

1 Introduction

The field of Natural Language Processing has experienced a major transformation in recent times, mostly because of the rapid advancements made in deep learning architectures. This rapid advancement has not only improved NLP systems performance but also opened the door for innovative uses in a variety of fields. Due to the field’s continuous need of innovation, once-difficult tasks like text generation, sentiment analysis, and machine translation have now reached previously unreachable levels of accuracy and fluency.

These days, NLP technologies are clearly embedded in our daily routines. Via the use of natural language, these tools—which range from sophisticated chatbots and recommendation systems to virtual assistants like Alexa and Siri—have emerged, enabling smooth communication between people and machines. The link that exists between technology and people highlights how powerful NLP can be in influencing how we work, communicate, and engage with information.

Examining the development of computational creativity makes it interesting to revisit established discussions about the role of machines in the creative process. In the past, people have questioned whether algorithms and machines are capable of creativity and imagination. Even if early critics expressed doubts about the creative capacity of machines, current AI systems continue to put doubt on these ideas by generating outputs that frequently confuse content created by humans and machines.

The creation of song lyrics based on genre and artist names is one of the applications of NLP that we will be investigating in this paper. We seek to understand the complexity of computational creativity and demonstrate how AI can support and improve artistic expression by utilising the power of innovative neural networks and transfer learning techniques. By pushing the limits of what is possible in the field of NLP and beyond, we seek to make a contribution to the continuing conversation about the connection between technology and creativity.

2 Motivation

Natural Language Processing and the creative arts are two separate but related fields that are the driving forces behind this research. There is a strong chance to investigate the use of language technology in the field of artistic expression, particularly in the creation of song lyrics, as developments in NLP keep rising.

For many years, audiences have been fascinated with music as a universal means of human expression, and it has been used to communicate feelings, stories, and cultural identity. In the world of music, lyrics are essential for influencing the listener’s experience, promoting feelings, and delivering deeply personal messages. Lyric writing is an area typically connected with human creativity, requiring a special combination of linguistic skill, emotional intelligence, and creative intuition.

But even with songwriting and lyricism’s history, there are still obstacles and restrictions that prevent this art form from becoming more widely accessible and collaborative. Traditional lyric writing techniques frequently depend on the skill and imagination of talented lyricists, which restricts the range of voices and viewpoints that are represented in the music industry. Additionally, writing original lyrics can take a lot of time and resources, which can be a barrier for musicians and content producers.

In this context, reinventing the lyric-generation process and expanding access to creative expression through the application of NLP technologies offers a new potential. With the use of large-scale language models and state-of-the-art machine learning algorithms, we can enable songwriters, musicians, and other content producers to explore new creative directions.

Moreover, based on genre and artist names, the capacity to produce customised and contextually appropriate lyrics offers up new opportunities for improving listener participation, customising music

suggestions, and producing engaging storytelling experiences. By incorporating NLP approaches into the music industry, we may transform the way we listen to and engage with music, promoting greater diversity, variety, and originality in the musical landscape.

3 Literature Review

An end-of-term review of a bi-directional LSTM song generator for creating song choruses is presented in this study [JA]. Although the creation of poetry has been studied for many years, stylistic output came to light in the mid-1990s when NLP, AI, and machine learning came together. But a lot of today's text creation algorithms don't really have a distinct author voice or style. The relevance of author authenticity is emphasised in the study, particularly for applications such as language studies and customer service systems. The authors recommend feeding a suitable corpus that mimics the intended author's style to the predictive model in order to enhance the quality of generated material. They also stress how crucial it is to include details about relationships in the text. To create unified choruses, their models integrate multiple NLP methods and are based on customised datasets. All things considered, the system was successful in linking several NLP tools and producing choruses that could be linked to a certain musician. But there's always room for development, especially when it comes to boosting style capture and strengthening the generated documents' readability and consistency. In later revisions of the system, the authors propose improvements including adding a Rhyme Analyzer component and striking a balance between lyrical flexibility and grammatical structure.

