# MILESTONE 1 - Data Visualization (COM-480)

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## TITLE

How do we link a song's mood to our emotions, and are these connections valid?

## DATASET

### Playlists

URL : https://www.aicrowd.com/challenges/spotify-million-playlist-dataset-challenge

Description : The dataset contains 1,000,000 playlists, including **playlist titles** and **track titles**, created by users on the Spotify platform between January 2010 and October 2017.

Preprocessing : The dataset is in JSON format, so we will only retrieve the name and id of the playlists and the tracks contained in these playlists. We will create a file in .csv format, in the form (playlist_id, playlist_name, track_id, track_name). This will allow us to easily identify which playlists the tracks belong to and which tracks appear together frequently in Spotify users' playlists.

### Tags

URL : MuSe: The Musical Sentiment Dataset | Kaggle

Description : The MuSe dataset contains sentiment information for 90,001 songs. Each track is associated with **social tags**, which have seeded the scraping of the latter on Last.fm.

Preprocessing : We will base our study on the tracks of this dataset. We only keep the track name, artist, genre, tags and spotify_id. This last one will allow us to complete the dataset with the audio features of the tracks retrieved from the Spotify API.

### Emotions

URL : https://saifmohammad.com/WebPages/NRC-Emotion-Lexicon.htm

Description : Manually generated dataset containing a list of **words** and their associations with eight basic **emotions** : disgust, joy, sadness, surprise, trust, anticipation, anger, fear plus two sentiments, positive and negative.

Preprocessing : We convert the file into a dataframe and remove the rows where all basic emotions are set to zero. Words that do not appear in the tags studied are also removed. This dataframe will be used to associate emotions with each track in the ***Tags*** dataset based on their tags.

## PROBLEMATIC

Through this project, we want to visualise the link between music and emotion.

We want to show how the different groups of tracks characterised by the same emotion are related to each other. Are the tracks belonging to the same playlist associated with the same emotions ? Can we notice a trend in the association of emotions among the playlists ? If yes, what are the different trends ? We also want to see if people create playlists randomly or if they pay attention to the emotions of the chosen tracks.

Another point that we want to underline with this project is the clustering of tracks by emotions. More precisely, we want to create clusters based, in part, on the theory of Robert Plutchik : Robert Plutchik - Wikipedia. We want to classify our tracks based on eight basic emotions (disgust, joy, sadness, surprise, trust, anticipation, anger and fear) and eight mixed emotions (love, submission, awe, disapproval, remorse, contempt, aggressiveness and optimism).

The aim of this process is to analyse how these clusters are composed. What are the different artists ? How are the genres distributed across the emotions? Do the tracks share common musical features ? Are there any predominant emotions among the tracks ? How balanced are the clusters ?

The motivation for this project is based on the fact that all three of us are music lovers. Finding a connection between music and emotions interested us.

In addition to that, this project does not require a deep knowledge of music because everyone feels emotions when listening to music. This last point makes our project accessible to everyone.

## EXPLORATORY DATA ANALYSIS

### PLAYLISTS :

After building a dataframe with columns (playlist_id, playlist_name, track_id, track_name) from the JSON file, we created the following graph to model the associations between tracks in Spotify playlists:

- Nodes: tracks
- Weighted edge (u,v) ⇔ tracks u and v appear in same playlist (weight = # playlists they appear together)

## TAGS :

We keep the tracks that have a Spotify ID and fetch their audio features through the Spotify API to enrich our data. Since a track can have multiple tags, we use Pandas' pd.explode() to create multiple rows for each track, each containing a single tag. We then determine the number of occurrences of each tag in the whole dataset and keep only those that appear more than 50 times. Tracks that no longer have associated tags are removed. We also store all the (unique) tags in a set for future use.

## EMOTIONS :

After selecting the words of interest ("tags" of the tracks studied), we associate them with an "emotion vector" where each binary component characterises one of the 8 basic emotions: 1 if the word conveys the emotion, 0 otherwise. We merge these vectors to the Tracks dataset based on the tag attribute. Each track is therefore associated with one or more "emotion vectors", which we sum together to obtain a single vector v.

We then simplify the vectors to make them similar for several tracks.

