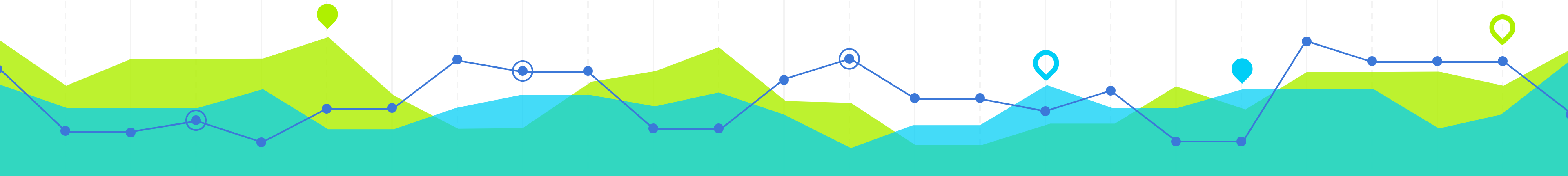


HeatReplay

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

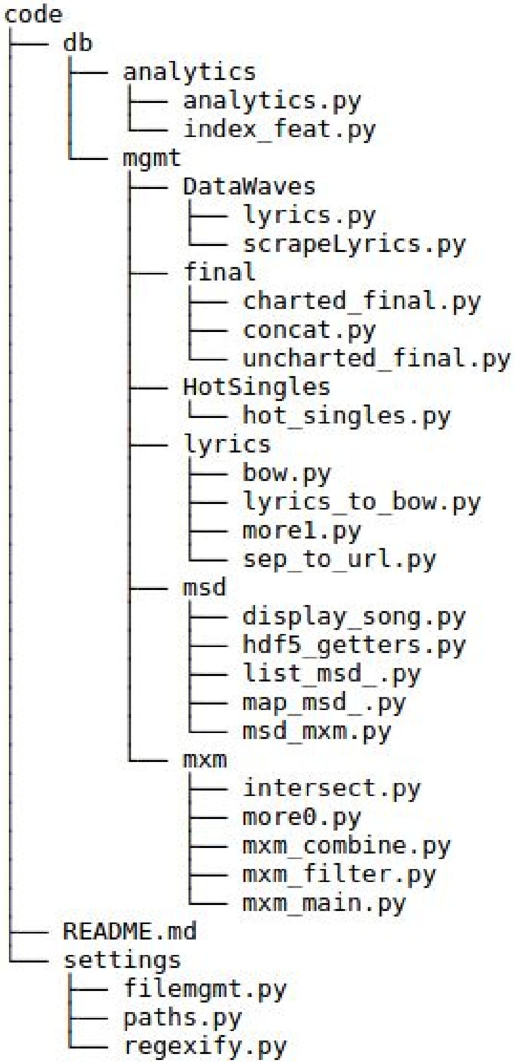
- **Billboard Year-End Charts**
  - A cumulative measure of a single or album's performance in the United States
  - Yielded 100 songs a year starting on 1961

- 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

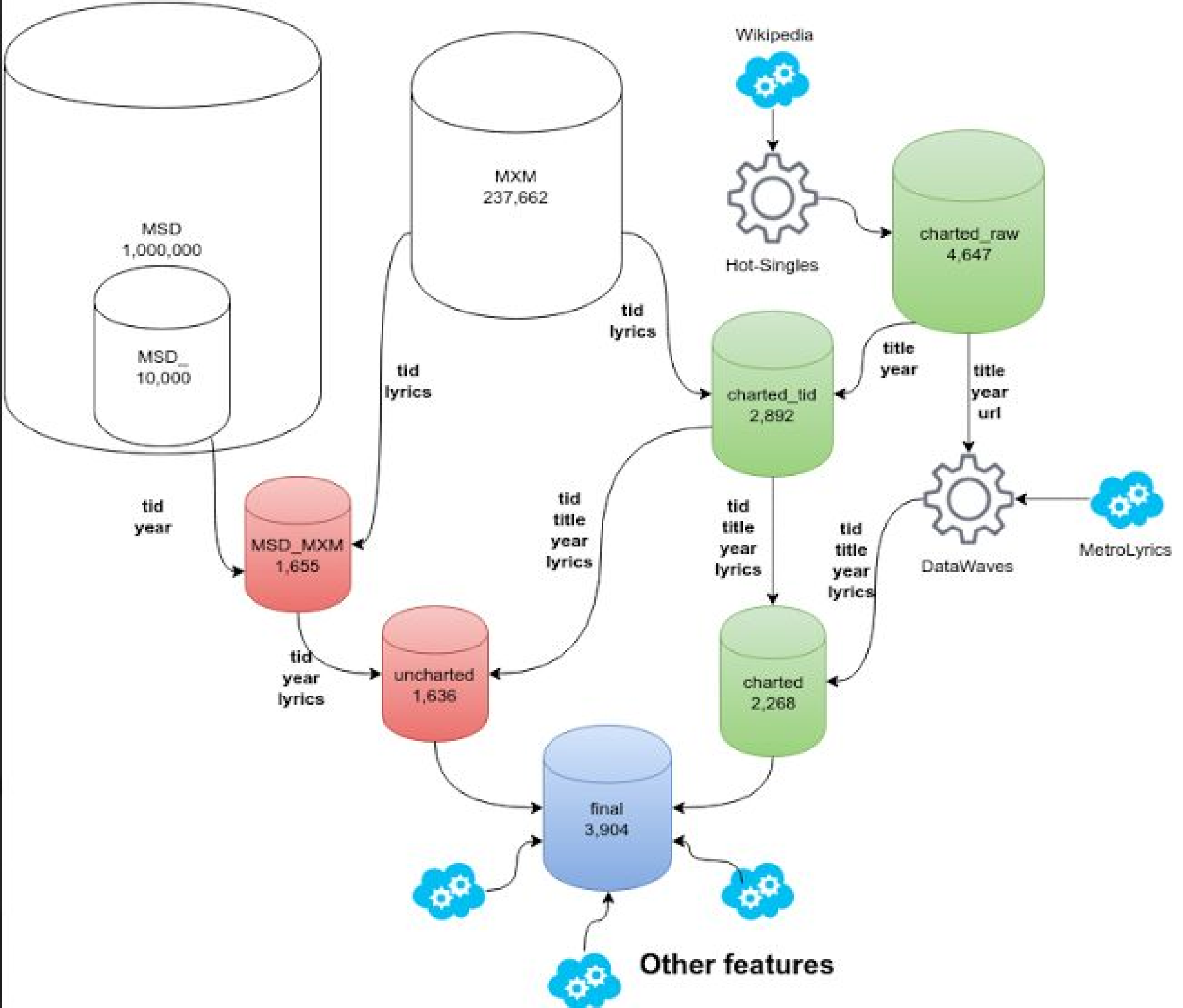
- The lyrics were obtained in 2 different ways:
  - musiXmatch dataset: official lyrics collection of Columbia University’s Million Song Dataset
  - DataWaves: a mini-API to scrape lyrics from MetroLyrics



```
code
├── db
│   ├── analytics
│   │   ├── analytics.py
│   │   └── index_feat.py
│   └── mgmt
│       ├── DataWaves
│       │   ├── lyrics.py
│       │   └── scrapeLyrics.py
│       ├── final
│       │   ├── charted_final.py
│       │   ├── concat.py
│       │   └── uncharted_final.py
│       ├── HotSingles
│       │   └── hot_singles.py
│       ├── lyrics
│       │   ├── bow.py
│       │   ├── lyrics_to_bow.py
│       │   ├── more1.py
│       │   └── sep_to_url.py
│       ├── msd
│       │   ├── display_song.py
│       │   ├── hdf5_getters.py
│       │   ├── list_msd_.py
│       │   ├── map_msd_.py
│       │   └── msd_mxm.py
│       └── mxm
│           ├── intersect.py
│           ├── more0.py
│           ├── mxm_combine.py
│           ├── mxm_filter.py
│           └── mxm_main.py
├── README.md
└── settings
    ├── filemgmt.py
    ├── paths.py
    └── regexify.py
```