This research paper [HG20] explores the possibility of creating lyrics for particular musical genres using deep learning techniques. Although recurrent neural networks (RNNs) or gated recurrent units (GRUs) have been used in computational research on linguistics to generate lyrics, this study uses an LSTM network to generate lyrics that are particular to a given genre. In order to examine language similarities, differences, and the effectiveness of the LSTM network, the authors compare the generated lyrics to other genres and the training set, evaluating them using a variety of linguistic metrics. The findings show that the LSTM model produces both pop and rap lyrics with good accuracy, with average line length and word variance across songs and genres being closely matched. Possible areas for research include delving into more basic models such as Markov Models and examining the application of GRUs to speed up training. The authors suggest training models across a variety of genres in order to efficiently capture linguistic structure similarities. The research highlights the possibility of pre-trained models being able to adjust to various linguistic styles with increased processing power, even in spite of computational constraints. It inspires more research into the creation of musical lyrics and beyond, especially when it comes to modifying generic models to fit different genres and writing styles. Finally, the paper highlights the importance of capturing not only semantic but also stylistic differences in text generation tasks.

The paper [Lau21] explores the relationship between machine learning and the production of creative content, with a specific emphasis on song lyrics. The introduction, which draws on Ada Lovelace's doubt over computers' ability to create unique content, sets the scene by reflecting on past discussions regarding the creative potential of algorithms and machines. Despite this mistrust, the study highlights the unexpected outcomes of machine learning algorithms, leading to a reconsideration of the place of computers in creative industries. The author wants to investigate how machine learning—more especially, the GPT-2 model—can be used to write original music lyrics. As part of the technique, a dataset with over 122,000 carefully chosen song lyrics and related metadata was cleaned up. Metrics such as repetition score and TF-IDF vectors are used to analyse the song lyrics' length, word usage, and musical genre. The steps involved in creating song lyrics with the GPT-2 model are explained in depth, emphasising how crucial the volume of training data is to the creation of meaningful and diverse lyrics. The absence of training data for specific musical genres presents difficulties and requires innovative methods of assembling datasets. In spite of these obstacles, the study offers suggestions for improving the training procedure to raise the calibre of lyrics that are produced. Following studies efforts may encompass expanding the range of song lyrics to encompass a greater variety of musical styles, enhancing metrics for contrasting lyrics produced by machines and humans, and integrating sentiment analysis to describe lyrics from other musical genres. In summary, the study highlights how machine learning might enhance creative processes and encourages more research in this area.

This work [MAGR22] investigates the possibility of creating poetry writings and song lyrics using GPT-2, an advanced neural network design. Although a lot has been accomplished in the field of

Natural Language Processing (NLP), especially in the areas of machine translation and text generation, there are still difficulties in producing texts that contain poetic devices like metaphors, metonymy, and paraphrases, especially in the musical genre. The performance of a GPT-2 model that has been refined using datasets of English and Portuguese lyrics is examined by the authors. They assess the produced writings according to their similarity to lyrics written by humans as well as their spelling, grammar, and semantics. The GPT-2 models successfully produce syntactically valid and semantically consistent musical/poetic writings, despite frequent spelling errors and hardware resource limits. The study argues that existing measures such as misunderstandings are insufficient for evaluating artistic aspects and admits a subjective way of judging the quality of such writings. The authors stress that the intention is to enhance human composers work rather than take their place. In order to increase the quality of generated writings, future study will define more relevant metrics for evaluating poetic poems, run further trials for analysis, and investigate the integration of semantic content into datasets. Overall, the study opens the door for more research into the subject of poetic text production by indicating that GPT-2 has special potential for producing text for a variety of genres and purposes.

