

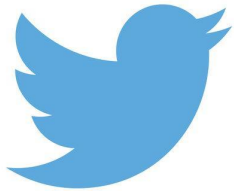
The background image shows a DJ's perspective of a nightclub. In the foreground, a Traktor DJ mixer is illuminated with blue and red lights. To its right, a laptop displays a software interface with various waveforms and data. In the background, a person is seen playing a guitar, and the club's atmosphere is filled with blurred lights and other patrons.

# Clustering de canciones usando Fourier

*Carlos Perales González*

# ¿Quién soy?

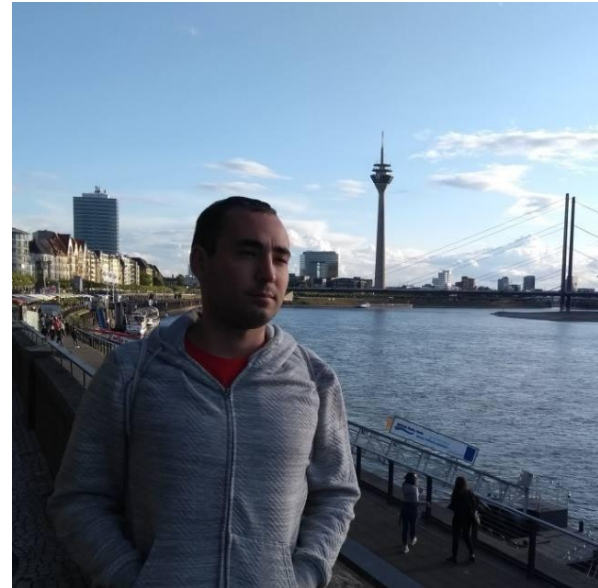
- Graduado en Física (UCO)
- Máster en Ingeniería Matemática (UCM)
- Doctorando en Ciencia de los Datos (Universidad Loyola Andalucía)



[@relampague](#)



[@cperales](#)





Cambiar

USUARIO

# Carlos Perales



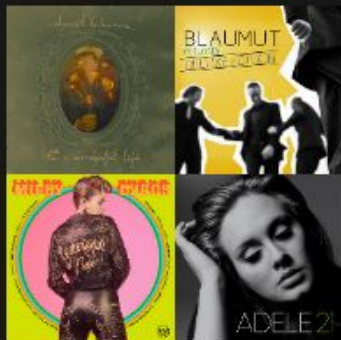
GENERAL

ARTISTAS ESCUCHADOS RECIENTEMENTE

PLAYLISTS PÚBLICAS

SIGUIENDO (81)

MÁS



Bajo

0 SEGUIDORES



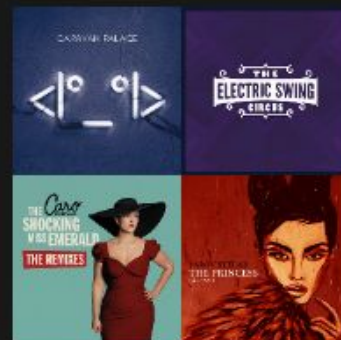
Español

0 SEGUIDORES



SSR - Slow and Strong Rock

0 SEGUIDORES



Nice electroswing

1 SEGUIDOR





Carlos Perales



GENERAL

ARTISTAS ESCUCHADOS RECIENTEMENTE

PLAYLISTS PÚBLICAS

SIGUIENDO (81)