DATA (CONT.)

Directory tree of scripts



DATA (CONT.)

DATABASE DIAGRAM*

*DIAGRAM NOT TO SCALE

DATA (CONT.)

FINAL DATA

3904

SONGS

58%
CHARTED

:

42%
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

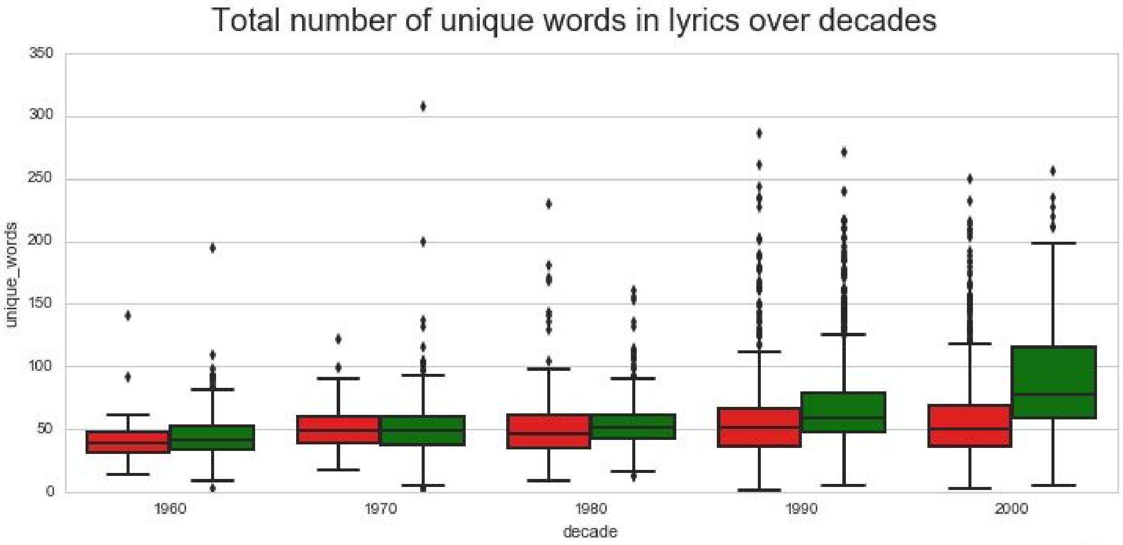
DATA (CONT.)

FEATURE ENGINEERING

- Reading Scores:
  - Flesch-Kincaid readability tests
  - Requires total number of sentences per document

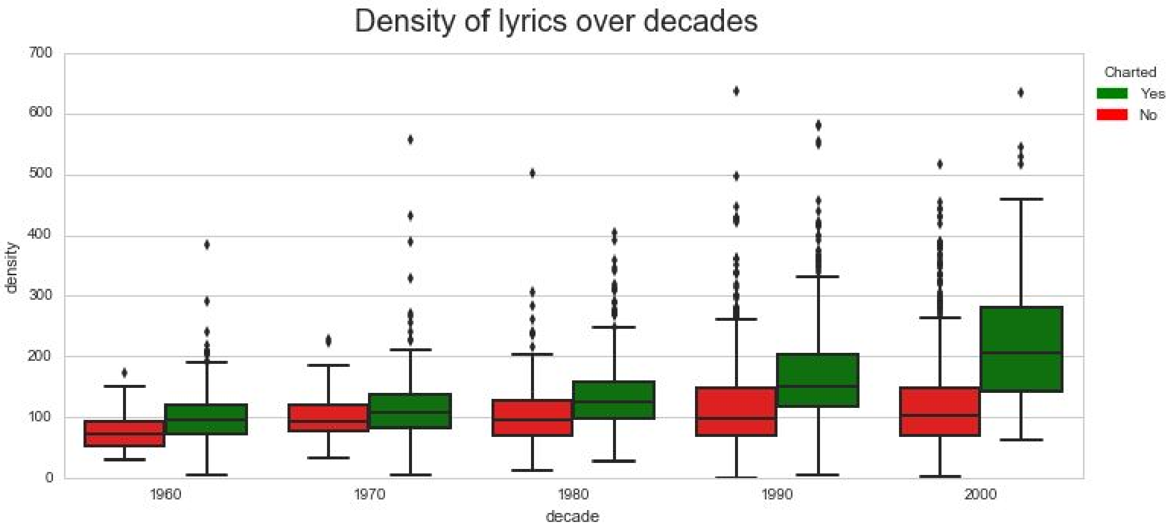
- Parts of speech tagging:
  - Total number of verbs, nouns, and adjectives

