Music Recommender

Jiaguan Pan, Justin Nguyen, Tien-Ning Lee, Vincent Kao, Yu-Shu Chen

Table of Contents

Dataset - Kaggle Spotify Tracks Dataset

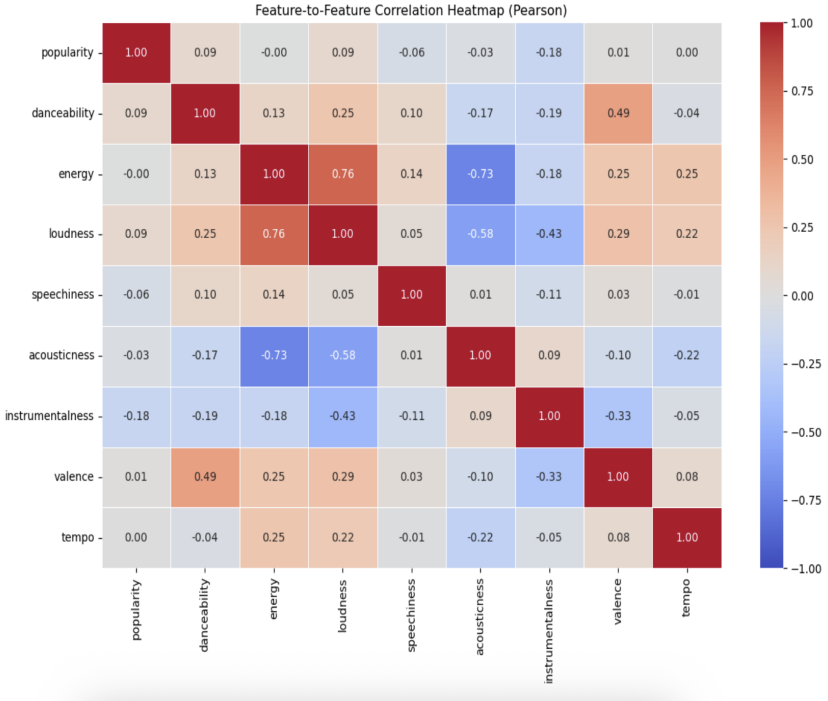
Categorical features:

'artists', 'album_name', 'track_name', 'explicit', 'key', 'mode', 'time_signature', 'track_genre'

Numerical features:

'popularity', 'duration_ms', 'danceability', 'energy', 'loudness', 'speechiness', 'acousticness', 'instrumentalness', 'liveness', 'valence', 'tempo'

Data Analysis - feature correlations



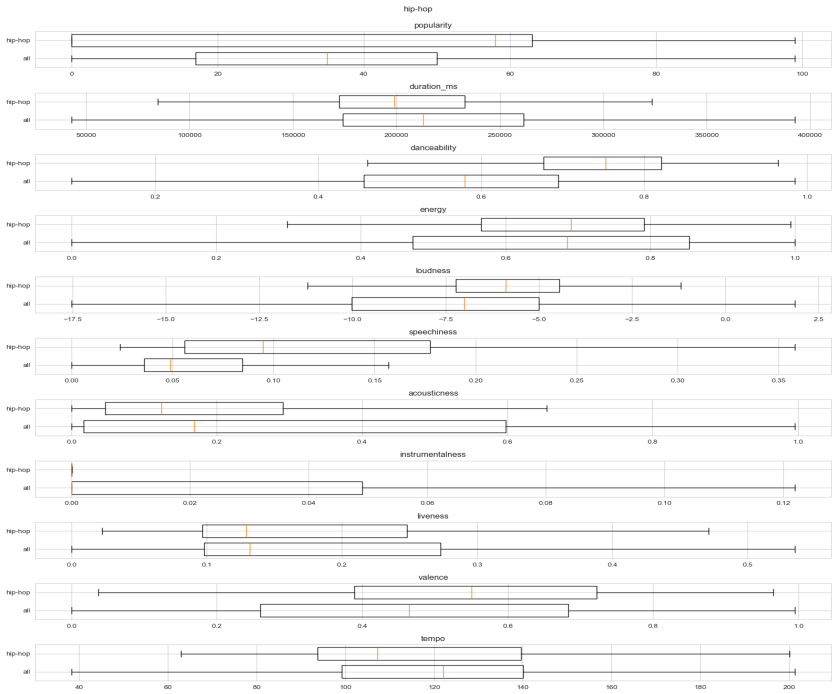
Positive correlations:

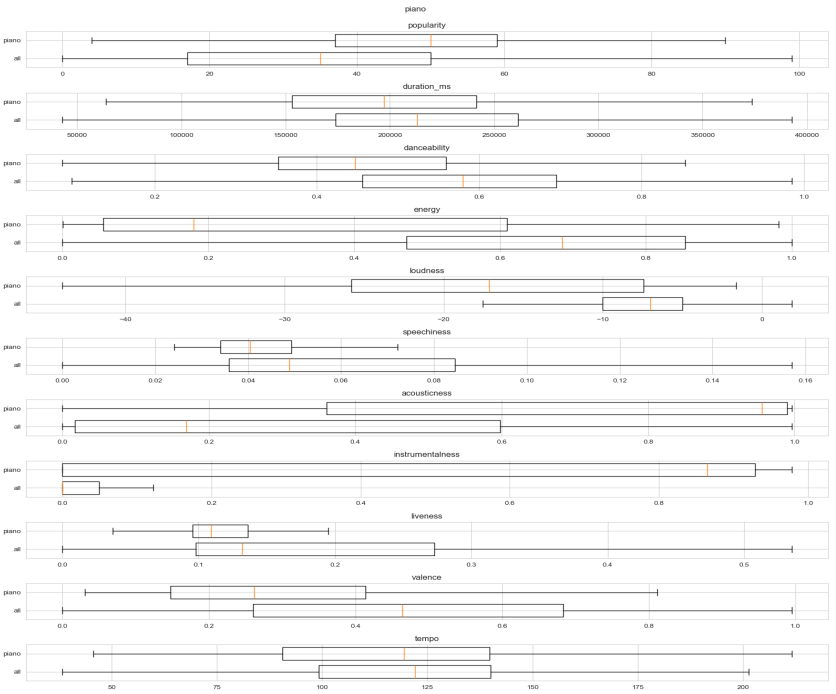
- Loudness ↔ Energy
- Valence ↔ Danceability

Negative correlations:

- Acousticness ↔ Energy
- Acousticness ↔ Loudness
- Instrumentalness ↔ Loudness

Data Analysis - comparing feature values





Recommendation System - overview

Recommend some songs from a dataset given some preferences

Preferences:

- similar songs
- number of songs
- filters
- weights
- random

Recommendation System - clean dataset

- Remove tracks where artists, album_name, and track_name are None
- Combine rows with the same track_id by using the max popularity of that songs and combine track_genre
- For songs that have the same artists and track_name, keep the first one

Recommendation System - inputs

- songs - [(artist, track_name)], songs to find similar tracks for
- k - number of songs to recommend
- filters - conditions on features to narrow down results
- weights - how much each feature contributes to the similarity score
- alpha - controls the balance between cosine and Jaccard similarity
- random - whether to randomly pick from the top results
- top_n - size of the top candidate list before selecting final results
- seed - ensures consistent random choices during testing

Recommendation System - similarity

Categorical and multiclass features:

Jaccard similarity: $J(A,B) = \frac{|A \cap B|}{|A \cup B|}$

Numeric features:

cosine similarity: $S_C(A,B) = \frac{A \cdot B}{\|A\|\|B\|}$

Combine: $\alpha \cdot S_C + (1-\alpha) \cdot J$

Recommendation System - outputs

Returns k recommended songs, each as (artists, track_name)

- Recommendations are ranked by similarity
- Optional: random selection from the top-n ranked songs
- If no input songs match → returns top-k most popular songs

