

Audio Features & Hit Songs

Predicting whether a song is likely to be a hit or a flop based on
song/audio features

Tanya Shapiro
December 3rd, 2020

What makes a song a hit? Simple Science?

Jordan: "We've been a comedy rock band for almost 40 years now, and in all that time we've never had a hit"

Benny: "But you guys know why...because we never wrote a 4-chord song"

[YouTube](#)

Inspiration & Data Notes

Project Inspiration

- When I'm not doing data things, I play guitar for fun
- I haven't had a hit song either in the 15 years I've been playing...
- Love the intersection of art & science

Data

- Found on Kaggle, by Farooq Ansari
- Author used Spotify API package (spotipy) and Billboard API package
- Easy to work with – balanced data set, features for audio profiles mostly standardized (lots of continuous variables)
- 40,000+ songs

kaggle



Billboard

Spotify Audio Features

On a scale from 0 to 1...

DANCEABILITY



ACOUSTICNESS



INSTRUMENTALNESS



ENERGY



VALENCE



SPEECHINESS



LIVENESS



HOT TAKES: Hits & Audio Feature Scales

DANCEABILITY

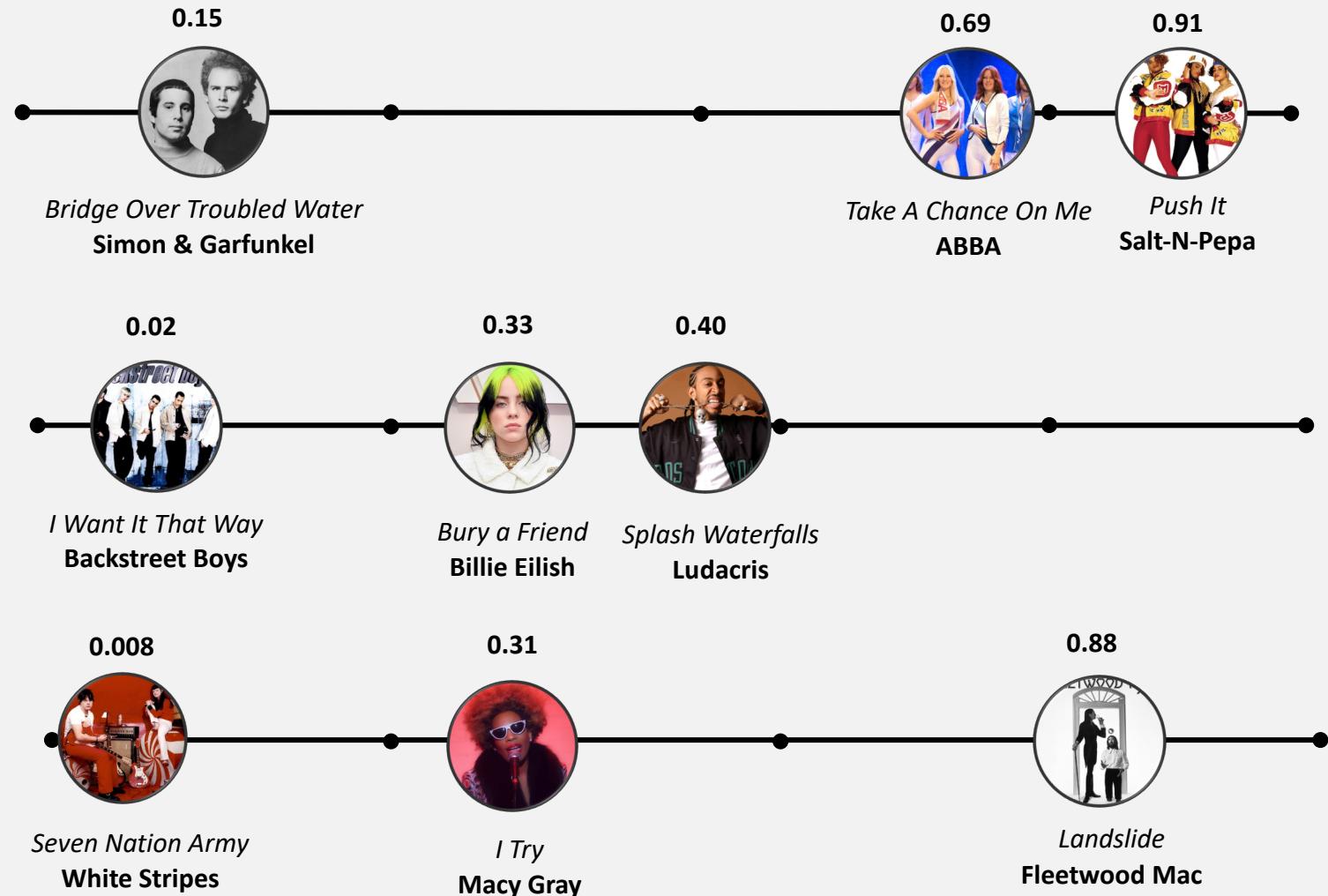
Danceability describes how suitable a track is for dancing based on a combination of musical elements including tempo, rhythm stability, beat strength, and overall regularity.

SPEECHINESS

Detects presence of spoken words in a track. The more exclusively speech-like (e.g. talk show, audio book, poetry), the closer to 1.0 the attribute value.

ACOUSTICNESS

A confidence measure from 0.0 to 1.0 of whether the track is acoustic. 1.0 represents high confidence the track is acoustic.



HOT TAKES: Hits & Audio Feature Scales

INSTRUMENT.