MÁS



Hip hop suave

0 SEGUIDORES



Voice

0 SEGUIDORES



Activa

0 SEGUIDORES



Medio activa

0 SEGUIDORES



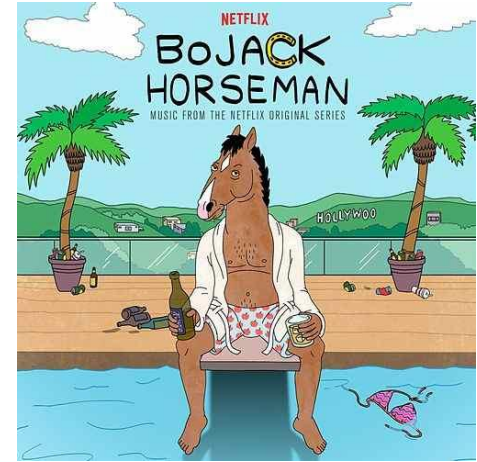
Medio

0 SEGUIDORES

# NETFLIX

Basado en el criterio  
de los usuarios

**BIG DATA**





Basado en el criterio  
de los expertos

**CONOCIMIENTO EXPERTO**

```
{
  "danceability" : 0.735,
  "energy" : 0.578,
  "key" : 5,
  "loudness" : -11.840,
  "mode" : 0,
  "speechiness" : 0.0461,
  "acousticness" : 0.514,
  "instrumentalness" : 0.0902,
  "liveness" : 0.159,
  "valence" : 0.624,
  "tempo" : 98.002,
  "type" : "audio_features",
  "id" : "06AKEBrKUckW0KREUWRnvT",
  "uri" :
    "spotify:track:06AKEBrKUckW0KREUWRnvT",
  "track_href" :
    "https://api.spotify.com/v1/tracks/06AKEBrKUckW0KREUWRnvT",
  "analysis_url" :
    "https://api.spotify.com/v1/audio-analysis/06AKEBrKUckW0KREUWRnvT",
  "duration_ms" : 255349,
  "time_signature" : 4
}
```



**¿SIN DATOS DE  
USUARIOS?**

**¿SIN CONOCIMIENTO  
EXPERTO?**





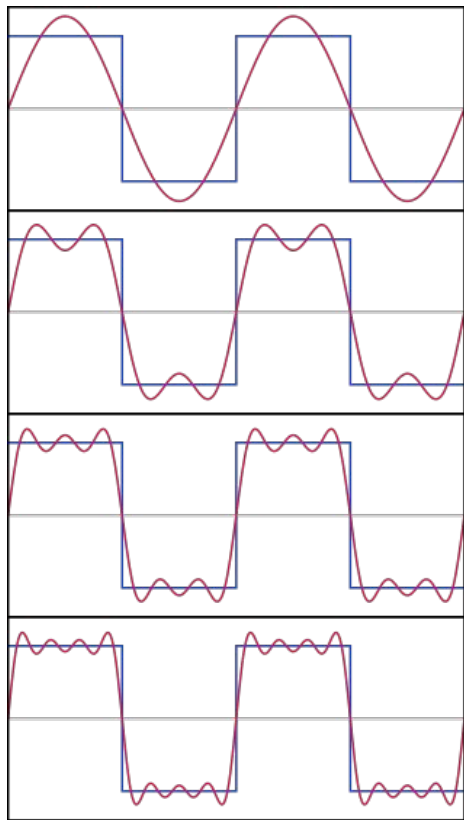


# ¿Quién es Fourier?

- Matemático francés del siglo XVIII - XIX
- **Series de Fourier**
- A través de la **transformada de Fourier**
- Resuelve la **ecuación del calor**

$$\frac{\partial u}{\partial t} - \alpha \left( \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} \right) = 0$$