In the final paper [SD24], a Large Language Model (LLM) specifically designed for song composing is presented: SongComposer. In contrast to earlier music-focused LLMs, which handle music as quantized audio data, SongComposer uses symbolic song representation to create lyrics and melodies in a manner that resembles human composition methods. This novel method has benefits in terms of accurate representation, token efficiency, and output that is readable by humans. The authors created SongCompose-PT, a large dataset of lyrics, melodies, and paired lyrics-melodies in both Chinese and English, in order to train SongComposer efficiently. SongComposer learns core musical knowledge, including melody-lyric alignment, through pre-training on this dataset. The study shows that SongComposer outperforms advanced LLMs like GPT-4 on a variety of song-related tasks, including text-to-song creation, melody-to-lyric generation, song continuation, and lyric-to-melody generation. SongComposer delivers efficient and effective lyrics-to-melody generation by combining both tasks into a single model and using text-based melody representation. Overall, SongComposer is a major step forward in the use of LLMs in the music industry, giving people who haven't studied music much of a platform to express their creativity. However, during its development and implementation, ethical concerns about copyright infringement and the misuse of intellectual property should be carefully taken into consideration.

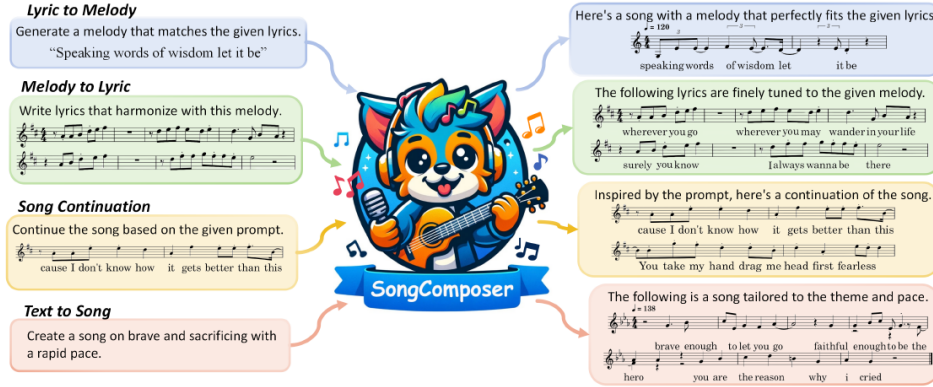


Figure 1: Overview of the song-related instruction-following generation by SongComposer

4 Data Analysis

Firstly, we used the Spotify 1 million songs dataset from kaggle [SHR] by Shrirang Mahajan.

4.1 Basic data exploration

To begin with, we started the data exploration by transforming the .csv file into a pandas dataframe. We gathered basic information about the dataset such as the total number of entries (57650 entries). Then we discovered the columns/features of our dataset ['artist', 'song', 'link', 'text'], where artist is the name of the singer, the song is the song's title, the link is spotify's link to the song and finally text signifies the lyrics of the song.

Then we discovered some statistics about our dataset such as the uniqueness of our attributes where we found that we have 643 unique artists, 44824 unique songs, 57650 unique spotify links and finally 57494 unique song lyrics.

4.2 Normalization

In the section, an initial assessment was conducted to identify any null values within the dataset. It was determined that the dataset is devoid of any null values. Subsequently, a detailed examination was undertaken to ascertain the presence of complete row duplicates. This analysis revealed an absence of such duplicates, indicating the uniqueness of each entry. However, upon closer inspection of individual feature statistics, it was observed that multiple songs share identical titles, albeit possibly performed by different artists. This phenomenon may suggest the existence of song remixes or cover versions within the dataset. Following the initial data examination, the subsequent step involved employing



```
song
Have Yourself A Merry Little Christmas    35
Angel                                     28
Hold On                                   27
Home                                       27
I Believe                                 26
..
Just Be Good (Bushman Dub)                1
Kingston Town                            1
Kiss And Say Goodbye                     1
Lamsbread                                1
Generation                               1
Name: count, Length: 44824, dtype: int64
```

Figure 2: Screenshot to show the song name repetitions

tokenization, segmentation, and lemmatization methods. However, prior to executing these processes, the dataframe was transformed into an array of string arrays containing the lyrics of each song. This preparatory step was imperative to ensure the accurate processing of the data. By converting the dataframe in this manner, the potential consequence of tokenizing each individual letter within a word was mitigated. This preemptive measure served to alleviate computational burden and prevent the generation of extraneous and redundant information.