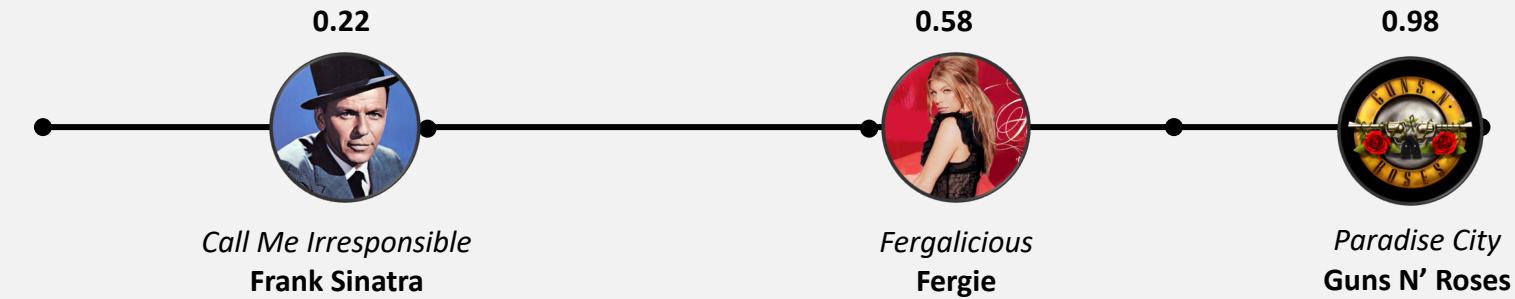
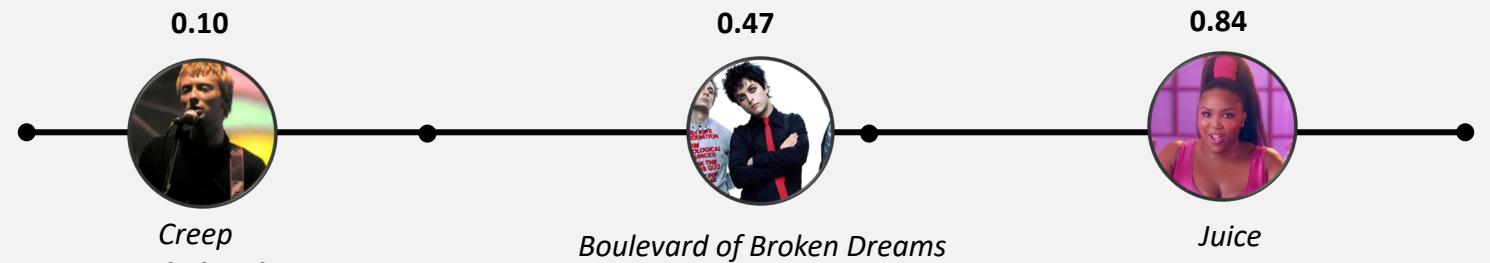
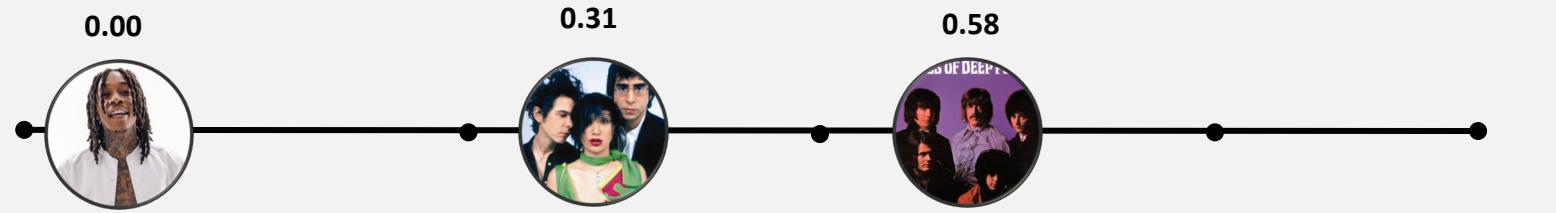
Predicts whether a track contains no vocals. "Ooh" and "aah" sounds are treated as instrumental in this context. Rap or spoken word tracks are clearly "vocal".

VALENCE

Positiveness conveyed by a track. Tracks with high valence sound more positive (e.g. happy, cheerful), while tracks with low valence sound more negative (e.g. sad, depressed, angry).

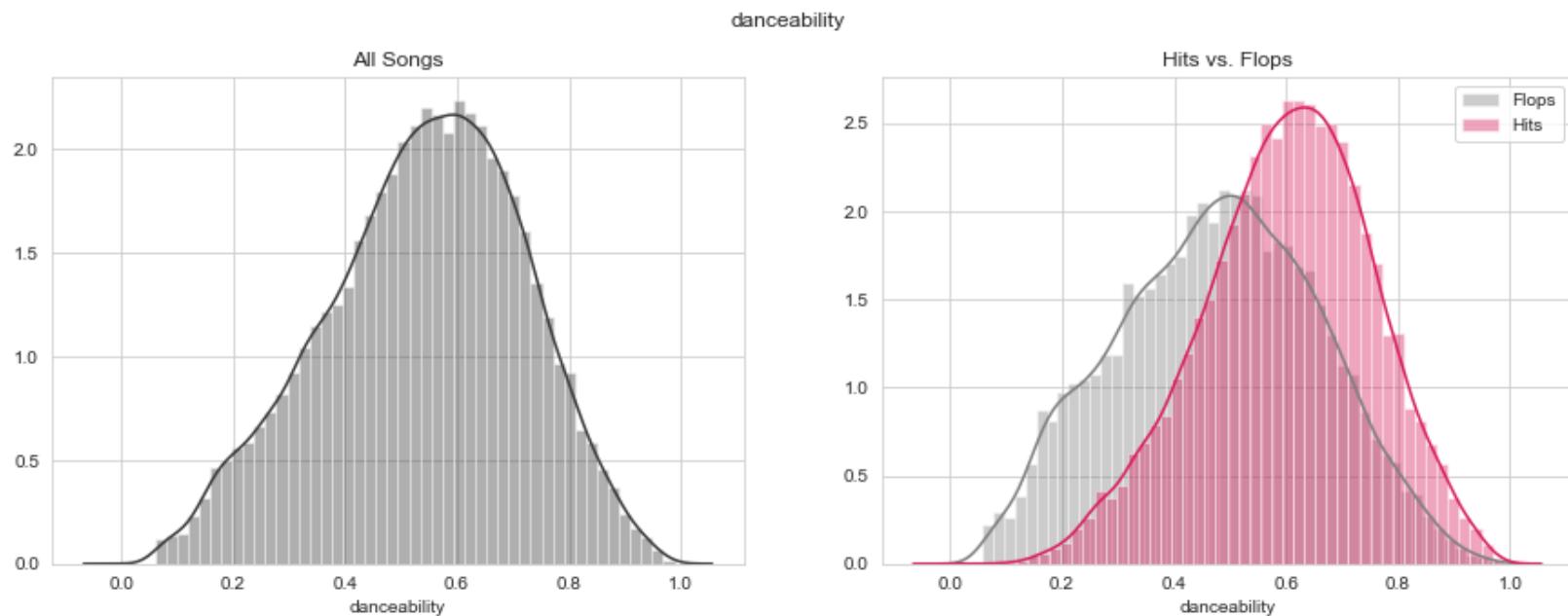
ENERGY

Energy represents a perceptual measure of intensity and activity. Typically, energetic tracks feel fast, loud, and noisy. For example, death metal has high energy, while a Bach prelude scores low on the scale.



