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)

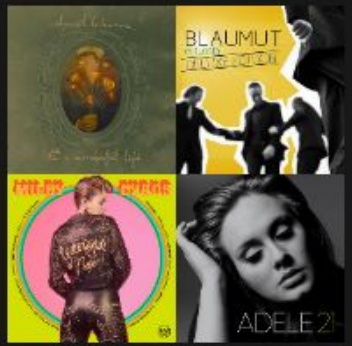
@relampague

@cperales

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

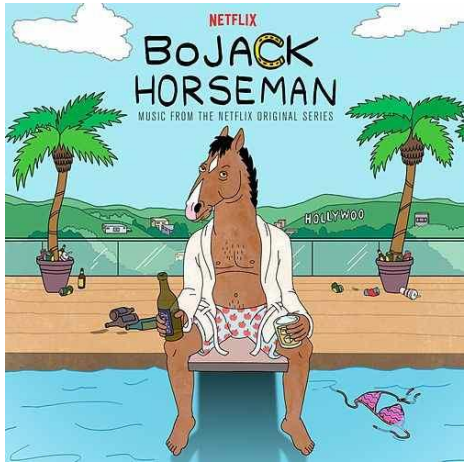
Medio activa

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/06AKEBrKUckW0
KREUWRnvT",
  "analysis_url" :
"https://api.spotify.com/v1/audio-
analysis/06AKEBrKUckW0KREUWRnvT",
  "duration_ms" : 255349,
  "time_signature" : 4
}
```

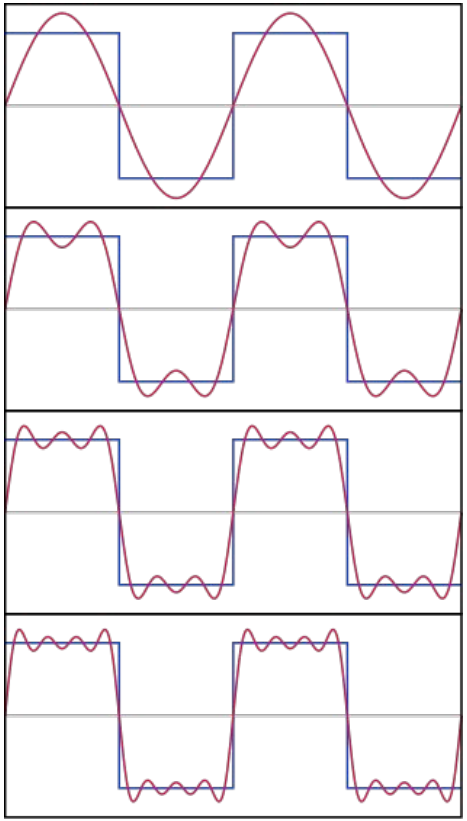
¿SIN CONOCIMIENTO EXPERTO?

¿SIN DATOS DE USUARIOS?

¿Quién es Fourier?