- Profanity



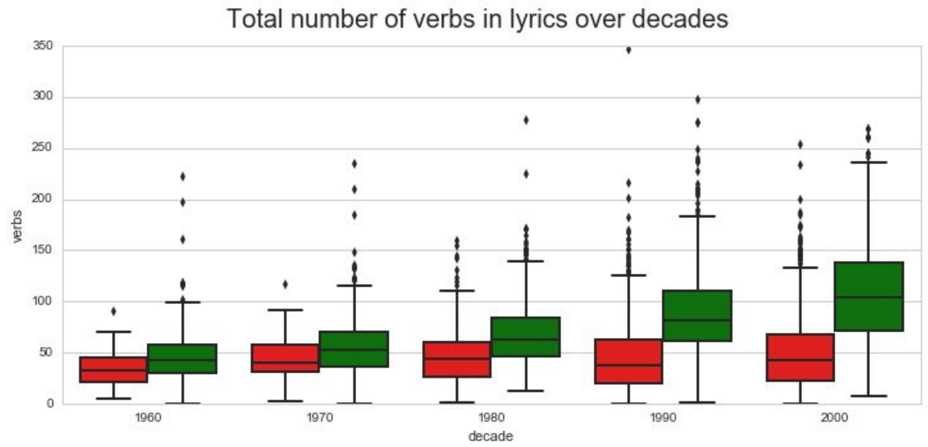
DATA (CONT.)

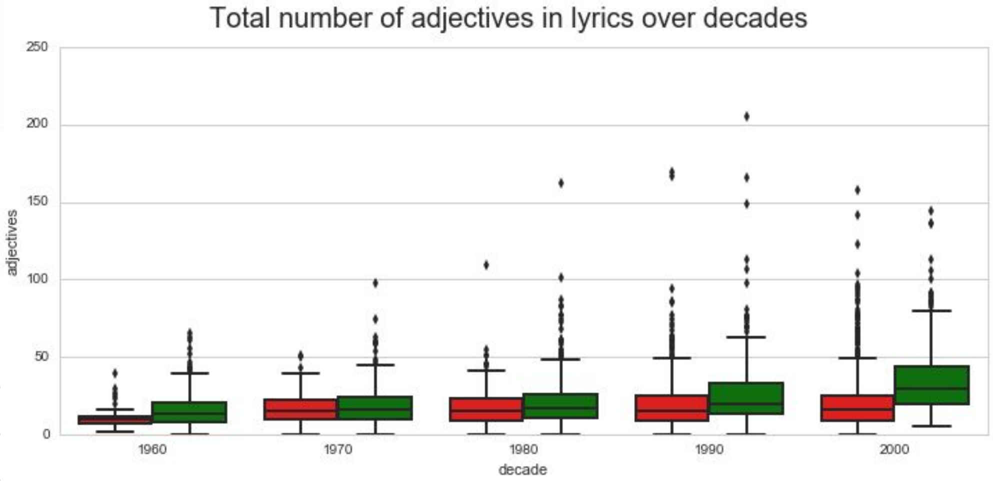
FEATURE ENGINEERING

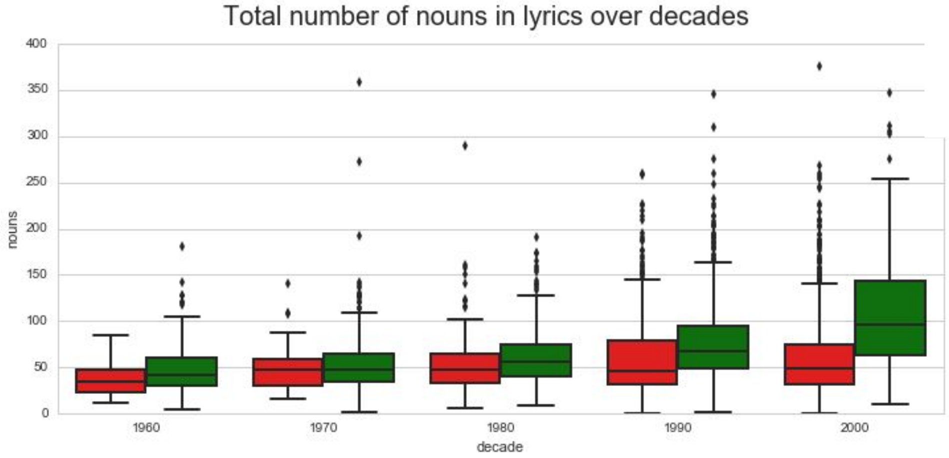


DATA (CONT.)

