Music Classification with PCA and K Means

COGS 118B

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Motivation

An abundance of vocaloid edm songs, manual search is not scalable

Need a better recommender system

Use signal analysis and clustering techniques to create recommender profiles

Related work

PCA

- Dimensionality reduction from signal features

KMeans Clustering

- Identify different groups in component space

Related Literature:

Audio feature reduction and analysis for automatic music genre classification

- MRMR, minimum redundancy maximum relevance
- SVM

https://ieeexplore.ieee.org/document/6973950?arnumber=6973950

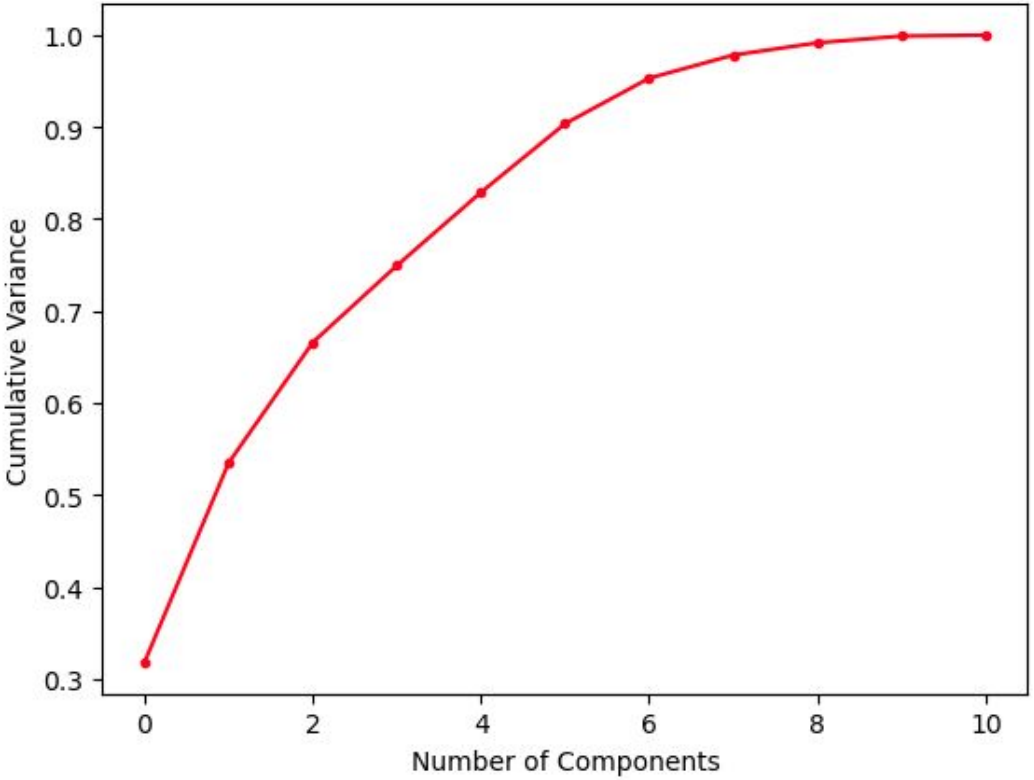
Methods

- Pull signal features from songs via spotify api
- Standardize data and fit to sklearn pca model
- Find ‘optimal’ number of principal components with 80% explained variance threshold
- Run Kmeans to fit centroids, identify clusters