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

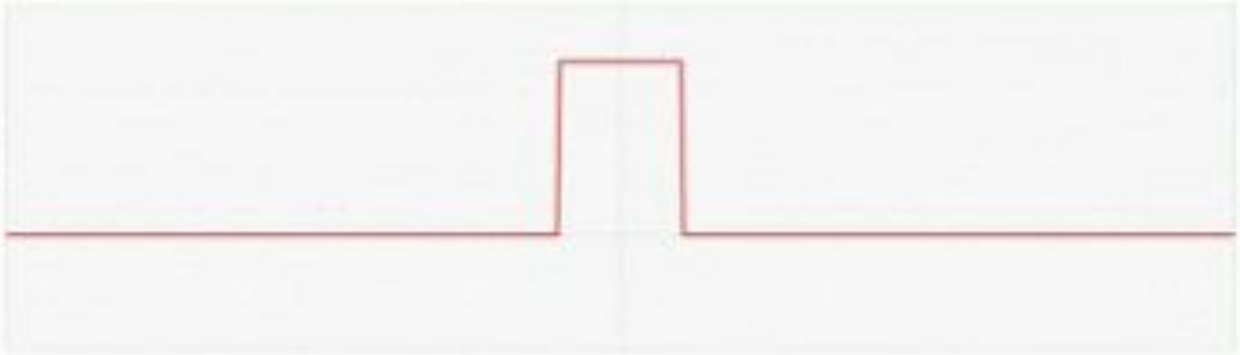
$$\frac{\partial u}{\partial t} - \alpha \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} \right) = 0$$



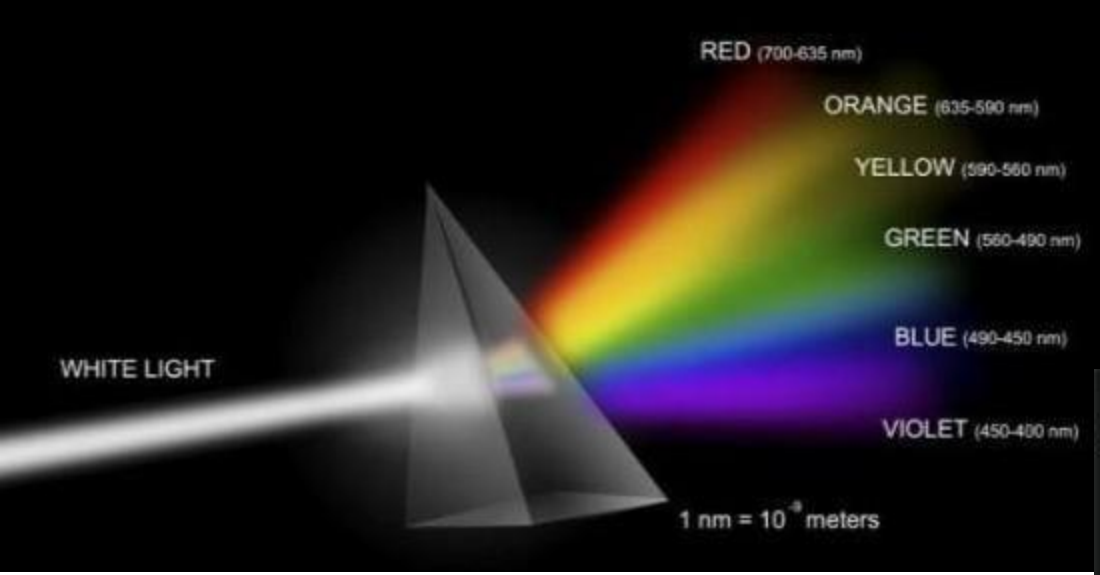
Vale para funciones continuas a trozos

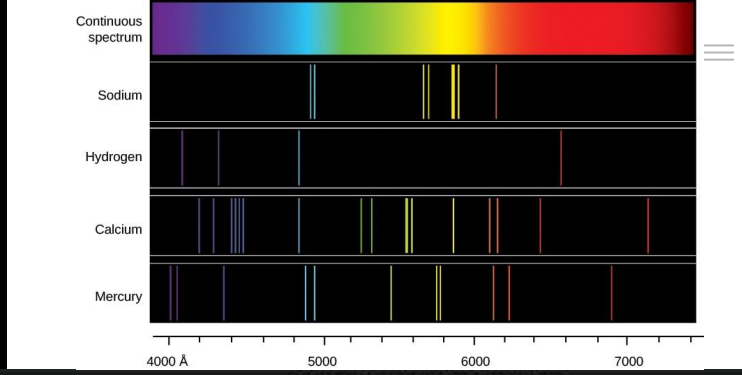
$$\frac{a_0}{2} + \sum_{n=1}^{\infty} \left[a_n \cos \frac{2n\pi}{T} t + b_n \sin \frac{2n\pi}{T} t \right]$$

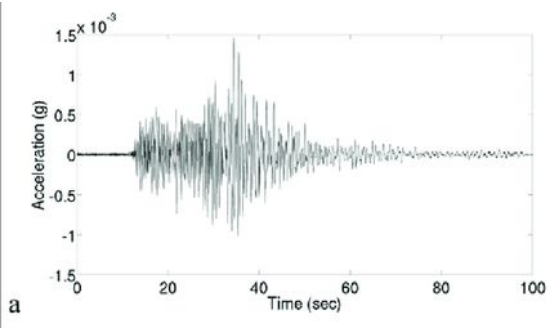
$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x)\, e^{-2\pi i x \xi}\, dx$$

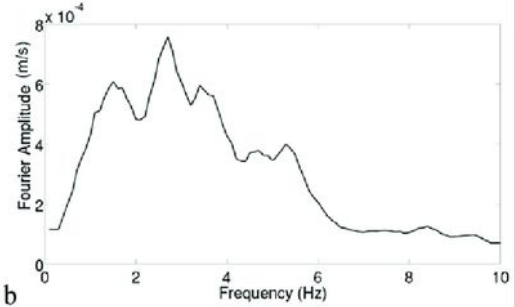


