Mood Detection with **Music Recommendation System**

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MSDS 692 : DATA SCIENCE PRACTICUM

WHY?

Globally

18

Hours per **week**
Spent listening to
Music

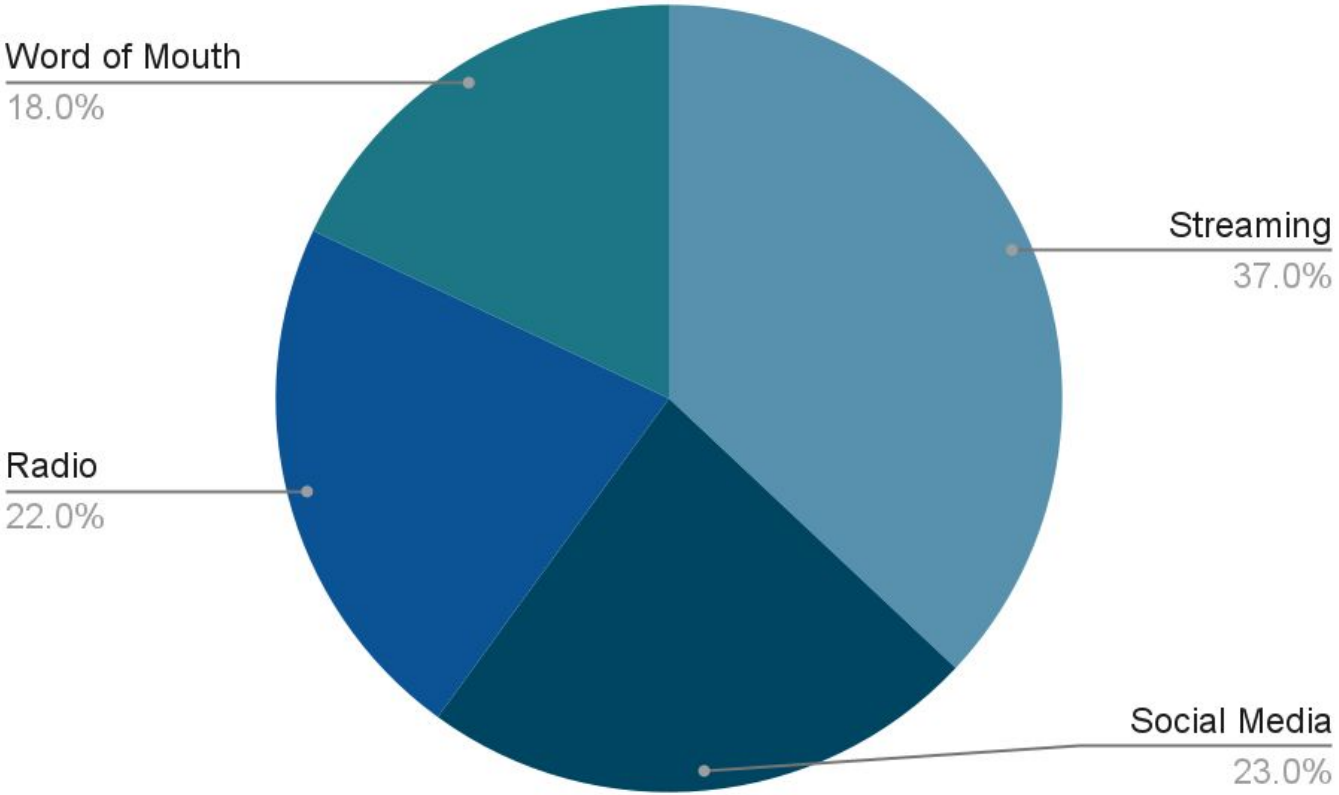
Over

106,000

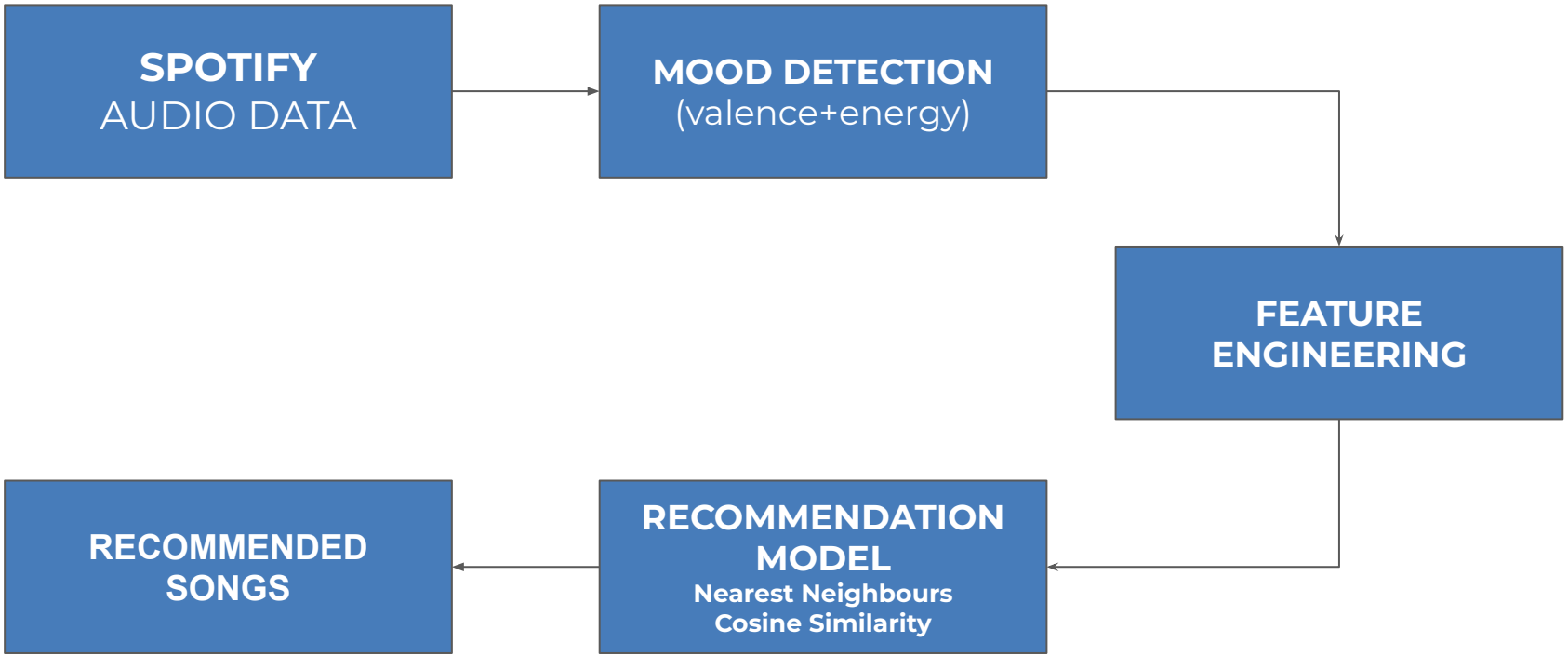
Songs are **uploaded** on
Streaming Platforms
Everyday

Source : Luminate

Music Discovery Sources



PROJECT **OVERVIEW**



DATASETS USED

- **2 Spotify Datasets** from **Kaggle**
- Over **107,000** songs combined
- **Audio features** describing **musical characteristics**
- **Valence, Energy, Danceability, Tempo,** and **Loudness**
- **Cleaned, standardized**, and **merged** before **analysis**

DATASETS CLEANING

- Loaded **Spotify dataset** containing song **audio features**
- Removed **unnecessary** metadata columns
- **Selected** key audio **features**
- **Checked and handled** missing values
- Standardized **features using scaling**

