



Master's Degree in Artificial Intelligence and Data
Engineering
Business and Project management Course Project

Tweet based Sentiment Analysis regarding ChatGPT

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1. Introduction

The aim of the project was to perform a sentiment analysis task regarding the release of a public available version of ChatGPT by OpenAI. ChatGPT is an optimised neural language model for dialog that interacts in a conversational way with the user. It is an AI tool capable of answer followup questions, perform text summarisation and proposal, write and suggest optimisation to code written in any programming language and much more. This new powerful tool freely available to everyone has been one of the major topic in technology after its release for a variety of reasons.

The release of this AI tool opened also a big discussion on the impact of AI tools applied to society and economic and how these tools can open new economic possibilities and how they can be used to help and integrate a lot of jobs, but on the other hand how they can hurt the economy, stealing a lot of job positions that can be replaced by AI tools like these.

The goal of the project was to perform sentiment analysis on the tweets posted on Twitter from 1 December 2022 to the start of February containing the hashtag #chatgpt trying to understand what is the public's opinion about this release and the related discussion to understand if this release is seen as a positive thing or not.

We performed text preprocessing on the tweets and we performed sentiment analysis using two of the most used tools in the NLP field that are TextBlob and vaderSentiment.

Using these tools we analysed the sentiment related to each tweet and we performed a statistical analysis on the results obtained.

We did this project using Python and Google Colaboratory, mainly for their effectiveness and ease of use.

In the end we performed also a brief analysis on what are the responses of the Major tech companies to this release and how they are moving to be competitive in this AI field that will be of a major importance in the next recent years.

2. Sentiment Analysis task process

2.1 Tweets collection

In order to perform this sentiment analysis task we collected the tweets from Twitter, that in recent years is become the default platform to share sentiment about a new product or release, containing the hashtag #chatgpt from the 1 December 2022 to the 7 of February of 2023. We have collected the top 2000 tweets for each day using the snsrape module. snsrape is a scraper for social networking services (SNS). It scrapes things like user profiles, hashtags, or searches and returns the discovered items, e.g. the relevant posts. At the end of the scraping process we obtained a Pandas dataframe containing for every tweet the "Datetime", the "Tweet Id", the "Text" and the "Username" of the user who published the tweet. In figure 1 is show an example of what we obtained.

	Datetime	Tweet Id	Text	Username
0	2022-11-30 23:56:59+00:00	1598103832080584704	Twitterのフォロワーを増やしたい。最低でも1万人。\\n#ChatGPT https://...	1024pixels1
1	2022-11-30 23:56:04+00:00	1598103601507102720	Overall, using AI to create art can expand the...	charis_ai
2	2022-11-30 23:56:02+00:00	1598103593634369536	Este prompt fue creado con #ChatGPT el nuevo m...	alarcon7a
3	2022-11-30 23:54:08+00:00	1598103115060084736	Just played around with OpenAI's new #ChatGPT ...	anthonypak
4	2022-11-30 23:51:34+00:00	1598102468243599361	I asked #ChatGPT to write me a story about Sov...	emargusity

Figure 1: Tweet's dataframe obtained from scraping

2.2 Text preprocessing

In order to perform sentiment classification first we preprocessed the tweet's text removing noise from the data. In particular we used the python regex module to remove from the text the urls presents, the twitter handlers, hashtags, multiple resulting spaces, punctuation and non ASCII characters that would not be understood by the sentiment analysis tools. We decided to maintain the format of the text without putting all the text in lowercase because both TextBlob and VaderSentiment handles all capitals text that usually is used to put emphasis on the sentence, resulting in an higher score for a specific sentiment. In the figure 2 is shown the dataframe obtained with the preprocessed text.

	Datetime	Tweet Id	Text	Username
0	2022-11-30 23:56:59+00:00	1598103832080584704	Twitter	1024pixels1
1	2022-11-30 23:56:04+00:00	1598103601507102720	Overall using AI to create art can expand the...	charis_ai
2	2022-11-30 23:56:02+00:00	1598103593634369536	Este prompt fue creado con el nuevo modelo de ...	alarcon7a
3	2022-11-30 23:54:08+00:00	1598103115060084736	Just played around with OpenAI s new model and...	anthonypak
4	2022-11-30 23:51:34+00:00	1598102468243599361	I asked to write me a story about Sova and Jet...	emargusity

Figure 2: Tweet's text after preprocessing

2.3 WordCloud creation

Before performing sentiment analysis we created a WordCloud to visualise what are the main words related to the topic. To do so we used the WordCloud module in python. In the figure 3 is shown the obtained wordcloud. As we can expect some of the main words present in the tweets are: write, AI, asked, question, future and answer.