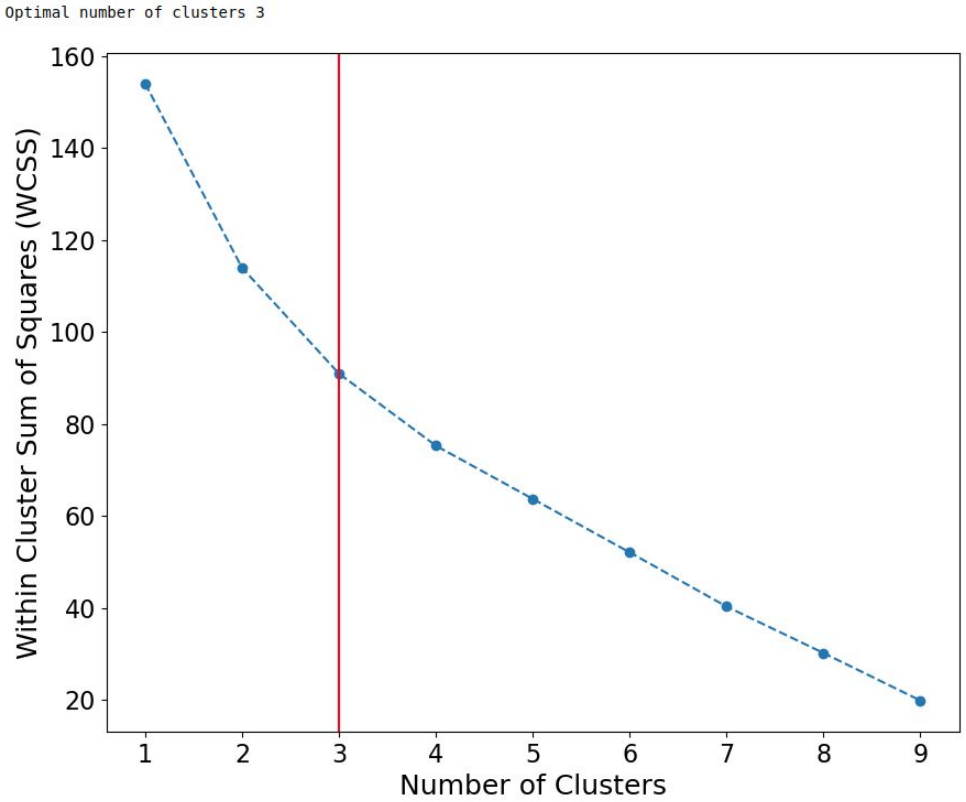
Extracted feature data

	danceability	energy	key	loudness	mode	speechiness	acousticness	instrumentalness	liveness	valence	tempo
0	0.519	0.958	6.0	-2.522	1.0	0.0619	0.024100	0.000000	0.0724	0.1700	139.985
1	0.625	0.920	2.0	-7.363	1.0	0.0492	0.033800	0.868000	0.1140	0.2990	128.001
2	0.623	0.861	2.0	-5.605	1.0	0.0332	0.025700	0.011600	0.1390	0.7250	100.023
3	0.509	0.883	5.0	-3.898	0.0	0.0409	0.000745	0.000034	0.2760	0.0588	173.980
4	0.524	0.967	7.0	-4.376	0.0	0.0372	0.006250	0.095400	0.1070	0.0702	132.001
5	0.417	0.999	7.0	-4.052	0.0	0.0613	0.000068	0.966000	0.4240	0.2530	138.005
6	0.562	0.976	1.0	-6.168	1.0	0.0452	0.000277	0.674000	0.7030	0.4660	138.004
7	0.524	0.993	6.0	-6.243	0.0	0.0734	0.000097	0.615000	0.1430	0.3980	138.000
8	0.497	0.960	3.0	-6.488	0.0	0.0465	0.000102	0.082700	0.0593	0.3390	134.980
9	0.506	0.968	2.0	-5.678	0.0	0.0523	0.000186	0.157000	0.3710	0.1590	137.993
10	0.631	0.944	0.0	-5.820	0.0	0.0527	0.015800	0.011400	0.2930	0.9580	133.001
11	0.496	0.807	3.0	-4.523	1.0	0.0438	0.000611	0.000011	0.1480	0.3830	129.958
12	0.510	0.978	5.0	-1.843	1.0	0.0863	0.023400	0.000000	0.0948	0.5220	130.963
13	0.470	0.943	8.0	-5.383	1.0	0.1470	0.003800	0.003030	0.0939	0.1420	130.991

