Context-based Music Recommendation System

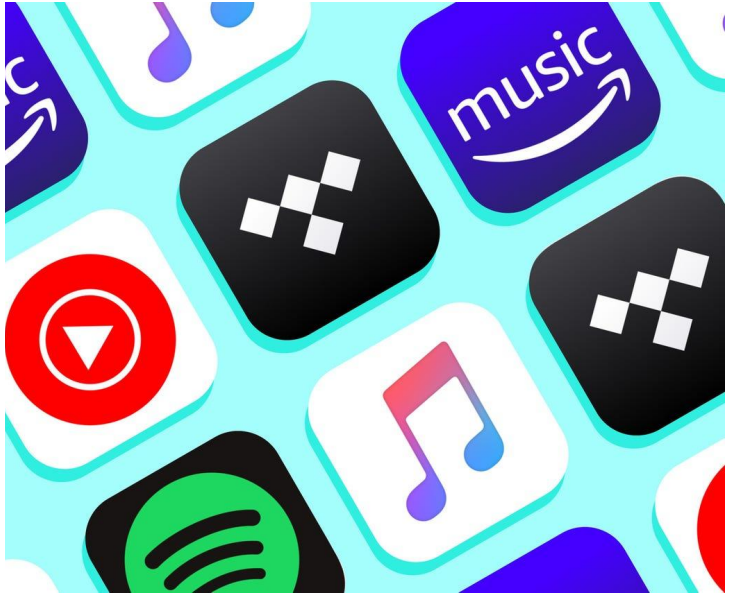
Team 6 - The United Nations

Introduction

Motivation

- Streaming services rely heavily on recommendation systems

- Traditional systems do not take in user context



Objectives

- Gather contextual data such as the current weather
- Classify mood
- Give more personalized recommendations that are more suitable to their situation

Related Works

Related Works

Mood-based

- Blog posts/ Social media
- chatbot

Environmental-based

- Time
- Location
- weather

Shortcomings:

- Too little categories
  - Weather types
  - mood
- Risk of using outdated information or irrelevant information

How is our approach different ?

Input: specific songs are chosen by the user

Other:

- No irrelevant data
- More mood classifications → Euphoric, Sad, Romantic, Happy, Focused, and Energetic
- More weather → clear rain, clouds, drizzle, atmosphere, thunderstorm

Data

Data

Problems

```
genre,artist_name,track_name,track_id,popularity,acousticness,danceability,
Movie,Henri Salvador,C'est beau de faire un Show,0BRjO6ga9RKCKjfDqeFgWV,0,0
Movie,Martin & les fées,Perdu d'avance (par Gad Elmaleh),0BjC1NfoEOOusryehm
Movie,Joseph Williams,Don't Let Me Be Lonely Tonight,0CoSDzoNIKCRs124s9uTVy
Movie,Henri Salvador,Dis-moi Monsieur Gordon Cooper,0Gc6TVm52BwZD07Ki6tIvf,
Movie,Fabien Nataf,Ouverture,0IuslXpMROHdEPvSl1fTQK,4,0.95,0.331,82625,0.22
Movie,Henri Salvador,Le petit souper aux chandelles,0Mf1jKa8eNAf1a4PwTbizj,
Movie,Martin & les fées,"Premières recherches (par Paul Ventimila, Lorie Pe
Movie,Laura Mayne,Let Me Let Go,0PbIF9YVD505GutwotpB5C,15,0.939,0.416,24006
Movie,Chorus,Helka,0ST6uPfvaPpJLtQwhE6KfC,0,0.00104,0.734,226200,0.481,0.00
Movie,Le Club des Juniors,Les bisous des bisounours,0VSqZ3KStsjcfERGdcWpFO,
Movie,Leopold Stokowski,Symphony No.4 In E Minor Op.98 : IV. Allegro Energi
Movie,Randy Newman,The Hanging (Maverick – Original Motion Picture Score) -
Movie,Idoles De La Musique,J'ai demandé à la lune,0jF6HUm18fg6QQCLHhfhC0,4,
Movie,Chorus,Mangala Aarti,0jIY0oRAp1T4mezDyEhOad,3,0.958,0.758,308627,0.26
```