FEATURE ENGINEERING

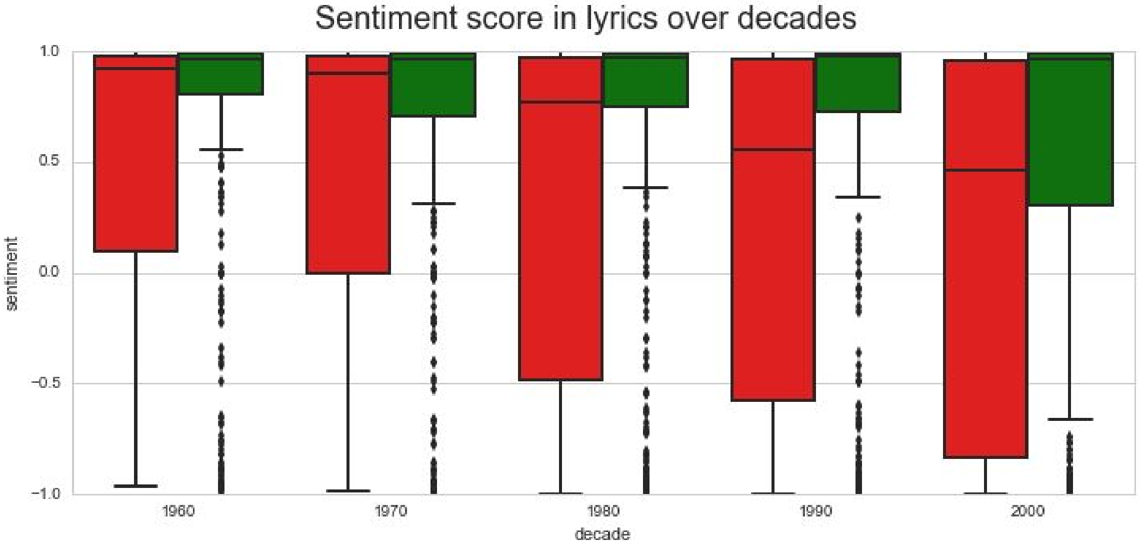


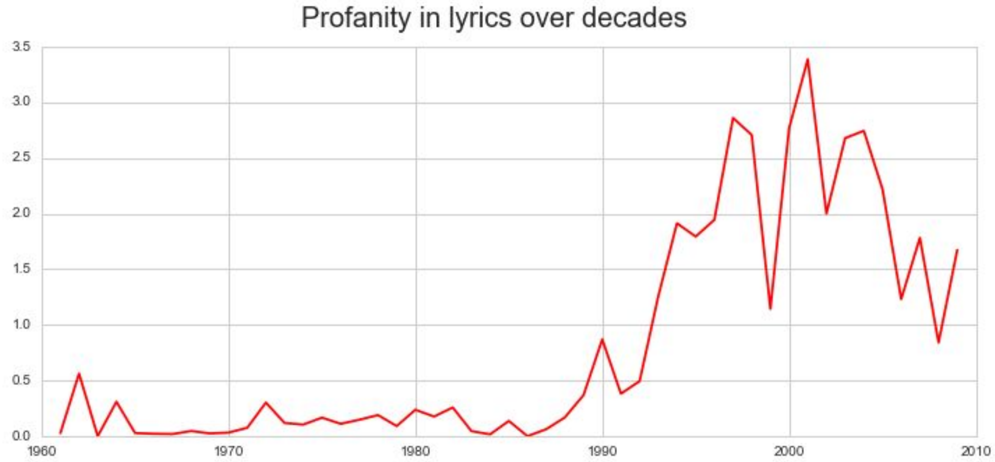


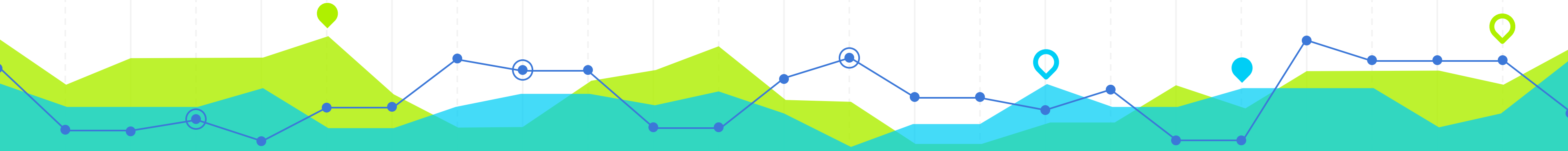


DATA (CONT.)

