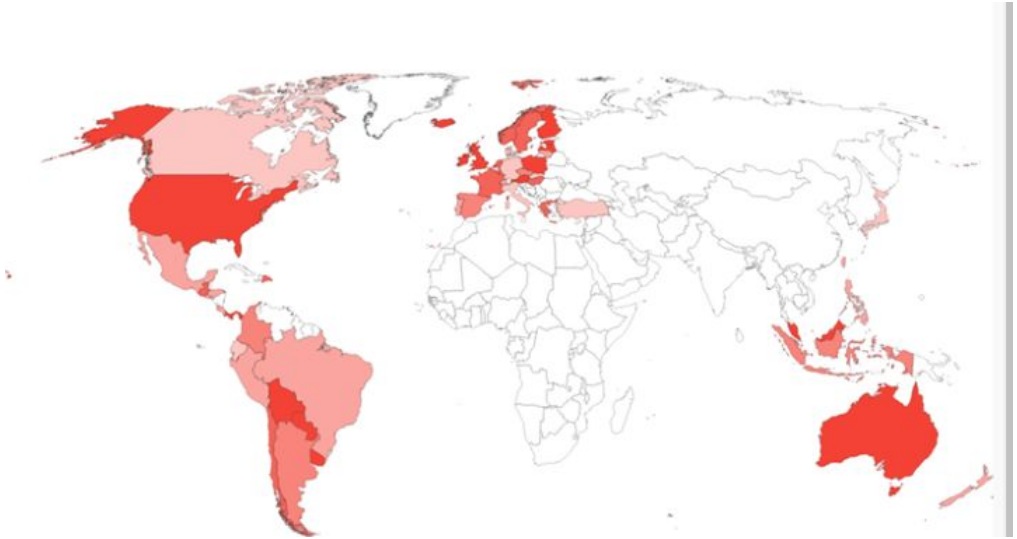
Group 19:

Song Success Prediction:

Ricky Pan, Martin Ziran Xu, Liam Shi, Deep Mistry, Brian Long

Project Summary:

- **Song success prediction** based on its musical features in different regions of the world.

