar studies I have found so far, is that they are all primarily presented in strictly academic ways. At best, the least academic iterations are articles that regurgitate the summaries provided by the studies. Due to this, I've decided that I want to present my findings in a way that is easily and quickly understood. Something that does not require reading large paragraphs populated by statistics to understand my conclusions.

Due to this, the final part of my project is currently planned to be a website where the results are presented in a user-friendly and easily understood way. Attention is a limited and highly competed for resource, so I wish to make the best use of any attention my project may receive, providing conclusions for those who just want to look over it quickly, while still retaining the detail for those who want it.

## **Main Features**

The main feature the project aims to achieve is a website that presents the conclusions of my research in a clear and user-friendly way, as described above. This is the only “application” that I aim to develop, and how my project will be interacted with by any users.

The website will aim to allow users to view the results provided my sentiment analysis alongside several other factors. For example: Which states had the most positive/negative sentiment? How does this relate to the majority political opinions of that state? How does it relate to literacy levels? Etc.

Of course, that is purely front-end. Most of the work on the project will be work that won't be seen to the final user as it will exist on the back end. This involves obtaining large amounts of Tweets via the Twitter Application Programming Interface (API), these will act as our data set. As well as setting up, training, and running a sentiment analysis program. Finally, it'll involve taking the analysis provided by the sentiment analysis and drawing conclusions and correlations from it – if there are any to be found.

## **Current Progress**

Unfortunately, current progress on the project has been slow – primarily due to hitting a large roadblock immediately that took a large period of time to navigate. After carrying out my initial research, the first step I wanted to take was to acquire my data. Once I had the data set to work with, everything else becomes possible.

Luckily, acquiring data from Twitter is simple, in theory. Twitter has an API that can be accessed via a Twitter Developer Account. Due to a project I carried out in my second year, I already had a Twitter Developer Account approved for use as a student. This was critical, as getting account approval is a very slow process.

However, this is where my luck ended. Within the account, to then get access to the API Keys required to query the API, I was required to create an “Application”, this was easy enough and was done in minutes. Unfortunately, without fail, within a few hours of creating any “Application”, I would receive an email informing me that my “Application” has been suspended, and to file an appeal with Twitter Support.

I would receive this notification of Application suspension even if I didn't use the API Keys at all, just creating the Application and doing nothing with it would still lead to a suspension within a few hours. I figured I was being caught in a broad-reaching anti-spam net and filed my appeal with Twitter and waited.

After a week of not receiving any response or even acknowledgment regarding my appeal, I started digging further. The Twitter Developer Forums were filled with people experiencing the exact same problem, none of whom had found a solution. I spent multiple days at this point trying to find a solution and frankly got very lucky when I found a forum thread that pointed out Twitter will not respond to any appeals if they believe the appeal is being filed by a spam account. Essentially meaning that any appeals made by accounts that had little-to-no Twitter activity would be ignored. I sadly fell right into this bracket, as I don't use Twitter and my developer account is tied to my empty personal account.

At this point, the solution was to go around begging my friends to follow me on Twitter. So that my account wouldn't be flagged immediately as spam. It took a while to get enough people to follow me, but eventually, I did. So, I filed *another* appeal to have my "Application" and API Keys unsuspended, and this time received an acknowledgment of my appeal. Not yet an approval – just an acknowledgment.

This brings me to last week when I finally woke up to find Twitter had unsuspended my "Application", and I was now able to use the API and acquire the data sets I'd set out to get weeks earlier.

However, due to the time taken in that whole escapade, progress in other development areas has been very limited. Regardless, I attempted to make the best use of my time and instead progressed in research and understanding of the project. As discussed in the *Research & Takeaways* sections, this has been a help in providing clarity regarding how I want to carry out my own project, as well as how it is going to differ from what has been done before.

## Personal Reflection

Overall, while I am further behind than where I would want to be, I am still confident in being able to complete my Honors Project to a very high standard. I have already encountered and dealt with a major roadblock, and it is no doubt not the first I will encounter. However, having got around this one I am confident in my ability to navigate others.

Mainly, I am very confident in the clarity I have regarding my project. I have a final product in mind, and I know what I want it to look like. Talking to many of my peers, they are still foggy about the specifics of their own projects, so having this clarity is certainly a relief.

## Plans Going Forward

The Final Report for this project is due on the 26<sup>th</sup> of April. Or, in approximately 13 weeks. To my mind, I have 4 major components left in this project. They are broken down as the following, alongside how much time I'm allocating to them, from the current date.

- Learn the poorly documented Twitter API and retrieve the *specific* data I require (1 Week)
- Design and implement my Sentiment Analysis program on my data set (5 Weeks)
- Take the results of the Sentiment Analysis and attempt to draw valuable conclusions and correlations from it (2 Weeks)
- Design and create my website to display the conclusions and value I've extracted from my research and analysis. (3 Weeks)

As you can tell, this leaves 2 weeks leftover, I have purposely excluded this period of time for both writing my final report/creating my poster. As well as for any emergencies that may occur during development. A Gantt Chart<sup>[4]</sup> laying this out can be found on the following page.



## References

[1] Article on Unvaccinated Patients:

<https://northeastlondonccg.nhs.uk/news/almost-90-of-patients-admitted-to-intensive-care-units-in-north-east-london-are-not-fully-vaccinated/>

[2] Cambridge Analytica Swinging Elections:

<https://www.theguardian.com/news/2018/may/06/cambridge-analytica-how-turn-clicks-into-votes-christopher-wylie>

[3] Piedrahita-Valdés H, Piedrahita-Castillo D, Bermejo-Higuera J, et al. Vaccine Hesitancy on Social Media: Sentiment Analysis from June 2011 to April 2019. *Vaccines (Basel)*. 2021;9(1):28. Published 2021 Jan 7. doi:10.3390/vaccines9010028

[4] Gantt Chart Template:

[https://www.vertex42.com/ExcelTemplates/simple-gantt-chart.html?utm\\_source=ms&utm\\_medium=file&utm\\_campaign=office&utm\\_content=text](https://www.vertex42.com/ExcelTemplates/simple-gantt-chart.html?utm_source=ms&utm_medium=file&utm_campaign=office&utm_content=text)

[5] Durbach, N. They might as well brand us: Working class resistance to compulsory vaccination in Victorian England. *The Society for the Social History of Medicine*. 2000;13:45-62.

[6] Neha Puri , Eric A. Coomes , Hourmazd Haghbayan & Keith Gunaratne (2020) Social media and vaccine hesitancy: new updates for the era of COVID-19 and globalized infectious diseases, *Human Vaccines & Immunotherapeutics*, 16:11, 2586-2593, DOI: 10.1080/21645515.2020.1780846

[7] Muric G, Wu Y, Ferrara E. COVID-19 Vaccine Hesitancy on Social Media: Building a Public Twitter Data Set of Antivaccine Content, Vaccine Misinformation, and Conspiracies. *JMIR Public Health Surveill*. 2021 Nov 17;7(11):e30642. doi: 10.2196/30642. PMID: 34653016; PMCID: PMC8694238.