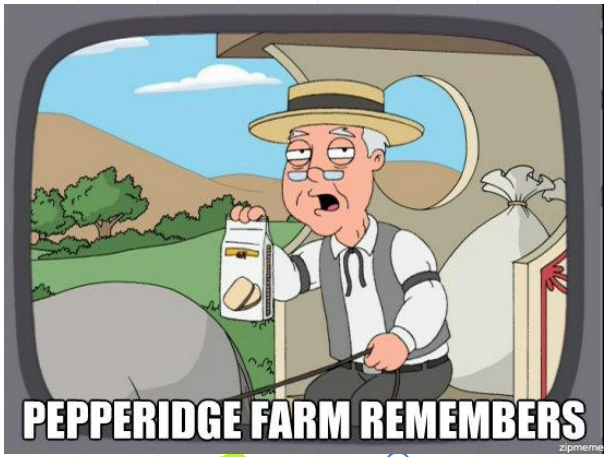
HeatReplay

By Sabbir Ahmed

INTRODUCTION

Remember when songs used to have meanings?



QUESTION

Can the lyrical content of a song determine if it will chart on Billboard?

HEAT REPLAY

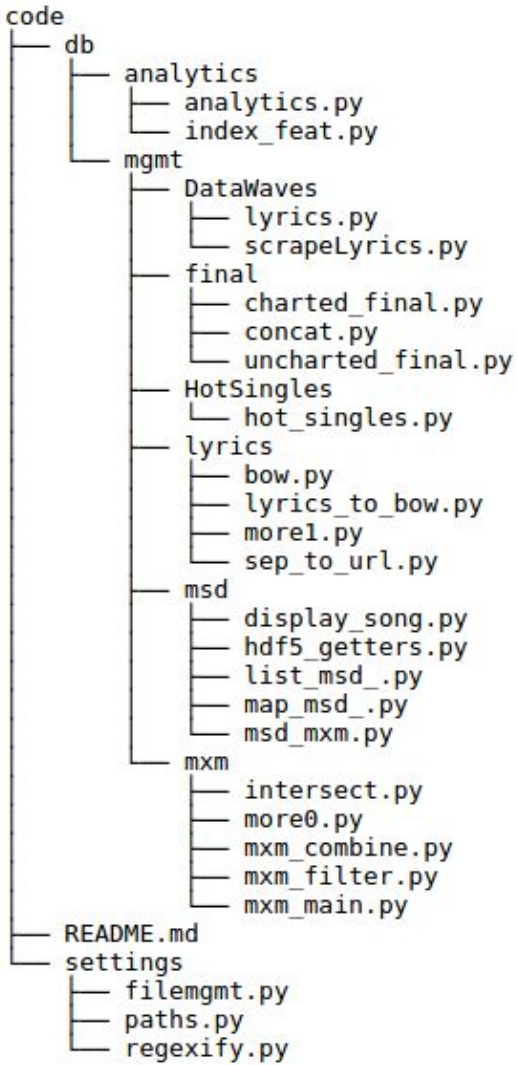
DATA

- **Billboard Year-End Charts**
  - A cumulative measure of a single or album's performance in the United States
  - Yielded 100 songs a year starting on 1961

- Hot Singles, a script that scrapes all the song titles and categorized them by year
    - Complied: 4647 charted songs
    - BUT:
        - |1961 - 2010| * 100 songs a year = 4900 songs, right?