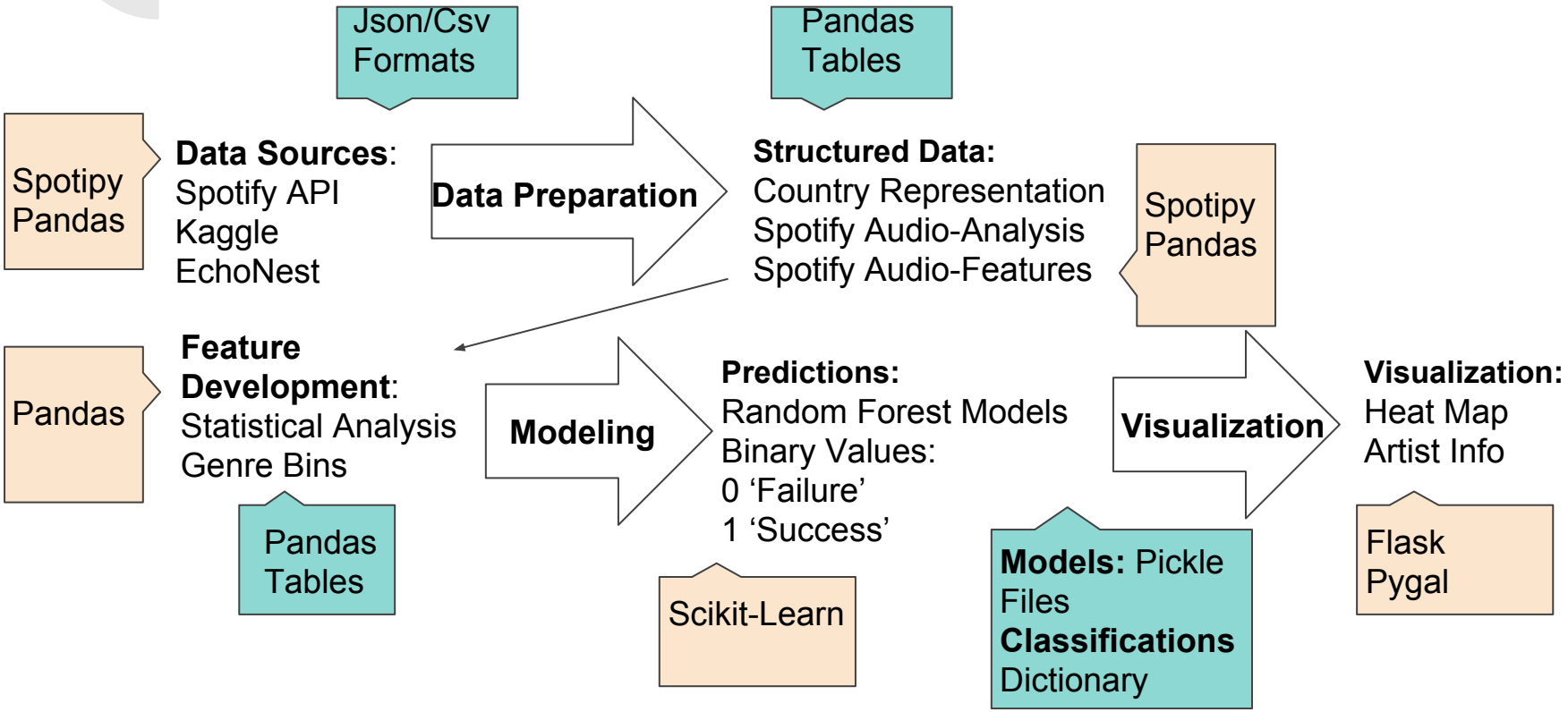


- Current benchmarks:
  - **University of Antwerpen:** 65% test accuracy on overall popularity

Product Demonstration

http://127.0.0.1:8080/search

System Architecture

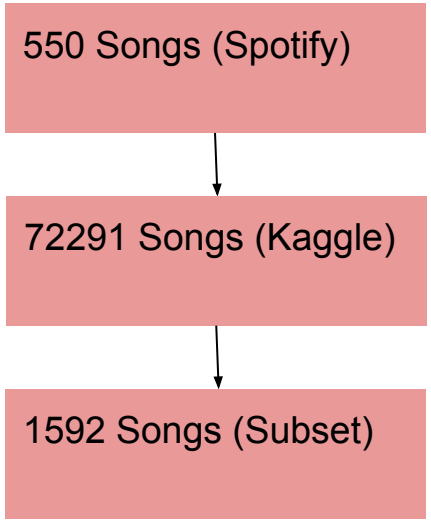


Learning Path and Biggest Challenges

- Regional output tags
- Cleaning and processing of big real world datasets
- Aggregating and balancing training set
- Feature extraction beyond spotify APIs standard features
- Working with various machine learning methods

Regional output

- Scraped top 50 regional charts on spotify
- Kaggle dataset tracked regional charts over one year
- Took unique songs and cross referenced them with the spotify API
- Defined binary tag for each region




```
['ee', 'br', 'my', 'cz', 'pe', 'gb', 'ie', 'se', 'sk', 'co', 'sg', 'ec', 'es', 'no', 'dk', 'be', 'lu', 'do', 'nz', 'de', 'hu',
'cr', 'jp', 'hk', 'lt', 'pl', 'it', 'hn', 'mx', 'ph', 'cl', 'is', 'ca', 'ar', 'at', 'ch', 'tr', 'py', 'tw', 'gt', 'sv', 'us',
'fr', 'global', 'nl', 'bo', 'lv', 'gr', 'pa', 'uy', 'au', 'pt', 'fi', 'popularity']
```

Feature extraction

- Accousticness
- Danceability
- Duration_ms
- Energy
- Instrumentalness
- Key
- Liveness
- Loudness
- Mode
- Speechiness
- Tempo
- Valence
- Genre

Spotify API

Timbre Vector 1-12

Timbre: *The characteristic quality of sound that distinguishes one voice or musical instrument from another or one vowel sound from another: it is determined by the harmonics of the sound and is distinguished from the intensity and pitch.*