FEATURE ENGINEERING



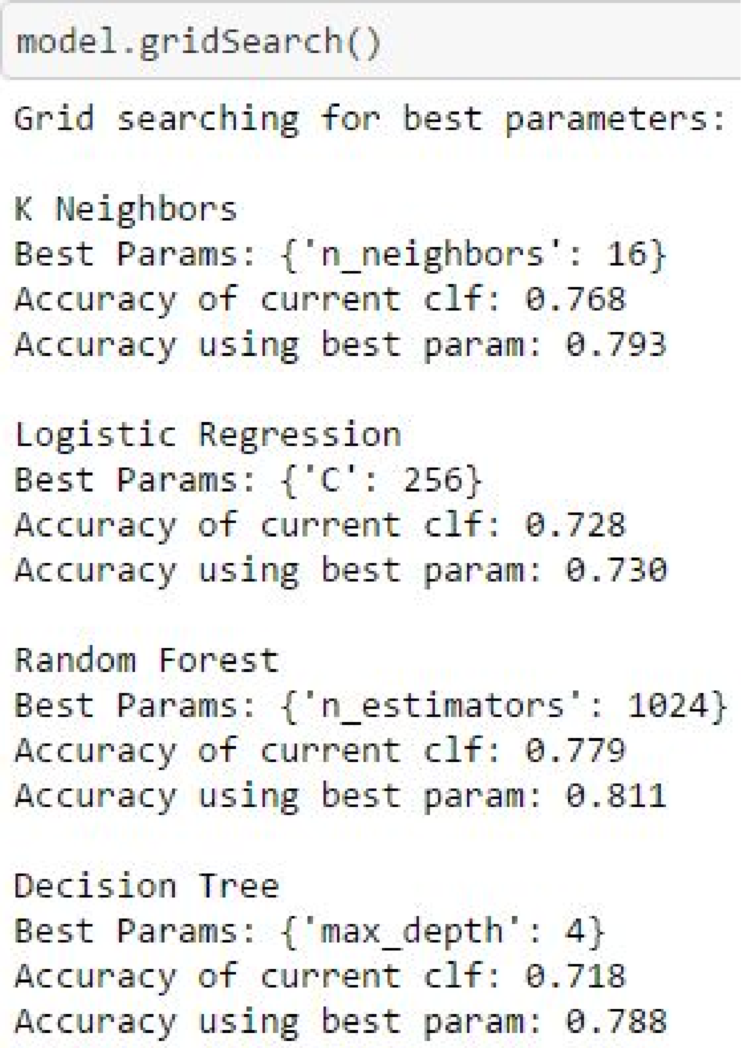




THE DATA SCIENCE PART

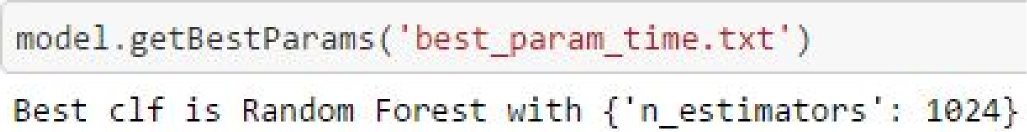
..... FINALLY

MACHINE LEARNING
WITH TIME



```
model.gridSearch()
```

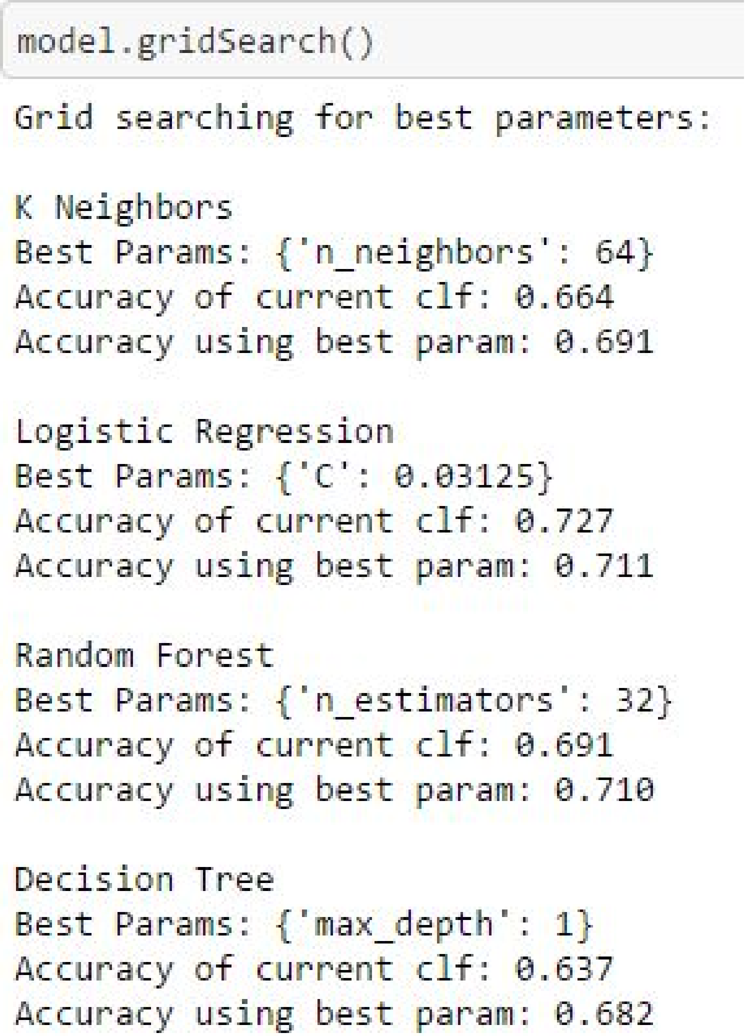
```
Grid searching for best parameters:

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
```



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

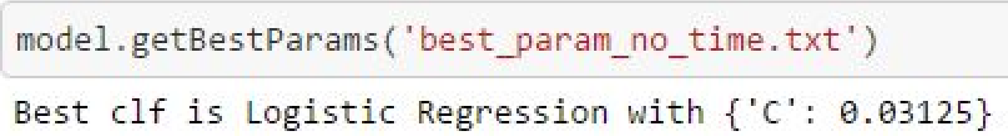
```
Best clf is Random Forest with {'n_estimators': 1024}
```

MACHINE LEARNING
WITHOUT TIME



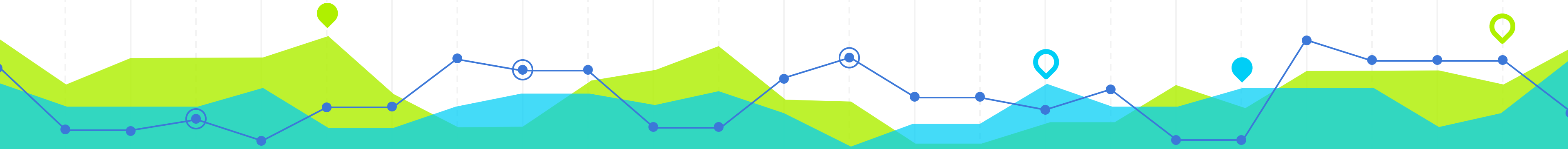
```
model.gridSearch()
```

```
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
```



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

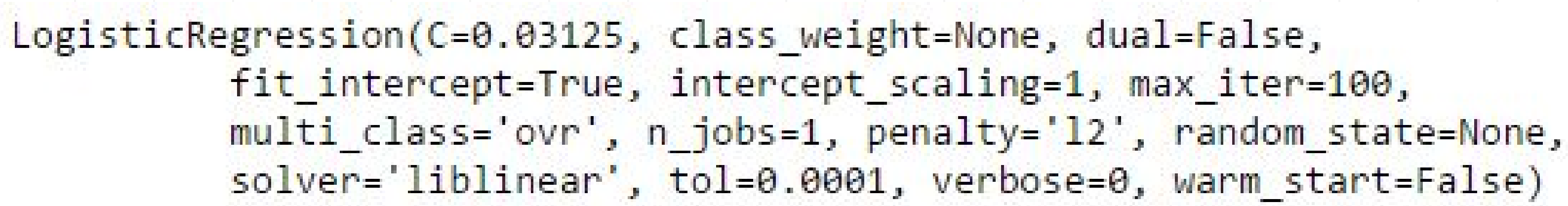
```
Best clf is Logistic Regression with {'C': 0.03125}
```



