

MUSIC VISUALIZATION

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“Without music, life would be a mistake”

–Friedrich Nietzsche

What do we mean by music viz?

Music related data viz

any data related to music

Sound visualization

pure audio visualization

Data sonification

similar to data viz but for ears



I'll Be Missing You—Puff Daddy And Faith Evans

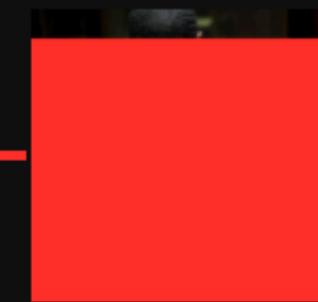
#1 ON AUGUST 01, '97

PAUSE / PLA

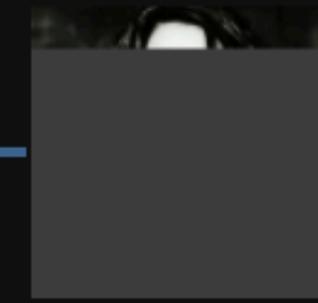
Find an artist...



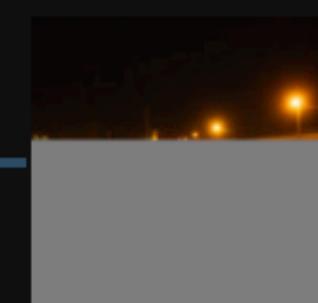
WEEKS AT #1 (TOP 100)

Puff Daddy and Faith Evans:
Hanson:

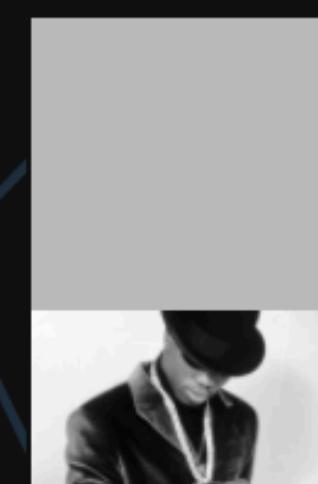
I'LL BE MISSING YOU



BITCH



QUIT PLAYING GAMES



SEMI-CHARMED LIFE



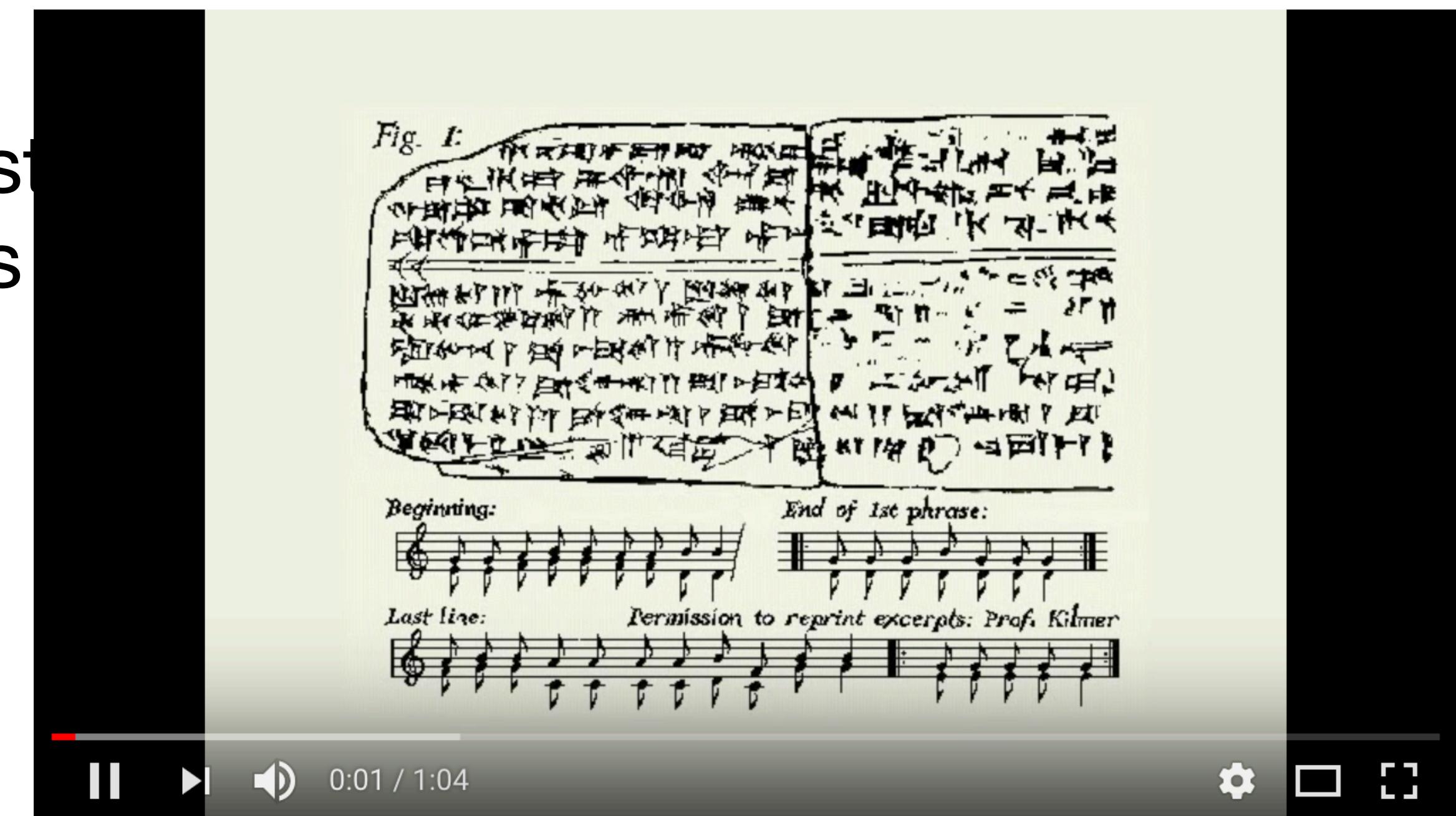
RETURN OF THE MACK



A bit of history

Music is found in every known culture, past and present, varying widely between times and places.

