Generating Song Lyrics in Style of Eminem

Mini-project, Module 8, DAT410

Dylan Osolian
MPALG
Chalmers University of Technology
dylan.osolian@gmail.com

Lisa Samuelsson
MPDSC
Chalmers University of Technology
lisasamuelssons@gmail.com

1 Introduction

Text generation has been a key part of artificial intelligence since the early days, and with recent development of large language models the topic seems more relevant than ever. There are a multitude of different kinds of texts, from descriptive and formal texts to free-form texts such as poetry. One special kind of text is song lyrics. While some contain deep meaning, other's are made up of nonsensical words. Another aspect of song lyrics is that different artists often have a certain style. They might for example be known for using some words more often, for singing about specific topics or for often using rhymes. This makes generating song lyrics in the style of different artists an interesting task. It could highlight specific traits of an artist's songs that make them different from other artists' songs, but also serve as inspiration for songwriters that appreciate the artist in question. In this project, we tackle the challenge of generating song lyrics in the style of the famous rapper Eminem. This is done by creating a simple AI that builds on Eminem lyrics.

2 Method

2.1 Data collection

To generate the lyrics, we needed data to build on. We chose to generate lyrics in the style of the rapper Eminem, but nothing apart from the data used is really specific to this certain artist. It would be possible to perform the same task using lyrics from another artist as a data set, which would generate lyrics in the style of that artist instead. There are three main reasons why we choose Eminem in this project. Firstly, he has a distinctive style which is rather easy to recognize even if you aren't a frequent listener of his music. Secondly, his lyrics generally contain a lot of words, which makes it easier to gather enough data. Thirdly, Eminem has a large catalog of songs with lyrics that are easy to access online.

To gather the lyrics data, we used LyricsGenius (Miller, 2023). This is a Python client for the Genius.com API (Genius, 2023). Genius.com is a website which contains song lyrics for a large number of songs. On the website, users can also highlight and annotate parts of songs. With the Genius API, song data as well as artist data can be reached. A limitation is however that the actual lyrics can't be accessed directly. LyricsGenius uses Beautiful Soup, a Python library that parses HTML and XML documents, which together with the Genius API allows you to access lyrics from the Genius website.

Using this set up, we accessed the lyrics from the 50 most popular Eminem songs available on Genius. At the beginning of each song's lyrics, a header was included. This header contained information about the song and title, and a number of languages that the lyrics were available in. These headers had to be removed as they aren't a part of the lyrics, but as the format was a bit different for each header, we removed these manually in the text file.

2.2 Models

There are different kinds of machine learning models commonly used to generate texts. Some of the most common models for text generation are deep learning models such as Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM) Networks and Transformers. These kinds of models have become popular because they can automatically learn to map input to output and create good texts without needing a lot of human input. Other common models to solve the task of generating texts are models based on Markov chains. These kinds of models have historically been very important in text generation. The Markov model generates sentences that are statis-

tically likely. It learns from the training data and predicts the next word or next phrase by choosing the most likely one.

In this project we decided to work with Markov models. The developed system uses Markovify (Singer-Vine, 2023), a library used to generate Markov chains based on input data. Markovify makes it simple to implement a text generator based on Markov chains but also allows for advanced control and tuning through parameters.

We build the Markovify model by running *markovify.NewLineText(data)* with our training data. To generate the lyrics we use the *make_sentence* function which generates a sentence based on the built model and the specified parameters. The parameters *min_words* and *max_words* control the length of the generated sentence. The parameter *max_overlap_ratio* tells the model to not accept generated sentences which have a word count overlap with the original text of more than the specified parameter. By changing this parameter some control of how similar the sentences are allowed to be to the original lyrics can be achieved.

During the project a deep learning model was also tried out to see how the results would differ. We implemented a LSTM recurrent neural network in order to learn to predict the next word in a sentence. To do this the input has to be encoded, this can be done either on a word level or on a character level. We decided to do the word level encoding where each word is encoded as an integer. To implement this model we followed a tutorial from Machine Learning Mastery (Brownlee, 2020). Because the course hasn't covered much deep learning and we didn't quite understand all parts of this implementation we decided to only work further with the Markov model.

2.3 Evaluation

We would like to evaluate both the quality of the generated text itself but also how similar it is to real lyrics by Eminem. Evaluating the quality of generated texts is challenging. We have no baseline text to compare to, so evaluating the grammar is difficult. However, even in the lyrics from real Eminem songs, grammar doesn't always make complete sense, which made us feel like it was acceptable to focus less on this. Evaluating how much the generated lyrics resemble Eminem's song texts is also a difficult task, as it is subjective and not really measurable. Ultimately, we decided to carry out an online survey where we allowed participants to guess if the text is from an Eminem song or if it's written by our AI. This online survey consisted of two parts. The first part had six questions where each question contained a single line of lyrics. Three of the questions had lyrics generated by the AI, and three were from real Eminem songs. Both the Eminem lyrics and the AI generated lyrics were selected at random. The second part had four questions, and in the same way users guessed if the presented lyrics were AI generated or from an Eminem song. However, in this part, each question contained three lines of lyrics. Two questions had AI generated lyrics, and the other two had real Eminem lyrics. Our AI produces one line at a time, so the three lines were selected at random. The three lines from the Eminem songs were of course taken as they appear in the real text.