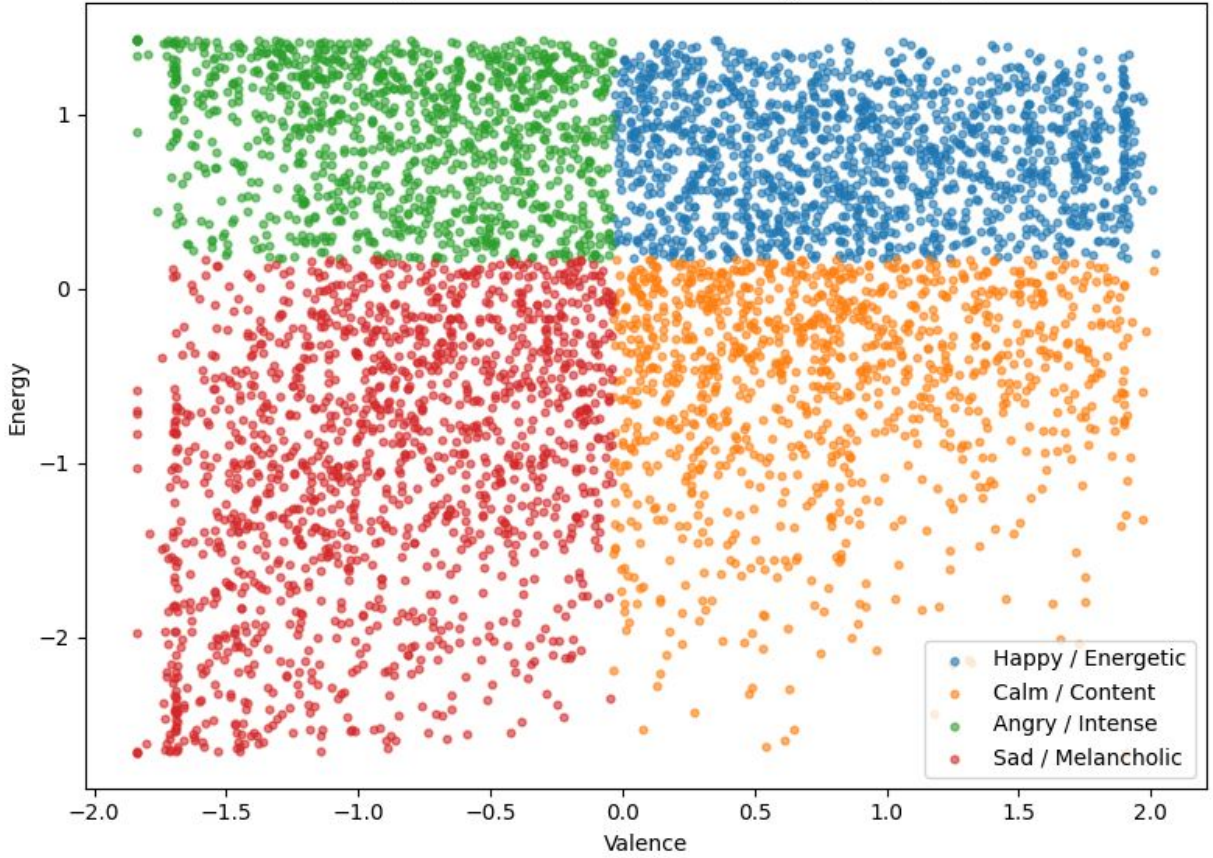
MOOD DETECTION METHOD

- **Inferred** using the audio features
- Two features : **Valence and Energy**
- **Valence** shows **happiness** of a song
- **Energy** shows **intensity** of a song
- **Four mood** groups based on **median thresholds**

MOOD LABELS

VALENCE	**ENERGY**	**MOOD**
HIGH	HIGH	**HAPPY/ENERGETIC**
HIGH	LOW	**CALM/CONTENT**
LOW	HIGH	**ANGRY/INTENSE**
LOW	LOW	**SAD/MELANCHOLIC**