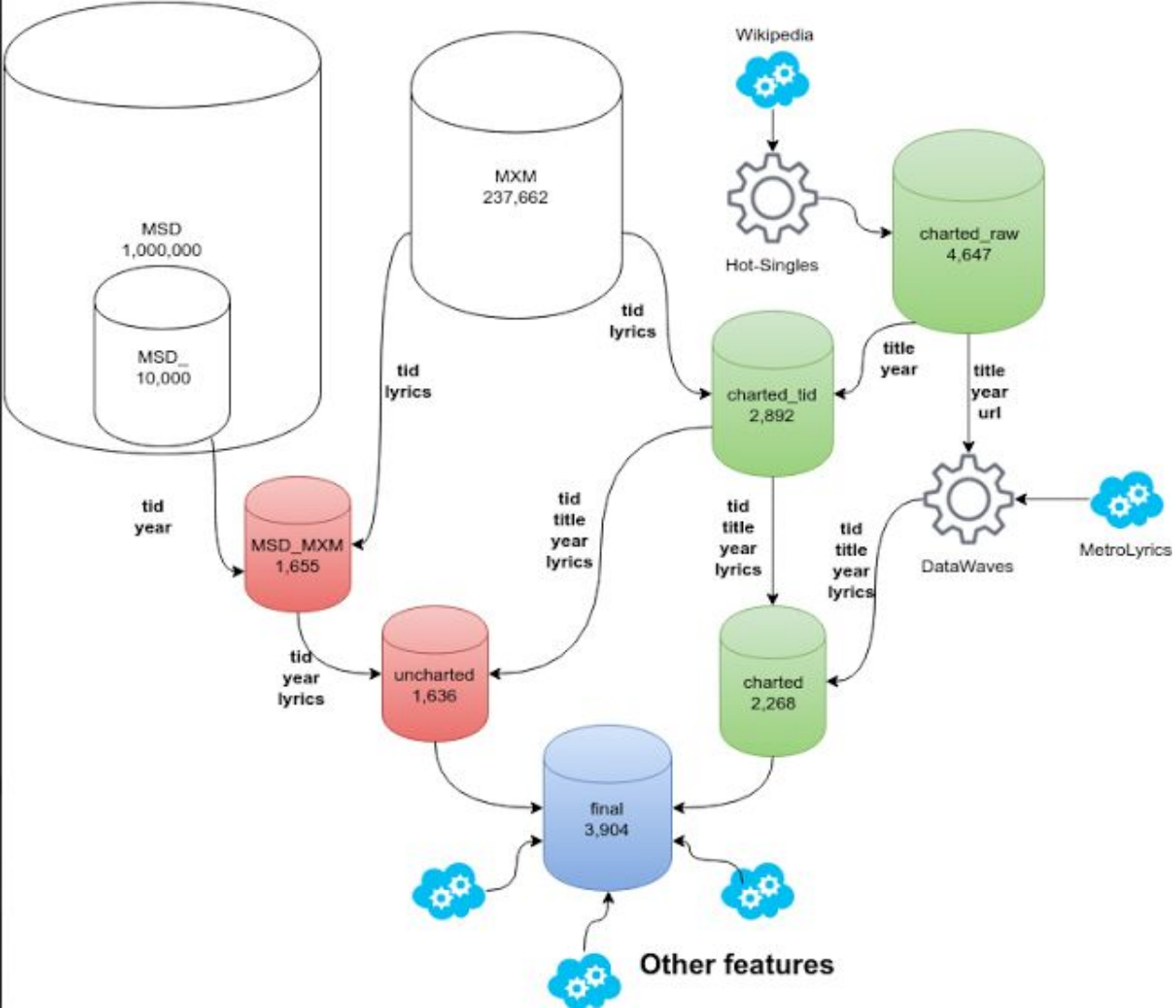
DATA (CONT.)
DATASETS/ DATA MINING

- The lyrics were obtained in 2 different ways:
  - musiXmatch dataset: official lyrics collection of Columbia University's Million Song Dataset
  - DataWaves: a mini-API to scrape lyrics from MetroLyrics



DATA (CONT.)

Directory tree of scripts



DATA (CONT.)

DATABASE DIAGRAM*

*DIAGRAM NOT TO SCALE

DATA (CONT.)

FINAL DATA

3904
SONGS

58% : **42%**
CHARTED : **UNCHARTED**

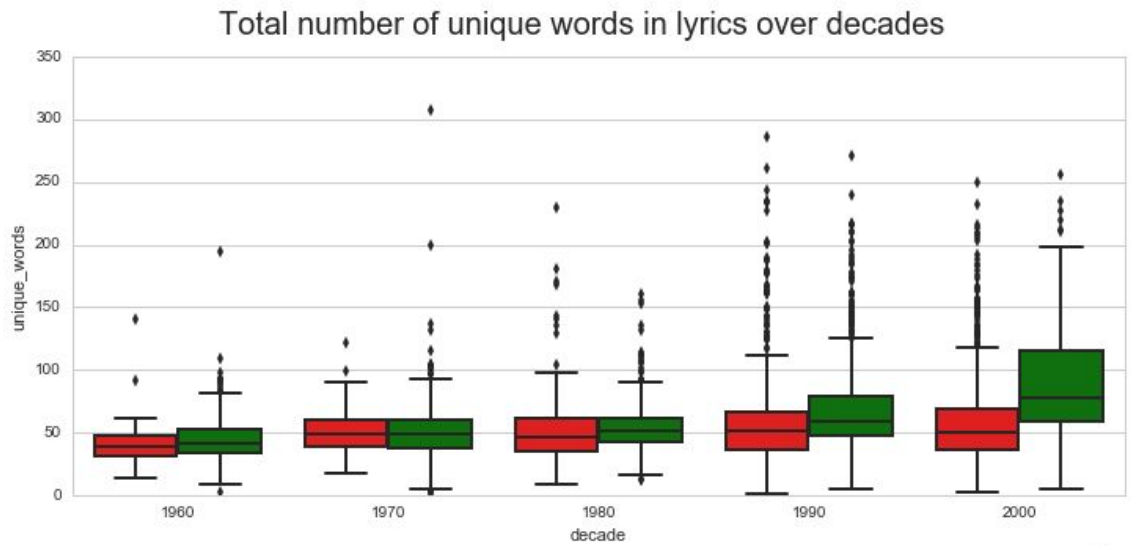
DATA (CONT.)
FEATURE ENGINEERING

- The bag-of-words version of lyrics:
  - stripped out the concept of context
  - contained a substantial amount of stopwords
  - words were stemmed
  - only mapped the top 5000 words that appeared in all the documents

- Sentiment analysis:
  - SentimentIntensityAnalyzer, from NLTK VADER Sentiment Analysis