- Lots of sources
- Inaccurate or incomplete data
- Non-relevant songs in dataset
- REST API is slow
- Web scraping unreliable
- Too much data needed
  - Min 100k songs

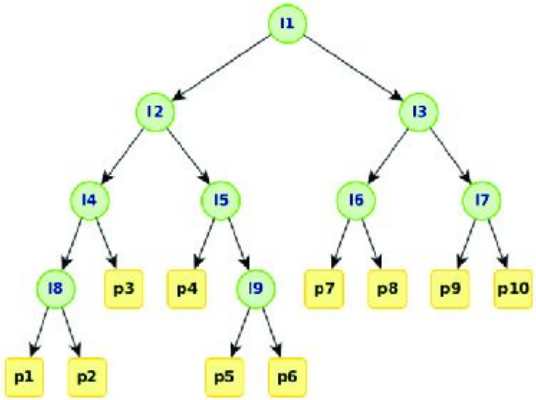
Solution

- Spotify songs
- Own database → fast
- Psycopg2 and spotipy
- Use premade CSV for db and REST if needed
- Easy data manipulation
- Most songs are relevant
  - 167k songs

id	danceability	energy	loudness	speechiness	acousticness	instrumentalness	liveness	valence	popularity	genre
0FazGsmQ8ePh8nU91BdVG2	0.708	0.673	-4.172	0.034	0.589	0	0.285	0.914	39	Country
1lUdXbhl6u6QMQZRTAhlWW	0.367	0.208	-16.734	0.0363	0.629	0.0584	0.106	0.663	68	Folk
3BT8hz7kFpxw8NbuBUobrS	0.256	0.211	-11.264	0.0365	0.949	0.785	0.104	0.0808	28	Anime

Solution

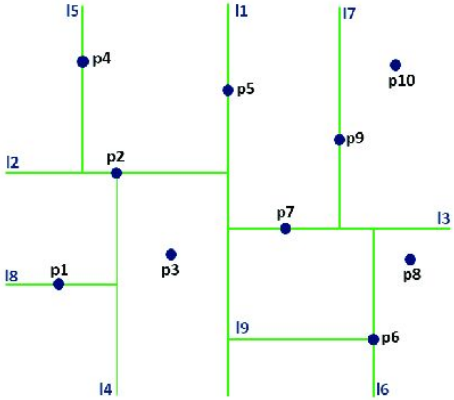
4.1 Models



Nearest Neighbors

- Unsupervised
- Clustering

- Sklearn function for implementing neighbor searches
- Uses KD_tree or BallTee algorithm
- Result of clustering: for each user song song there are lists with five neighbors → find best based on the smallest sum distance
- Final result: list of songs and for each song the 5 most suitable songs

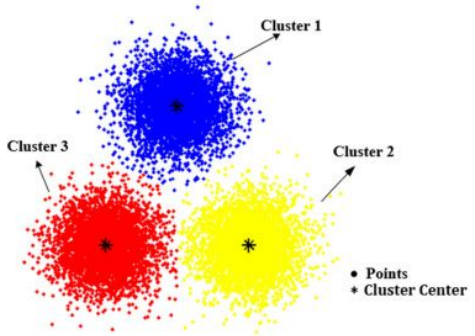


4.1 Models

KMeans

- Unsupervised
- Clustering

K-means is a centroid-based clustering algorithm, where we calculate the distance between each data point and a centroid to assign it to a cluster. The goal is to identify the K number of groups in the dataset.