Subsequent to the initial preprocessing steps, extraneous words and punctuations, such as common stop words like "a" and "the", were systematically removed from the text data. This process, known as stop words removal, effectively pruned the dataset of non-essential linguistic elements, thereby enhancing the quality and relevance of the remaining text for subsequent analysis.


After discovering the presence of words starting with uppercase letters within the dataset, we standardized our vocabulary to lowercase. This unified approach facilitates easier detection, comparison, and analysis of the data.

After identifying the presence of newline characters, spaces, and other whitespace characters within our vocabulary, we proceeded to remove them. This action was essential to streamline the analysis process and ensure accurate results.

4.3 Insights

4.3.1 Statistical Insights

We commenced our analysis by examining the class distribution within the dataset. Notably, among the dataset's features, the "artist" attribute exhibited the least number of unique entries, suggesting its suitability as the primary classifying category. The utilization of the "artist" feature as the primary classification criterion was deemed the most robust approach. As depicted in the figure below, the top 10 classes within the dataset were identified. For instance, "Donna Summer" emerged as the foremost class, boasting a total of 191 unique entries within the dataset. This visualization provides a comprehensive overview of the distribution of classes, offering insights into the dataset's structure and composition.



artist	
Donna Summer	191
Gordon Lightfoot	189
Bob Dylan	188
George Strait	188
Loretta Lynn	187
Cher	187
Alabama	187
Reba Mcentire	187
Chaka Khan	186
Dean Martin	186

Name: count, dtype: int64

Figure 3: Screenshot of Top 10 from the most frequent class

Following our initial analysis, we determined that computing TF (Term Frequency), IDF (Inverse Document Frequency), and TF-IDF scores would provide valuable insights into our dataset. To begin, TF computation entails counting the occurrences of a specific word in the vocabulary of an individual song.

After computing the TF scores, we proceeded to calculate the IDF scores, which offer a measure of how unique or rare a word is across all documents in the dataset. Essentially, IDF evaluates the significance of a term by inversely weighting words that occur frequently across the entire corpus. This weighting helps prioritize terms that are less common but potentially more informative.

Having computed both TF and IDF scores, we merged them to derive the TF-IDF scores, which offer a comprehensive evaluation of word importance within individual documents relative to the entire corpus. TF-IDF underscores terms that demonstrate high frequency within a specific document (TF), while also considering their rarity across all documents (IDF). This integrated metric effectively captures the distinctive relevance of each term in the context of the entire dataset, allowing us to prioritize words and phrases that are less common in the corpus. This strategic emphasis on less common terms contributes to the creation of more novel and engaging lyrics. As depicted in the following figure, the word 'Kind' demonstrates a notably high TF-IDF score in the first song, indicating its frequent occurrence within the song itself coupled with its rarity across the entire dataset. Conversely, the term 'special' exhibits a comparatively lower TF-IDF score, suggesting its moderate frequency within the document alongside its modest rarity across the corpus. This distinction underscores the nuanced evaluation provided by TF-IDF, allowing for the identification of terms that are both commonly encountered within specific documents and distinctive across the broader dataset.

```
{0: {'kind': 9.044448916049255,
'girl': 7.3677222729989325,
'?': 5.007201770982746,
'fine': 4.760091081653636,
'blue': 4.200247046584387,
'believ': 3.9197522596349987,
'face': 3.770781503107308,
'walk': 3.7592859811103083,
'leav': 3.7514418549629873,
'fellow': 3.551284297088087,
'look': 3.2302736818463433,
'squeez': 3.2057048630523988,
'feel': 3.10595302525842,
'lucki': 2.8909811036513897,
'park': 2.8453994764184483,
'special': 2.8438192643103357,
```

Figure 4: Screenshot of example of TF-IDF Scores

4.3.2 Graphical Insights

In the figure presented below, we observe the top 30 artists ranked by song frequency. This graphical representation aids in discerning the distribution of songs and the prominence of each class discussed in Section 4.3.1.