Figure 3: Wordcloud obtained

2.4 Sentiment analysis using TextBlob

The first sentiment analysis tool that we used is TextBlob. TextBlob is a Python library for processing textual data. It provides a simple API for diving into common natural language processing (NLP) tasks such as part-of-speech tagging, noun phrase extraction, sentiment analysis, classification, translation, and more. In particular we used the sentiment analysis module of TextBlob to perform our task. The sentiment property returns a named tuple of the form `Sentiment(polarity, subjectivity)`. The polarity score is a float within the range `[-1.0, 1.0]`, `-1` indicates very negative sentiment and `1` very positive sentiment. The subjectivity is a float within the range `[0.0, 1.0]` where `0.0` is very objective and `1.0` is very subjective. We associated to every tweet the relative subjectivity and polarity obtaining the dataframe shown in figure 4.

	Datetime	Tweet Id		Text	Username	Subjectivity	Polarity
0	2022-11-30 23:56:59+00:00	1598103832080584704		Twitter	1024pixels1	0.000000	0.000000
1	2022-11-30 23:56:04+00:00	1598103601507102720	Overall using AI to create art can expand the...		charis_ai	0.227273	0.068182
2	2022-11-30 23:56:02+00:00	1598103593634369536	Este prompt fue creado con el nuevo modelo de ...		alarcon7a	0.000000	0.000000
3	2022-11-30 23:54:08+00:00	1598103115060084736	Just played around with OpenAI s new model and...		anthonympak	0.454545	0.136364
4	2022-11-30 23:51:34+00:00	1598102468243599361	I asked to write me a story about Sova and Jet...		emargusity	0.600000	0.500000

Figure 4: We added Subjectivity and Polarity value for every tweet

We plot a graph with the pair subjectivity and polarity for every tweet and we obtained the result shown in the figure 5.

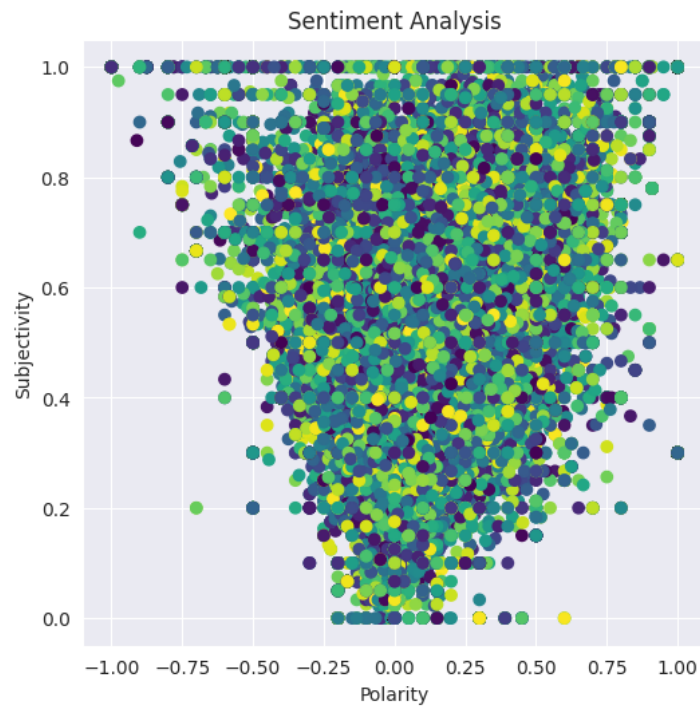


Figure 5: Polarity-Subjectivity plot

As we can see from the graph, the subjectivity is generally higher than 0.5 meaning that tweets about ChatGPT generally tends to contain a personal opinion of the user about this tool. We can hypothesise that a lot of tweets, mainly in the first period after the release, contain the astonishment about the power of this tool and how it can be used in the future. In general the polarity is really sparse but we can see that there is a little bit more points in the right part of the graph underling a general positive sentiment about the topic. Later to have a clearer vision of the sentiment of every tweet we classified every tweet with a polarity score above zero as a positive tweet, the tweets with a score equal zero with a neutral sentiment and the tweets with a score lower than zero as a negative tweet. After this classification we obtain a dataframe in the following form.