Extracted 120 Timbre Features

```
['acousticness', 'danceability', 'duration_ms', 'energy', 'instrumentalness', 'key', 'liveness', 'loudness', 'mode', 'speechine
ss', 'tempo', 'valence', 'mean_timbre1', 'median_timbre1', 'std_timbre1', 'min_timbre1', 'max_timbre1', 'range_timbre1', '80Per
centile_timbre1', 'kurtosis_timbre1', 'skewness_timbre1', 'mean_timbre2', 'median_timbre2', 'std_timbre2', 'min_timbre2', 'max_
timbre2', 'range_timbre2', '80Percentile_timbre2', 'kurtosis_timbre2', 'skewness_timbre2', 'mean_timbre3', 'median_timbre3', 's
td_timbre3', 'min_timbre3', 'max_timbre3', 'range_timbre3', '80Percentile_timbre3', 'kurtosis_timbre3', 'skewness_timbre3', 'me
an_timbre4', 'median_timbre4', 'std_timbre4', 'min_timbre4', 'max_timbre4', 'range_timbre4', '80Percentile_timbre4', 'kurtosis_
timbre4', 'skewness_timbre4', 'mean_timbre5', 'median_timbre5', 'std_timbre5', 'min_timbre5', 'max_timbre5', 'range_timbre5',
'80Percentile_timbre5', 'kurtosis_timbre5', 'skewness_timbre5', 'mean_timbre6', 'median_timbre6', 'std_timbre6', 'min_timbre6',
'max_timbre6', 'range_timbre6', '80Percentile_timbre6', 'kurtosis_timbre6', 'skewness_timbre6', 'mean_timbre7', 'median_timbre
7', 'std_timbre7', 'min_timbre7', 'max_timbre7', 'range_timbre7', '80Percentile_timbre7', 'kurtosis_timbre7', 'skewness_timbre
7', 'mean_timbre8', 'median_timbre8', 'std_timbre8', 'min_timbre8', 'max_timbre8', 'range_timbre8', '80Percentile_timbre8', 'ku
rtosis_timbre8', 'skewness_timbre8', 'mean_timbre9', 'median_timbre9', 'std_timbre9', 'min_timbre9', 'max_timbre9', 'range_timb
re9', '80Percentile_timbre9', 'kurtosis_timbre9', 'skewness_timbre9', 'mean_timbre10', 'median_timbre10', 'std_timbre10', 'min_
timbre10', 'max_timbre10', 'range_timbre10', '80Percentile_timbre10', 'kurtosis_timbre10', 'skewness_timbre10', 'mean_timbre1
1', 'median_timbre11', 'std_timbre11', 'min_timbre11', 'max_timbre11', 'range_timbre11', '80Percentile_timbre11', 'kurtosis_tim
bre11', 'skewness_timbre11', 'mean_timbre12', 'median_timbre12', 'std_timbre12', 'min_timbre12', 'max_timbre12', 'range_timbre1
2', '80Percentile_timbre12', 'kurtosis_timbre12', 'skewness_timbre12']
```

Machine Learning Methods

Input

- Feature importance
- Feature selection
- Normalizing
- Gap Creation
- Grouping into genres

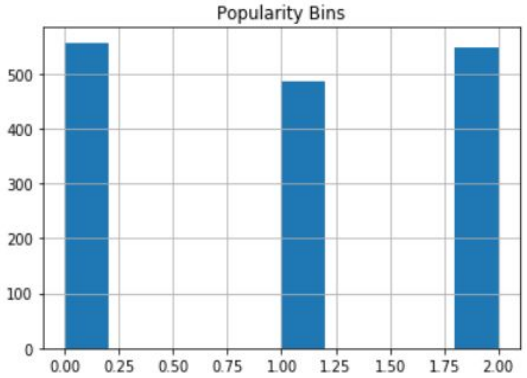
Models

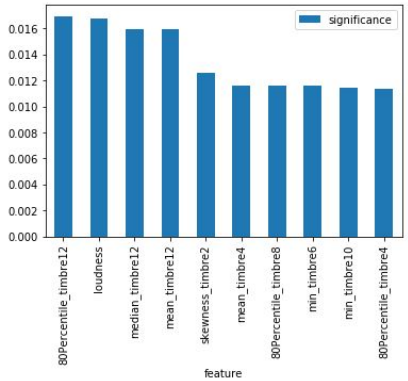
- Binary classification problem
- SVM, Random Forest, Gradient Boosting, Logistic Regression, KNN, Perceptron
- Hyperparamter tuning using stratified K-fold