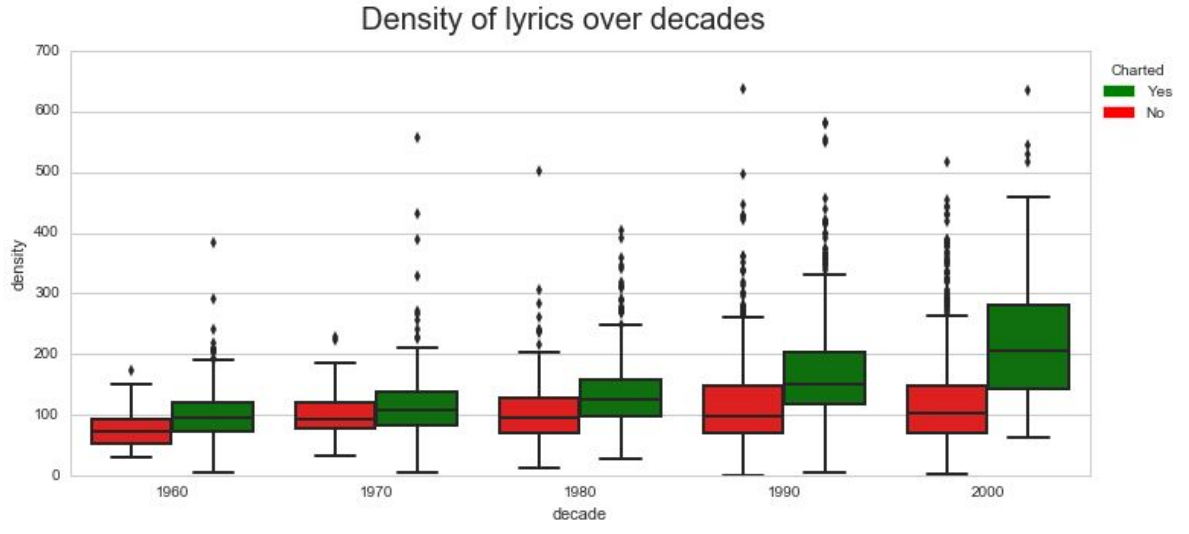
DATA (CONT.)
FEATURE ENGINEERING

- Reading Scores:
  - Flesch-Kincaid readability tests
  - Requires total number of sentences per document
- Parts of speech tagging:
  - Total number of verbs, nouns, and adjectives
- Profanity

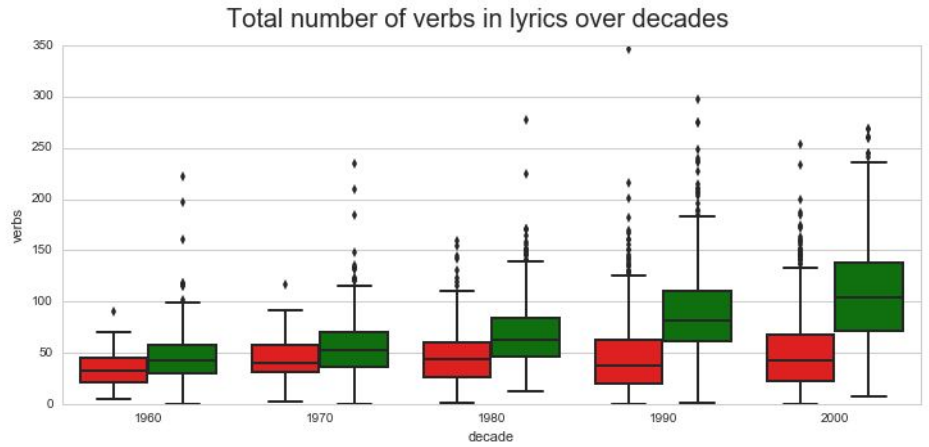


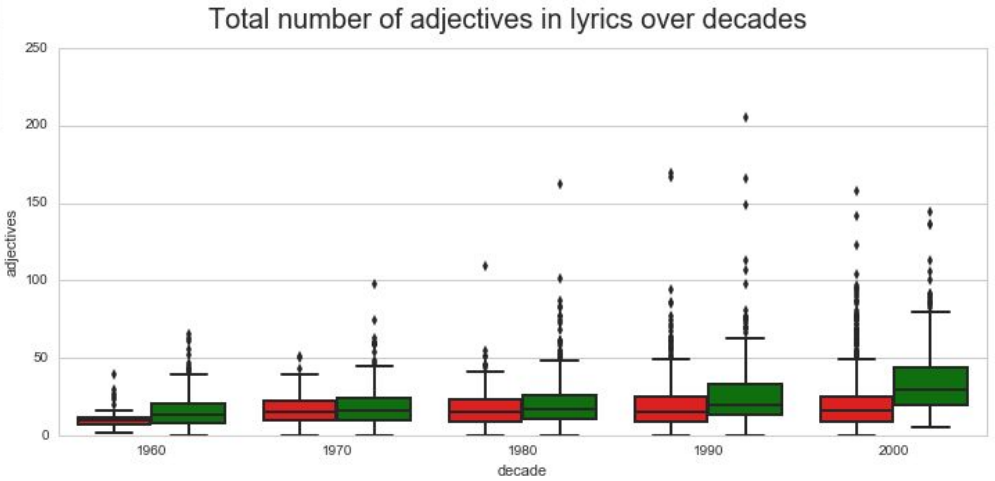
DATA (CONT.)