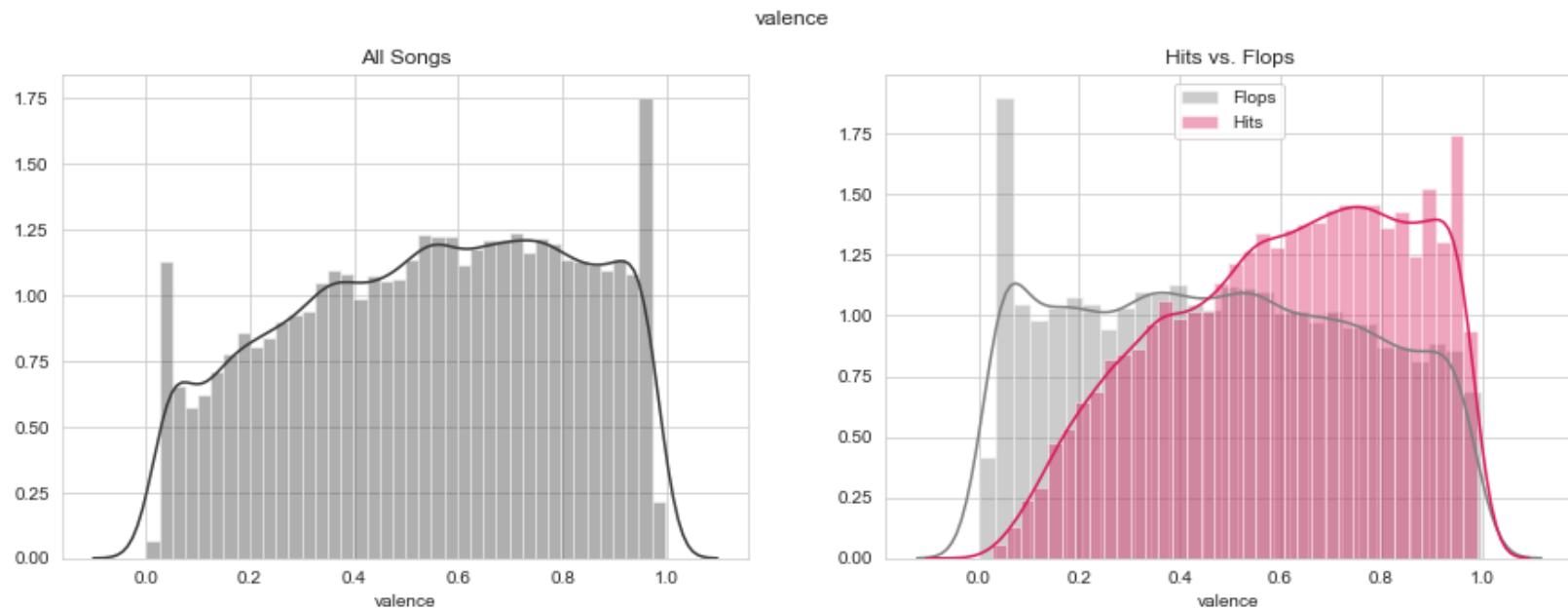
DANCEABILITY

CORR: +0.37



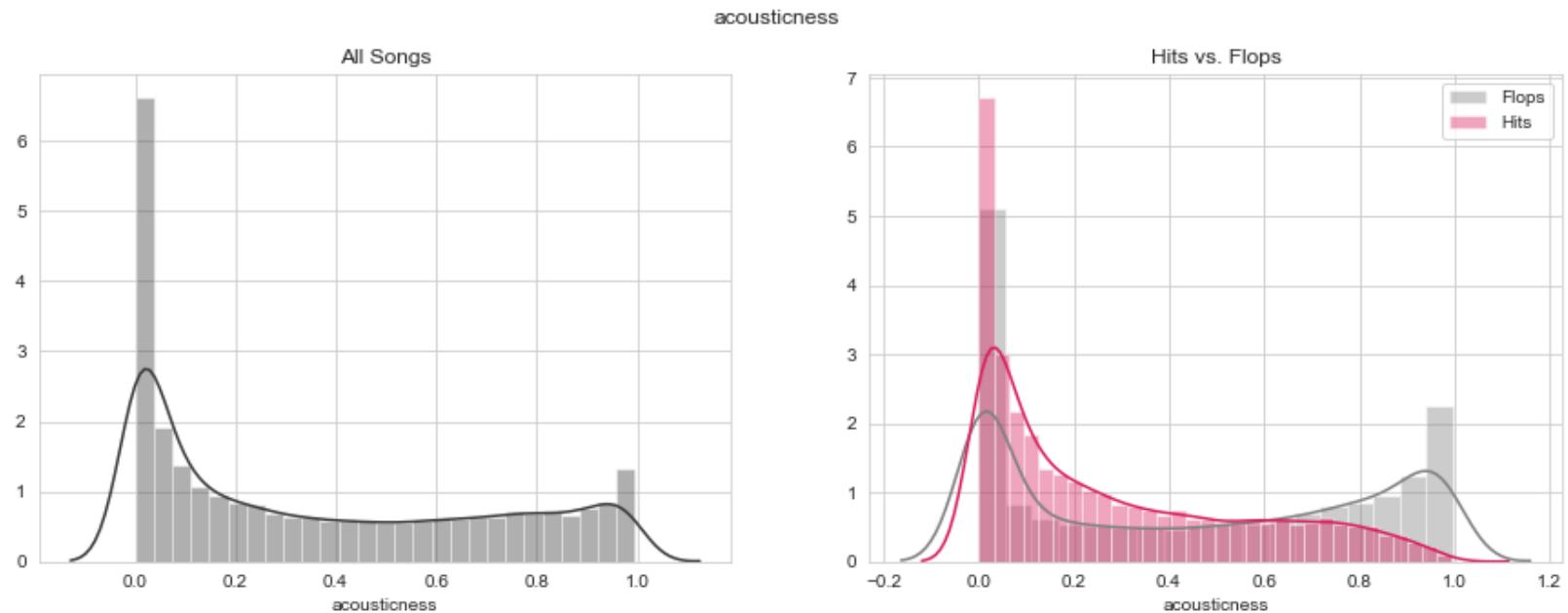
VALENCE

CORR: +0.25



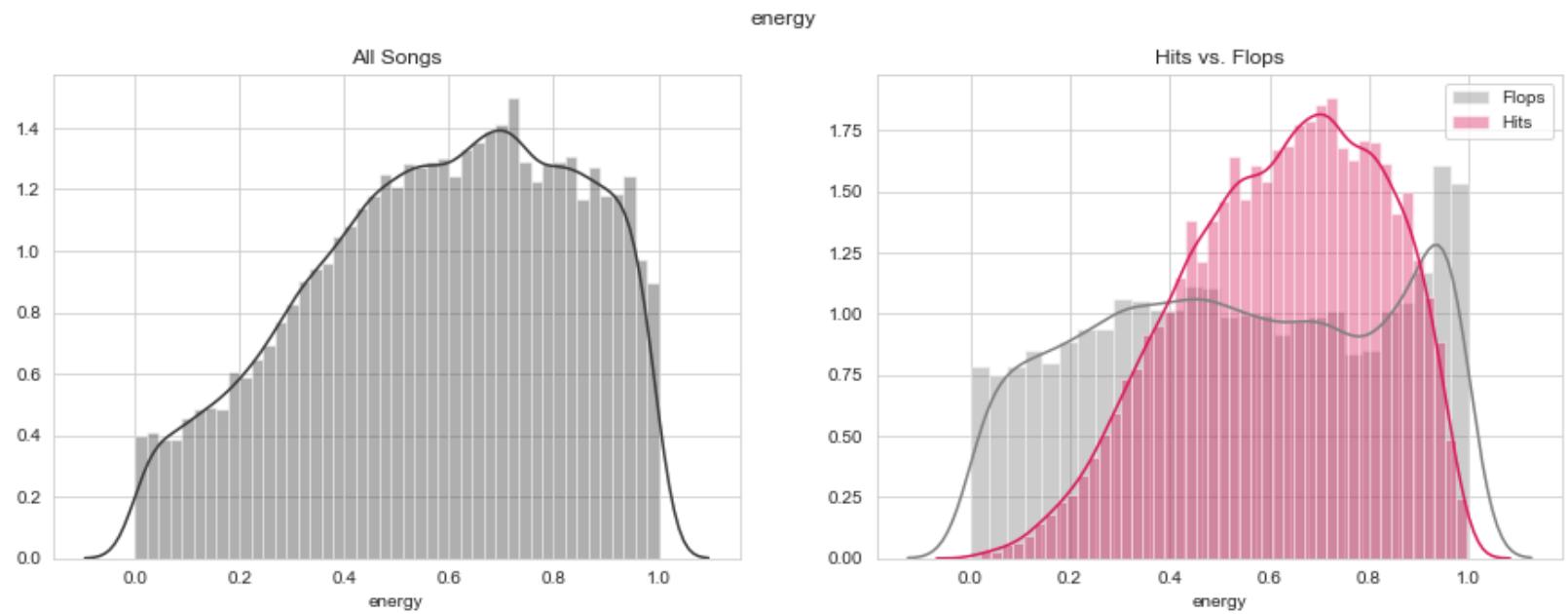
ACOUSTICNESS

CORR: -0.24



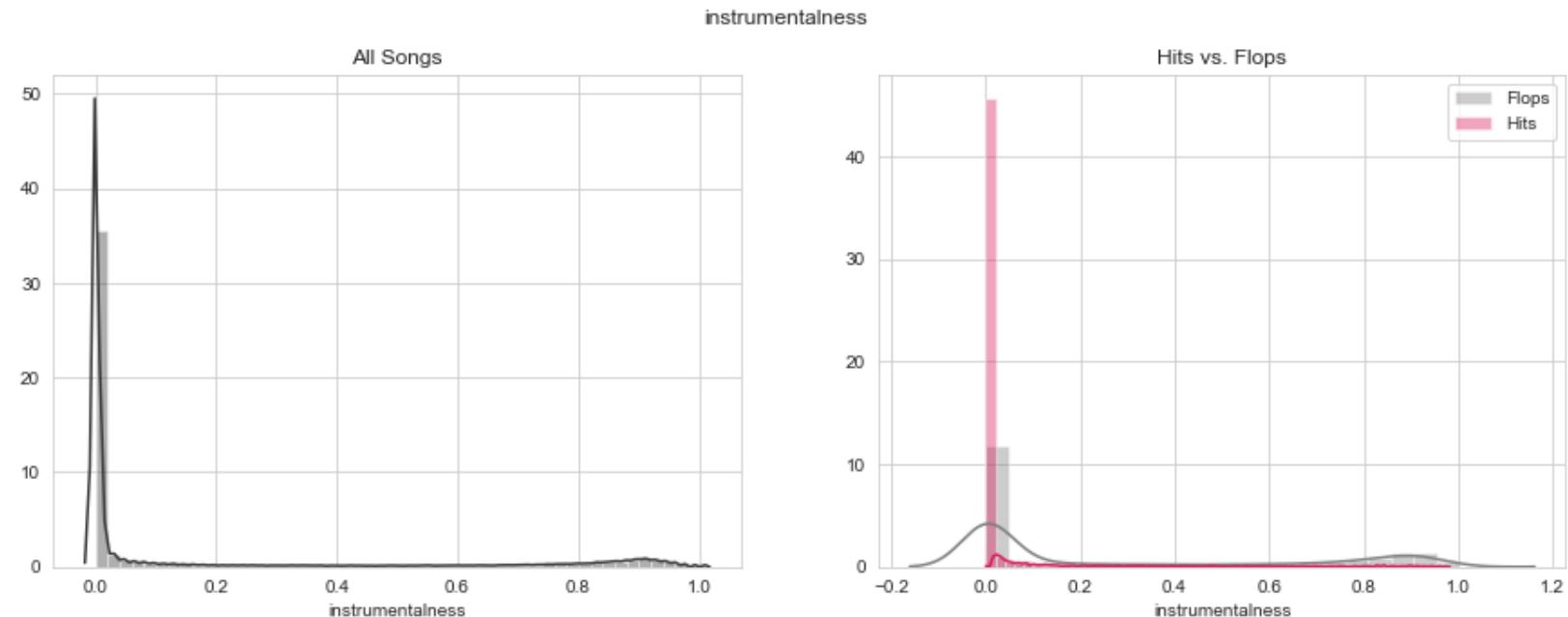
ENERGY

CORR: +0.18



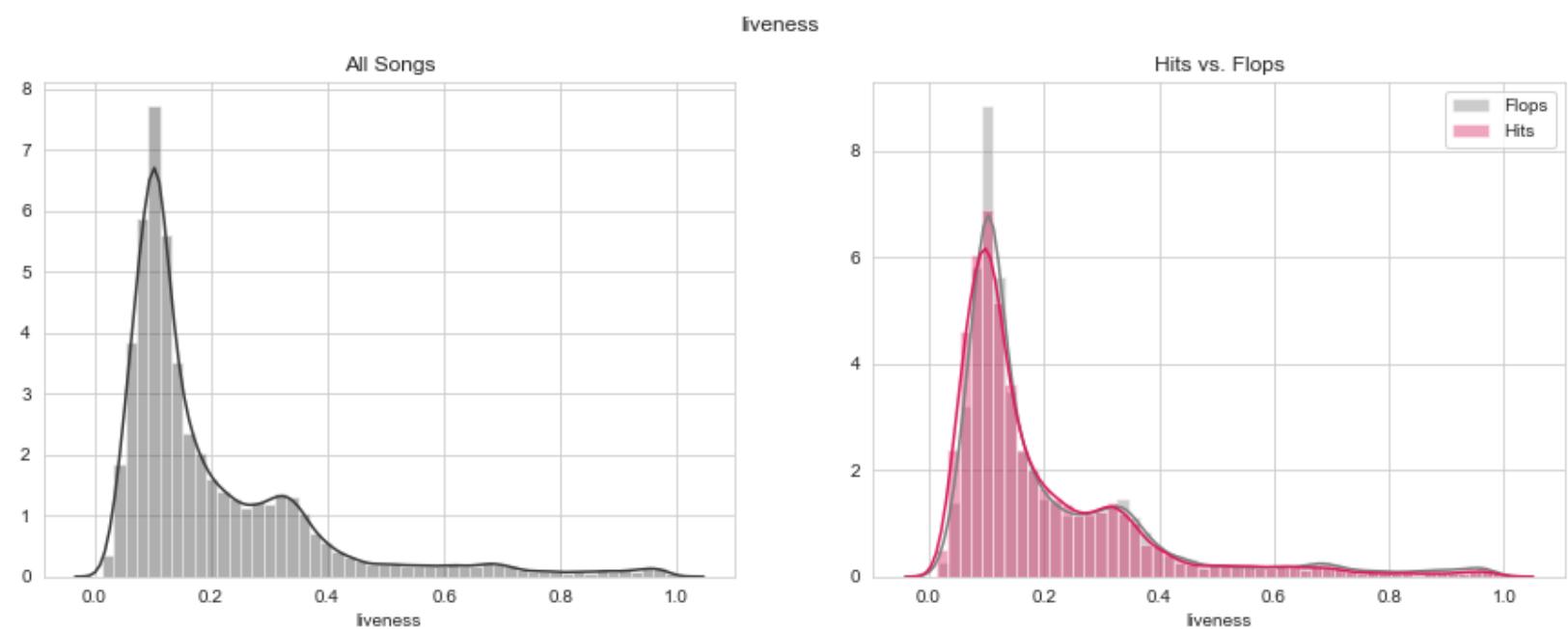
INSTRUMENTALNESS

CORR: -0.41



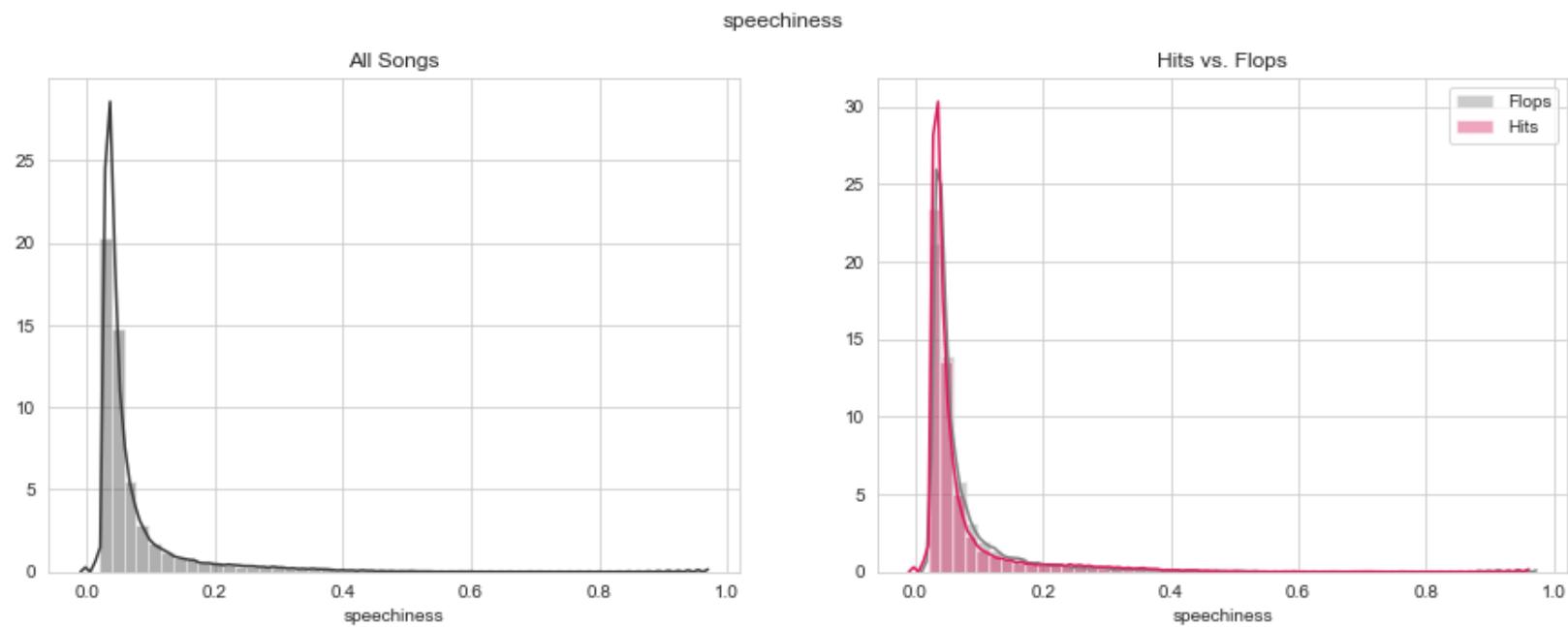
LIVENESS

CORR: -0.05

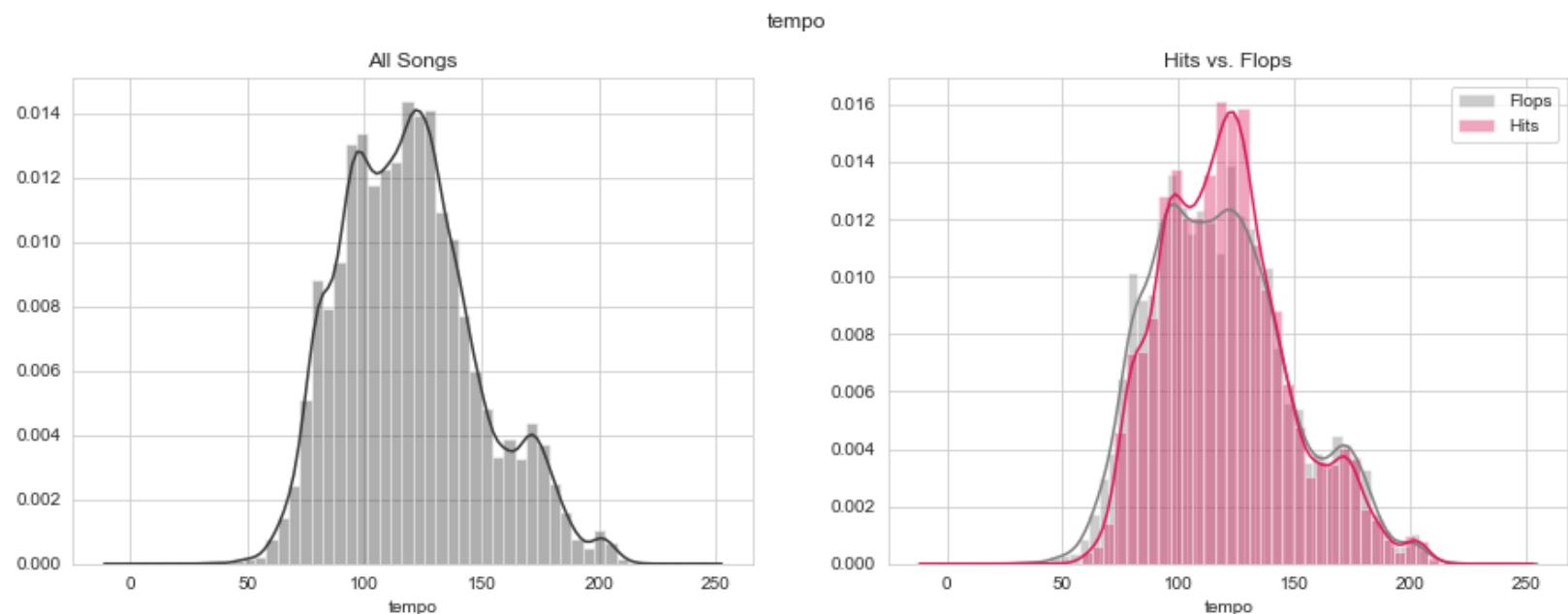