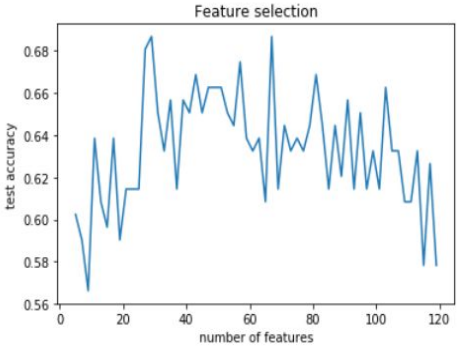
Performance

- Training and test accuracy
- ROC curve and AUC score
- Confusion matrix

ML Performance on overall popularity



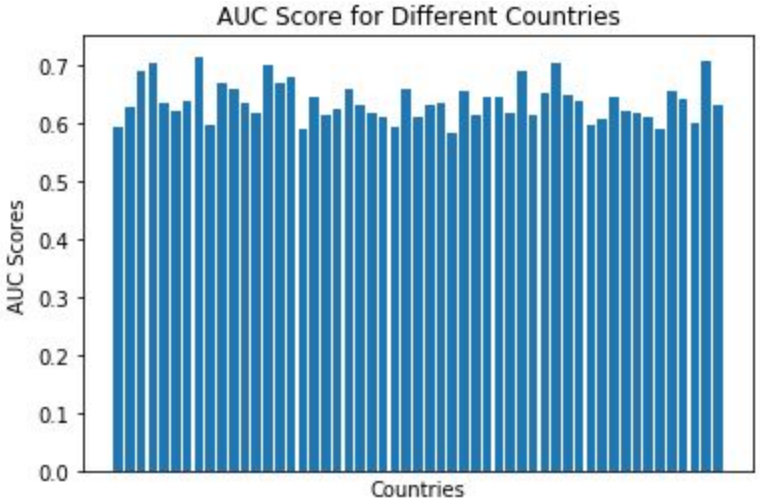




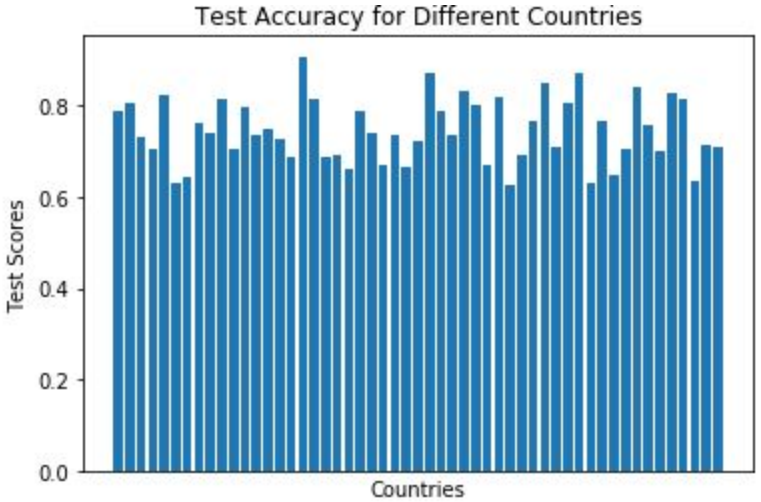
Random Forest: 67.50%
Test Accuracy
No timbre = 50%

```
Top 10 Features:
[('loudness', 0.01786902630361211), ('80Percentile_timbre12', 0.01760271801219514), ('median_timbre12', 0.016583438399828395),
('mean_timbre12', 0.015389716219674653), ('80Percentile_timbre4', 0.01313153205058648), ('skewness_timbre2', 0.012189930767476579), ('80Percentile_timbre8', 0.011957885326952833), ('mean_timbre4', 0.011617575335665611), ('kurtosis_timbre7', 0.011146743936069552), ('min_timbre10', 0.01084267661855836)]
```