MOOD CATEGORIES



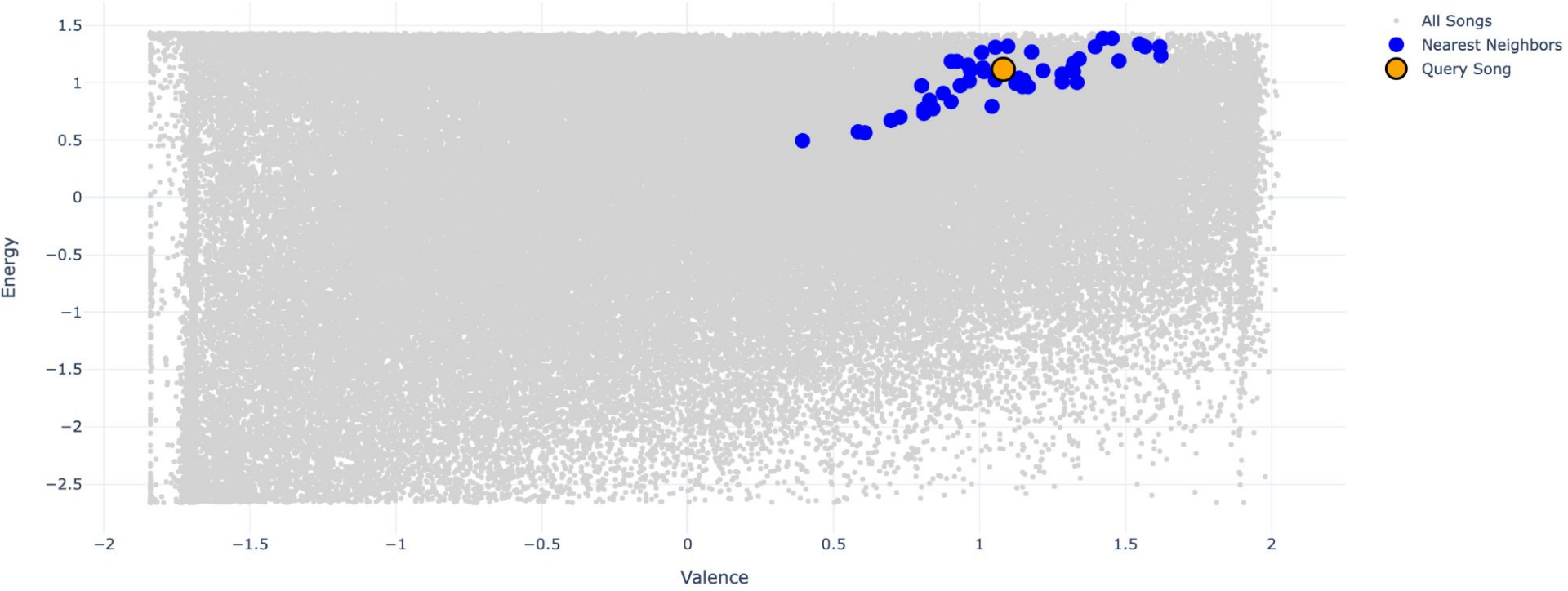
RECOMMENDATION MODEL

- Songs represented as a vector of **audio features**
- **Valence, Energy, Danceability, Tempo,** and **Loudness**
- **Standardized** using **StandardScaler** to normalize values
- Level of similarity measured using **Cosine Similarity**
- **Nearest Neighbors** model returns the most similar songs