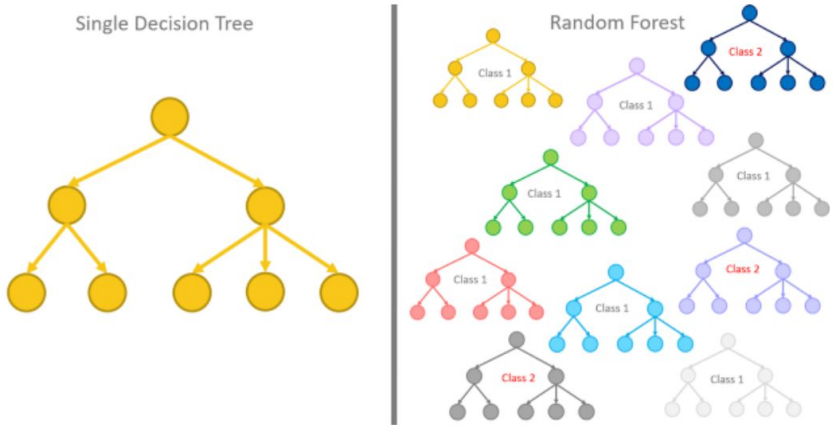


4.1 Models

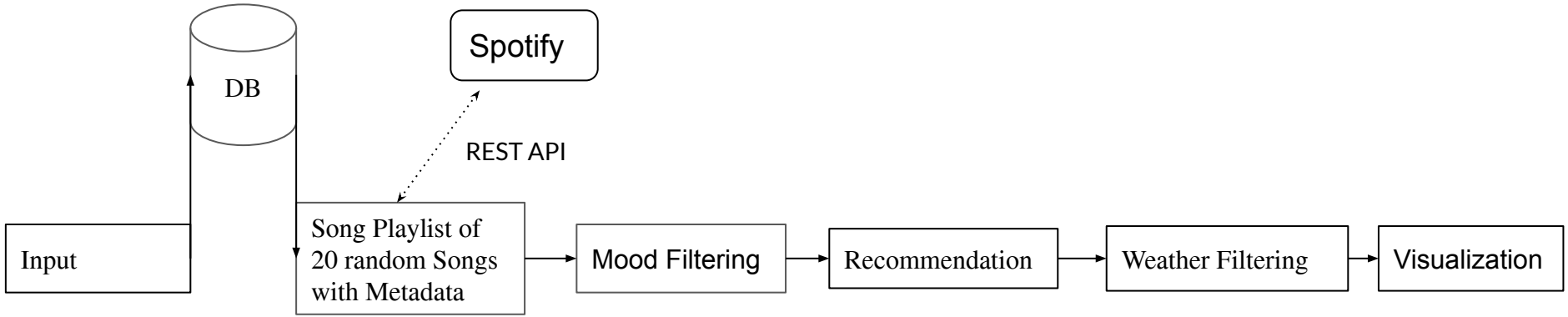
Random Forest

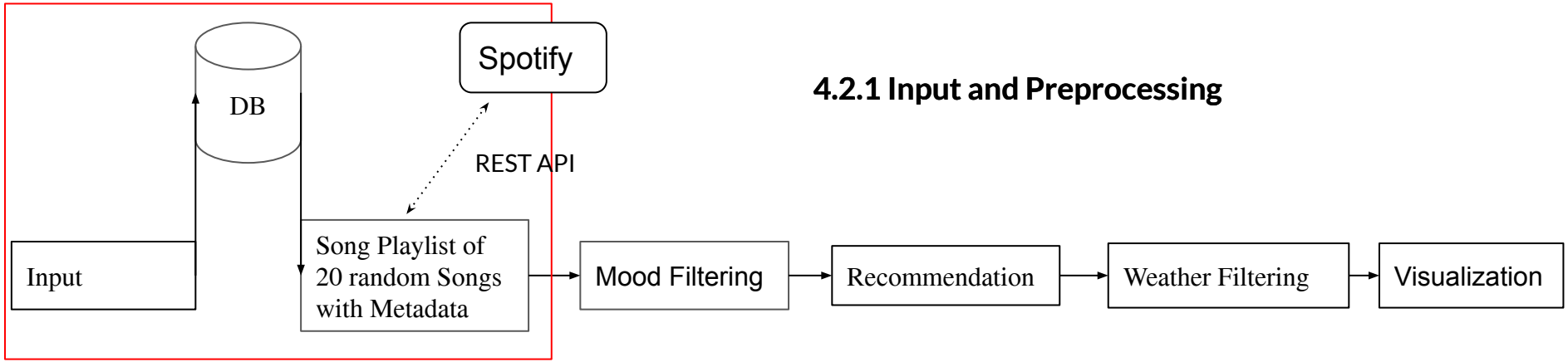
- Supervised Algorithm
- Consists of large number of decision trees.
- Classification

In random forest each decision tree produces a class prediction and the class prediction with the most votes becomes the models prediction.
In our recommendation system we use Random forest to predict th mood of a song. Mood categories are based on the features in the song metadata.