	Datetime	Tweet Id	Text	Username	Subjectivity	Polarity	Sentiment
0	2022-11-30 23:56:59+00:00	1598103832080584704	Twitter	1024pixels1	0.000000	0.000000	Neutral
1	2022-11-30 23:56:04+00:00	1598103601507102720	Overall using AI to create art can expand the...	charis_ai	0.227273	0.068182	Positive
2	2022-11-30 23:56:02+00:00	1598103593634369536	Este prompt fue creado con el nuevo modelo de ...	alarcon7a	0.000000	0.000000	Neutral
3	2022-11-30 23:54:08+00:00	1598103115060084736	Just played around with OpenAI s new model and...	anthonypak	0.454545	0.136364	Positive
4	2022-11-30 23:51:34+00:00	1598102468243599361	I asked to write me a story about Sova and Jet...	emargusity	0.600000	0.500000	Positive

Figure 6: Added Sentiment column

Adding this column let us to count the number of positive, neutral and negative tweets plotting the graph show in the figure 7 and 8.

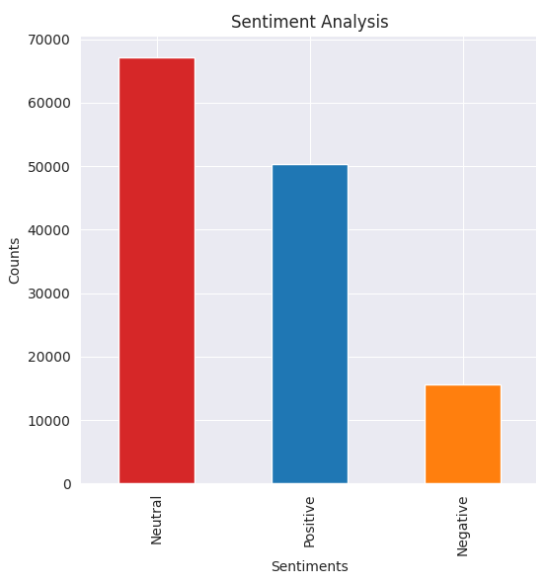


Figure 7: Bar plot of the sentiments counts

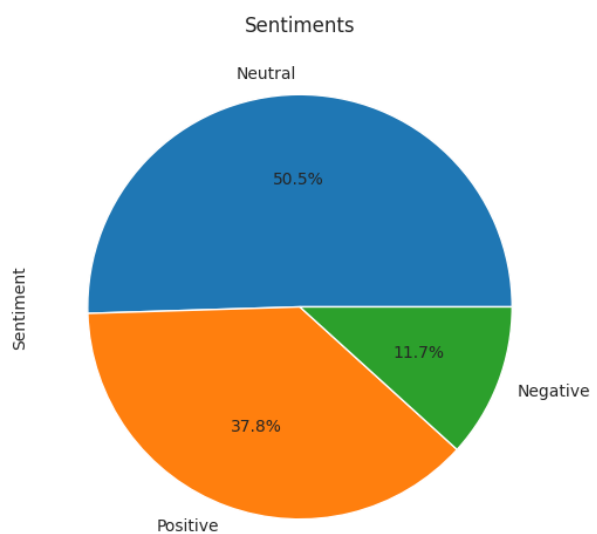


Figure 8: Pie plot of the sentiment distribution

As we can see from the bar plot there are about 68000 neutral tweets on the topic, about 50000 positive tweets and about 17000 negative tweets. Also the pie chart confirm this distribution with a 50.5% of neutral tweets 37.8% of positive tweets and 11.7% of negative tweets. We have to consider that the high number of neutral tweets is also conditioned by the fact that TextBlob perform sentiment analysis on English text giving a zero score both on subjectivity and polarity in tweets written in other languages as we can observe from the third row of figure 6. The results shown in these graphs are coherent on what we saw in the plot shown in the figure 5 underlying a general positive sentiment about ChatGPT.

In order to perform a deeper analysis we tried to analyse the temporal change in the sentiment of the tweets. To do that we used the timestamp of the tweet that we had from the scraping. We computed the daily average value of the tweet's polarity over the entire period and compared it with the general mean of the polarity. Furthermore, we computed the same daily average over the tweets classified as positive and negative independently. The results are shown in the figures 9, 10 and 11.

