Echo: NLP Based Music Recommendation System to Mirror Your Mood

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USC Viterbi
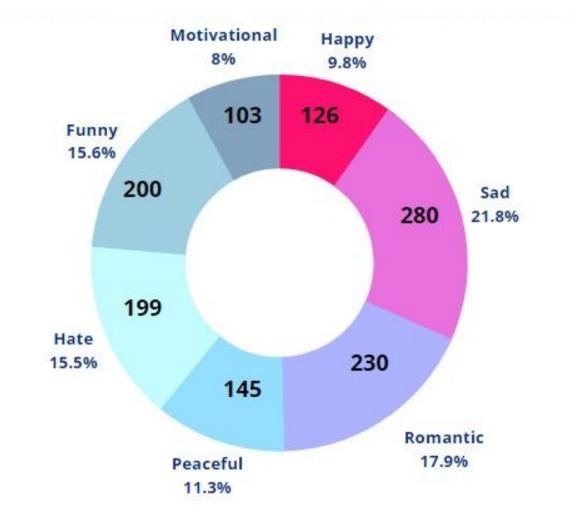School of Engineering

Motivation and Introduction

Good Music Recommendations can enhance user experience. For this, mood identification is extremely crucial. Understanding the song lyrics can be a good way of understanding the mood/genre. YT provides good recommendations but for listening to music people prefer music streaming apps. This research can serve as a good base for building a recommendation system in a music streaming app.

Dataset

GENIUS

- Dataset generated using various YouTube playlists and other song lists on basis of various moods.
- Lyrics of every song extracted using LyricsGenius
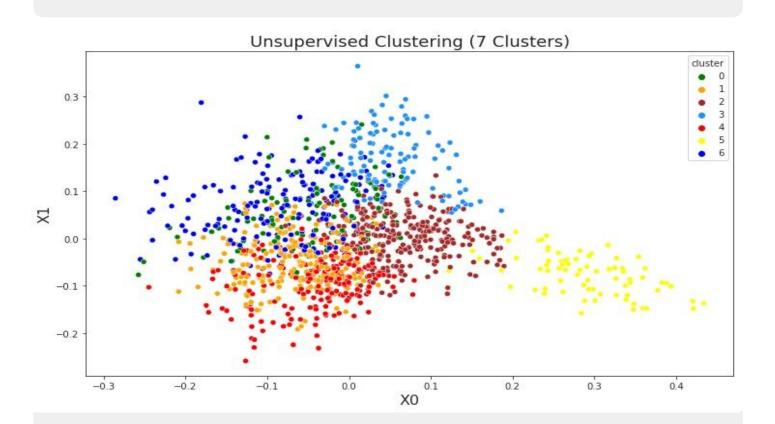- 7 Classes and Total of 1283 Songs.

Artist	Song	Mood	Lyrics
Pharrell Williams	Happy	Happy	It might seem crazy what I am 'bout to say Sunshine she's here, you can take a break ....
Gayle	ABCDEFU	Hate	F**k you and your mom and your sister and your job And your broke-ass car and that shit you call art ....
Ed sheeran	Perfect	Romantic	I found a love for me Oh, darling, just dive right in and follow my lead ....
....	....	....	....

Class Distributions

Motivational 8% — 103
Happy 9.8% — 126
Sad 21.8% — 280
Romantic 17.9% — 230
Peaceful 11.3% — 145
Hate 15.5% — 199
Funny 15.6% — 200
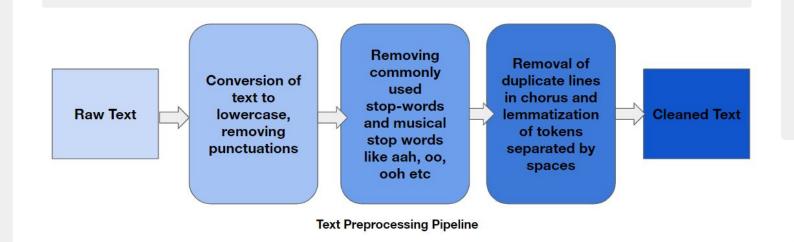
Novel Contributions

- Used various models and RoBERTa yielded the highest accuracy.
- Created a new dataset.
- Probabilistic Output for Multi-class Classification.
- Pre-calculated probability vectors for all the songs in the Database.

Unsupervised Clustering (7 Clusters)

Word Cloud of 4 Classes

Lyrics Preprocessing

Raw Text → Conversion of text to lowercase, removing punctuations → Removing commonly used stop-words and musical stop words like aah, oo, ooh etc → Removal of duplicate lines in chorus and lemmatization of tokens separated by spaces → Cleaned Text

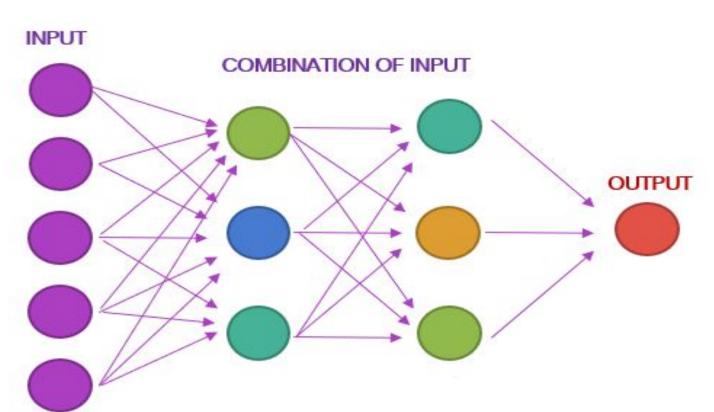**Text Preprocessing Pipeline**

Frequent Tokens

RoBERTa / BERT

- A robustly optimized method for pretraining NLP systems
- RoBERTa Improves on BERT
- RoBERTa, which was implemented in PyTorch, modifies key hyperparameters in BERT, including removing BERT's next-sentence pretraining objective, and training with much larger mini-batches and learning rates.
- This allows RoBERTa to improve on the masked language modeling objective compared with BERT and leads to better downstream task performance.