4.2 System Overview



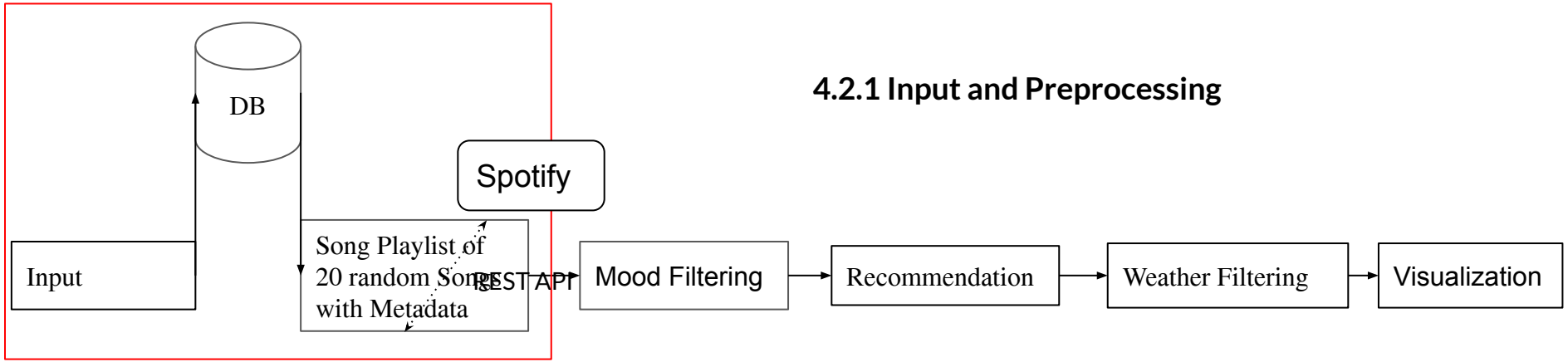


4.2.1 Input and Preprocessing

Input:

- CSV file with Spotify URI (Can be obtained from Spotify Scraper in the project)
- Type in song names

4.2.1 Input and Preprocessing



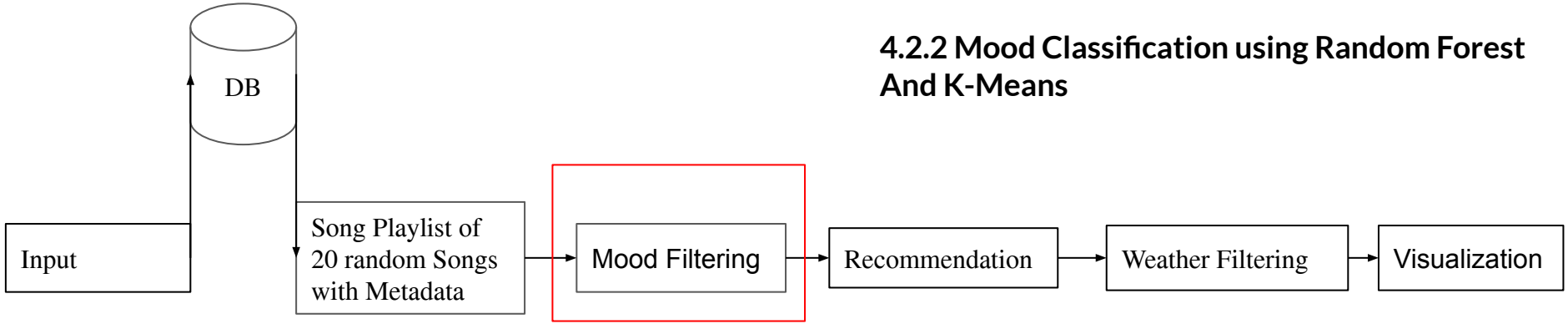
Preprocess

- 20 Random songs from the input
- Extract the Metadata from Database.

Metadata

1. Danceability
2. Energy
3. Loudness
4. Speechiness
5. Acousticness
6. Instrumentalness
7. Livenes
8. Valence
9. Popularity.