The "oldest known song" was written in cuneiform, dating to 3400 years ago from Ugarit



[Wikipedia]

Music transcription



Digitizing music

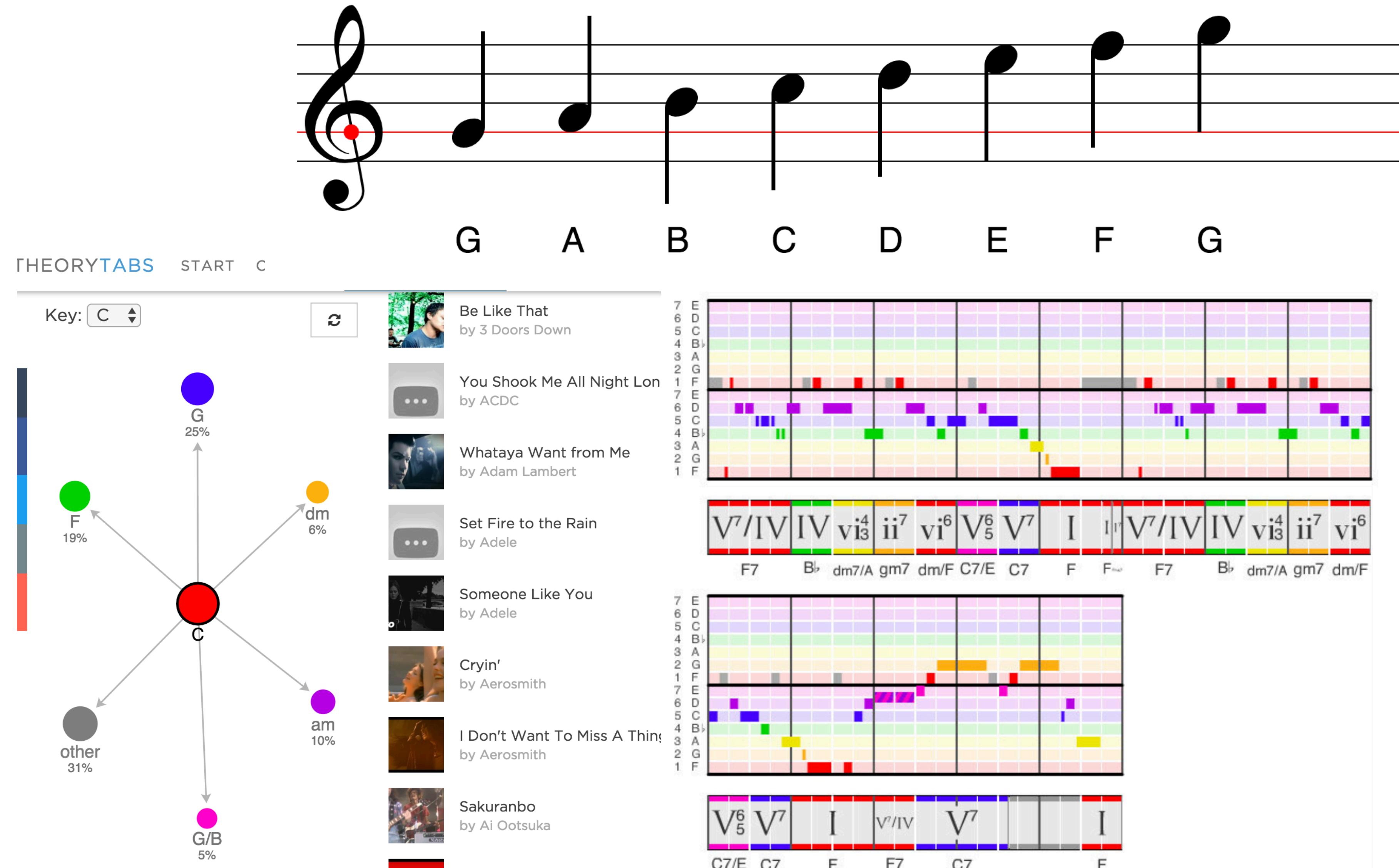
Process of converting information into computer-readable format