ML Performance on regional data

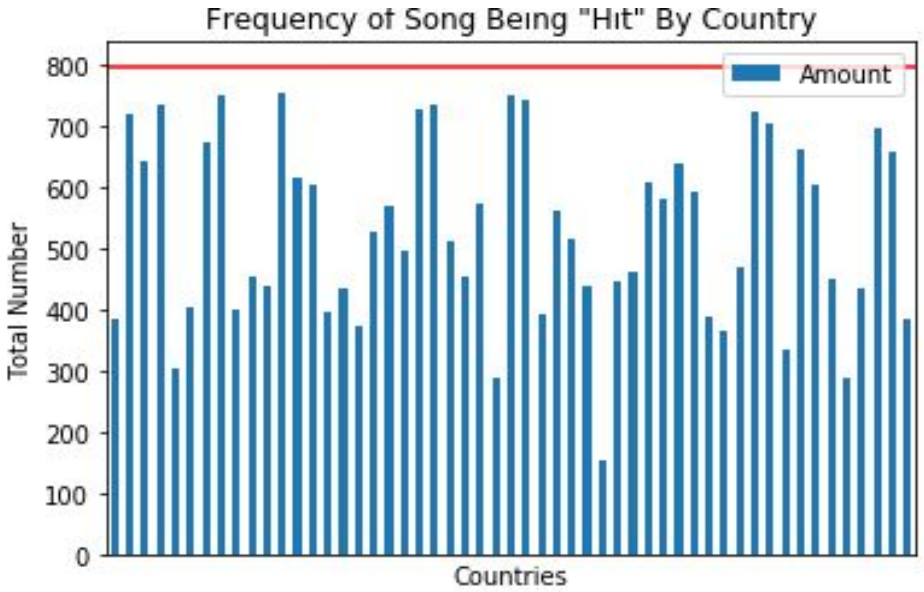


Average auc Score: 0.6391501585937819
Best auc Score: 0.7164389664389663
Worst auc Score: 0.5838422181878197