Principle Component selection

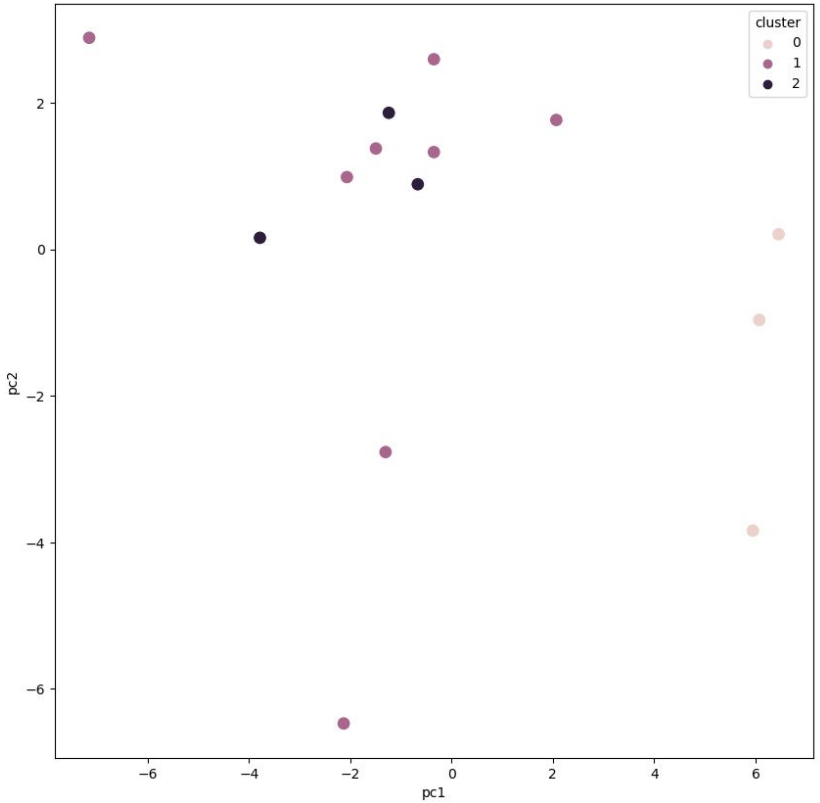


Kmeans cluster selection



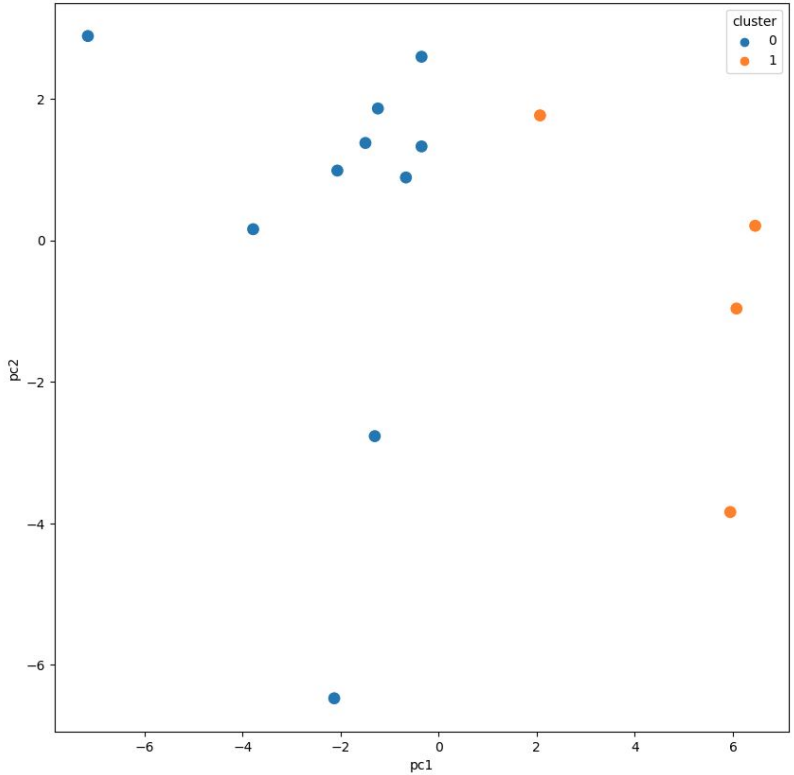
Results: K = 3

	name	artists	music_uri	pc1	pc2	cluster
1	Perforation	Clean Tears	spotify:track:7bTI1JD4gZAJXccmHNndCy	6.074445	-0.964264	0
2	Heart (feat. 初音ミク)	Clean Tears	spotify:track:3sTKNq4PseeXoeP35E5NJ0	5.947232	-3.839649	0
10	Light Song - Hiroyuki ODA remix	livetune	spotify:track:6fpECq2gyhlhDYXcCAHxTN	6.456086	0.205385	0
3	Acceleration (Breeze Remix)	Clean Tears	spotify:track:207DIUqvLlPfYdYNSB3MRR	-1.303938	-2.767471	1
4	come to the surface (Deep Reflection Remix)	Clean Tears	spotify:track:0dMTNpI1Lygf55VmWSnoNk	-0.349837	1.326298	1
5	Polaris	Hiroyuki Oda	spotify:track:7vY0SkxUvdahT9IGPHI6bx	-7.155760	2.885829	1
6	The Endless Love (Original Mix)	HSP	spotify:track:3DjygsFAjgIrgK7Uo8gNhf	2.067220	1.764916	1
7	インカーネイション (Original Mix)	HSP	spotify:track:69q2vVFeMPBoomX65AzDwo	-0.349837	2.593417	1
8	Dreamscape (TeigakuP Remix)	Clean Tears	spotify:track:52MgHxF7mvQfVIS5TFZ4pm	-2.067220	0.985150	1
9	Inverse Relation (HSP Remix)	Clean Tears	spotify:track:0u0ZyrLLEwz3KPqikEr4Sh	-1.494759	1.375033	1
11	Light Song	livetune	spotify:track:1d6EatnCY8nH2YltbnU0Du	-2.130826	-6.471358	1
0	MEDIUS LOCUS ~EXORDIUM	AVTechNO!	spotify:track:3rdlSpUHpP4rxYAKSsILaM	-0.667871	0.887680	2
12	Pink or Black	livetune	spotify:track:1FHxUuZIqbJRDqtl9FnBbu	-1.240332	1.862386	2
13	our music	livetune	spotify:track:4HfGSKj8g9Gxb10L9PjQHh	-3.784602	0.156649	2



Results: K = 2

	name	artists	music_uri	pc1	pc2	cluster