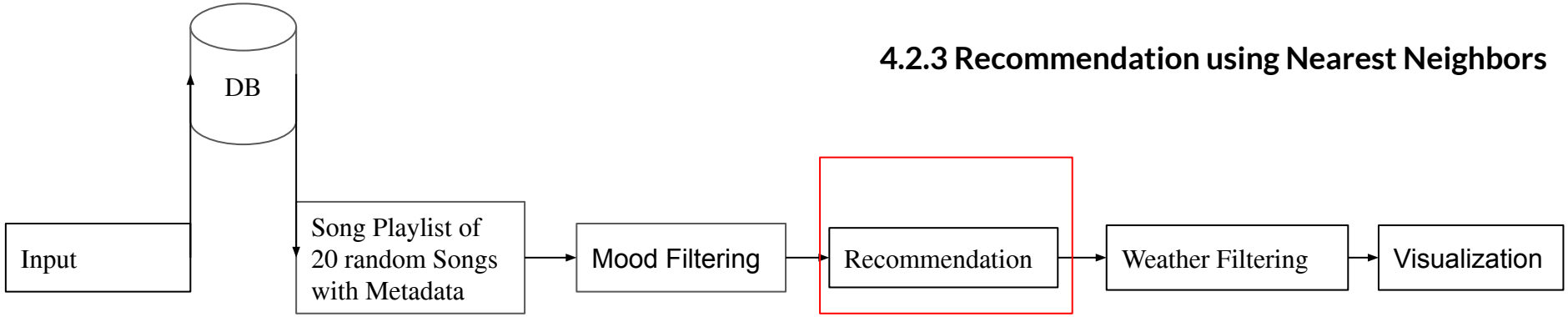
4.2.2 Mood Classification using Random Forest And K-Means



Mood Classification

- Classify the users mood into the following classification Using Random Forest and K-Means
  - Euphoric
  - Happy
  - Romantic
  - Sad
  - Focused
  - Energetic

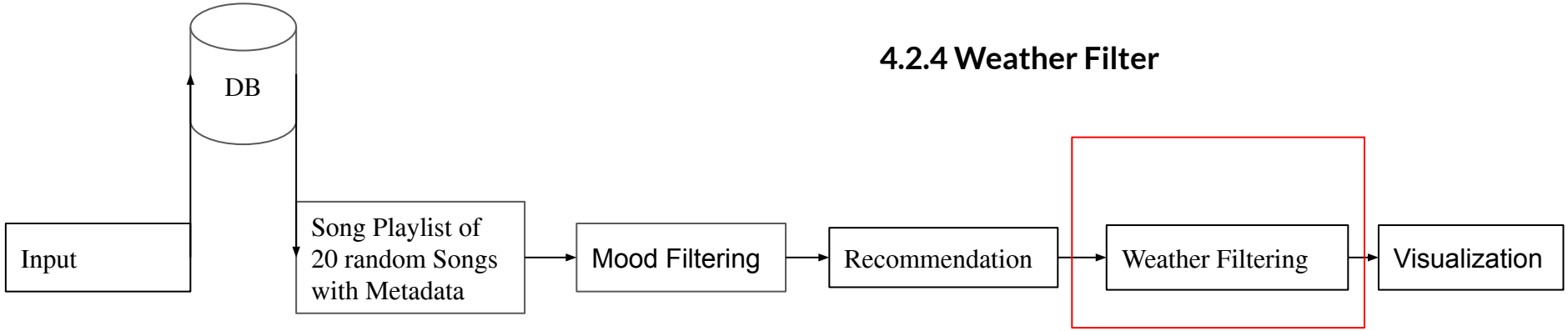
4.2.3 Recommendation using Nearest Neighbors



Song Recommendation:

- Preprocessing: standardize the features + apply weights
- Recommendation: using NearestNeighbors unsupervised neighbor searcher
    - BallTree or KDTree algorithms
- Result: 5 closest songs to each of users input playlist song
    - using the smallest distance function