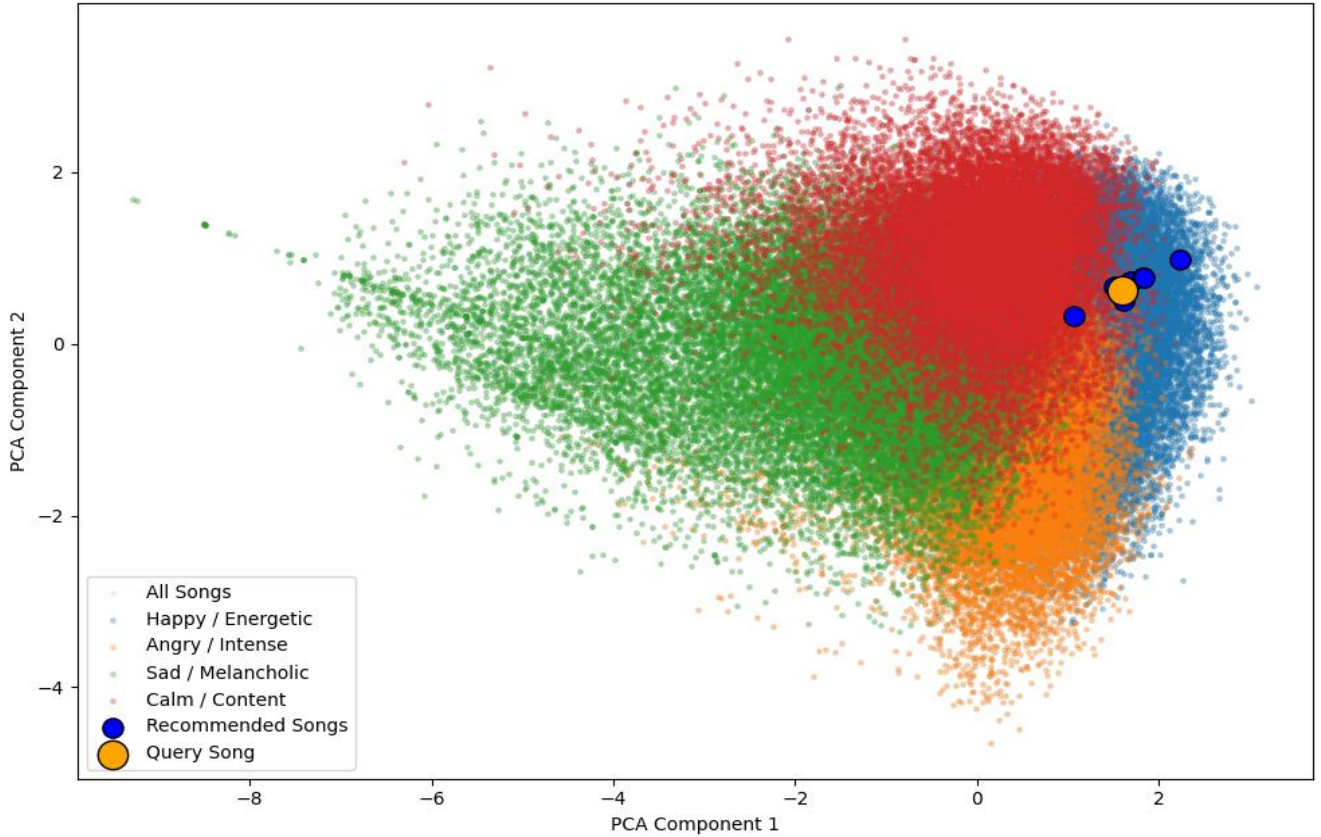
RECOMMENDATION EXAMPLE

song_index	track_name	track_artist	mood_label	valence	energy	danceability	tempo	loudness	similarity_score
45901	Headnoise (Get Hype)	Martin Ikin;Dope Earth Alien	Happy / Energetic	1.454122	1.388470	0.694685	0.071617	0.440418	0.998817
52417	Hay una Luz	Miranda!	Happy / Energetic	0.875147	0.909240	0.420723	0.072774	0.199528	0.997037
41934	Dogs, Dogs and More Dogs	Tommy Ryman	Happy / Energetic	0.583716	0.573369	0.300865	-0.044908	0.236384	0.996384
38169	Shadows of Your Love	J.M. Silk	Happy / Energetic	1.053891	1.023928	0.426431	-0.074822	0.410892	0.994956
22892	All Mine	Chris Goldarg	Happy / Energetic	1.217092	1.105847	0.609072	-0.066280	0.230683	0.994739
92387	GET UP - Remastered 2022	Eikichi Yazawa	Happy / Energetic	0.960633	1.154999	0.403601	0.007229	0.353877	0.994402
85631	Frei für Dich - Radio Version	Wolfgang Petry	Happy / Energetic	0.809089	0.733112	0.380771	0.057324	0.148214	0.994183
37672	It's Alright (feat. Paris Brightledge) - Radio...	Sterling Void	Happy / Energetic	0.828518	0.847800	0.409308	-0.052259	0.391140	0.994113
46521	In Da Jungle - Elliot Fitch Remix	Orlando Voorn;Elliot Fitch	Happy / Energetic	1.566808	1.314743	0.711808	0.107045	0.503746	0.994012
85487	Sowieso für dich das Letzte	Matthias Reim	Happy / Energetic	1.395836	1.314743	0.574827	0.124673	0.557910	0.993867

RECOMMENDATION EXAMPLE



MUSIC MAP


All Songs
Happy / Energetic
Angry / Intense
Sad / Melancholic
Calm / Content
Recommended Songs
Query Song
PCA Component 1
PCA Component 2
2
0
−2
−4
−8
−6
−4
−2
0
2

MODEL **EVALUATION**

- **Mood Only & Extended Audio Features**
- **4 Metrics** Used
- **Mood Consistency**
- **Average Similarity**
- **Intra-List Similarity (ILS)**
- **Catalog Coverage**

RESULTS

	MOOD ONLY	EXTENDED AUDIO FEATURES
K	10	10
Mood Consistency	0.9497	0.9423
Average Similarity	1.000	0.994
Intra-List Similarity	1.000	0.9888
Catalogue Coverage	0.0898	0.0895
Coverage Sample	1000	1000
Songs Used	106555	106555
Features Used	Valence, Energy	Valence, Energy, Danceability, Tempo, Loudness

SUBJECTIVE **EVALUATION**

- **Cosine similarity** to measure **song similarity**
- **Comparison** based on Similarity Angle
- **Verified s**imilar songs shared comparable **features**
- Evaluated consistency of **nearest-neighbor recommendations**

BENCHMARK EVALUATION

- Reviewed recommended songs **manually** for musical similarity
- Recommended songs have the expected mood category
- Verified audio features **similarity**
- Suggested songs were **coherent**

KEY **FINDINGS**

- **Mood features** effectively capture **song emotions**
- **Nearest neighbors** works well **music similarity**
- **Similar** songs **cluster** closely **feature space**
- **Audio features** enable meaningful **music recommendations**
- **Feature selection** influences **recommendation** diversity balance

CONCLUSION & FUTURE WORKS

- **Audio features** enable mood-based recommendations
- **Model retrieves** similar songs effectively
- **System** can work on **large music datasets**
- **Apply deep learning embeddings** for music features
- Incorporate **lyrics-based mood detection**
- Build **real-time streaming recommendation** pipeline

QUOTE

“A wrong note played with the right intention is much to be preferred to the right note played with no soul.”

-Janine Jansen

THANK YOU!