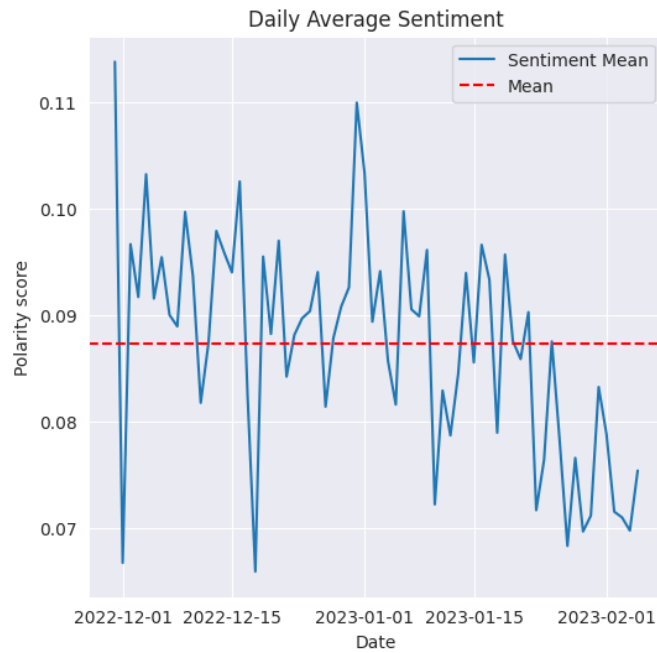


Figure 9: Daily average polarity score

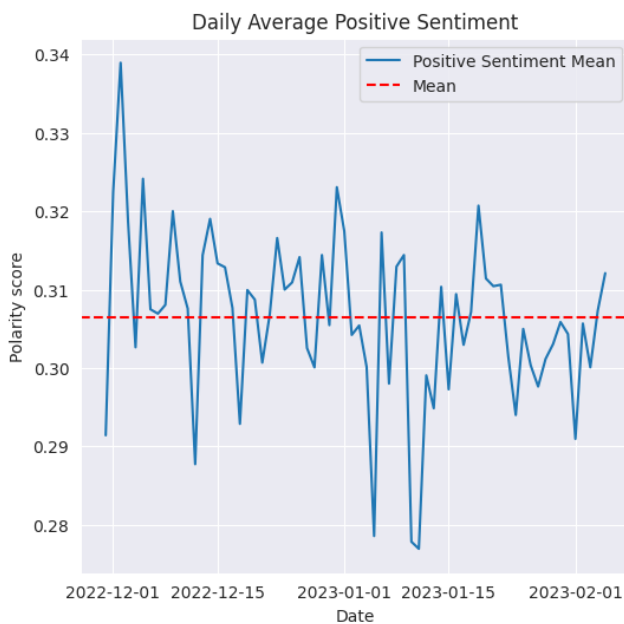


Figure 10: Daily average polarity of positive tweets

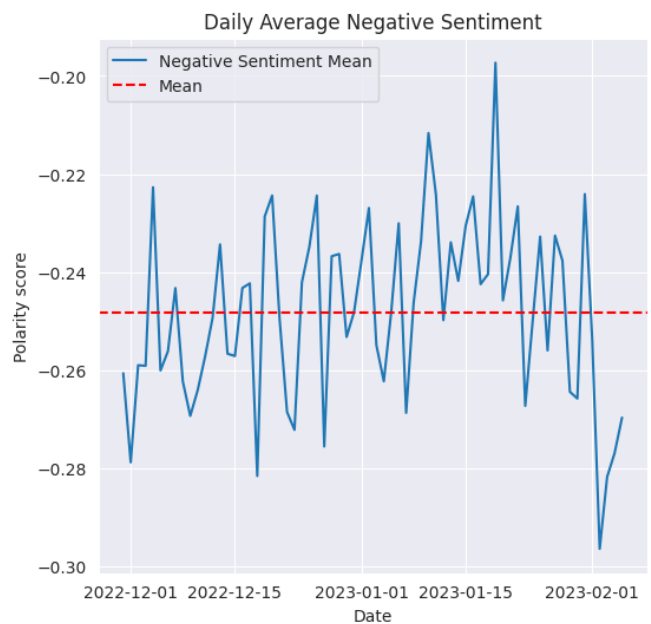


Figure11: Daily average polarity of negative tweets

As we can observe from the graphs above the daily average polarity of the tweets decreases over time reaching a value far below the average in the last period. The same behaviour is observed in the positive sentiments graph where the average decreases during time while the daily average polarity of negative tweets remains more or less the same with a peak in the second part of January.