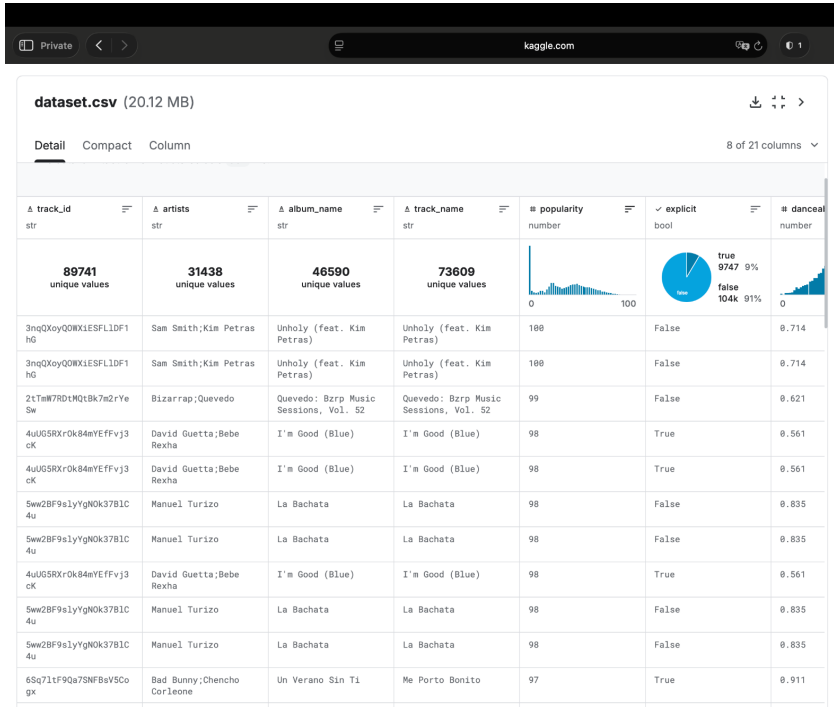
Recommendation Examples - basic

```
songs = recommender_sys.recommend()
print_songs(songs)
```

```
Recommending most popular songs:
Unholy (feat. Kim Petras) — Kim Petras, Sam Smith
Quevedo: Bzrp Music Sessions, Vol. 52 — Bizarrap, Quevedo
I'm Good (Blue) — Bebe Rexha, David Guetta
La Bachata — Manuel Turizo
Tití Me Preguntó — Bad Bunny
```

*note:

“Me Porto Bonito” and “Tití Me Preguntó” both have popularity of 97 in the dataset



Recommendation Examples - with filters

```
songs = recommender_sys.recommend(filters={'explicit': [False]})
print_songs(songs)
```

```
Recommending most popular songs:
Unholy (feat. Kim Petras) - Kim Petras, Sam Smith
Quevedo: Bzrp Music Sessions, Vol. 52 - Bizarrap, Quevedo
La Bachata - Manuel Turizo
Tití Me Preguntó - Bad Bunny
I Ain't Worried - OneRepublic
```

```
songs = recommender_sys.recommend(filters={'track_genre': ['mandopop']})
print_songs(songs)
```

```
Recommending most popular songs:
如果可以 - 電影"月老"主題曲 - WeiBird
最後一堂課 - 《媽,別鬧了!》影集片尾曲 - Eric Chou
孤勇者 - 《英雄聯盟:雙城之戰》動畫劇集中文主題曲 - Eason Chan
閣愛妳一擺 - EggPlantEgg
好不容易 (《華燈初上》片尾曲) - 告五人
```

```
songs = recommender_sys.recommend(filters={'speechiness': {'gt': 0.66}})
print_songs(songs)
```

```
Recommending most popular songs:
Chop (Nouvelle École) - Fresh
Alone With You - Arz
Aaron Burr, Sir - Anthony Ramos, Daveed Diggs, Leslie Odom Jr., Lin-Manuel Miranda, Okieriete Onaodowan
Suburban, Pt. 2 - 22Gz
Intro - j-hope
```

Recommendation Examples - with input song

```
songs = [('ヨルシカ', 'だから僕は音楽を辞めた')] # ヨルシカ – だから僕は音楽を辞めた
# ヨルシカ(yorushika) is an amazing Japanese music group. All of you should try listening to some of their songs.
print('Input songs: ')
print_songs(songs)
songs = recommender_sys.recommend(songs)
print('\nRecommended songs: ')
print_songs(songs)
```

```
Input songs:
だから僕は音楽を辞めた – ヨルシカ

Recommended songs:
ただ君に晴れ – ヨルシカ
Hard To Handle – The Black Crowes
ラブ・ドラマティック (Funky Flag Version) – Masayuki Suzuki, 伊原六花
スターマーカー (Album Mix) – KANA-BOON
When the Going Gets Tough, The Tough Get Going – Billy Ocean
```