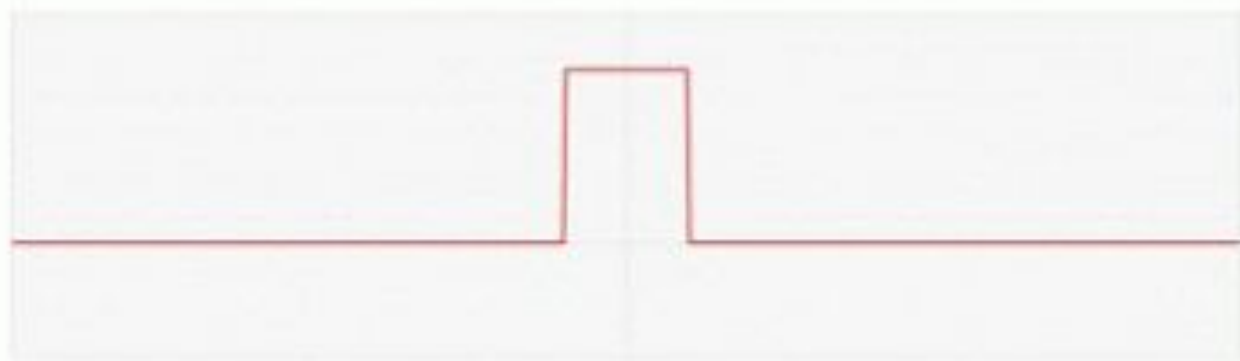


Vale para funciones  
continuas a trozos

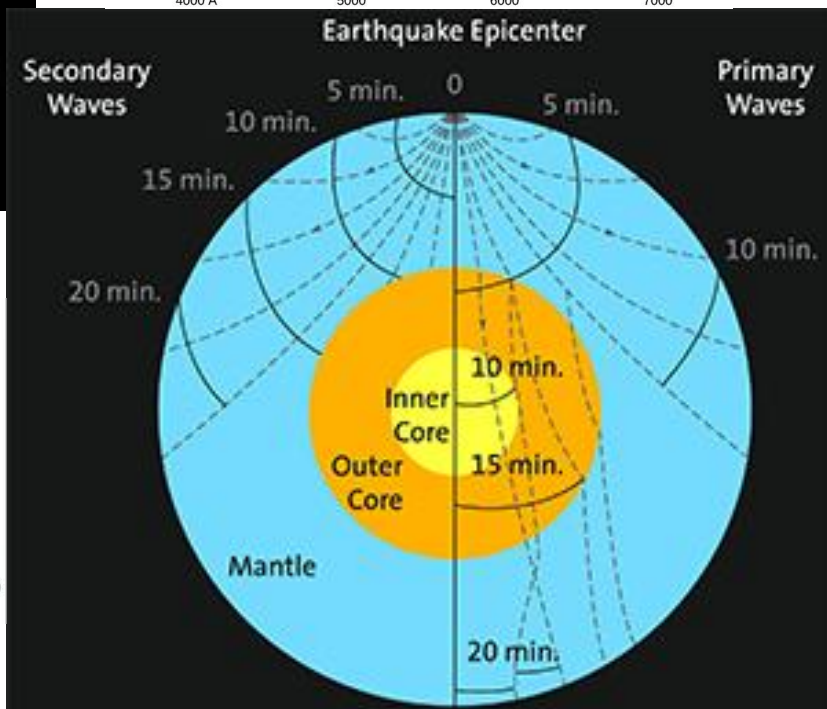
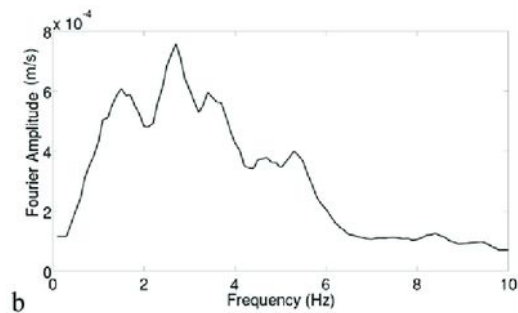
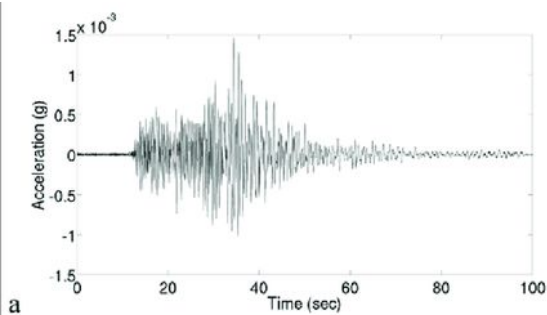