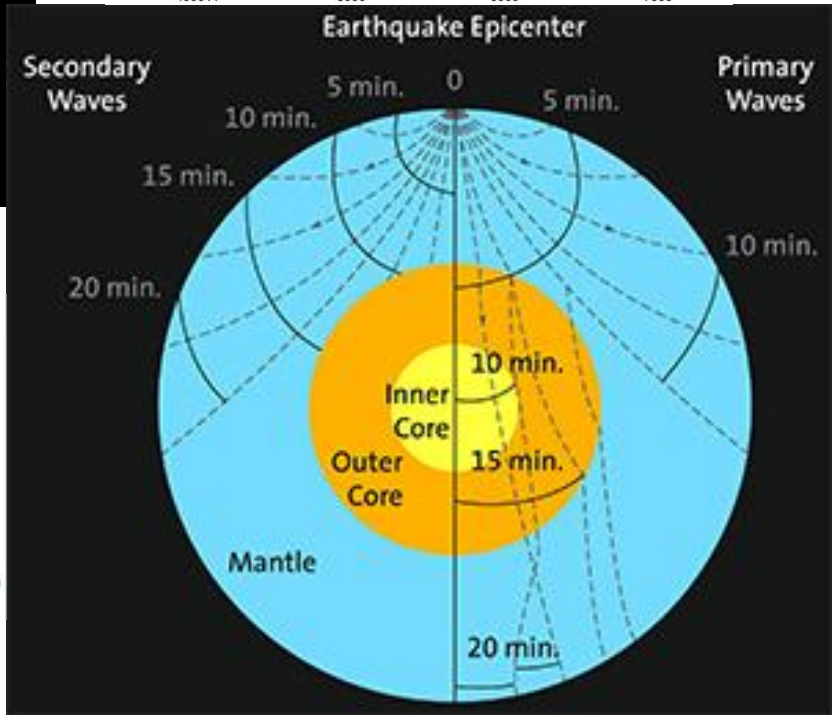
$f(x)$


RED (700-635 nm)
ORANGE (635-590 nm)
YELLOW (590-560 nm)
GREEN (560-490 nm)
BLUE (490-450 nm)
VIOLET (450-400 nm)
WHITE LIGHT
1 nm = 10⁻⁹ meters


Continuous spectrum
Sodium
Hydrogen
Calcium
Mercury
4000 Å
5000
6000
7000


x 10⁻³
Acceleration (g)
Time (sec)
a

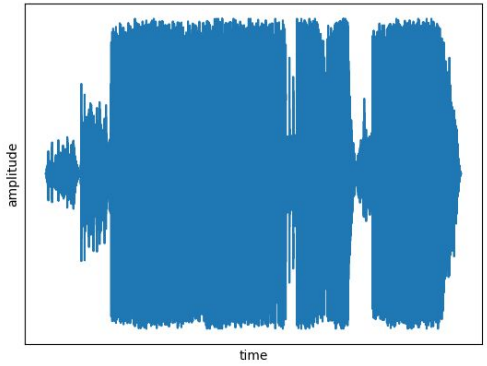

x 10⁻⁴
Fourier Amplitude (m/s)
Frequency (Hz)
b

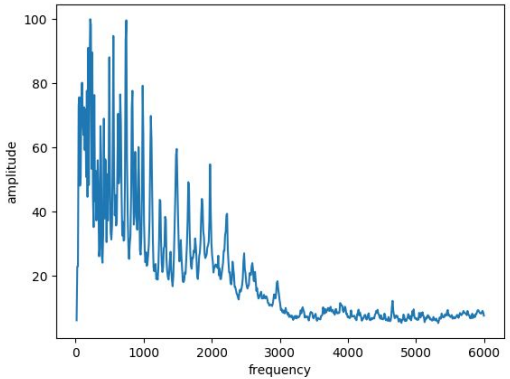

Earthquake Epicenter
Secondary Waves
Primary Waves
0
5 min.
5 min.
10 min.
15 min.
10 min.
20 min.
10 min.
Inner Core
15 min.
Outer Core
Mantle
20 min.

¡¡IDEA!!