SPEECHINESS

CORR: -0.04



TEMPO



Other Song Features

Length

- Duration
- Sections
- Chorus Hit

Melody

- Mode – major (1) or minor (0)
- Key –Pitch Class
- Tempo – beats per minute
- Time Signature

decade	60s	70s	80s	90s	00s	10s
feature						
acousticness	-0.275892	-0.289887	-0.292108	-0.374949	-0.223842	-0.184479
chorus_hit	-0.014197	-0.025696	-0.024451	-0.049170	-0.093390	-0.085587
danceability	0.236872	0.275601	0.347748	0.453966	0.458550	0.384486
duration_min	-0.178550	-0.041493	0.022023	0.072873	-0.138384	-0.189203
energy	0.299523	0.241756	0.185201	0.219283	0.084521	0.060701
instrumentalness	-0.330012	-0.371937	-0.386725	-0.427337	-0.471290	-0.499624
key	0.018414	-0.021019	0.015615	0.053454	-0.004444	0.005548
liveness	0.033234	-0.036014	-0.101236	-0.102237	-0.075539	-0.062612
loudness	0.316439	0.265339	0.248918	0.334691	0.347300	0.327471
mode	0.193878	0.093410	0.044977	-0.018487	0.096097	0.032021
sections	-0.137554	-0.051034	0.013143	0.044678	-0.100742	-0.113383
speechiness	-0.133006	-0.127620	-0.195129	0.050704	0.057114	0.097783
tempo	0.123845	0.024487	0.044943	-0.035056	-0.044054	0.039226
time_signature	0.046787	0.130295	0.127942	0.114015	0.138600	0.127544
valence	0.323920	0.258680	0.262301	0.170499	0.281006	0.203774

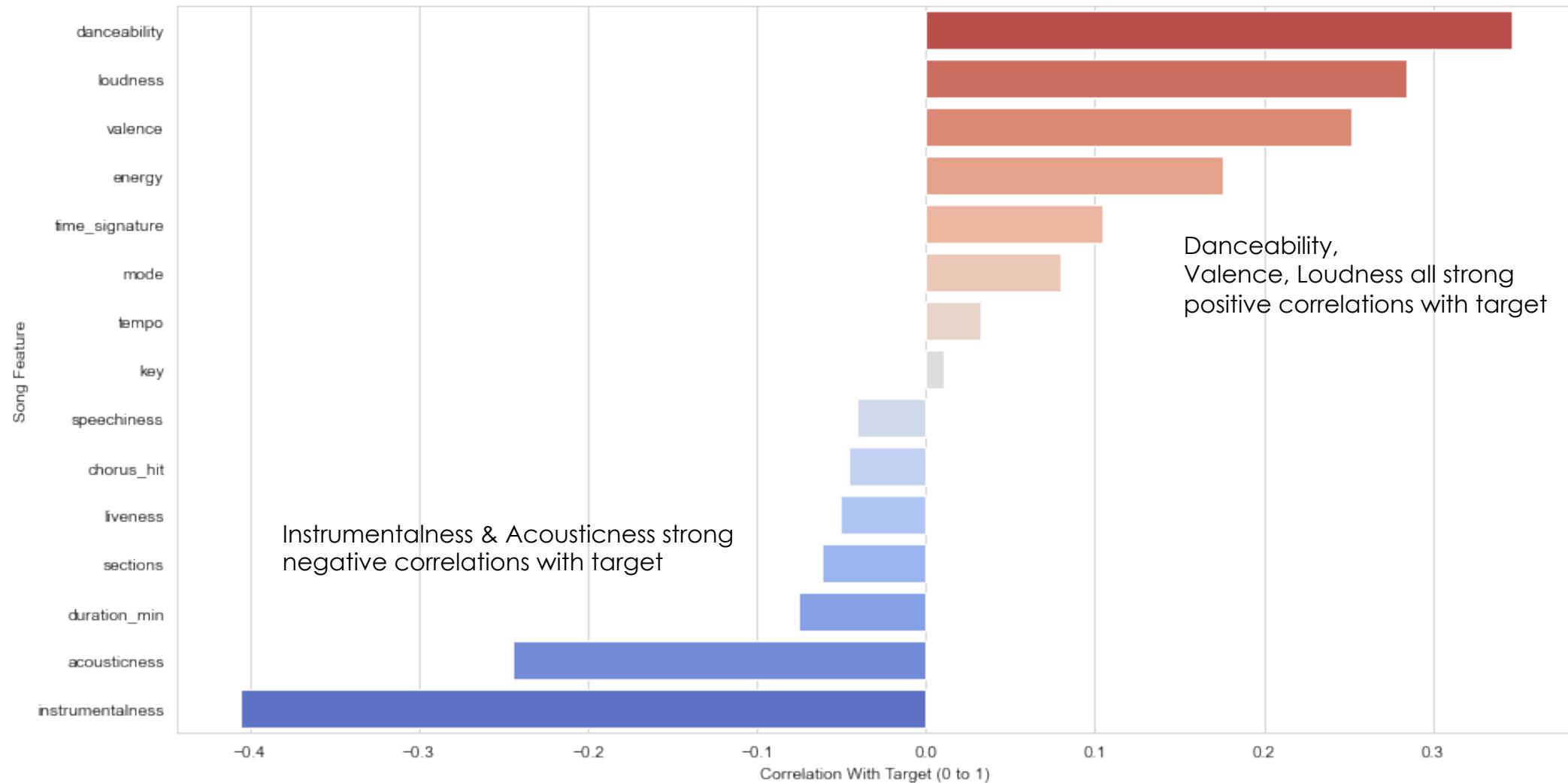
How has music evolved?