Recommendation Examples - with weights

```
songs = [("Adele", "Rolling in the Deep"),
         ("Bruno Mars", "Just the Way You Are")]
print('Input songs: ')
print_songs(songs)
songs = recommender_sys.recommend(songs)
print('\nRecommended songs: ')
print_songs(songs)
```

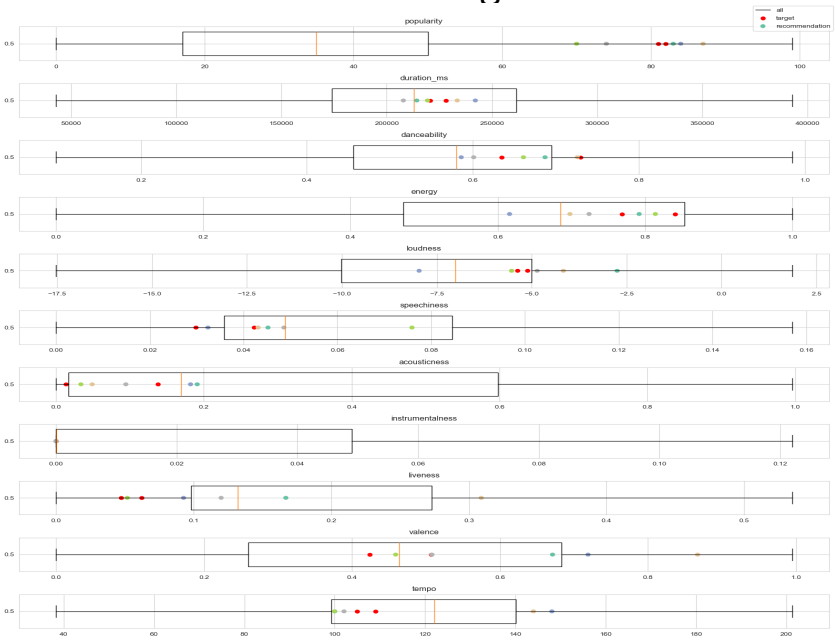
```
Input songs:
Rolling in the Deep – Adele
Just the Way You Are – Bruno Mars

Recommended songs:
Happier – Bastille, Marshmello
Leave The Door Open – Anderson .Paak, Bruno Mars, Silk Sonic
Capital Letters – BloodPop®, Hailee Steinfeld
Locked out of Heaven – Bruno Mars
Back To You – From 13 Reasons Why – Season 2 Soundtrack – Selena Gomez
```

```
songs = [("Adele", "Rolling in the Deep"),
         ("Bruno Mars", "Just the Way You Are")]
weights = {'artists': 2, 'popularity': 10, 'track_genre': 20}
print('Input songs: ')
print_songs(songs)
songs = recommender_sys.recommend(songs, weights=weights)
print('\nRecommended songs: ')
print_songs(songs)
```