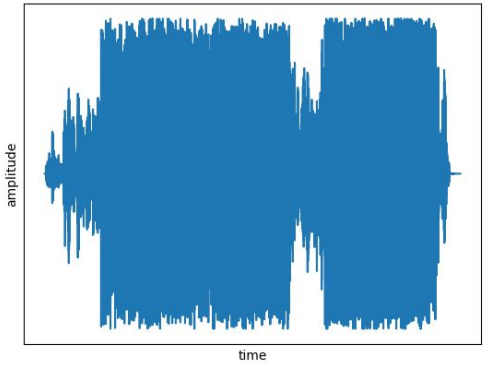
Las canciones son series temporales

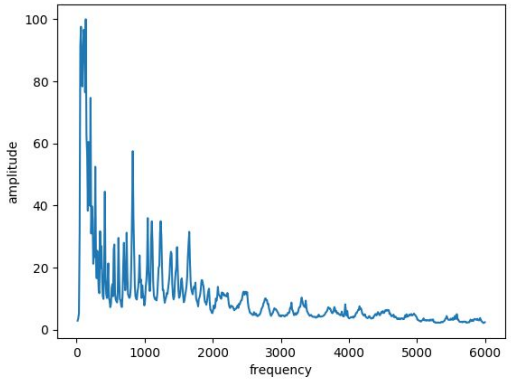
The Buggles
Video killed the radio star



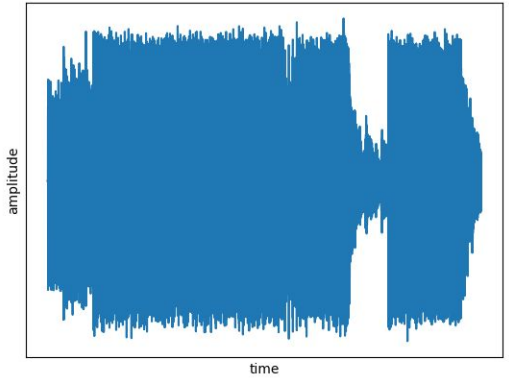


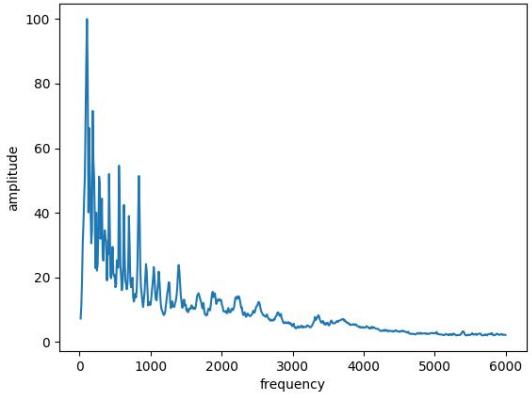
Backstreet Boys
I want in that way