We can hypothesise that the increase in the negative sentiment regarding ChatGPT after the first period of January can be related to the technical problems that OpenAI was facing due to the high demand of the service that lead to the inaccessibility of the service for a long period of time.

2.5 Sentiment Analysis using vaderSentiment

The second tool we used is vaderSentiment. VADER (Valence Aware Dictionary and sEntiment Reasoner) is a lexicon and rule-based sentiment analysis tool that is specifically attuned to sentiments expressed in social media [Hutto, C.J. & Gilbert, E.E. (2014)]. In particular we used the SentimentIntensityAnalyzer module that given a text returns a list of scores: neg, neu, pos and compound. The compound score is computed by summing the valence scores of each word in the lexicon, adjusted according to the rules, and then normalized to be between -1 (most extreme negative) and +1 (most extreme positive). This is the most useful metric if you want a single unidimensional measure of sentiment for a given sentence. Generally we can classify as a positive sentiment if the compound score is higher than 0.05, neutral if the score is between 0.05 and -0.05 and as a negative sentiment if the score is below -0.05. The pos, neu, and neg scores are ratios for proportions of text that fall in each category. These scores can be used to analyse single sections of each document or text. In this analysis we won't use this separate score but we will use only the compound score. Indeed for each tweet we classified it in positive, negative or neutral following the suggestions above and we added a compound column in our tweet's dataframe. The result is shown in figure 12.

	Datetime	Tweet Id	Text	Username	Sentiment	Compound
0	2022-11-30 23:56:59+00:00	1598103832080584704	Twitter	1024pixels1	neutral	0.0000
1	2022-11-30 23:56:04+00:00	1598103601507102720	Overall using AI to create art can expand the...	charis_ai	positive	0.7845
2	2022-11-30 23:56:02+00:00	1598103593634369536	Este prompt fue creado con el nuevo modelo de ...	alarcon7a	neutral	0.0000
3	2022-11-30 23:54:08+00:00	1598103115060084736	Just played around with OpenAI s new model and...	anthonypak	positive	0.3400
4	2022-11-30 23:51:34+00:00	1598102468243599361	I asked to write me a story about Sova and Jet...	emargusity	positive	0.5574

Figure 12: Classified tweets and relative compound score

Then we performed a statistical analysis on the distribution of the sentiments obtaining a bar chart and a pie chart of the counts of each sentiment shown in figure 13 and 14.

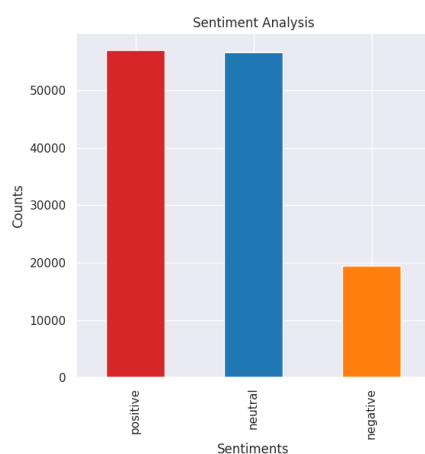


Figure 13: Bar chart of sentiments

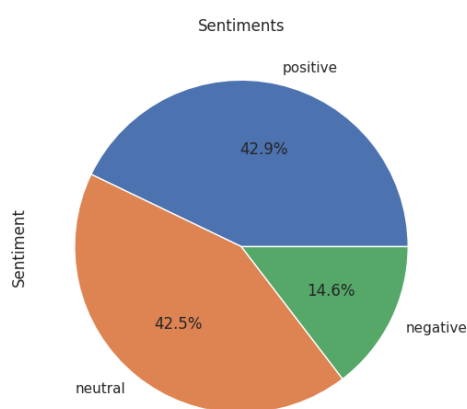


Figure 14: Sentiments distribution

With this analysis we obtain about 56000 positive tweets, about 55000 neutral tweets and about 20000 negative tweets. This result is slightly different from the one obtained using TextBlob but leads to the same results. The majority of tweets are positive about ChatGPT.