3 Result

Some example sentences generated by the AI are presented here:

- "Say you got me in a sidekick as I get shocked at the bridge now"
- "But your picture on my shit in a line, compliment me on blast on MTV"
- "You sound like a job for me to rap like I'm on my wall"
- "Prove that if you want me to rap like I'm on fire"

More examples (those used to evaluate the system) are shown in Table 1. To evaluate the system, an online survey was carried out, as described in *Method*. The survey was carried out online, with a total of 23 respondents. A question in the first part of the survey looked as in Figure 4. A question in the second part of the survey looked as in Figure 5. Each question is shown in Table 1 along with the correct answers. The total number of answers for each question is presented in Table 2.

Ideally, we would like an even distribution of answers on the lyrics generated by our AI, as that would mean that the lyrics generated by our system can't easily be distinguished from the real lyrics. We created confusion matrices to show the

distribution of right and wrong answers for each of the two parts and for the whole survey. These can be seen in Figure 1, Figure 2, and Figure 3. Looking at the confusion matrix for the whole survey, we see that answers generally are rather evenly distributed. However, the guesses for part two are more correct than the ones for part one.

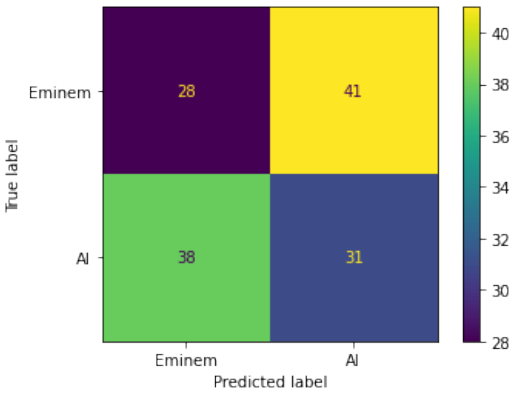

Figure 1: Confusion matrix for the first part of the survey.

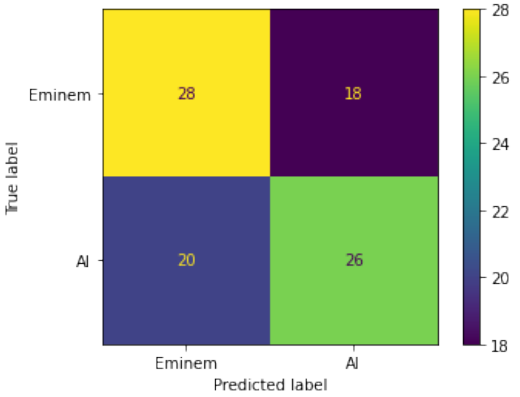

Figure 2: Confusion matrix for the second part of the survey.

4 Discussion

A big difficulty of this project was evaluation since there are so many parts of the generated texts that can be evaluated. The generated lyrics can be evaluated in regards to things which are common to text evaluation like grammar and coherency but also in how similar the generated lyrics is to the artist's style or how well the generated lyrics resembles a song. Due to the limited available time for this project we as mentioned decided to only do a survey to check if the generated lyrics could pass as lyrics written by Eminem. However we did do research about metrics that are commonly used

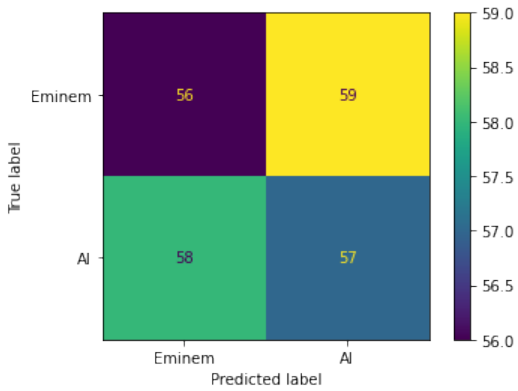

Figure 3: Confusion matrix for the whole survey.

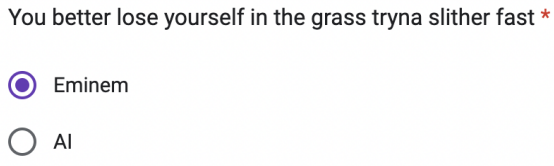

Figure 4: Example of question in part 1 of survey.