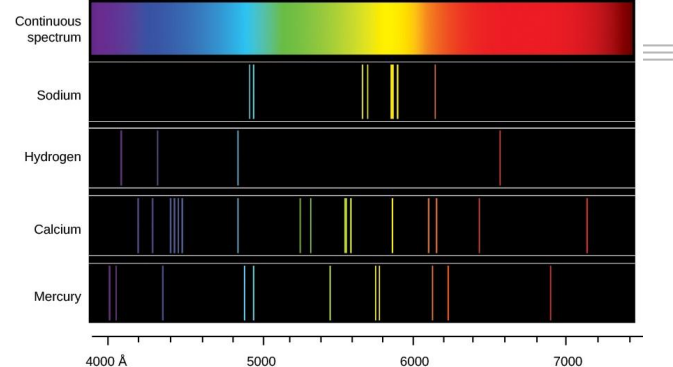
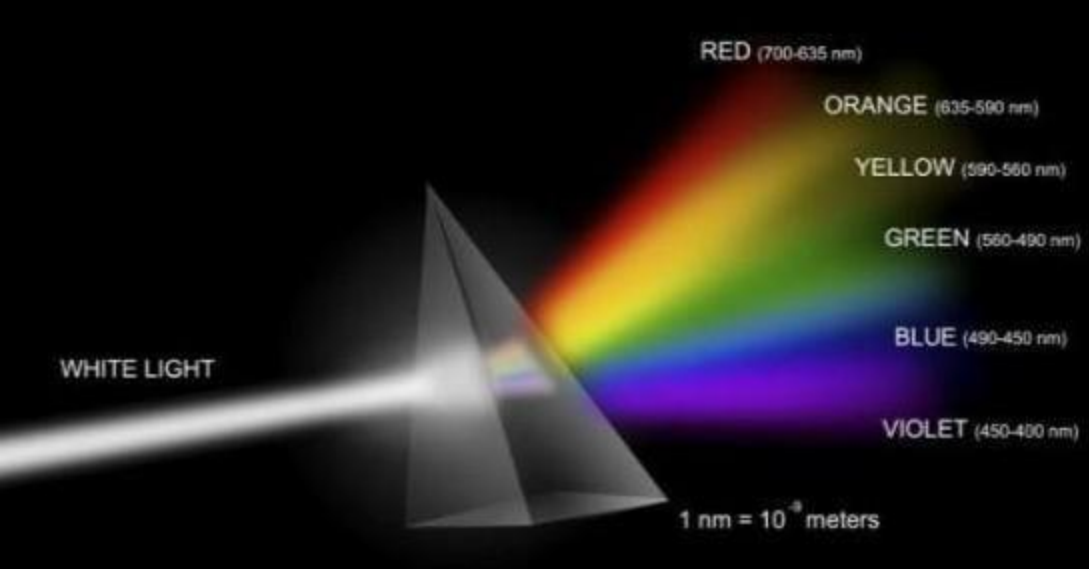
$$\frac{a_0}{2} + \sum_{n=1}^{\infty} \left[ a_n \cos \frac{2n\pi}{T} t + b_n \sin \frac{2n\pi}{T} t \right]$$