We performed the same temporal analysis done in the previous experiment on the data computing the daily average of the compound score and comparing it with the absolute average. We also computed the daily average of the compound score of the tweets classified as positive and negative independently. The results are shown in the figures 15, 16 and 17.

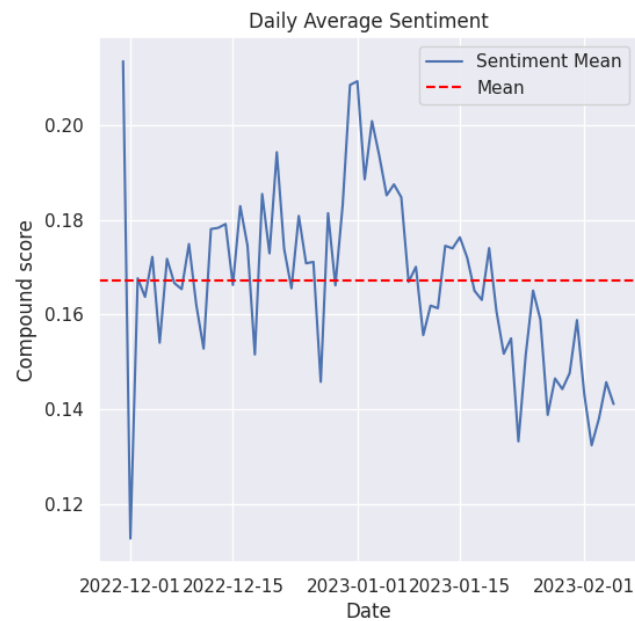


Figure 15: Daily compound score average

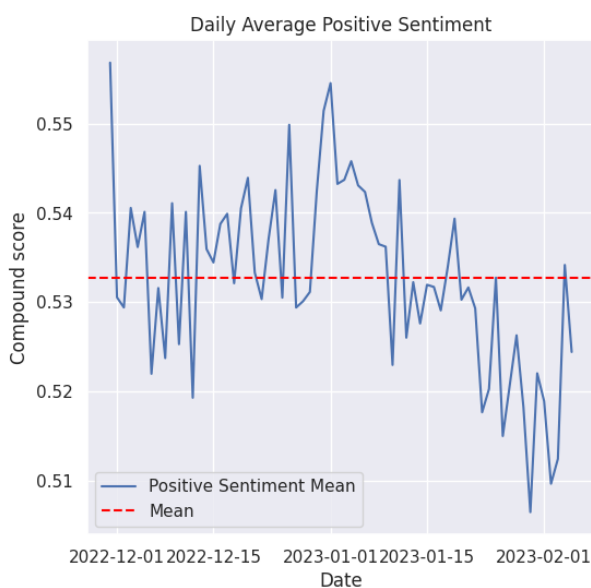


Figure 16: Daily average positive sentiment

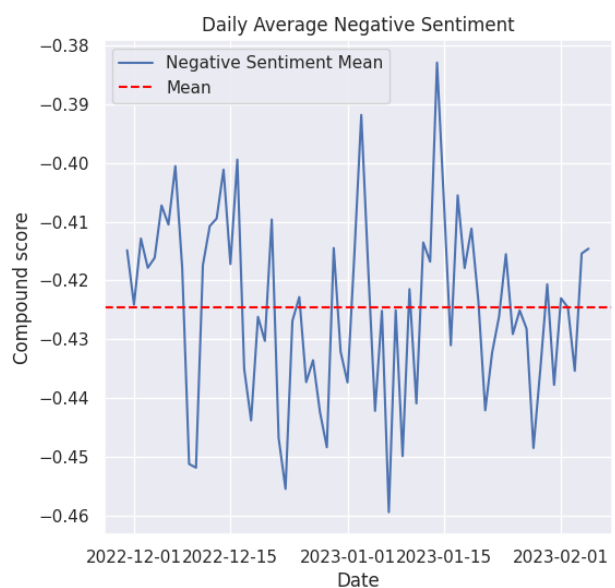


Figure 17: Daily average negative sentiment

These graphs show the same results obtained from the previous analysis where the daily compound score average of the tweets decreases over time reaching a value far below the average in the last part. The same behaviour is shown in the positive sentiment tweets where the compound score decreases during time in particular after the start of January.