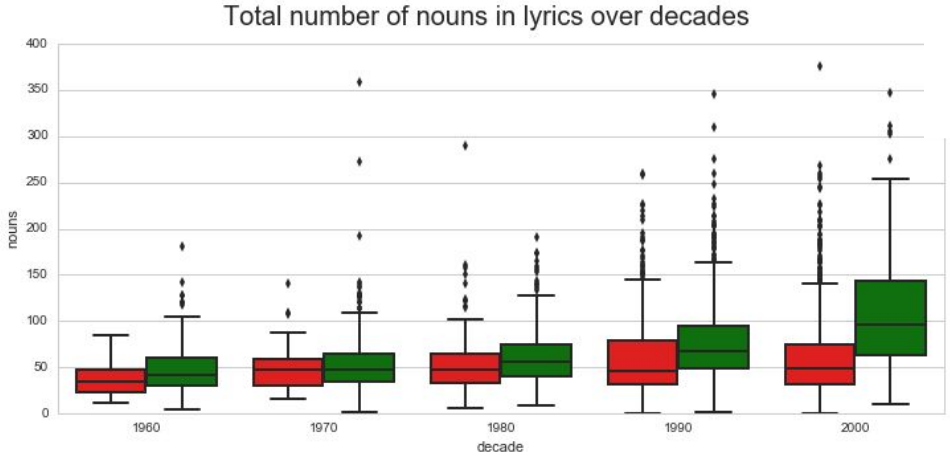
FEATURE ENGINEERING

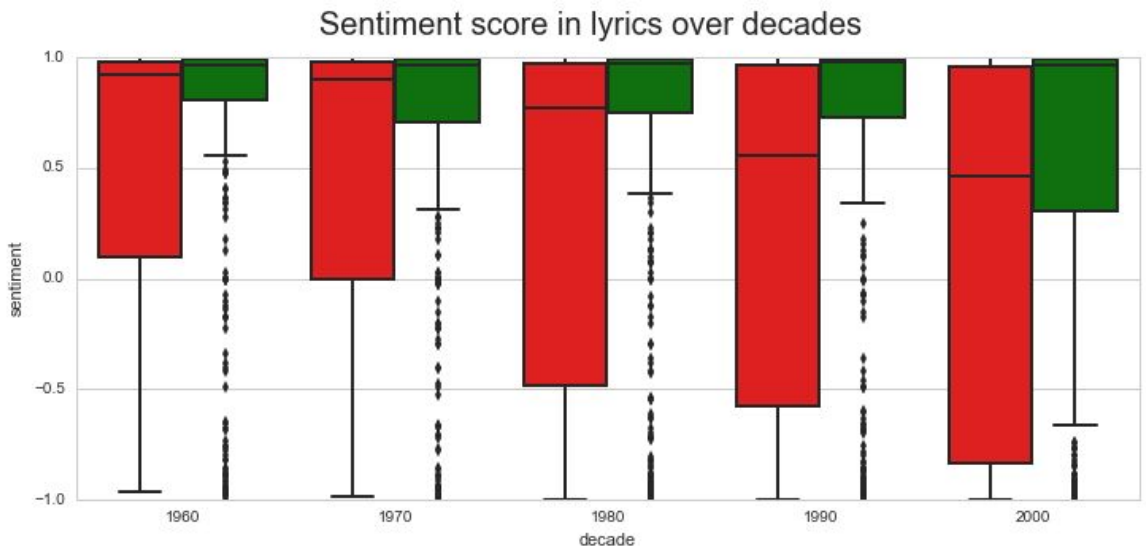


DATA (CONT.)
FEATURE ENGINEERING



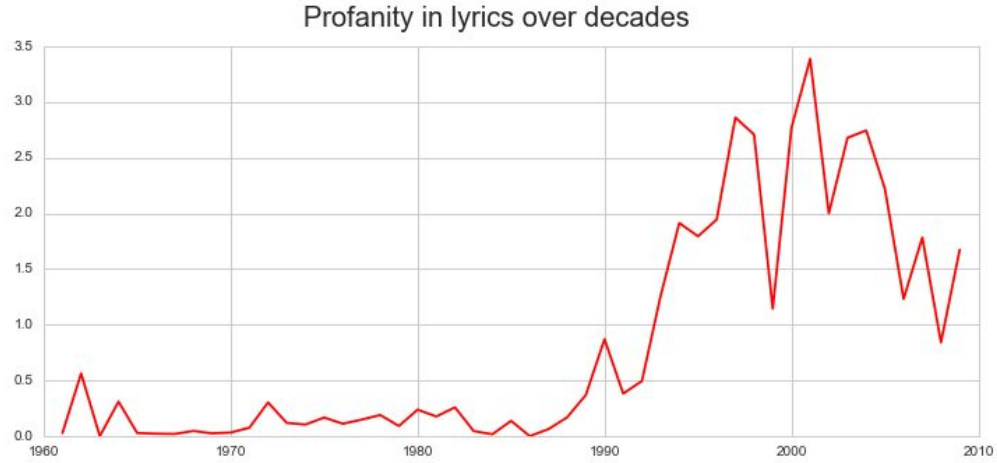


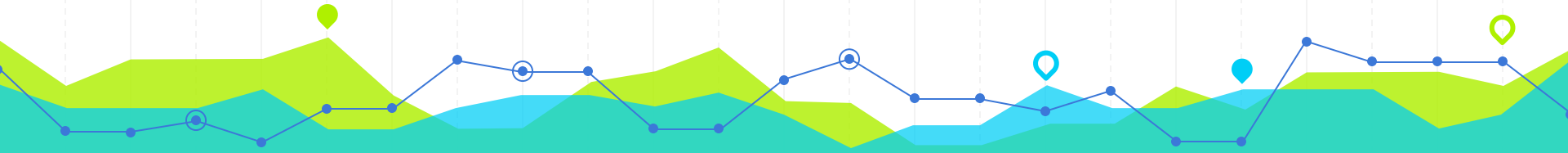




DATA (CONT.)

FEATURE ENGINEERING





THE DATA SCIENCE PART

..... FINALLY

```
model.gridSearch()
```

```
Grid searching for best parameters:

K Neighbors
Best Params: {'n_neighbors': 16}
Accuracy of current clf: 0.768
Accuracy using best param: 0.793

Logistic Regression
Best Params: {'C': 256}
Accuracy of current clf: 0.728
Accuracy using best param: 0.730

Random Forest
Best Params: {'n_estimators': 1024}
Accuracy of current clf: 0.779
Accuracy using best param: 0.811

Decision Tree
Best Params: {'max_depth': 4}
Accuracy of current clf: 0.718
Accuracy using best param: 0.788
```

MACHINE LEARNING
WITH TIME

```
model.getBestParams('best_param_time.txt')
```

```
Best clf is Random Forest with {'n_estimators': 1024}
```