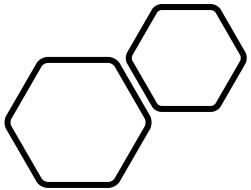
Feature Correlation with Target Variable Across Decades

- **Valence** – the happier the vibe, the better. 60s, 70s stronger positive correlation than recent decades.
- **Speechiness** – interesting divergence between older decades and newer decades – rap influence?
- **Energy** – more prevalent in 70s and 70s

Which song features might be the best predictors for a hit?

Correlations between features and target

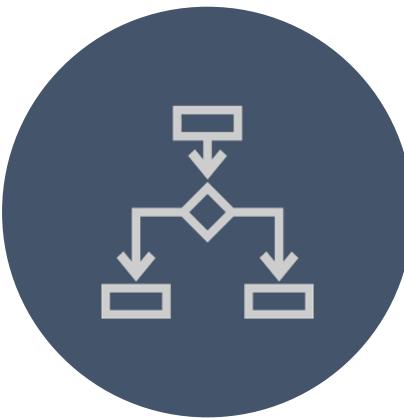




Classification Data Models



**LOGISTIC
REGRESSION**



**DECISION
TREE**



**RANDOM
FOREST**

Decision Tree (Simplified)

Notes on making a hit song:

- Hits need to have enough words to be catch (can't be all instrumentals)
- They need to inspire people to hit the dancefloor (high danceability)
- Older decades were fans of acoustic songs, newer eras, less emphasis