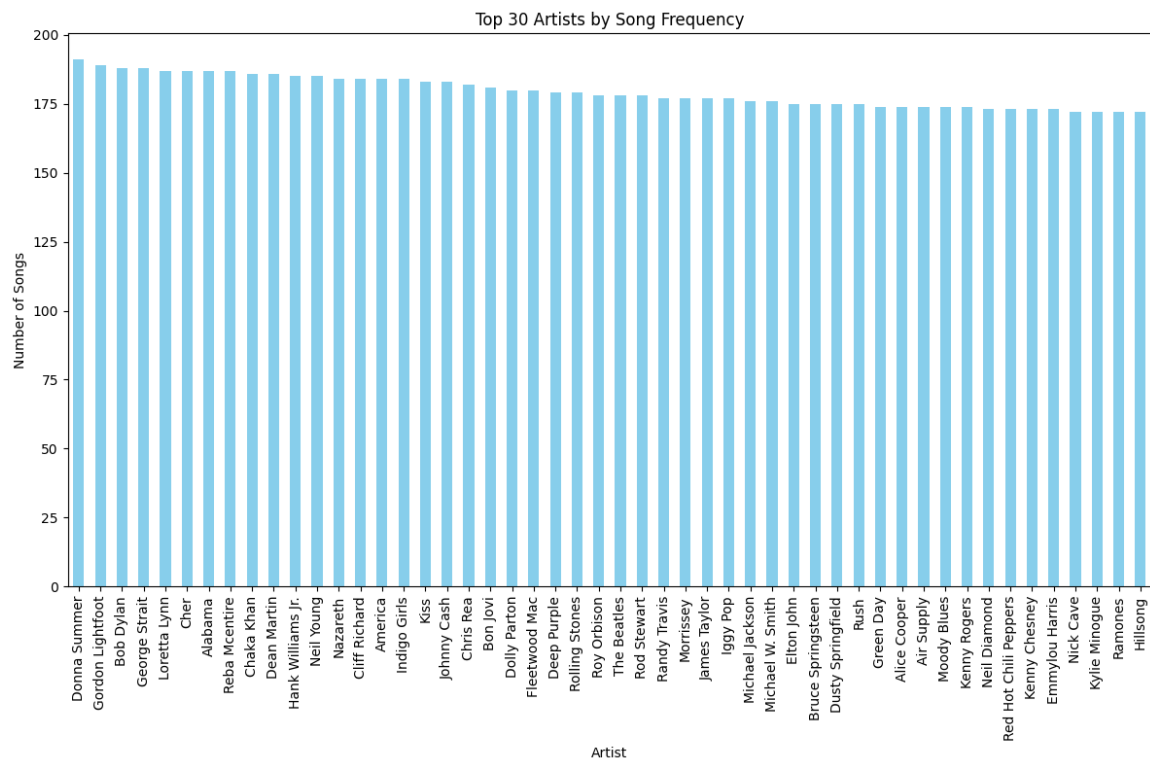


Figure 5: Screenshot of Top 30 most frequent artists

Following our initial investigation, we turned our attention to the lyrical content of the songs. Our aim was to determine the average number of words typically found in a song after the model training process. This analysis provides valuable insight into the expected output length for each song generated by the trained model.