$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \xi} dx$$





$$f(x)$$



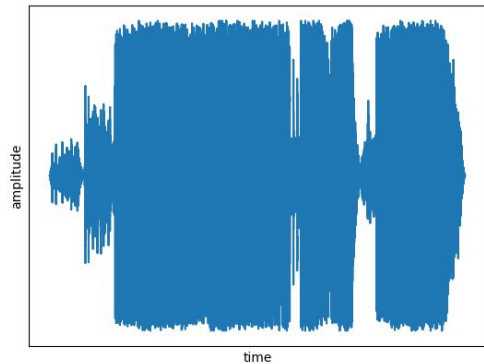


¡ ¡ IDEA !!

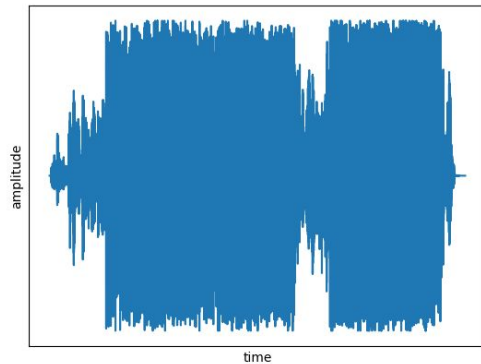
Las canciones son  
series temporales



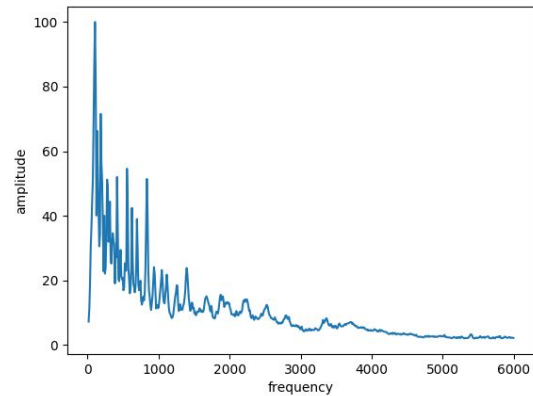
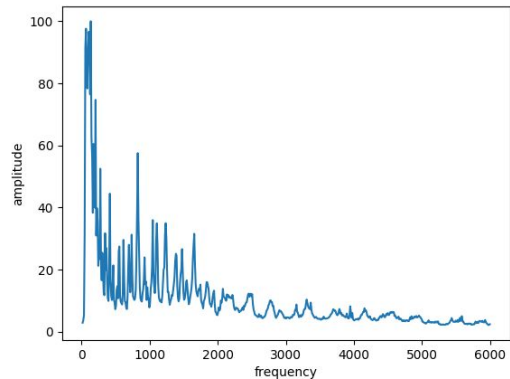
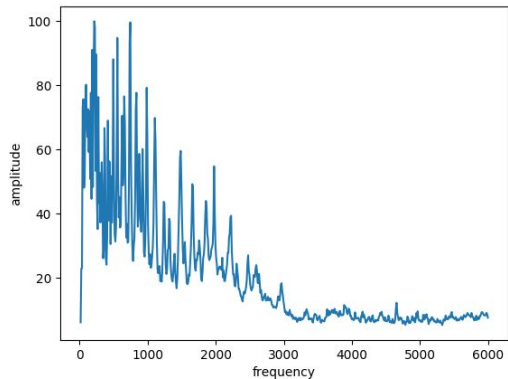
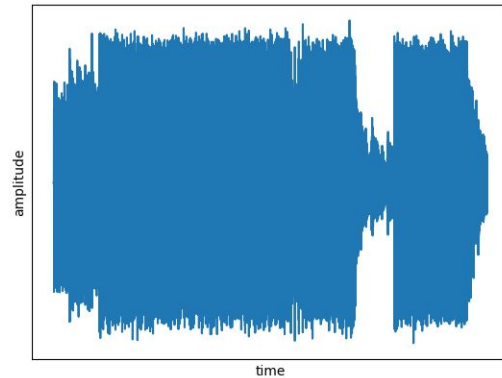
The Buggles  
Video killed the  
radio star