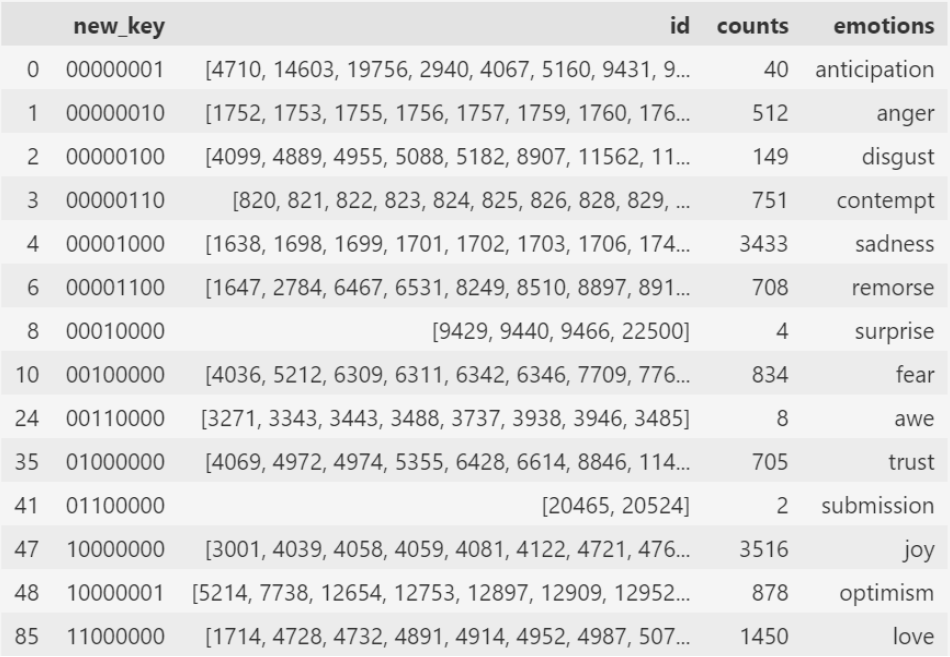
To do this:

– We create a binary vector $w$, s.t. $wi = \begin{cases} 1 & \text{if } i = \text{argmax}_k\, v, \\ 0 & \text{otherwise} \end{cases}$

– We retain only the simplified vectors that correspond to the emotions targeted by Plutchik (basic and mixed emotions)

Finally, we group the data by their emotion vector to obtain clusters of tracks according to their principal sentiment. The final dataset thus contains an "emotions" column that associates one of the emotions introduced by Plutchik to each track.

The graph below shows each mixed and basic emotion along with the number of tracks (and theirs ids) associated to it.



| | new_key | id | counts | emotions |
|---|---|---|---|---|
| 0 | 00000001 | [4710, 14603, 19756, 2940, 4067, 5160, 9431, 9... | 40 | anticipation |
| 1 | 00000010 | [1752, 1753, 1755, 1756, 1757, 1759, 1760, 176... | 512 | anger |
| 2 | 00000100 | [4099, 4889, 4955, 5088, 5182, 8907, 11562, 11... | 149 | disgust |
| 3 | 00000110 | [820, 821, 822, 823, 824, 825, 826, 828, 829, ... | 751 | contempt |
| 4 | 00001000 | [1638, 1698, 1699, 1701, 1702, 1703, 1706, 174... | 3433 | sadness |
| 6 | 00001100 | [1647, 2784, 6467, 6531, 8249, 8510, 8897, 891... | 708 | remorse |
| 8 | 00010000 | [9429, 9440, 9466, 22500] | 4 | surprise |
| 10 | 00100000 | [4036, 5212, 6309, 6311, 6342, 6346, 7709, 776... | 834 | fear |
| 24 | 00110000 | [3271, 3343, 3443, 3488, 3737, 3938, 3946, 3485] | 8 | awe |
| 35 | 01000000 | [4069, 4972, 4974, 5355, 6428, 6614, 8846, 114... | 705 | trust |
| 41 | 01100000 | [20465, 20524] | 2 | submission |
| 47 | 10000000 | [3001, 4039, 4058, 4059, 4081, 4122, 4721, 476... | 3516 | joy |
| 48 | 10000001 | [5214, 7738, 12654, 12753, 12897, 12909, 12952... | 878 | optimism |
| 85 | 11000000 | [1714, 4728, 4732, 4891, 4914, 4952, 4987, 507... | 1450 | love |

## RELATED WORK

The paper related to the dataset ***Playlist*** is Recsys challenge 2018 | Proceedings of the 12th ACM Conference on Recommender Systems. We can find this dataset on AIcrowd. This dataset was used for a challenge called ***Spotify One Milion Playlist Dataset Challenge.*** The purpose of this challenge was to use this dataset in order to develop a system for the task of automatic playlist continuation. More especially, the system should choose new tracks to add into a given dataset according to its composition.

The ***Emotions*** dataset is based on the two works done here https://saifmohammad.com/WebDocs/Mohammad-Turney-NAACL1EmotionWorkshop.pdf and here https://arxiv.org/pdf/1308.6297.pdf. This dataset is used for applications like works on computational literature. For example, the work From Once Upon a Time to Happily Ever After: Tracking Emotions in Novels and Fairy Tales use this dataset for sentiment analysis into both individual books and very large collections of books.

The work that explains the creation of the ***Tags*** dataset is explained here Toward a Musical Sentiment (MuSe) Dataset for Affective Distant Hearing.

Our approach is original because we base our project on three different datasets and we mix their information. Further, we add a new feature to the tracks based on Robert Plutchik's theory of emotions in order to visualise music from a different angle. What also makes our project interesting is that we want to mix two different types of visualisation into one. Thus, or project is inspired by visualisation like Plutchik's Wheel of Emotions: Feelings Wheel • Six Seconds and Hierarchical edge bundling – from Data to Viz.