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

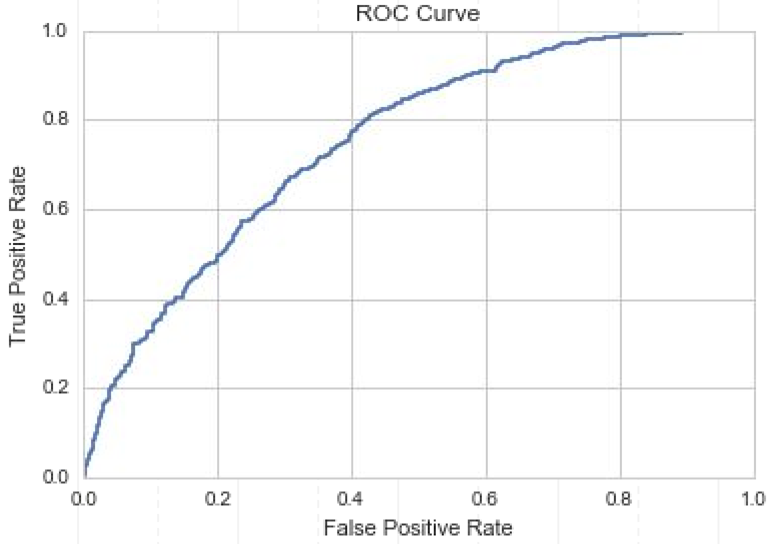
72.7%

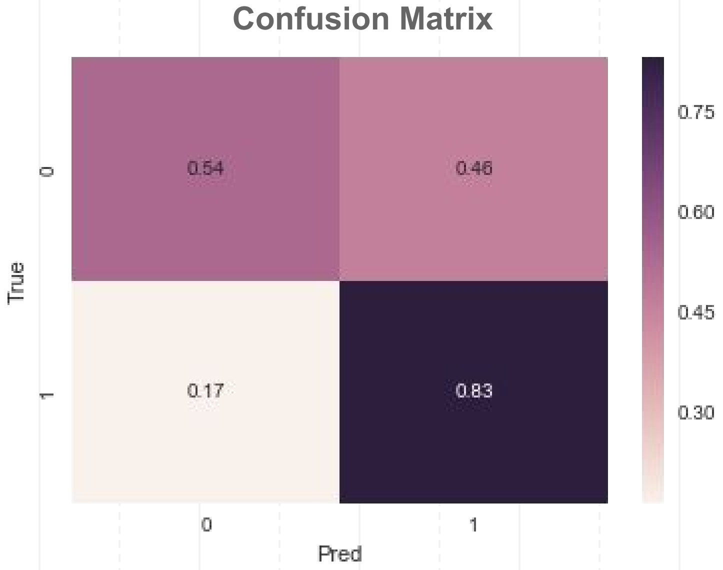
Training Set

71.0%

Test Set

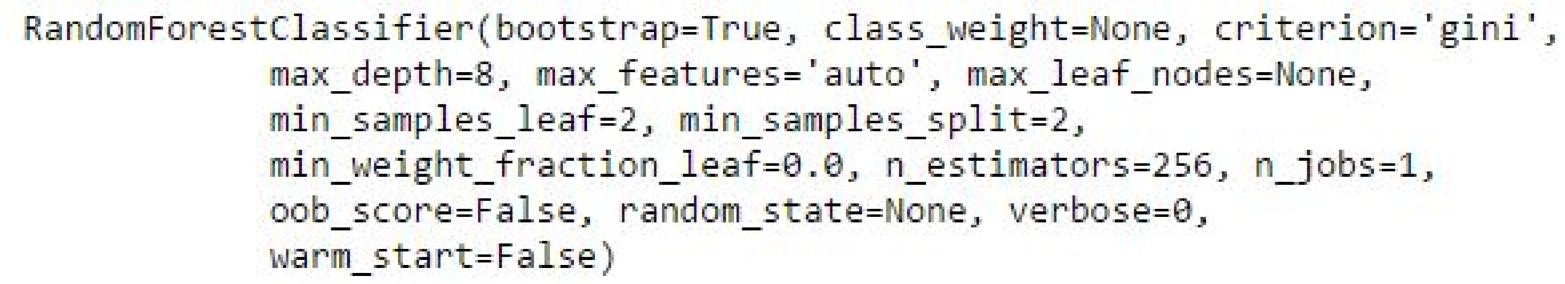
MODEL
WITHOUT TIME





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