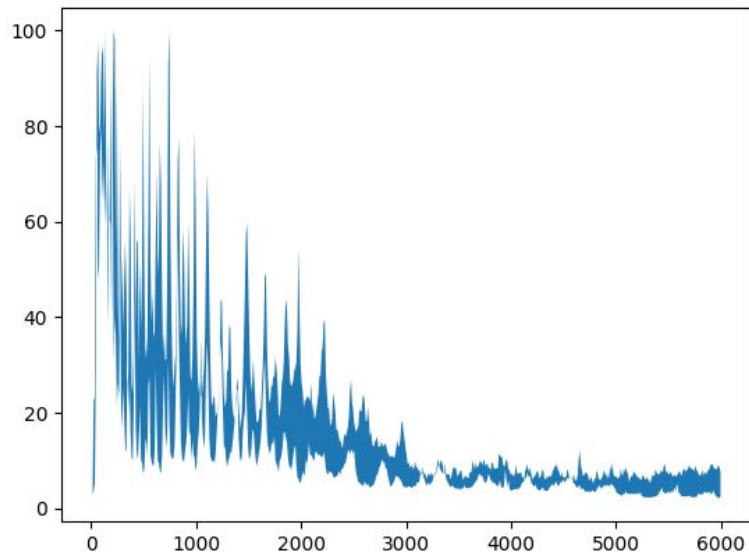
Backstreet Boys  
I want in that  
way



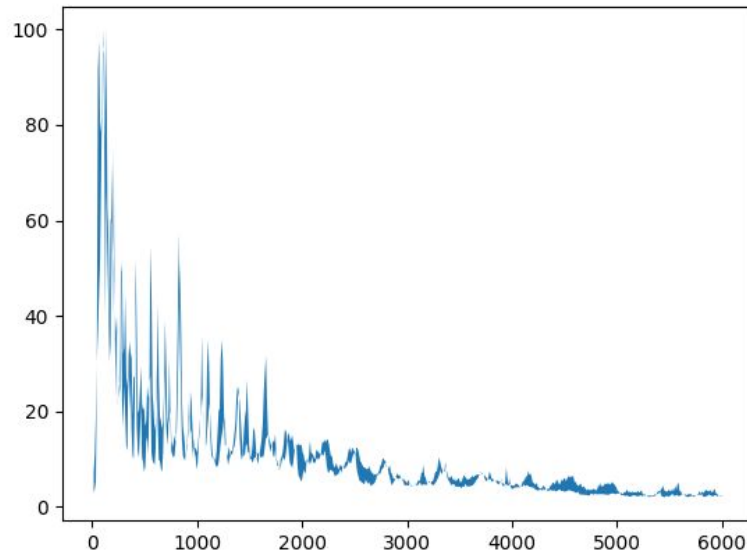
Presidents of the United  
States  
Video killed the radio star



Se computan las distancias  
entre series



**¡Podemos establecer  
una métrica!**



<https://github.com/cperales/foucluster>

GitHub, Inc. [US] | <https://github.com/cperales/foucluster>

## FouCluster

*This project will be presented at [PyCon ES 2018](#). An informative note can be found in spanish [here](#)*

### Motivation

Recommendation song systems nowadays, like **Spotify**, use song clustering by made up [parameters](#) such as *danceability*, *energy*, *instrumentalness*, ... etc, which need an expert in that area to create those parameters.

In order to avoid expert knowledge and make access to machine learning applied to song easier, this library use signal analysis for measuring distances between songs. With this distances, when the amount of songs is considerable clustering can be applied.

Because [musical notes have associated frequencies](#), this proposal is based on transforming from time series to frequency series, and then grouping theses series using various techniques and distance metrics.

### Use

An example as a commented script, using this library, can be found in [example.py](#). Python requirements are listed in *requirements.txt*, and it is also necessary install *mpg123* or *ffmpeg*.



Prueba:

- Género  
rock de  
los 70
- Género  
pop de  
los 80

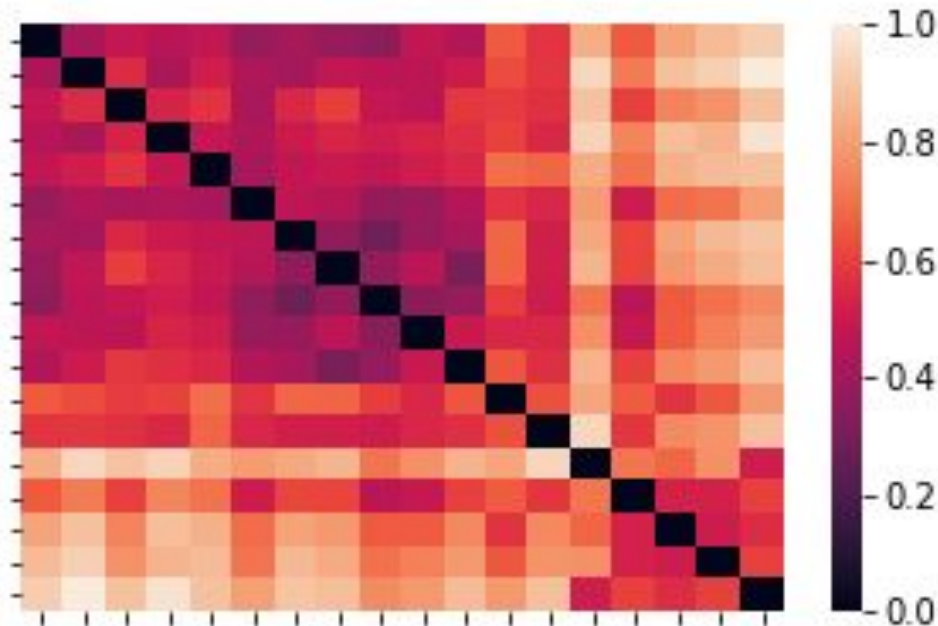
### Songs

2 - Creedence Clearwater Revival Proud Mary.mp3  
2 - Dreams - Fleetwood Mac.mp3  
2 - Have You Ever Seen The Rain - Creedence Cl...  
2 - Hey Jude - The Beatles.mp3  
2 - House Of The Rising Sun - The Animals.mp3  
2 - Me & Bobby McGee - Janis Joplin.mp3  
2 - Sweet Home Alabama - Lynyrd Skynyrd.mp3  
2 - The Weight - The Band.mp3  
2 - Under pressure - Queen.mp3  
2 - Van Morrison - Brown Eyed Girl (Outlier).mp3  
3 - A-ha - Take On Me.mp3  
3 - Berlin - Take My Breath Away.mp3  
3 - Culture Club - Karma Chameleon.mp3  
3 - Cyndi Lauper - Girls Just Want To Have Fun.mp3  
3 - Kenny Loggins - Footloose.mp3  
3 - Madonna - Like a Virgin.mp3  
3 - Rick Astley - Never gonna give you up.mp3  
3 - Whitney huston - Wanna dance with somebody.mp3