4.2.4 Weather Filter

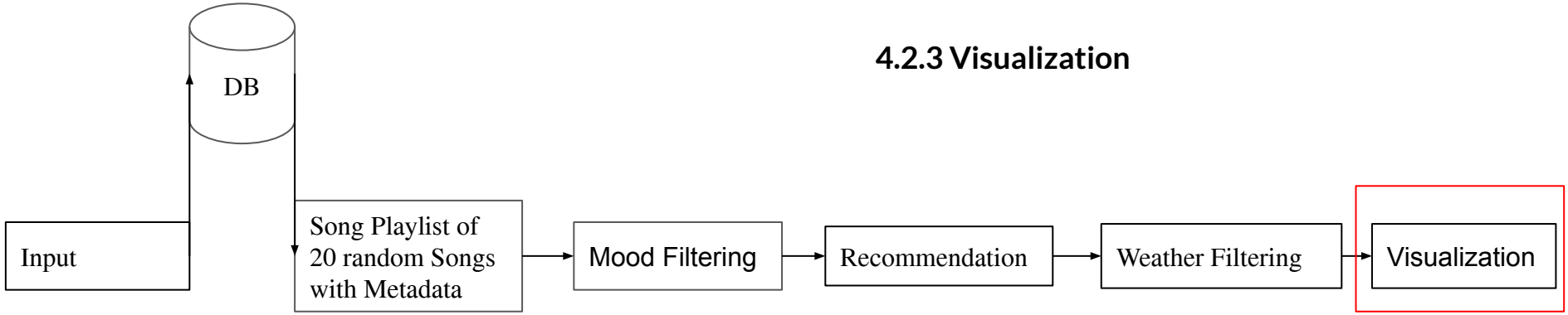


'Rain': [0.3, 0.4, 0]

Weather Filtering

- Based on the current weather of the users location, we add certain weights to energy, valence feature of the songs.
- Filter the obtained recommended list of songs

4.2.3 Visualization



URI	Artist	Song	Popularity	Genre	Mood
6MWtB6iiXyIwun0YzU6DFP	Post Malone	Wow.	99	Rap	Happy
6JQvHMSaR8fIFsN53ypOfP	Lil Mosey	Noticed	87	Rap	Sad
4hQ6UGyWQIGJmHSo0J88JW	Selena Gomez	Back To You - From 13 Reasons Why – Season 2 S...	84	Dance	Energetic
1XRgIKC5TPwo7nWGyKqgG0	Gucci Mane	I Get the Bag (feat. Migos)	79	Hip-Hop	Happy

Experiment & Results

Finding the Best K for the K-means Model

Evaluation metrics:

-Elbow method (not used)

-Silhouette Coefficient (used)

Preprocessing:

-Normalization (not used)

-StantardScaler (used)

Features = `["danceability",`

`"Energy",`

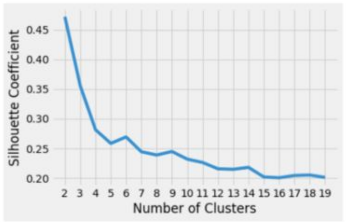
`"loudness",`

`"speechiness",`
`"acousticness",`
`"instrumentalness",`
`"liveness",`
`"valence",`
`]`

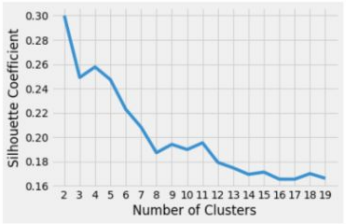
Results of Best K for K-means model

K=6, Preprocessing = Standardscaler, Features = `["speechiness", "acousticness","instrumentalness"]`