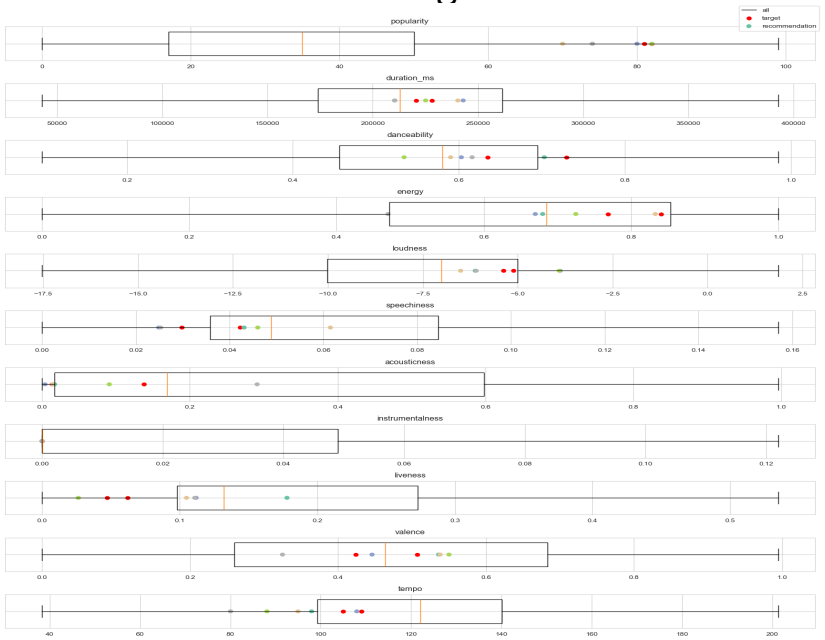
```
Input songs:
Rolling in the Deep – Adele
Just the Way You Are – Bruno Mars

Recommended songs:
Can I Get It – Adele
Set Fire to the Rain – Adele
Oh My God – Adele
Water Under the Bridge – Adele
Chasing Pavements – Adele
```

Recommendation Examples - with weights

without weights



with weights



Recommendation Examples - randomly choosing k songs from top n choices

```
songs = [("Eminem", "The Real Slim Shady"),
         ("Dr. Dre;Snoop Dogg", "Still D.R.E.")]
print('Input songs: ')
print_songs(songs)
songs = recommender_sys.recommend(songs)
print('\nRecommended songs: ')
print_songs(songs)
```

```
Input songs:
The Real Slim Shady - Eminem
Still D.R.E. - Dr. Dre;Snoop Dogg

Recommended songs:
What's The Difference - Dr. Dre, Eminem, Xzibit
Drop It Like It's Hot - Pharrell Williams, Snoop Dogg
Forgot About Dre - Dr. Dre, Eminem
Smack That - Akon, Eminem
Young, Wild & Free (feat. Bruno Mars) - Bruno Mars, Snoop Dogg, Wiz Khalifa
```

```
songs = [("Eminem", "The Real Slim Shady"),
         ("Dr. Dre;Snoop Dogg", "Still D.R.E.")]
print('Input songs: ')
print_songs(songs)
songs = recommender_sys.recommend(songs, k=7, random=True, top_n=10)
print('\nRecommended songs: ')
print_songs(songs)
```

```
Input songs:
The Real Slim Shady - Eminem
Still D.R.E. - Dr. Dre;Snoop Dogg

Recommended songs:
Forgot About Dre - Dr. Dre, Eminem
Superman - Dina Rae, Eminem
Young, Wild & Free (feat. Bruno Mars) - Bruno Mars, Snoop Dogg, Wiz Khalifa
2 Of Amerikaz Most Wanted (ft. Snoop Doggy Dogg) - 2Pac, Snoop Dogg
Drop It Like It's Hot - Pharrell Williams, Snoop Dogg
Gospel (with Eminem) - Dr. Dre, Eminem
Nuthin But A G'Thang - Snoop Dogg
```

Recommendation Examples - with all options

```
songs = [("Jay Chou", "青花瓷"),
         ("David Tao", "就是愛妳")]
weights = {'track_genre': 20}
filters={'popularity': {'gt': 50}}
print('Input songs: ')
print_songs(songs)
songs = recommender_sys.recommend(songs, k=7, filters=filters, weights=weights, random=True, top_n=10, seed=0)
print('\nRecommended songs: ')
print_songs(songs)
```

```
Input songs:
青花瓷 - Jay Chou
就是愛妳 - David Tao

Recommended songs:
小幸運 - Hebe Tien
剛好遇見你 - Li Yugang
情非得已 - Harlem Yu
愛笑的眼睛 - JJ Lin
櫻花草 - Sweety
親愛的那不是愛情 - Angela Chang
當你 - JJ Lin
```

Recommendation Examples - command line

Conclusion & Future Directions

- Add more data
- Use user history for personalization
- Group feature categories for better similarity scoring
- Build a user interface

Thank You!