Representation of an object, image, sound, document or signal (usually an analog signal) by generating a series of numbers that describe a discrete set of its points or samples.

Involves: **Discretization, Quantization, (optional) Compression**

Music theory?

- Notes
- Scale
- Chords
- Tempo



Timbre, pitch, chroma

Timbre: the character or quality of a musical sound or voice as distinct from its pitch and intensity.

Pitch: perceptual property of sounds that allows their ordering on a frequency-related scale, consists of **tone height** and **chroma**

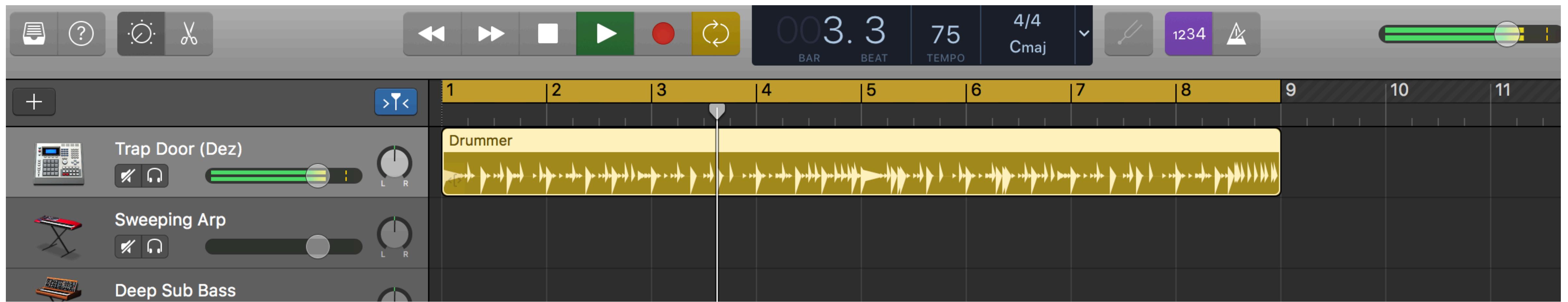
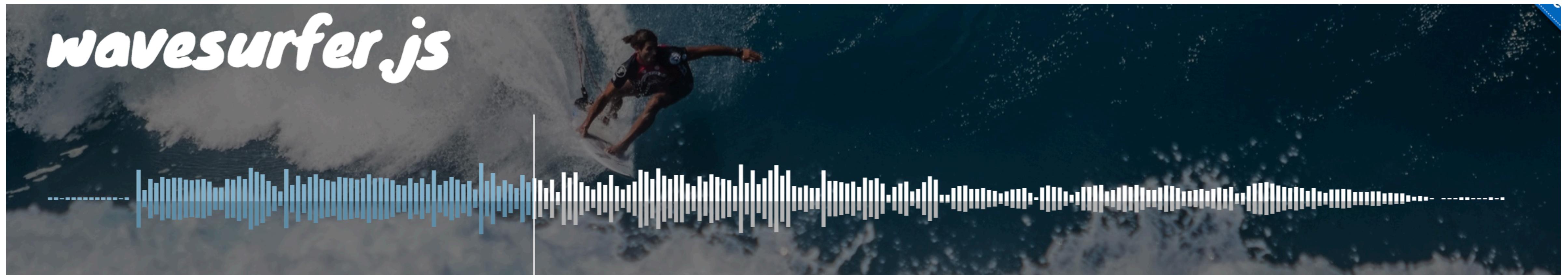
Chroma: {C, C#, D, D#, E, F, F#, G, G#, A, A#, B}