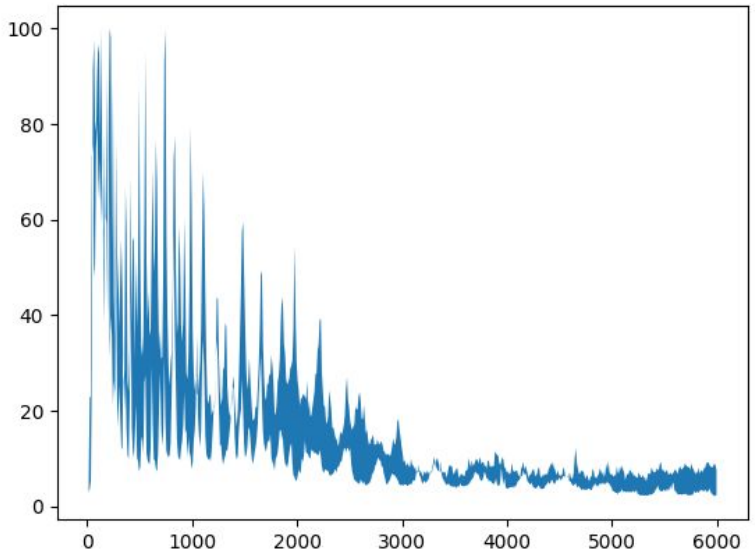


Presidents of the United States
Video killed the radio star

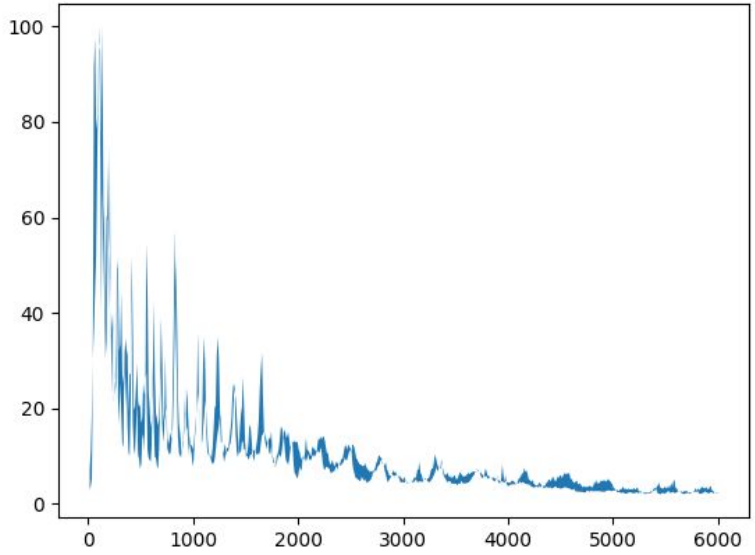




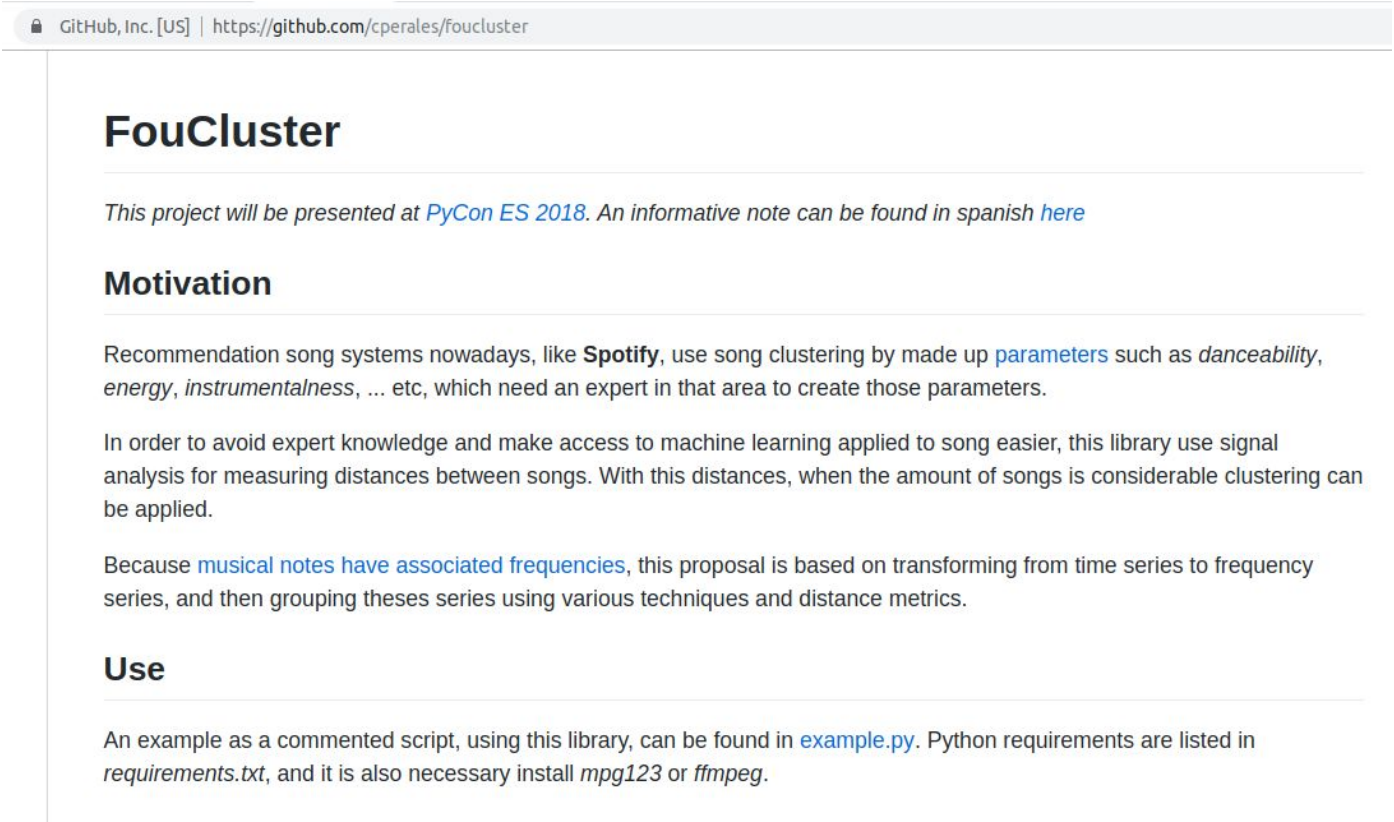
Se computan las distancias entre series



¡Podemos establecer una métrica!