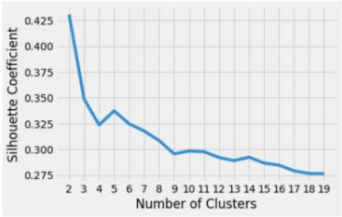
Silhouette score = 0.576



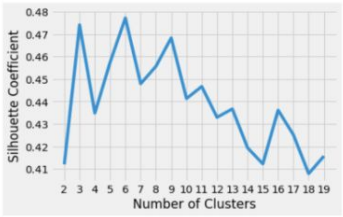
(a) Standardscaler with 8 features



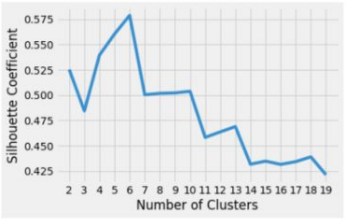
(b) Normalization with 8 features



(c) Standardscaler with 6 features

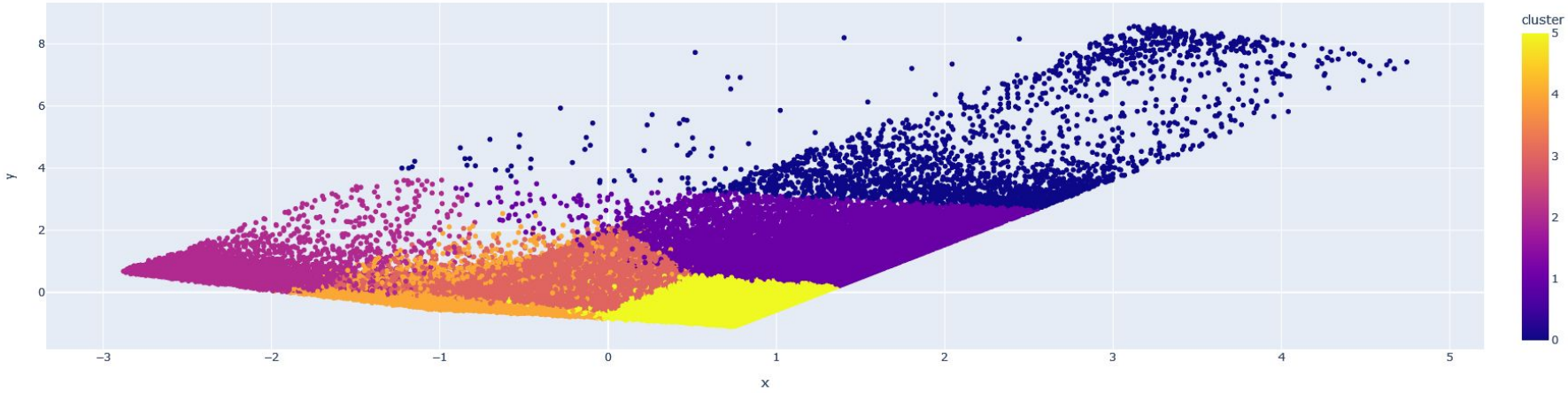


(d) Standardscaler with 4 features



(e) Standardscaler with 3 features

Visualization of the clustering



Predict the clustering

-RandomForestClassifier
-KNeighborsClassifier
-Multi-layer Perceptron classifier
-Support Vector Classifier

Model	Accuracy	Precision	Recall	F1 Score
RandomForestClassifier	0.9988	0.9988	0.9988	0.9988
KNeighborsClassifier	0.9974	0.9974	0.9974	0.9974
Support Vector Classifier	0.9987	0.9987	0.9987	0.9987
Multi-layer Perceptron classifier	0.9982	0.9982	0.9982	0.9982

Determining the mood of each cluster

-Mood playlists from Spotify

	Cluster 0	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Euphoric	0.51	0.17	0.00	0.00	0.00	0.32
Happy	0.01	0.65	0.00	0.00	0.00	0.34
Romantic	0.00	0.00	0.86	0.13	0.00	0.01
Sad	0.014	0.014	0.014	0.74	0.00	0.21
Focused	0.0	0.0	0.25	0.03	0.65	0.07
Energetic	0.00	0.12	0.0	0.05	0.00	0.83

Discussion

Discussion

Problems Faced

- Insufficient data

Solution

- API calls + premade datasets

Limitations

- Size of database
- Number of weather and emotion types

	Cluster 0	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Count	2542	17542	21651	38344	12398	74623

Limitations:

- Mood prediction

	Cluster 0	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Euphoric	0.51	0.17	0.00	0.00	0.00	0.32
Happy	0.01	0.65	0.00	0.00	0.00	0.34
Romantic	0.00	0.00	0.86	0.13	0.00	0.01
Sad	0.014	0.014	0.014	0.74	0.00	0.21
Focused	0.0	0.0	0.25	0.03	0.65	0.07
Energetic	0.00	0.12	0.0	0.05	0.00	0.83

Future Work

- Expand on the number of emotion and weather types
- Be able to recommend songs from a bigger dataset

Thank you!