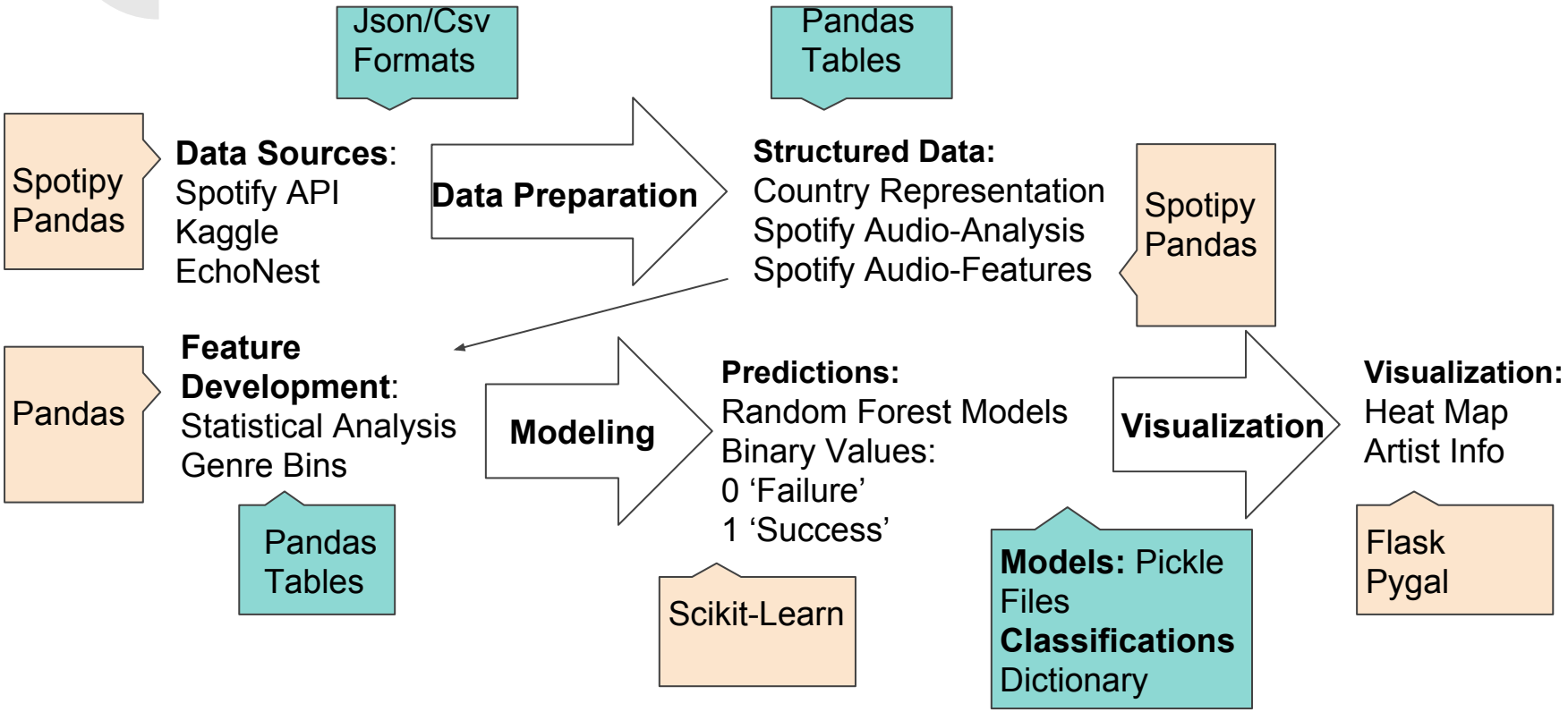


Average test accuracy: 0.7459540538406885
Best test accuracy: 0.9079497907949791
Worst test accuracy: 0.6276150627615062