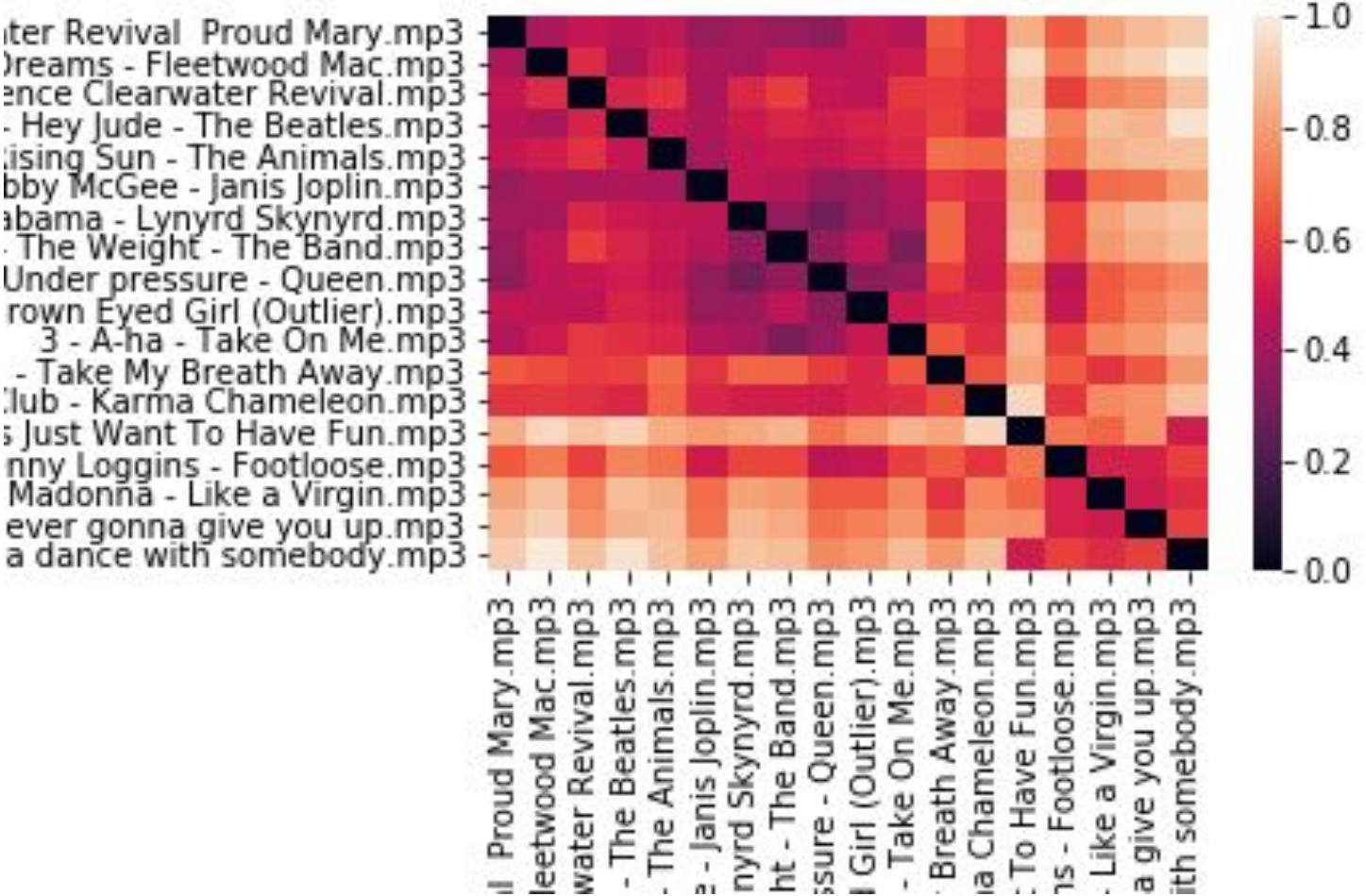
https://github.com/cperales/foucluster

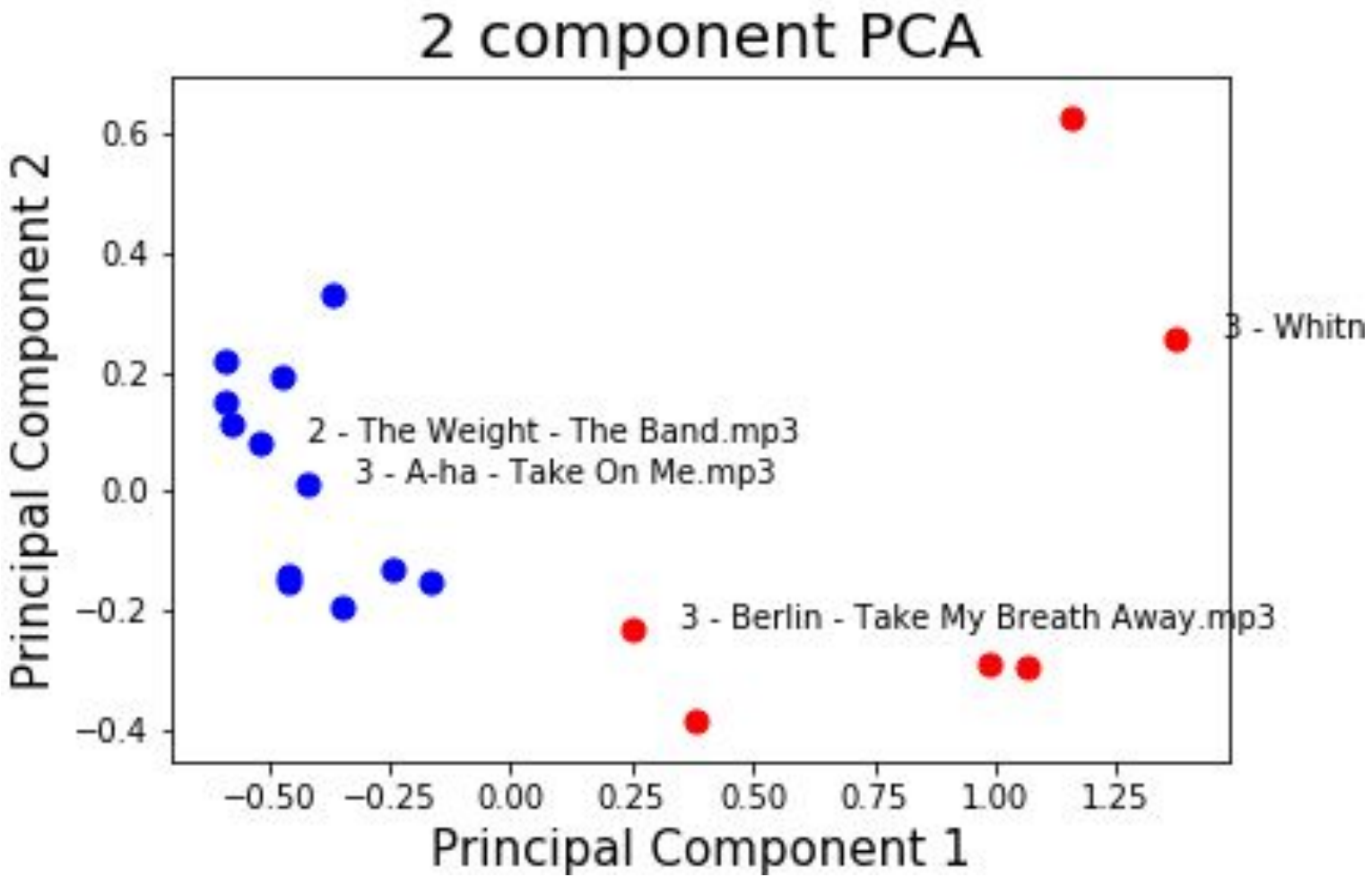


Prueba:

- 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
```


ter 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
Club - 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
1.0
0.8
0.6
0.4
0.2
0.0


2 component PCA
Principal Component 2
Principal Component 1
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
1.25
2 - The Weight - The Band.mp3
3 - A-ha - Take On Me.mp3
3 - Berlin - Take My Breath Away.mp3
3 - Whitn


Gracias