Deep-Hop Rapper: Using LSTM and Transformer for Rap Lyric Generation

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Problem
- Natural language generation techniques have developed substantially to a point where it can effectively assist in more creative fields.
- News article writing, coding, even poetry!
- However, these techniques have not been used to much success in hip-hop lyric generation.
- Other academic papers use outdated techniques or depend on pre-existing lyrics (not 100% original generation).
- We applied these techniques to hip-hop lyric generations and compared results between LSTM and Transformer models in this project.

Methods
- Each rapper’s lyric style is very distinguishable, meaning that the generated lyrics should follow a single style.
- As such, we chose to train separate models on lyrics of two artists with very distinguishable lyrics, Eminem and Kanye West.
- Data for the models were retrieved from Genius.com’s lyrics database.
- It included lyrics for every single song by Eminem and Kanye West respectively.
- Translated lyrics and transcripts of interviews were parsed from the dataset.
- Formatted line-by-line, to follow Hip-Hop’s “bar” structure.
- LSTM: Seq2Seq with 128 hidden states.
- Transformer: Seq2Seq with 512 hidden states.
- For any set of words given as input, our model predicts the following word based on the probability distribution returned by the forward-feed of the model.

Experiments
- We trained our models to take an input string to generate the following lyrics of the verse, which allows for:
  - Generating a lyric based on a starting line or topic that we desire.
  - Using BLEU score as a quantitative measure to evaluate the models.
  - Checking that the model is not completely copying an existing verse of the artist.
- The baseline was referenced using [GitHub](https://github.com/), which is a rap lyric generator that does line-by-line generation drawing from existing lyrics. [1]

Analysis
- We expected our Transformer model to outperform our LSTM model, because Transformers utilize attention scores to better predict the sequence.
- The quantitative metrics we used gave a slight edge to LSTM over Transformer.
- The baseline’s rhyme density is very high because it “cheats” by drawing from existing lyrics instead of generating completely new lyrics.
- No automated rap lyric generation achieved rhyme density close to a real, human rapper (threshold at around 1).
- The existence of attention in Transformer model may have allowed grammatical and contextual coherence.
- One interesting find was that training on Kanye’s lyrics was quicker while training on Eminem’s lyrics was more arduous, mostly due to Eminem’s higher complexity of lyrics.

Future Work
- Limitations of our work:
  - Our rhyme density evaluator disregards unique rhymes which Eminem often utilizes.
  - Our quantitative evaluator does not evaluate grammatical or contextual coherence.
- Future work includes:
  - Augmenting generative model with rhyme models.
  - Evaluating the lyrics’ style-wise likeness to the rapper.
  - Hyperparameter tuning.
  - Using more human evaluators to judge lyric quality.

References

Transformer Eminem
- I can swallow a bottle of alcohol and I feel like godzilla hit a vault box
- I never thought you could use a phone to call your love
- To the door of your house, where you live
- I don’t understand how I’m going to do this
- I’m gonna go another song to me
- I can’t see the time, but I can
- I’m going to do this

LSTM Eminem
- I can swallow a bottle of alcohol and I feel like godzilla hit a vault box
- I never thought you could use a phone to call your love
- To the door of your house, where you live
- I don’t understand how I’m going to do this
- I’m gonna go another song to me
- I can’t see the time, but I can
- I’m going to do this

Transformer Kanye
- The last to be written, we get it right
- We say the last to be written, we get it right
- We say the last to be written, we get it right
- We say the last to be written, we get it right
- We say the last to be written, we get it right

LSTM Kanye
- The last to be written, we get it right
- We say the last to be written, we get it right
- We say the last to be written, we get it right
- We say the last to be written, we get it right
- We say the last to be written, we get it right

Transformer
- no one should have all that power on a magazine two days I’m out
- No look at’ ye hit the last spark to light no fire if we
- We’re the last to be written, we get it right
- We say the last to be written, we get it right
- We say the last to be written, we get it right

LSTM
- no one should have all that power on a magazine two days I’m out
- No look at’ ye hit the last spark to light no fire if we
- We’re the last to be written, we get it right
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