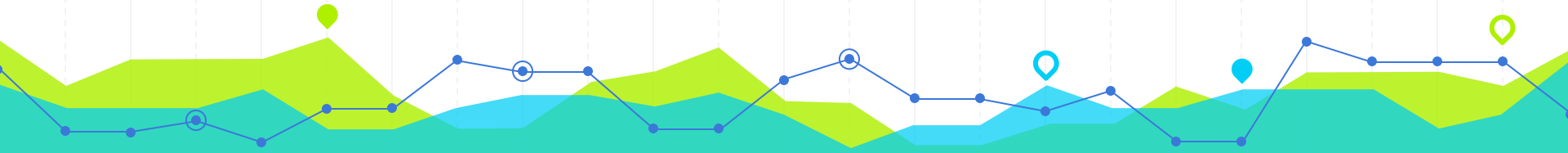
```
model.gridSearch()
```

```
Grid searching for best parameters:

K Neighbors
Best Params: {'n_neighbors': 64}
Accuracy of current clf: 0.664
Accuracy using best param: 0.691

Logistic Regression
Best Params: {'C': 0.03125}
Accuracy of current clf: 0.727
Accuracy using best param: 0.711

Random Forest
Best Params: {'n_estimators': 32}
Accuracy of current clf: 0.691
Accuracy using best param: 0.710

Decision Tree
Best Params: {'max_depth': 1}
Accuracy of current clf: 0.637
Accuracy using best param: 0.682
```

MACHINE LEARNING
WITHOUT TIME

```
model.getBestParams('best_param_no_time.txt')
```

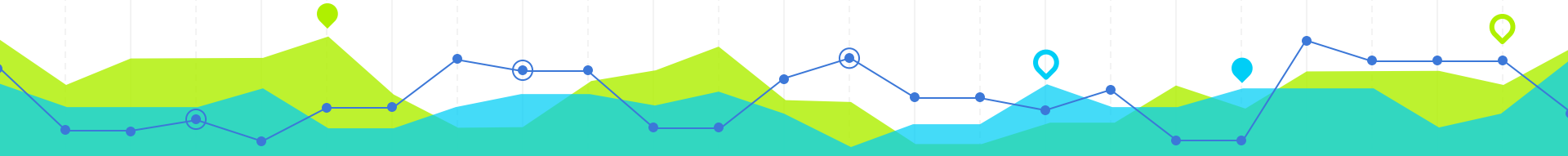
```
Best clf is Logistic Regression with {'C': 0.03125}
```



WHY TWO MODELS?

MODEL
WITHOUT TIME

```
LogisticRegression(C=0.03125, class_weight=None, dual=False,
          fit_intercept=True, intercept_scaling=1, max_iter=100,
          multi_class='ovr', n_jobs=1, penalty='l2', random_state=None,
          solver='liblinear', tol=0.0001, verbose=0, warm_start=False)
```