Scientific pitch notation, the pitch class corresponding to the chroma C is the set {..., C-2, C-1, C0, C1, C2, C3 ...} consisting of all pitches separated by an integer number of octaves.

[Wikipedia]

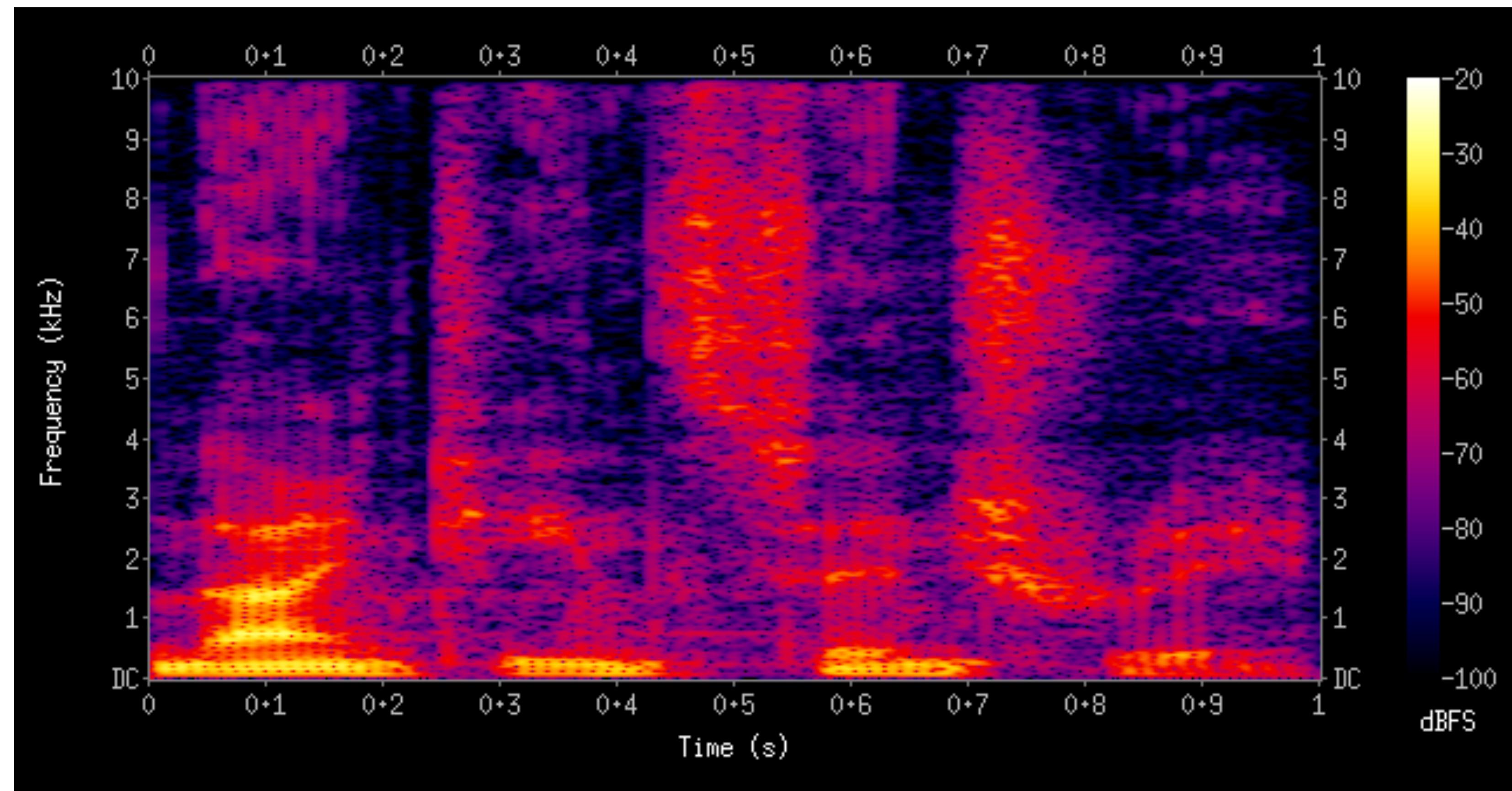
Waveform viz

Waveforms: perceived loudness (sound pressure) over time



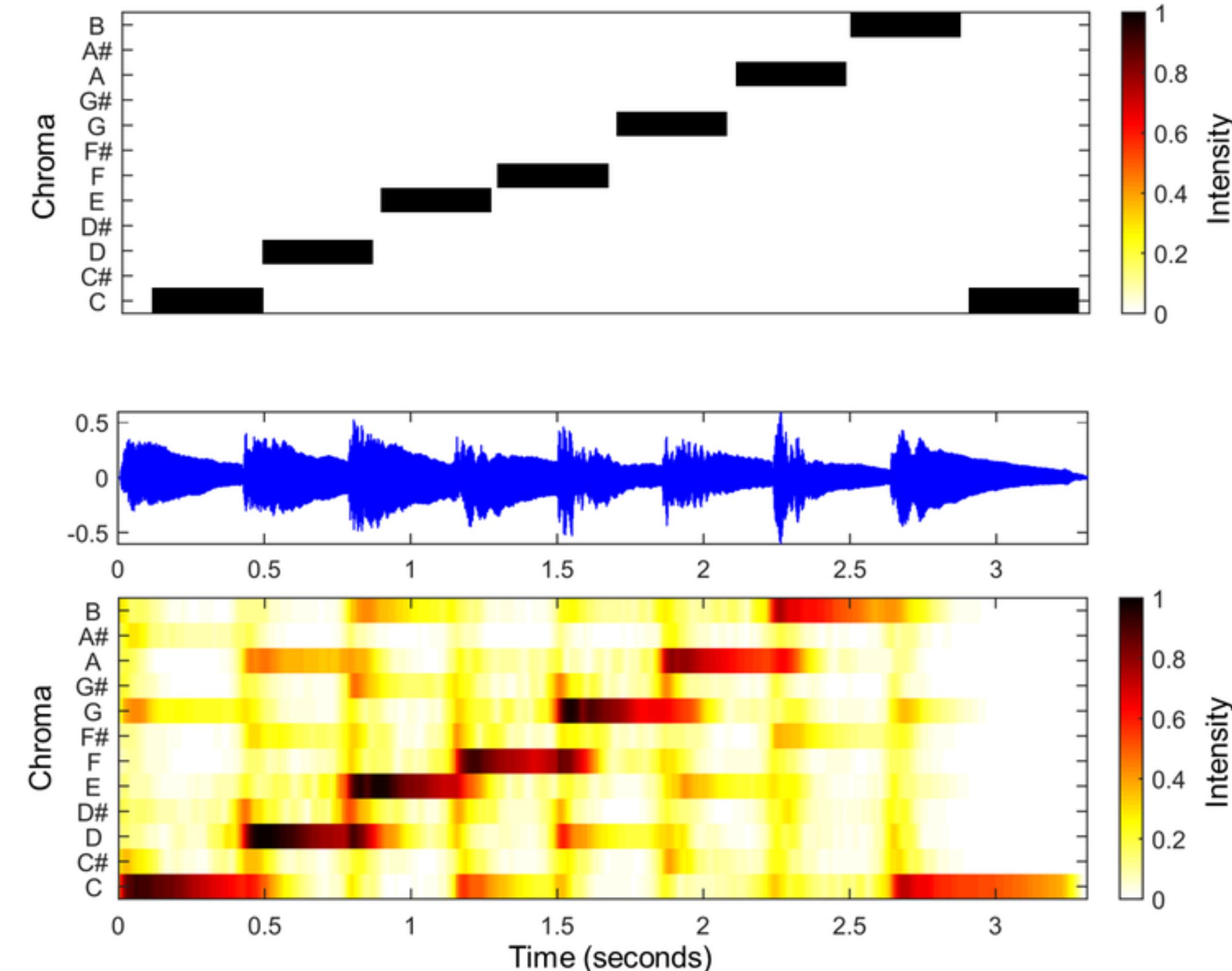
Spectrogram

Visual representation of the spectrum of frequencies of sound as they vary with time.