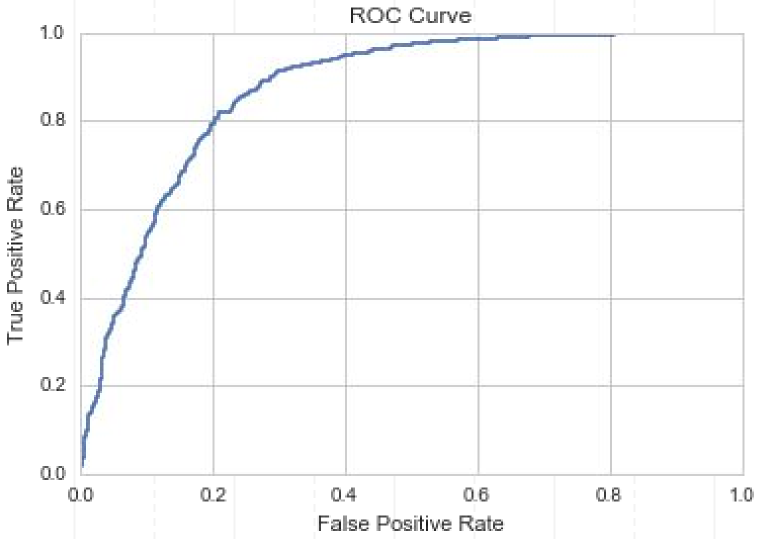
88.9%

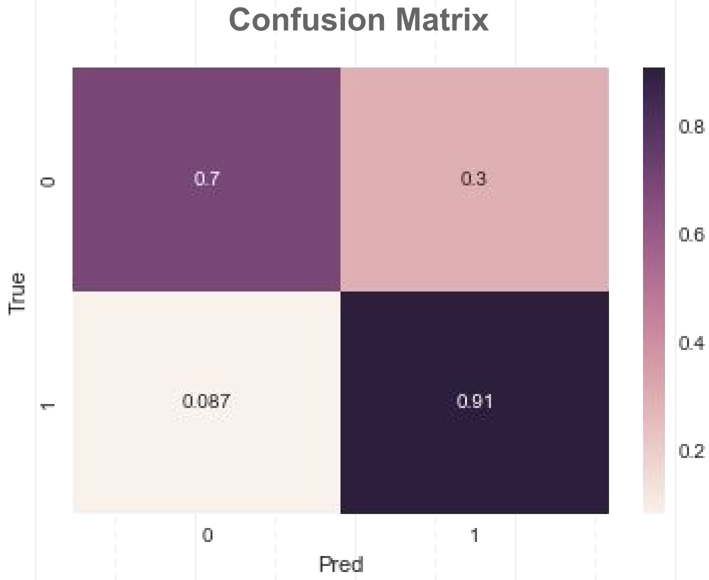
Training Set

82.3%

Test Set

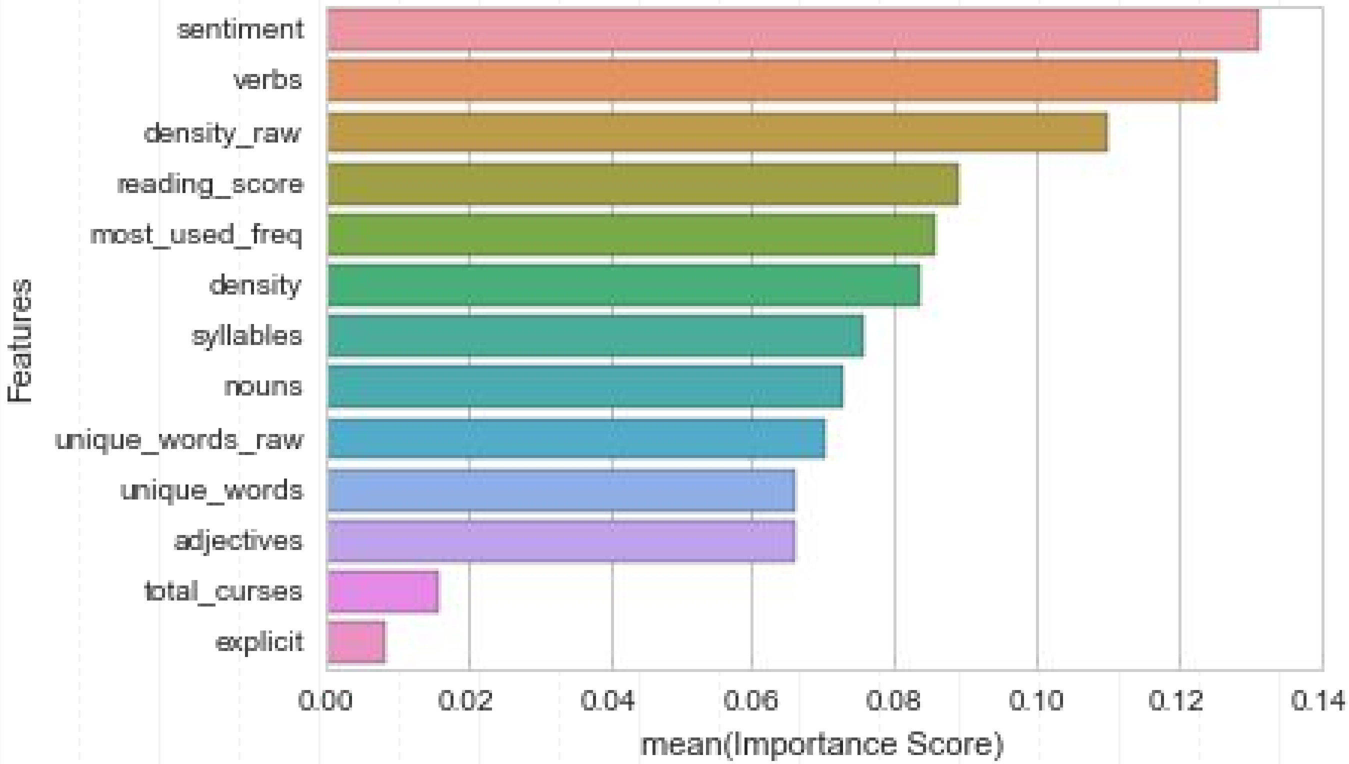
MODEL
WITH TIME



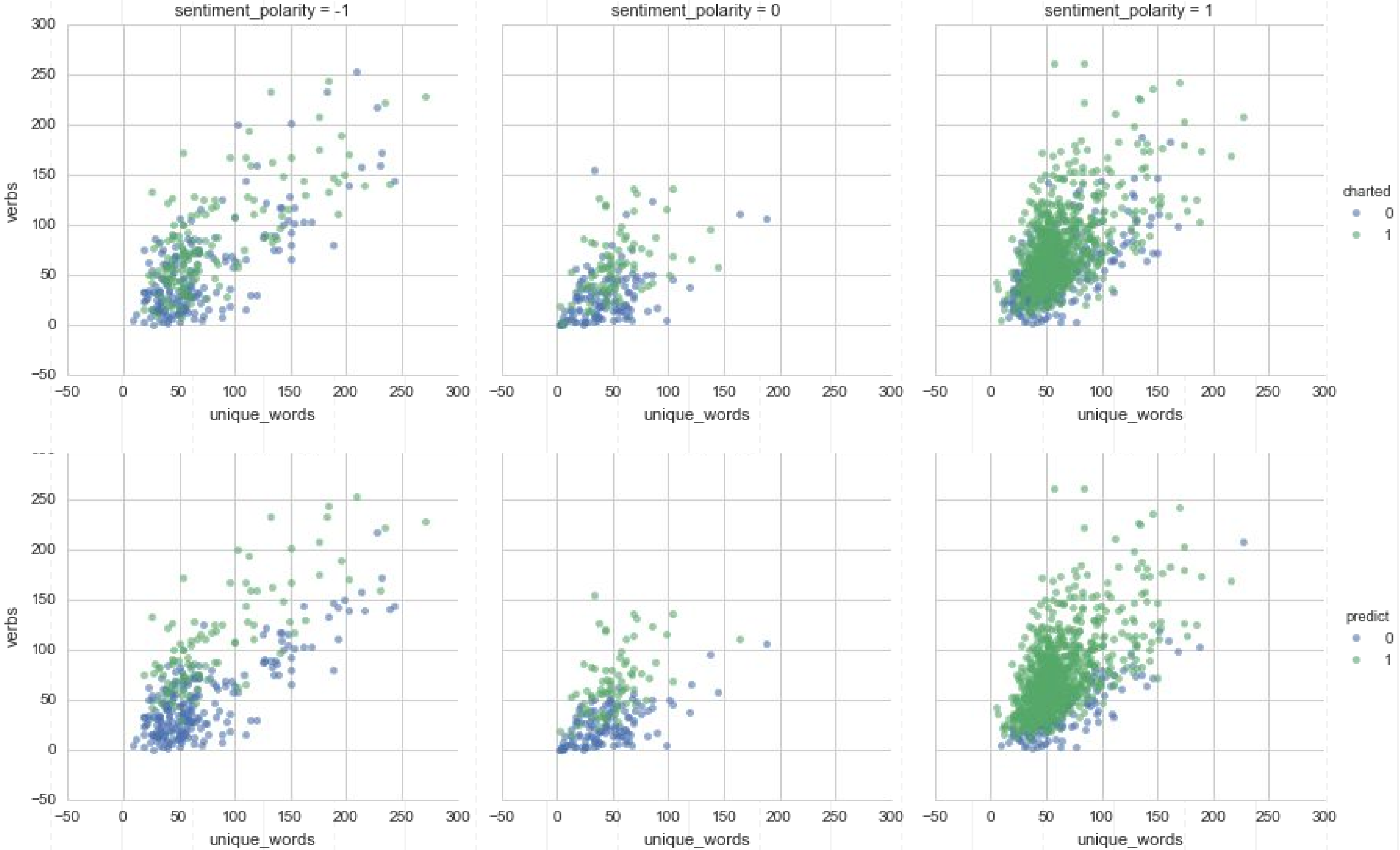


MODEL

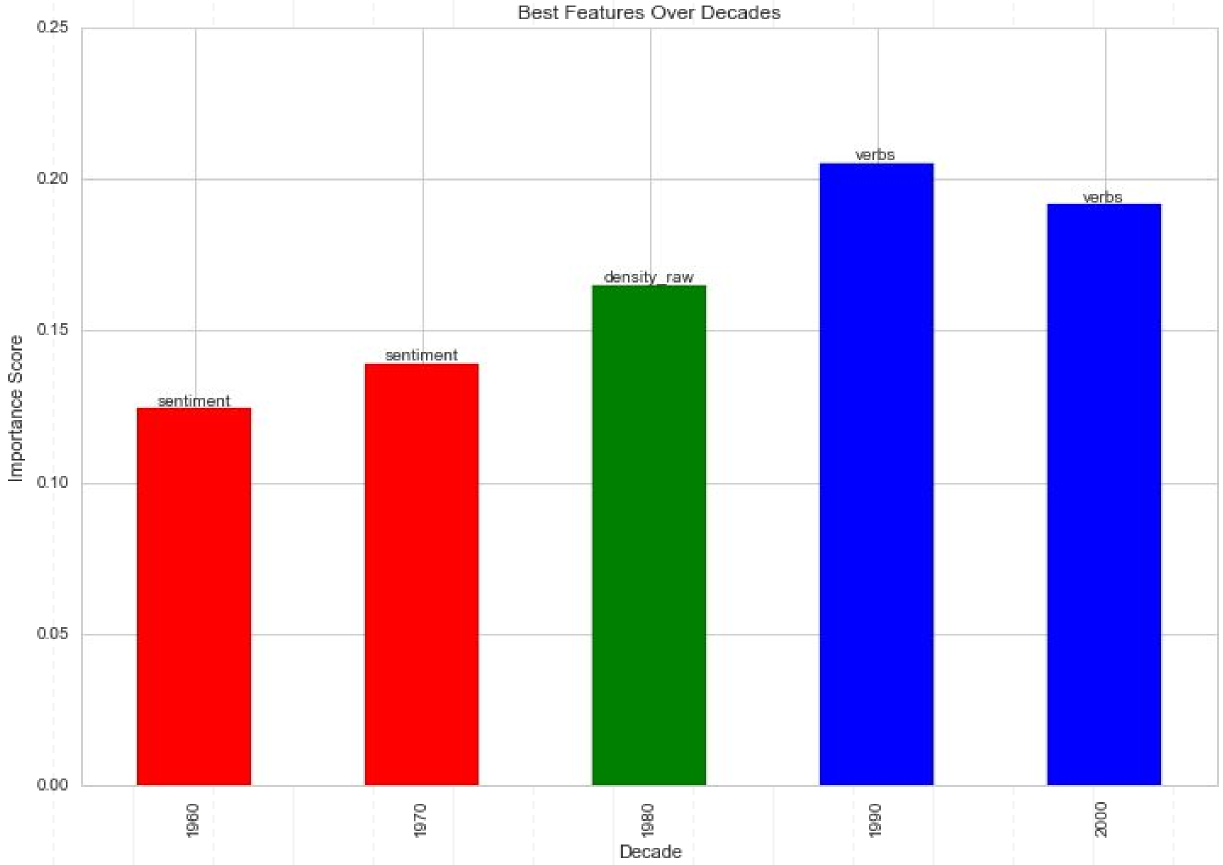
FEATURE IMPORTANCE



FINDINGS


sentiment_polarity = -1
sentiment_polarity = 0
sentiment_polarity = 1
verbs
unique_words
300
250
200
150
100
50
0
−50
−50
0
50
100
150
200
250
300
charted
0
1
predict
0
1

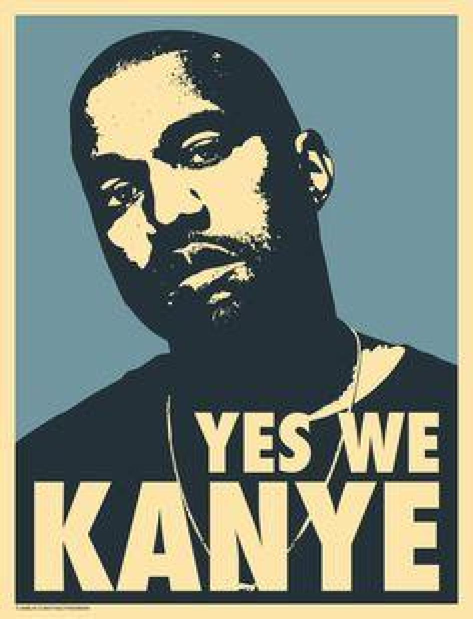
FINDINGS


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