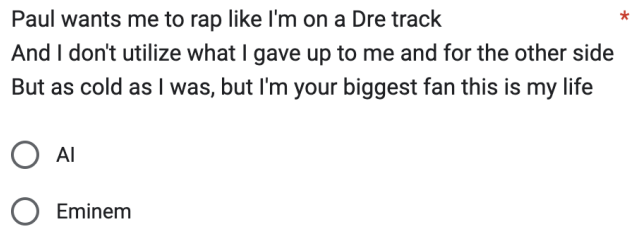

Figure 5: Example of question in part 2 of survey.

to evaluate NLG models, and examples of common metrics are N-gram based metrics and BERT score.

There are limitations to the method we used to generate the lyrics, the main one being that the AI generates lyrics line by line. This means that we don't get lyrics that follow the typical format of songs, with verses and choruses. Therefore, one can argue that the lyrics aren't proper songs but only a collection of lines or sentences. This way of generating lyrics also means that lines won't rhyme with each other, or that a generated "song" won't have any meaning or context. The first sentence can be about a completely different thing compared to the second sentence, which means that generating a complete song with this model doesn't give very good results. While generating one sentence can make sense, generating a complete song is not really feasible. This would likely make it easier to spot which lyrics are real Eminem lyrics and which are not if a larger number of lines are presented.

We did notice that this was the case in our evaluation. In Figure 2, it can be seen that more people were able to correctly classify the sentences compared to the first part of the survey, see Figure 1. We believe this is due to the fact that sentences have different context and it makes it easier to distinguish the AI generated lyrics. We assume that this would be even more obvious if the lyrics would be longer than 3 sentences.

The evaluation of the model with the survey was mainly done to get an idea of whether the generated lyrics could be seen as Eminem's lyrics. The survey is not perfect and doesn't provide a thorough evaluation of the system. The people who answered the survey were our friends and family and their previous knowledge of Eminem is not known. Previous knowledge of Eminem can of course affect how the questions in the survey are answered. No previous knowledge about Eminem will obviously not yield good results but knowing all of Eminem's songs will not give fair results either, ideally the participants are somewhere in between these two thresholds. Since the survey was small and only a few sentences were included the choice of sentences can also affect the outcome greatly. We chose the sentences to use in the survey randomly, but there were some generated sentences which were clearly better and some which were worse. Furthermore some of Eminem's lyrics are well known which also might affect the outcome since participants might recognize the lyrics.

5 Conclusion

In this project, we created a simple AI that generates lyrics inspired by the rapper Eminem, built on a large collection of Eminem lyrics gathered from the website Genius.com. The evaluation was done by letting people guess if lines were generated by the AI or if they came from Eminem lyrics. Looking at our results, we believe that it is possible to generate lyrics that resemble Eminem lyrics enough that people believe that they come from real songs. However, we also notice that people to a higher degree spot the generated texts when they are longer, likely to the lack of context and rhymes. Also, people more familiar with the artist in question are probably more likely to spot the differences between real and generated text.

To summarize, this project showcases a good starting point for generating lyrics in the style of a certain artist. The project could be implemented for other artists, and performance could likely be improved if a more complex model was used.

References

Jason Brownlee. 2020. How to develop a word-level neural language model and use it to generate text. *Machine Learning Mastery*.

Genius. 2023. Genius api documentation. *Genius*.

John W. Miller. 2023. Lyricsgenius: a python client for the genius.com api. *LyricsGenius*.

Jeremy Singer-Vine. 2023. Markovify. *Github*.

	Lyric	Correct answer
Question 1	To burn it in front of you, ho	Eminem
Question 2	You better lose yourself in the grass tryna slither fast	AI
Question 3	The best thing since Elvis Presley	AI
Question 4	They moved on to the point I'm like a fifth of a hundred thousand bucks	AI
Question 5	And say I empathize with the people this evil serpent	Eminem
Question 6	But you coulda signed an autograph for Matthew	Eminem
Question 7	Rappers are hungry lookin' at me like it's lunchtime I know there was a time where once I Was king of the underground	Eminem
Question 8	Paul wants me to rap like I'm on a Dre track And I don't utilize what I gave up to me and for the other side But as cold as I was, but I'm your biggest fan this is my life	AI
Question 9	I know there was a 24/7 special on the guy with a crystal ball I'm devastating more than I do want you to do But she don't know who the fuck can him and fuck you too!	AI
Question 10	Lil Pump Lil Xan imitate Lil Wayne I should aim at everybody in the game pick a name I'm fed up with being humble	Eminem

Table 1: Table showing each question along with the correct answer. Questions 1-6 are "part 1" while questions 7-10 are "part 2".

	# of people that guessed AI	# of people that guessed Eminem	Correct
Question 1	13	10	Eminem
Question 2	13	10	AI
Question 3	9	14	AI
Question 4	9	14	AI
Question 5	16	9	Eminem
Question 6	12	11	Eminem
Question 7	18	5	Eminem
Question 8	14	9	AI
Question 9	12	11	AI
Question 10	13	10	Eminem

Table 2: Table showing the number of answers for each of the questions, along with the correct answer.