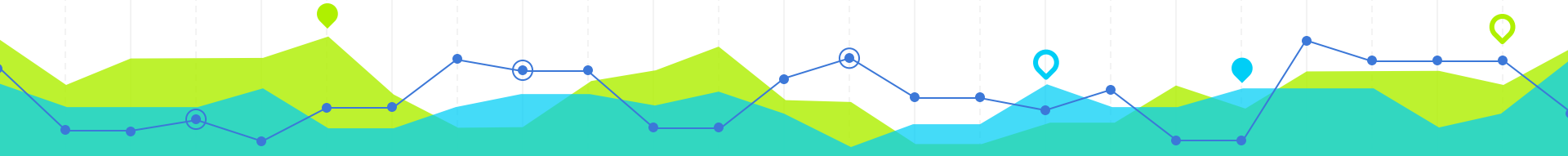
MODEL
WITHOUT TIME

72.7%

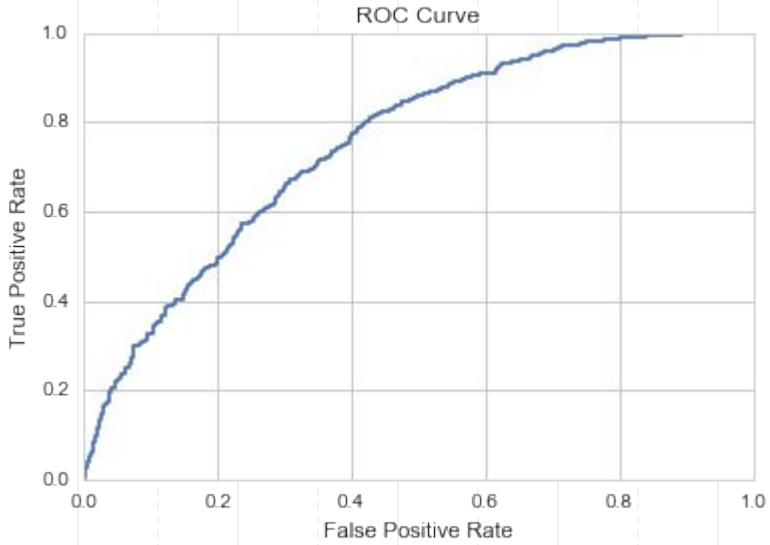
Training Set

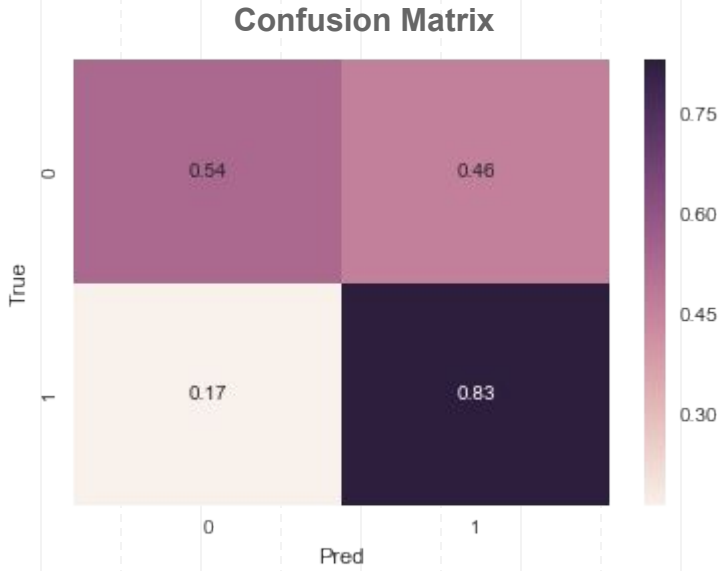
71.0%

Test Set



MODEL
WITHOUT TIME





MODEL
WITH TIME

```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
            max_depth=8, max_features='auto', max_leaf_nodes=None,
            min_samples_leaf=2, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators=256, n_jobs=1,
            oob_score=False, random_state=None, verbose=0,
            warm_start=False)
```