Class Label

C | T_1 | T_2 | ... | T_N

RoBERTa / BERT

E_[CLS] | E_1 | E_2 | ... | E_N

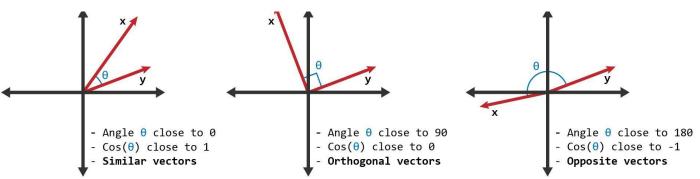[CLS] | Tok 1 | Tok 2 | ... | Tok N

Single Sentence

Feed forward Neural Network

- Used TFIDF Vectorizer.
- Optimizer: ADAM
- Loss Function: Binary Cross Entropy
- Activation Function: ReLU
- 7 Feed Forward Neural Networks. One for each class
- Output is a Probability Vector.
- Probability Vector is used for computing cosine similarity.

INPUT — COMBINATION OF INPUT — OUTPUT

Cosine Similarity

- Cosine similarity measures the similarity between two vectors of an inner product space.
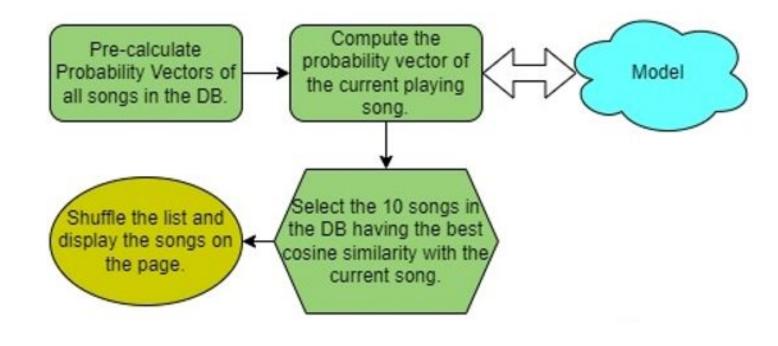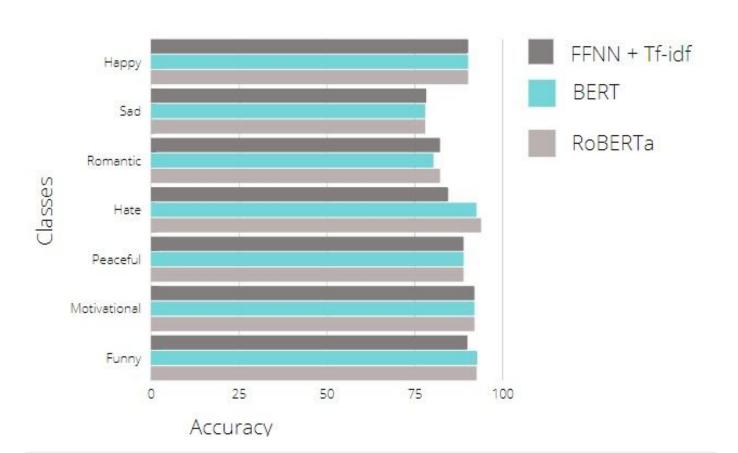- It is often used to measure document similarity in text analysis.

- Angle θ close to 0
- Cos(θ) close to 1
- Similar vectors

- Angle θ close to 90
- Cos(θ) close to 0
- Orthogonal vectors

- Angle θ close to 180
- Cos(θ) close to -1
- Opposite vectors

Probability Vectors

Song	Happy	Sad	Romantic	Hate	Peaceful	Motivational	Funny
Agamemnon	0.06763	0.2260	0.050166	0.081293	5.433927e-06	0.001263	0.25627
Stuck Like Glue	0.10415	0.2524	0.236007	0.288053	1.996922e-02	0.077675	0.02639
Hate to Feel	0.07575	0.1911	0.092943	0.421903	4.665852e-04	0.049611	0.26781
Don't Worry Be Happy	0.37665	0.2331	0.128397	0.178368	6.122708e-03	0.054017	0.15763
Calling The Targets	0.01455	0.0205	0.008305	0.105131	2.980919e-08	0.000636	0.86082
...	...	...	...	...	...	...	...

Recommendation System

- Recommendations are obtained using Cosine Similarity.
- 10 Songs Recommended Based on Current Song
- These recommendations aim to mirror the user's mood which is identified based on the current playing song.

Pre-calculate Probability Vectors of all songs in the DB. → Compute the probability vector of the current playing song. ↔ Model → Select the 10 songs in the DB having the best cosine similarity with the current song. → Shuffle the list and display the songs on the page.

Results and Fine Tuning

Legend: FFNN + Tf-idf, BERT, RoBERTa

Classes: Happy, Sad, Romantic, Hate, Peaceful, Motivational, Funny — Accuracy (0 to 100)

Fine Tuning The Model

1. Countering the Problem of Overfitting
   - Early Stopping
   - L2 Regularization

2. Hyperparameters Tuned
   - Number of layers, Neurons, Learning Rate

3. Convergence of Loss Function
   - Weight Decay
   - Tracking No. of Epochs
   - Specifying Max Sequence Length