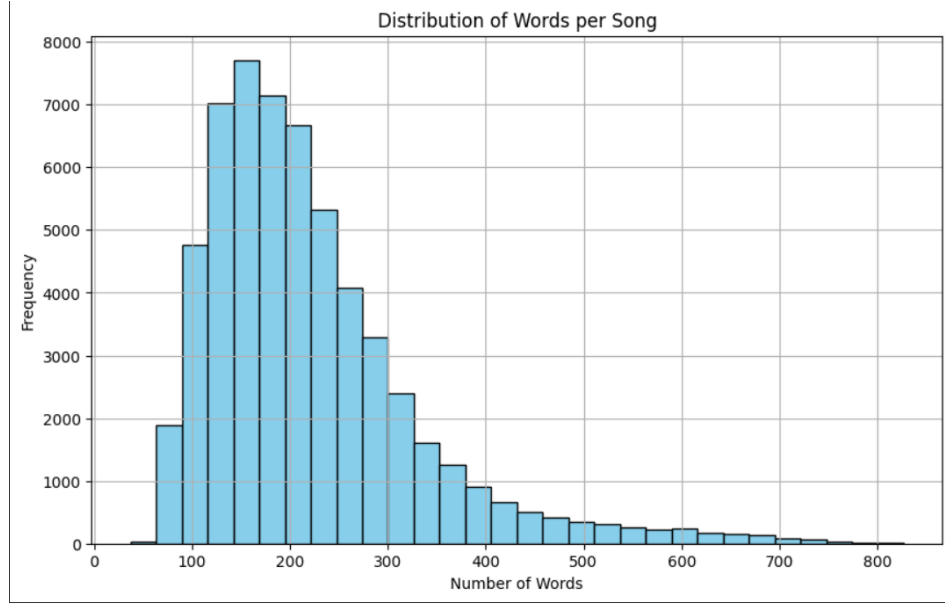


Figure 6: Distribution of words/song

$$\text{Repetition Score} = \frac{\text{Number of Repeated Words}}{\text{Total Number of Words}}$$

This formula quantifies the repetition score, which is the ratio of the number of repeated words in a song to the total number of words present in that song. It provides a metric for assessing the degree of word repetition within individual songs.

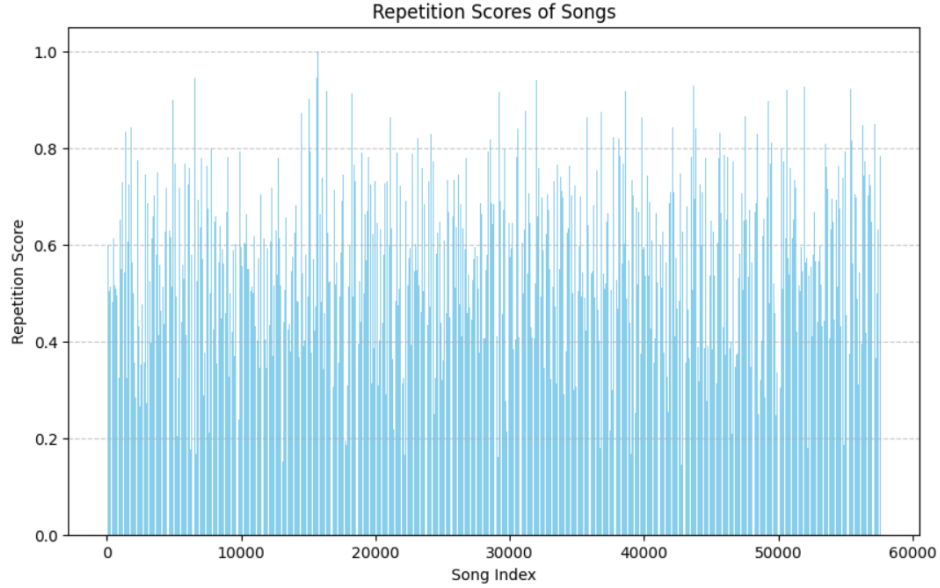


Figure 7: Repetitions of words in lyrics

4.4 Limitations

- Conducting a spelling check on the entire dataset proves to be computationally demanding and often leads to IDE crashes. With an average processing time of 0.3 seconds per song, the task necessitates approximately 4 hours to complete for the entire dataset. However, a pertinent consideration arises: is it imperative to perform a spell check on song lyrics? The distinction between expressions such as "oh" and "ohhhhh" may not be perceived in the same way by humans.
- Another noteworthy limitation of this dataset is its sparse feature set, which lacks crucial attributes pertaining to songs such as genre, duration, musical key, release date, among others. As a result, leveraging web scraping techniques or integrating with external datasets available online becomes imperative to extract or augment this essential information. Such endeavors are necessary to enrich the dataset and enhance its utility for comprehensive analysis and insights generation.

References

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