0	MEDIUS LOCUS ~EXORDIUM	AVTechNO!	spotify:track:3rdlSpUHpP4rxYAKSsILaM	-0.667871	0.887680	0
3	Acceleration (Breeze Remix)	Clean Tears	spotify:track:207DlUqvLlPfYdYNSB3MRR	-1.303938	-2.767471	0
4	come to the surface (Deep Reflection Remix)	Clean Tears	spotify:track:0dMTNpl1Lygf55VmWSnoNk	-0.349837	1.326298	0
5	Polaris	Hiroyuki Oda	spotify:track:7vY0SkxUvdahT9IGPHI6bx	-7.155760	2.885829	0
7	インカーネイション (Original Mix)	HSP	spotify:track:69q2vVFeMPBoomX65AzDwo	-0.349837	2.593417	0
8	Dreamscape (TeigakuP Remix)	Clean Tears	spotify:track:52MgHxF7mvQfVIS5TFZ4pm	-2.067220	0.985150	0
9	Inverse Relation (HSP Remix)	Clean Tears	spotify:track:0u0ZyrLLEwz3KPqikEr4Sh	-1.494759	1.375033	0
11	Light Song	livetune	spotify:track:1d6EatnCY8nH2YltbnU0Du	-2.130826	-6.471358	0
12	Pink or Black	livetune	spotify:track:1FHxUuZlqbJRDqtl9FnBbu	-1.240332	1.862386	0
13	our music	livetune	spotify:track:4HfGSKj8g9Gxb10L9PjQHh	-3.784602	0.156649	0
1	Perforation	Clean Tears	spotify:track:7bTI1JD4gZAJXccmHNndCy	6.074445	-0.964264	1
2	Heart (feat. 初音ミク)	Clean Tears	spotify:track:3sTKNq4PseeXoeP35E5NJ0	5.947232	-3.839649	1
6	The Endless Love (Original Mix)	HSP	spotify:track:3DjygsFAjgIrgK7Uo8gNhf	2.067220	1.764916	1
10	Light Song - Hiroyuki ODA remix	livetune	spotify:track:6fpECq2gyhlhDYXcCAHxTN	6.456086	0.205385	1



Learnings

- Higher fidelity signal features, frequency domain (global), wave transforms (local)
- SVM could categorize better given the nature of the feature set, improves on Kmeans clustering
- Importance of data quality and assumptions on the data and model being used