MODEL
WITH TIME

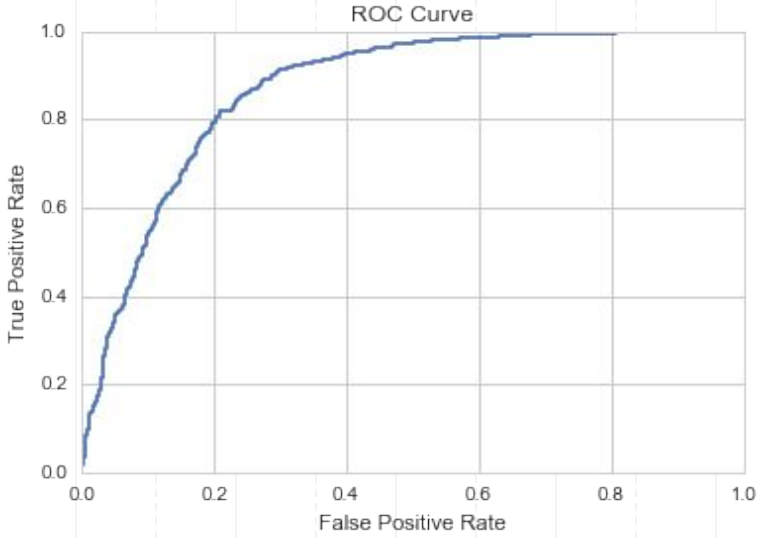
88.9%

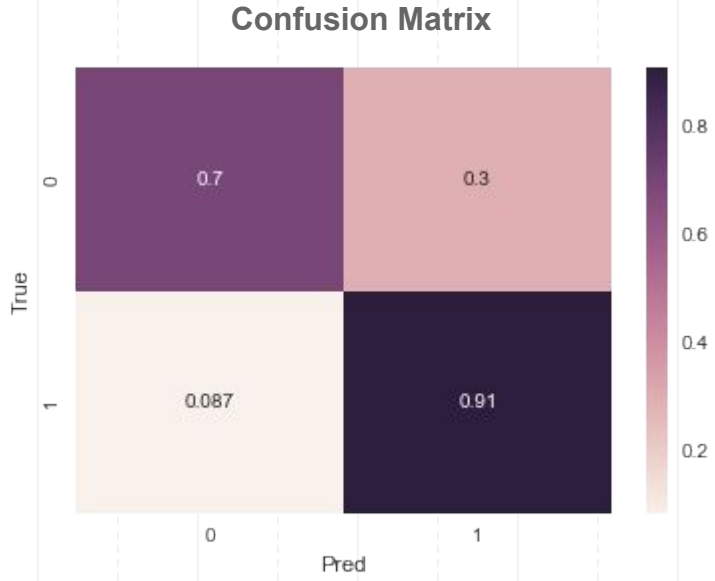
Training Set

82.3%

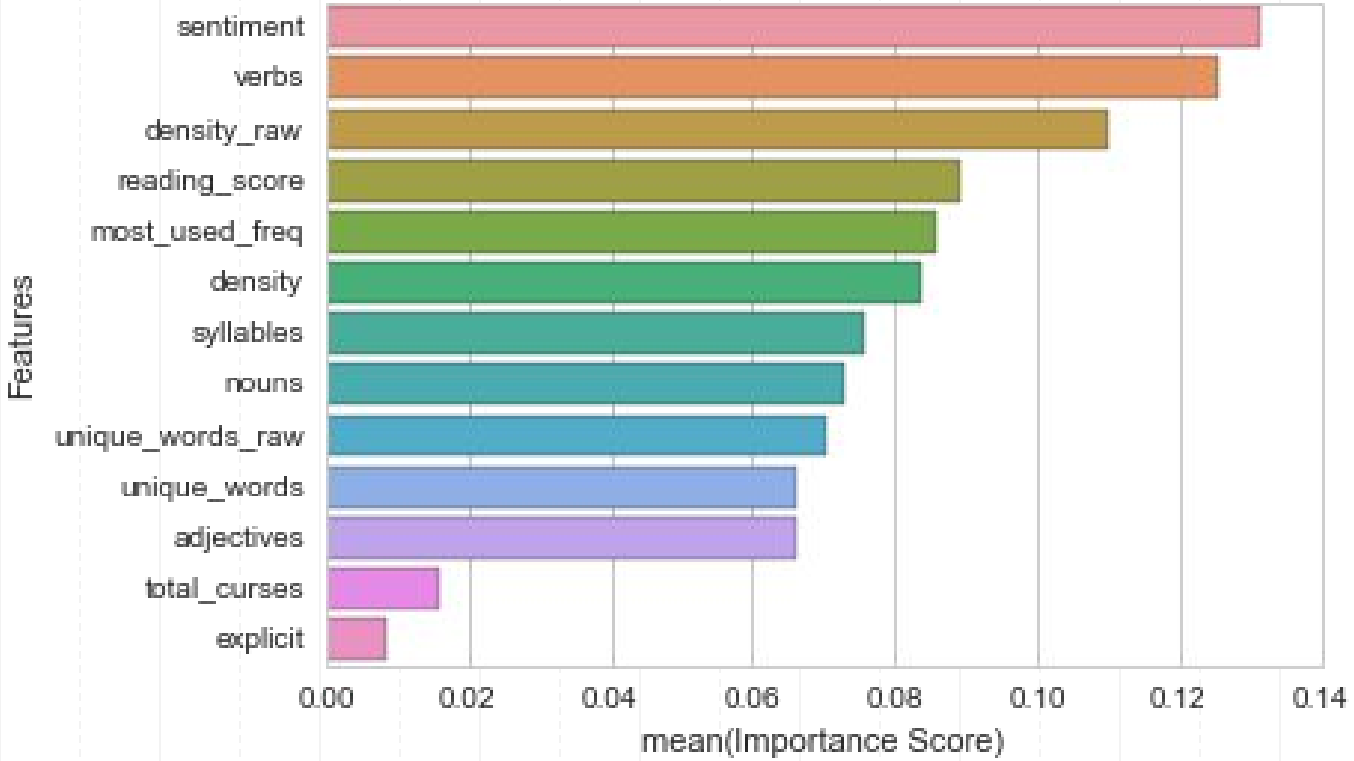
Test Set

MODEL
WITH TIME

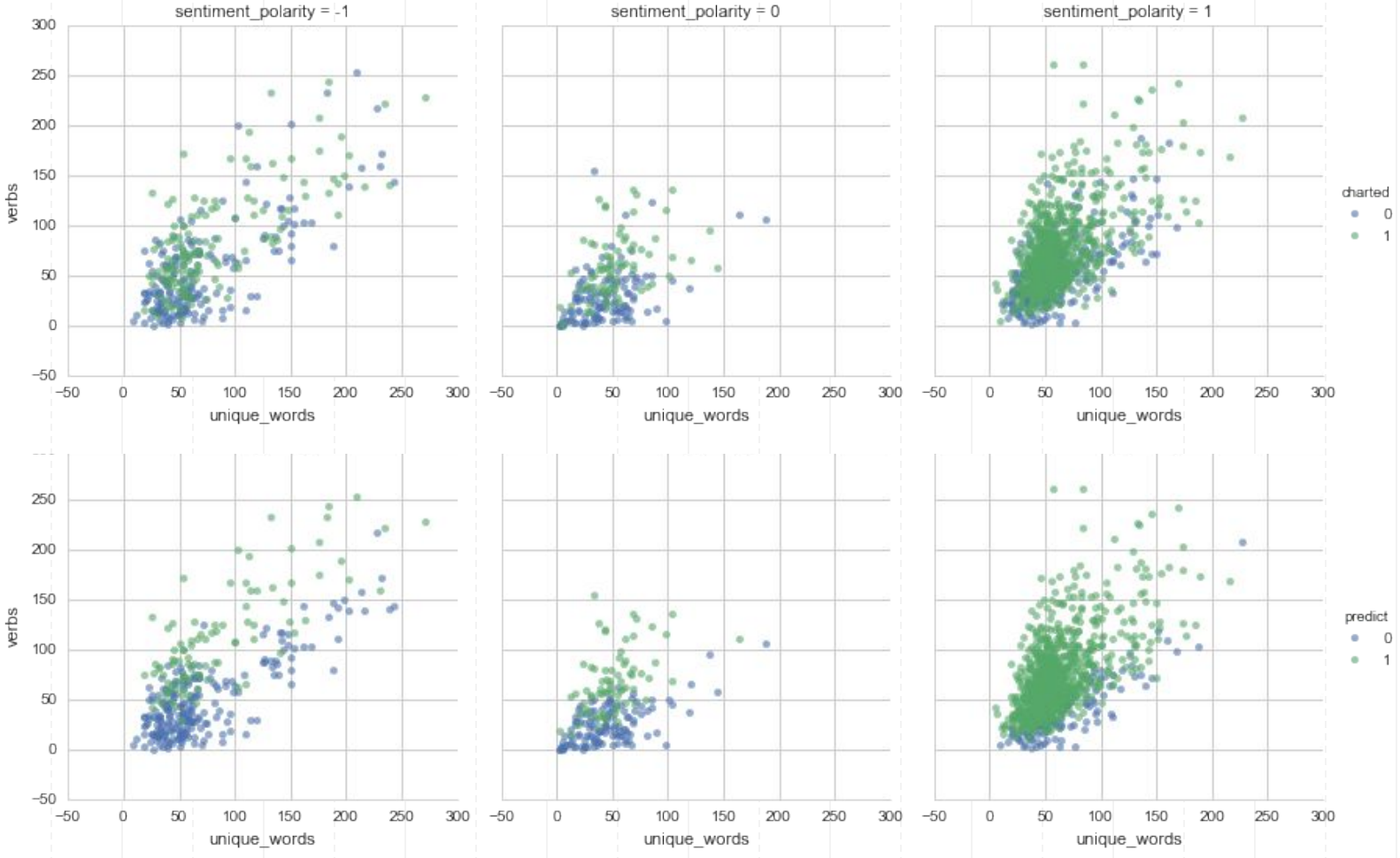




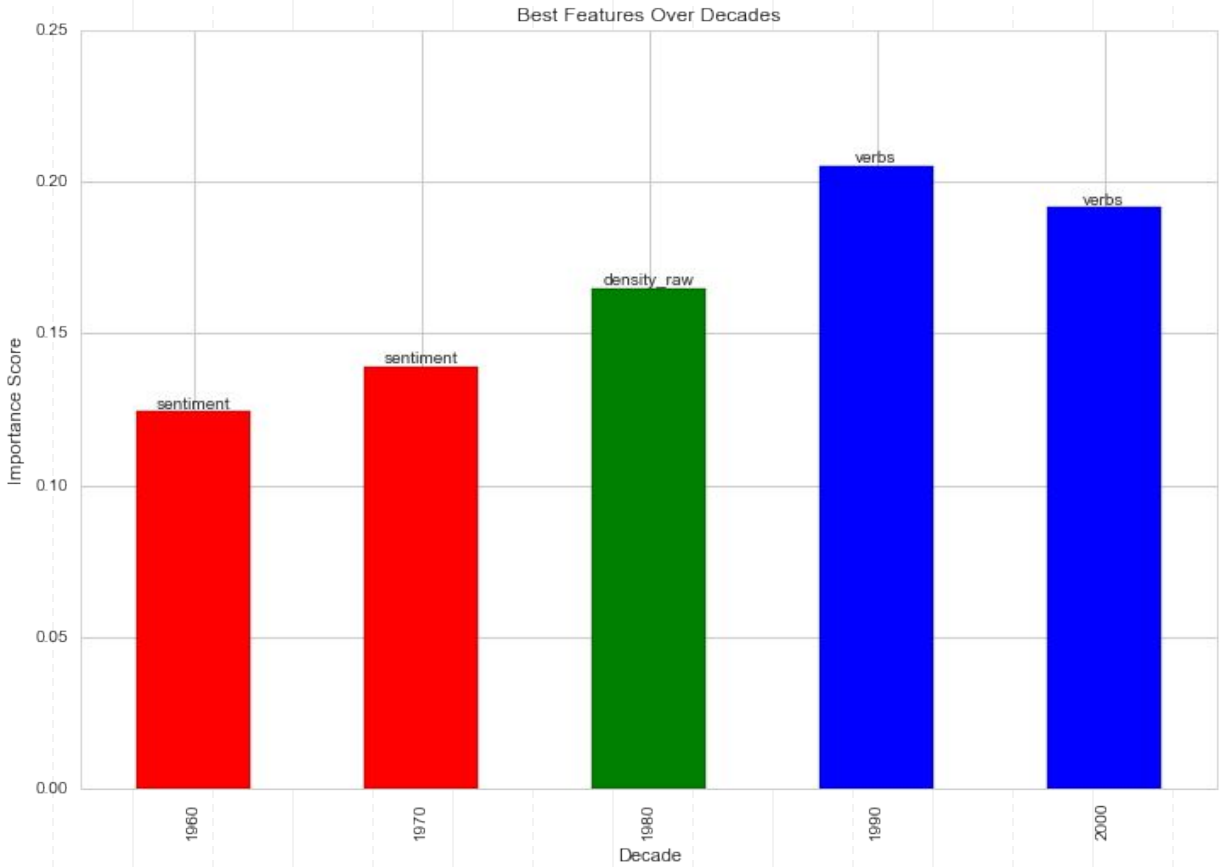
MODEL
FEATURE IMPORTANCE



FINDINGS

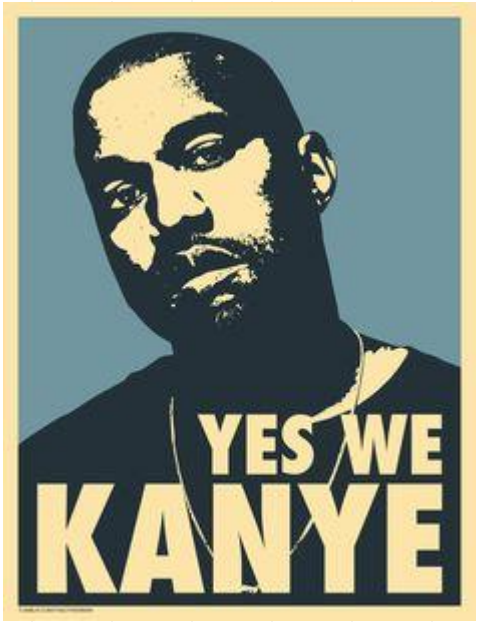

sentiment_polarity = -1
sentiment_polarity = 0
sentiment_polarity = 1
verbs
unique_words
charted
0
1
predict
0
1

FINDINGS


Best Features Over Decades
Importance Score
0.25
0.20
0.15
0.10
0.05
0.00
sentiment
sentiment
density_raw
verbs
verbs
1960
1970
1980
1990
2000
Decade

NEXT STEPS

- Compile my own Million Song Dataset
- Improve my reading score function
- Plea to gain access to MetroLyrics's API



- Sell to Kanye West $$$

THANKS!

Any questions?

You can find me at

sabbirsphere.com / sabbir0ahmed0@gmail.com

REFERENCES

- NLTK: Bird, Steven, Edward Loper and Ewan Klein (2009).
  Natural Language Processing with Python. O'Reilly Media Inc.
- musiXmatch dataset, the official lyrics collection for the Million Song Dataset,
  available at: http://labrosa.ee.columbia.edu/millionsong/musixmatch
- Thierry Bertin-Mahieux, Daniel P.W. Ellis, Brian Whitman, and Paul Lamere.
  The Million Song Dataset. In Proceedings of the 12th International Society
  for Music Information Retrieval Conference (ISMIR 2011), 2011.
- Scikit-learn: Machine Learning in Python, Pedregosa *et al.*, JMLR 12, pp. 2825-2830, 2011.
- And of course, MetroLyrics