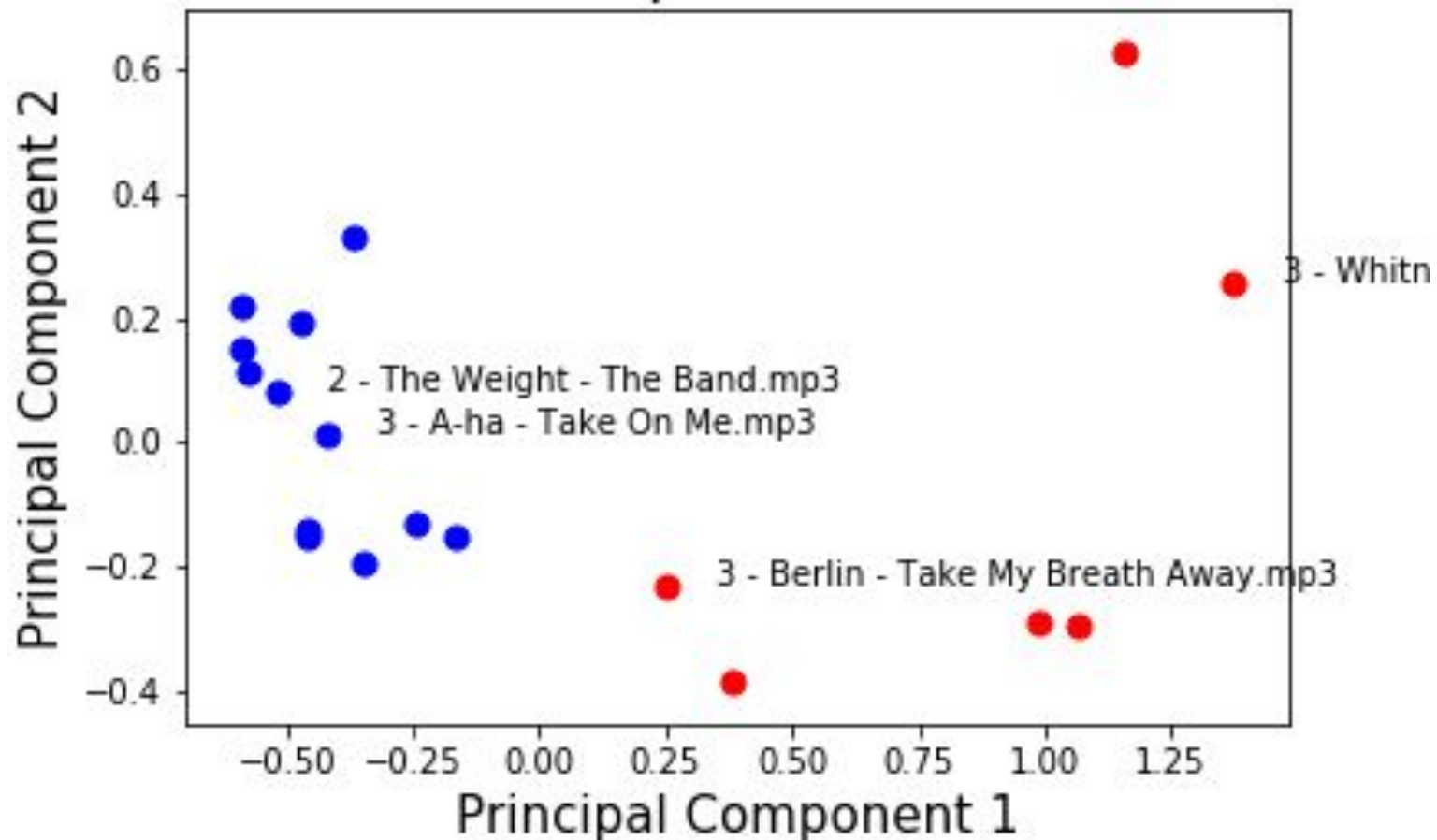
---

iter Revival - Proud Mary.mp3  
 Dreams - Fleetwood Mac.mp3  
 ence Clearwater Revival.mp3  
 - Hey Jude - The Beatles.mp3  
 ising Sun - The Animals.mp3  
 bby McGee - Janis Joplin.mp3  
 abama - Lynyrd Skynyrd.mp3  
 - The Weight - The Band.mp3  
 Under pressure - Queen.mp3  
 rown Eyed Girl (Outlier).mp3  
 3 - A-ha - Take On Me.mp3  
 - Take My Breath Away.mp3  
 lub - Karma Chameleon.mp3  
 s Just Want To Have Fun.mp3  
 nny Loggins - Footloose.mp3  
 Madonna - Like a Virgin.mp3  
 ever gonna give you up.mp3  
 a dance with somebody.mp3

il - Proud Mary.mp3  
 leetwood Mac.mp3  
 water Revival.mp3  
 - The Beatles.mp3  
 . The Animals.mp3  
 a - Janis Joplin.mp3  
 nyrd Skynyrd.mp3  
 ht - The Band.mp3  
 ssure - Queen.mp3  
 l Girl (Outlier).mp3  
 - Take On Me.mp3  
 - Breath Away.mp3  
 ia Chameleon.mp3  
 : To Have Fun.mp3  
 ns - Footloose.mp3  
 - Like a Virgin.mp3  
 a give you up.mp3  
 ith somebody.mp3



## 2 component PCA



A close-up photograph of a DJ's hand with a tattoo and a beaded bracelet, adjusting a knob on a professional DJ mixer. The scene is dimly lit with blue and purple stage lights. In the background, a blurred crowd of people is visible under a bright blue light bar.

# Gracias