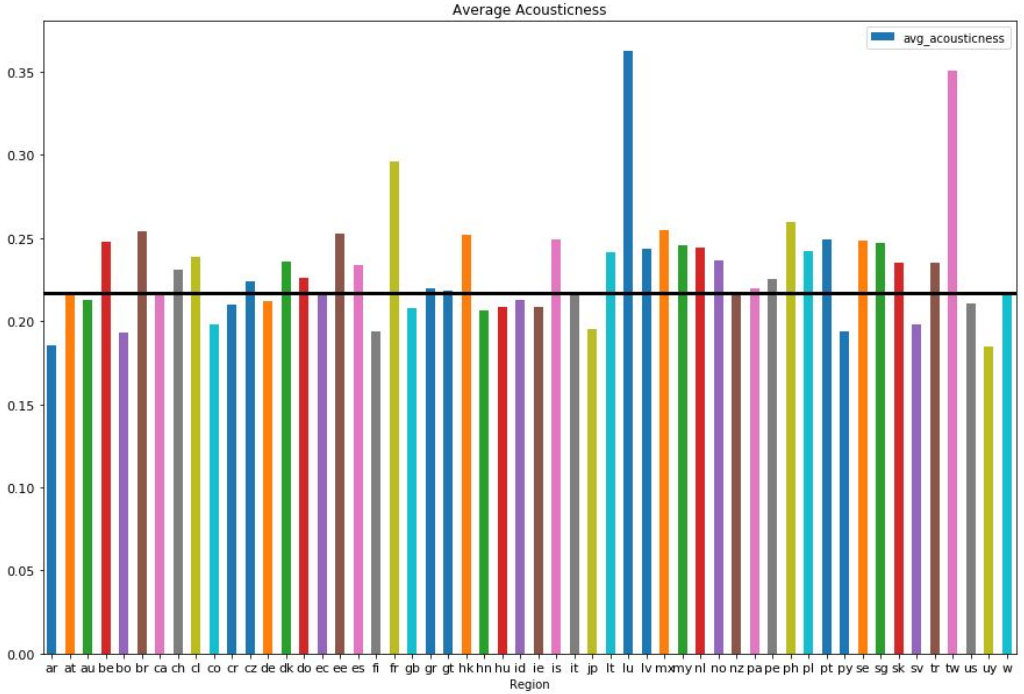
Balanceness of dataset



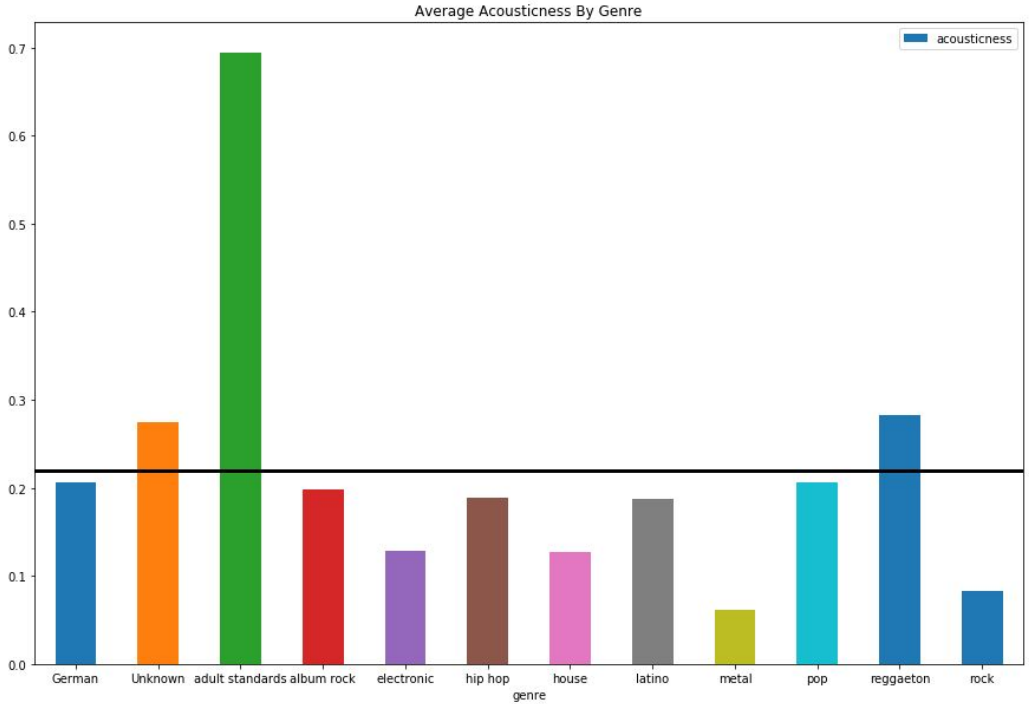
System Architecture



Data Exploratory



Data Exploratory



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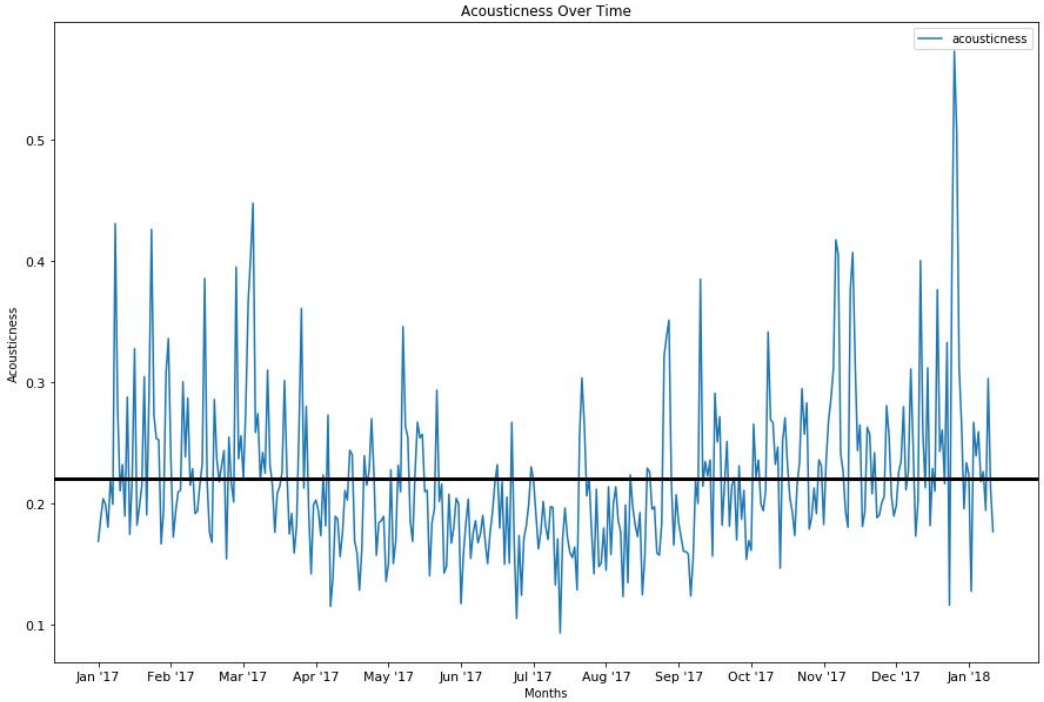

Future steps:

- Perform training on the whole dataset: 15x more songs
- Include meta-data as features: artist hotness, lyrics (bag of words)
- Train neural network with raw timbre vectors

Thank you!

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