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  - Other academic papers use outdated techniques or depend on pre-existing lyrics (not 100% original generation)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.
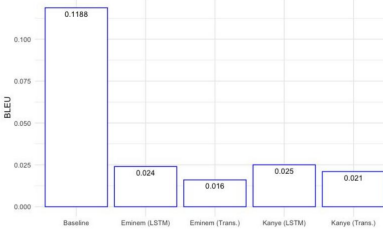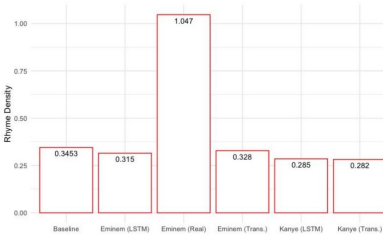
Methods

- **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 purged 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 https://deepbeat.org/, which is a rap lyric generator that does line-by-line generation drawing from existing lyrics. [1]

Results

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 use gave a **slight edge to LSTM over Transformer**
  - Rhyme density: how frequent
  - BLEU: How closely the generated text follows the original lyrics
- However, qualitative evaluation of the models show that **Transformer-based models are more likely to generate grammatically and contextually coherent bars**
- 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 generators 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 assiduous, 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

[1] Eric Malmi, Pyry Takala, Hannu Toivonen, Tapani Raiko, and Aristides Gionis. DopeLearning: A computational approach to rap lyrics generation. In *Association for Computing Machinery (ACM)*, 2015.

Transformer Eminem

i can swallow a bottle of alcohol and i'll feel like godzilla hit a valium

but there are back guess bein' weird's

i had to explain this shit i just put it to be a soldier

gonna go another song to me

where you and if you can see my dick and a blouse and the

you're flight so innovative was so won't keep winkin' and ran to the door

afford to the joe bring it lainie—uncle's i'm gonna can't be a stomach ammunition

and to the lawsuits soon as i'm lucky you

LSTM Eminem

i can swallow a bottle of alcohol and i'll feel like godzilla it seems

a lane and he's always looked off my love holds

you can love you baby boy i can say i like it sent me

so i went to profit ah

i'll probably like a girl like a phone call

this game her business that's as i like it's just another i have is

x i got that adrenaline momentum

and for no sense of it it's an addict

Transformer Kanye

no one man should have all that power on a magazine two days i'm out

hell look at 'ye hit the last sparkle to fight no you if we

he spit the last meal i'm the cooks it birdseye view i wanna live

the last trust me wanna wake up it go again gone loosen right now

can't because— diamonds face is strokin' gig am

look at all liars mmh mmh mmh mmh mmh mmh mmh mmh mmh mmh

we don't see the ice getting money should've changed the same time and this

you take all dem gwaan sofsofsofter dough new l and that's on chrome

LSTM Kanye

no one man should have all that power logo bundun ranch ronald mr early

now this is the after summer chain

hu the night star star price

whoa a little on and a hold broken or

half of it mmh mmh

chitown paranoid my only time

now ain't nothin' to talk rich

miss i that hits this might feel like