All The Small Things
Blink-182



HIT

Low instrumentals,
Low acousticness,
Low danceability,
Lower energy

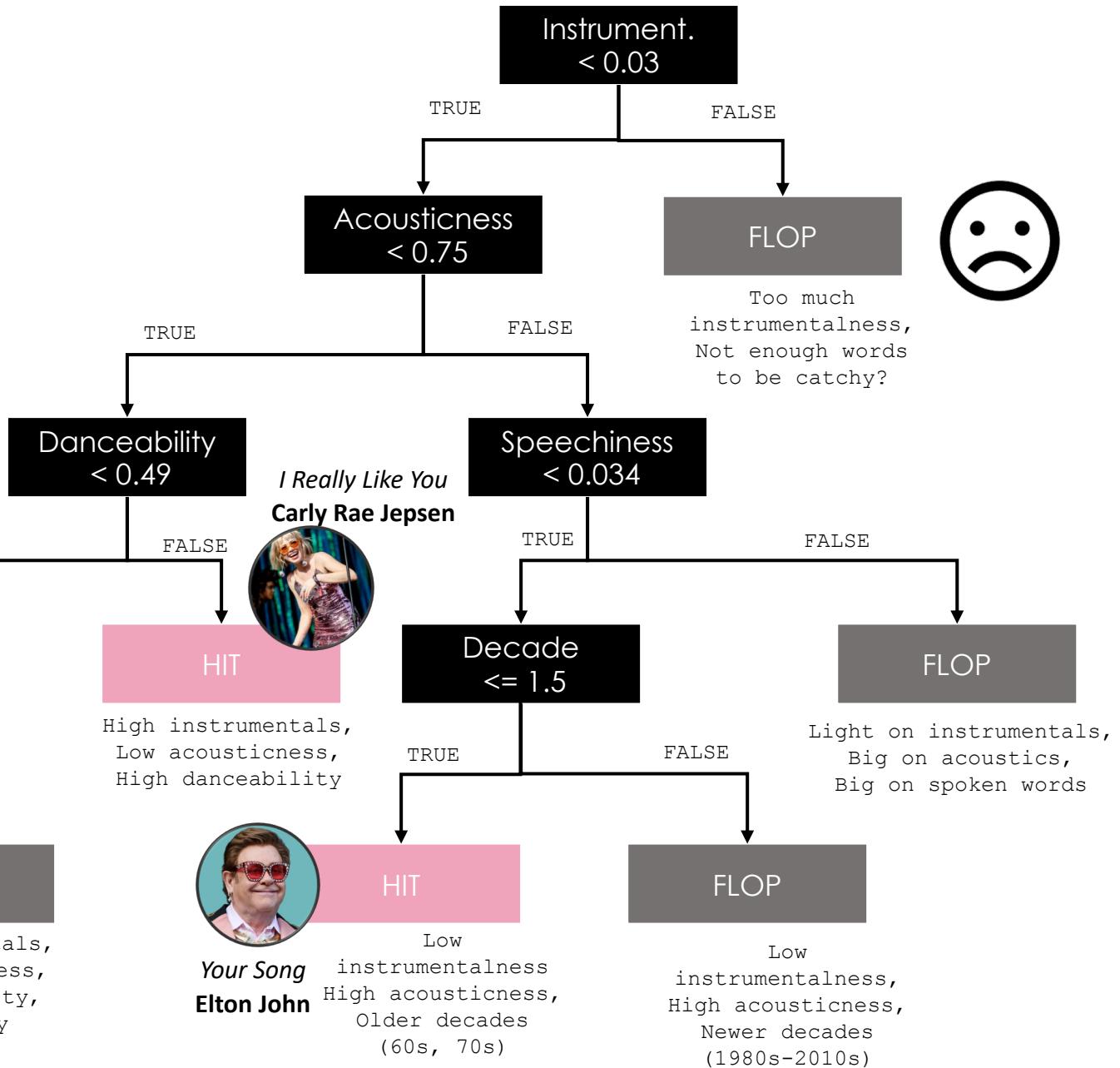
Energy
 < 0.91

TRUE

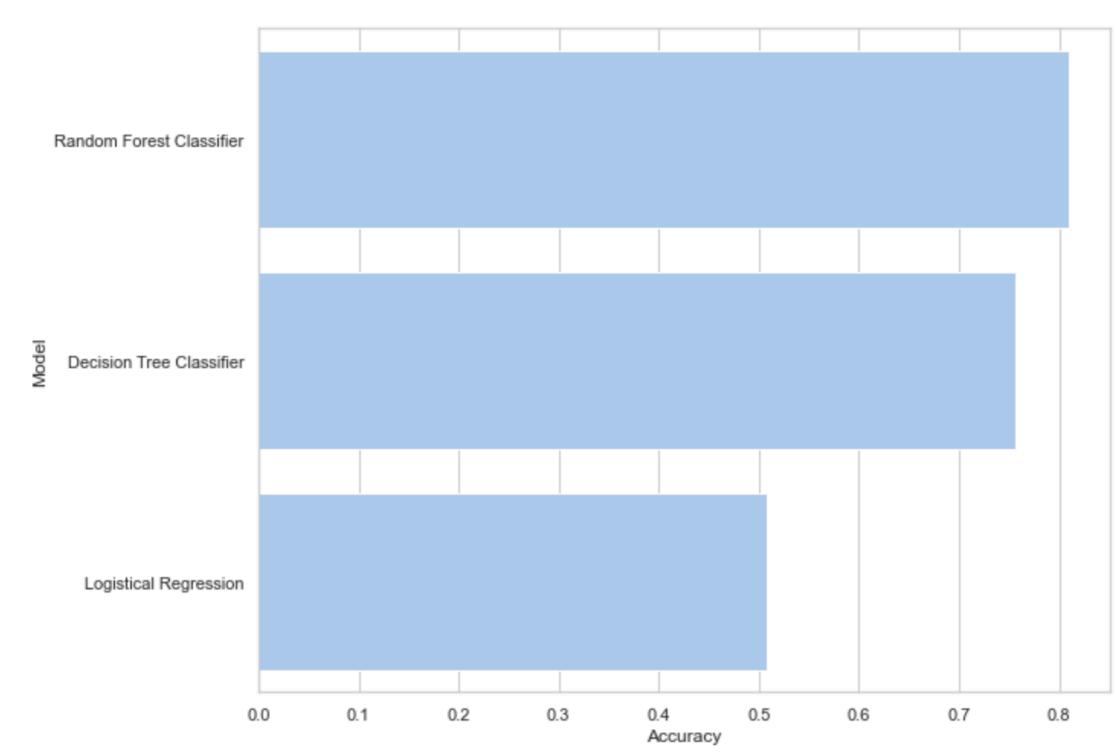
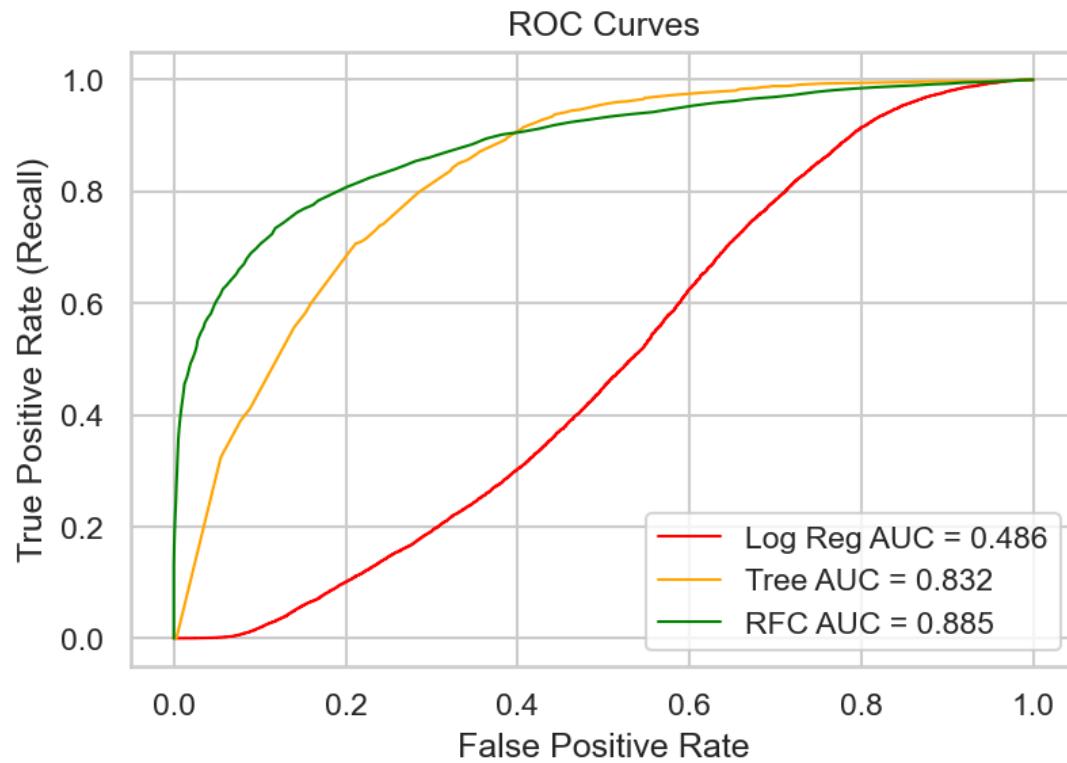
FALSE

FLOP

Low instrumentals,
Low acousticness,
Low danceability,
High energy



RFC Model FTW



Conclusions

- Logistic Regressions not so great with many variables, not the best with categorical variables
- Decision Tree better than LR – very clear to interpret- but puts a heavy emphasis on one feature (instrumentalness)
- Random Forest produced the best outcome with predictions, harder to interpret given the nature of the model
- Hit songs are influenced a lot by level of “instrumentalness” – needs to have words! Acousticness and danceability also seem to play a role

Future Research Recommendations



ARTIST & LABEL POPULARITY. SONG
“HIT” COULD ALSO BE A FUNCTION OF
MARKETING DOLLARS



DECADE SPAN – MAYBE BETTER TO
FOCUS ON ONE DECADE. MUSIC TASTES
CAN EVOLVE OVER TIME



SENTIMENT ANALYSIS & TOPIC
MODELING - NLP

THANK YOU!

#DS-GA-WRAPPED

Inspo for next hit title song...