3. Sentiment Analysis results

Our sentiment analysis task showed that there is a general positive sentiment about the release of ChatGPT by OpenAI with both the tools that gives us a percentage of positive tweets that is more than the half of negative tweets. As we can expect a lot of tweets are neutral, this depends on the nature of the tweets that not always want to express a personal opinion about the fact and even because the tools classify as neutral the tweets in other languages apart from English. The temporal analysis shows that the peak of positive tweets are in the first period, after the release of the service, probably showing the enthusiasm of a lot of people about this new powerful tool. This enthusiasm obviously led to an high demand of the freely available service, that couldn't handle so much request and that finished to be unavailable for a quite long period, resulting in an increase of negative tweets in the first days of January with a peak in the half of it. We can hypothesise that the decrease of the average polarity and compound score during time is caused also by a more accurate analysis of this tool and in general of this type of AI tools that highlights the risks of these services such as the lost of the human personalisation and touch on the more creative jobs and also the lost of a lot of job positions that can be easily substitute by an AI.

4. Competition analysis

In this section we will briefly analyse what the major tech companies are doing in response to this big release by OpenAI that also with limitations and problems, released a very powerful tool that works quite well in the majority of cases. In particular we will analyse what Microsoft and Google are doing.

4.1 Microsoft extends OpenAI partnership

Microsoft in July of 2019 already invested in OpenAI with a \$1 billion dollar investment. This investment make Microsoft the “exclusive” provider of cloud computing services to OpenAI, and the two companies started working together to develop new technologies [[theverge.com James Vincent 2019](#)]. After the release of ChatGPT Microsoft extended OpenAI partnership in a ‘multibillion dollar investment’. We don't know exactly the dimension of the investment but some rumours talk about a huge investment of \$10 billion dollars. Rumours of this deal suggested Microsoft may receive 75 percent of OpenAI's profits until it secures its investment return and a 49 percent stake in the company. The deal will see Microsoft increase its investments in the development and

deployment of supercomputing systems to assist OpenAI's research [[theverge.com Tom Warren 2023](#)]. Furthermore Microsoft's response to Google's ChatGPT rival will come in the form of ChatGPT integration into Bing search results. The updates will see Bing results include smooth, written responses to queries that summarise information found on the web, and the addition of a new chatbot interface for complex queries. The move is by far the biggest threat Google has seen to its dominance in web search and marks the beginning of an AI arms race between the companies [[bbc.com James Clayton 2023](#)]. Microsoft is also planning to deploy OpenAI's various models into its own consumer and enterprise products. Outside of Bing, there are rumours of Word, PowerPoint, Outlook and Teams getting OpenAI technology.

4.2 Google's Bard

Google said that it will soon release an experimental chatbot called Bard as it races to respond to ChatGPT, which has wowed millions of people since it has been released at the end of November. Bard is based on experimental technology called LaMDA, short for Language Model for Dialogue Applications, which Google has been testing inside the company and with a limited number of outsiders for several months. Unlike ChatGPT, which is trained on data ending in 2021, Bard pulls information from the web and can "provide fresh, high-quality responses," according to Alphabet CEO Sundar Pichai. The explosive growth of ChatGPT has created panic at Google considering that, its main product, Google Search, lost a lot of users, that now are turning to ChatGPT to answer questions they previously asked Google [[cbsnews.com Irina Ianova 2023](#)].

On February 6, Google shared a demo on Twitter revealing Bard. Unfortunately in the demo Bard made a mistake and an astrophysicist named Grant Tremblay noticed the blunder at a crucial moment for Google, during a week when the company was trying to showcase its AI tool and compete with Microsoft. The company's stock went down pretty quickly. Alphabet's stock fell by an astonishing 9%, losing \$100 billion on market cap.

In trying to keep pace with what some think could be a radical change in how people search online, Google now risks its search engine's reputation of retrieving reliable information.

References

Hutto, C.J. & Gilbert, E.E. (2014). VADER: A Parsimonious Rule-based Model for Sentiment Analysis of Social Media Text. Eighth International Conference on Weblogs and Social Media (ICWSM-14). Ann Arbor, MI, June 2014.

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<https://www.bbc.com/news/business-64562672>

<https://www.cbsnews.com/news/google-chatbot-bard-answer-to-chatgpt/>