Chromagram

Projected the entire music spectrum onto 12 bins representing the 12 distinct semitones (or chroma) of the musical octave



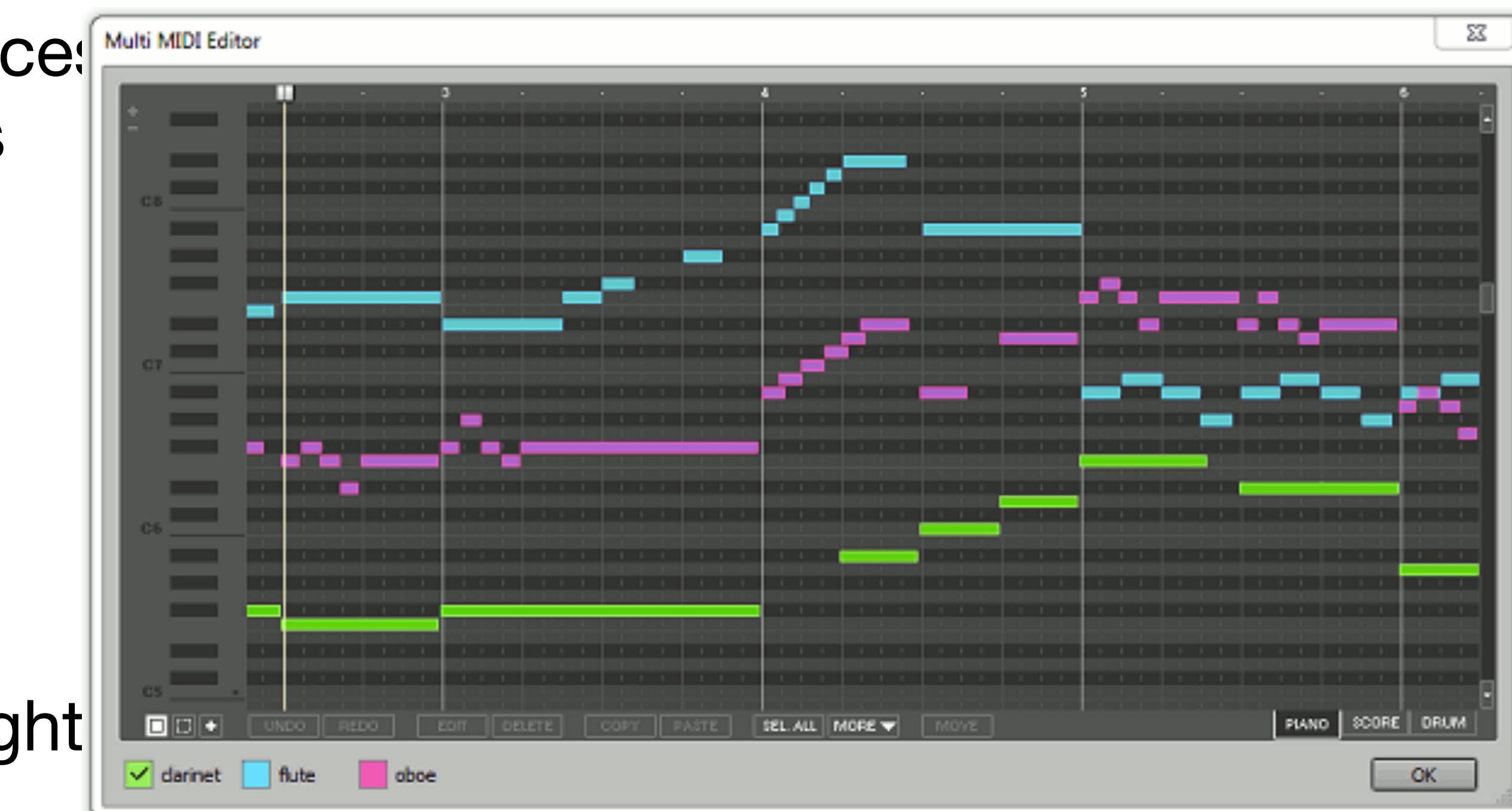
MIDI

MIDI, (Musical Instrument Digital Interface):
communications protocol between audio devices
also digital interface and electrical connectors

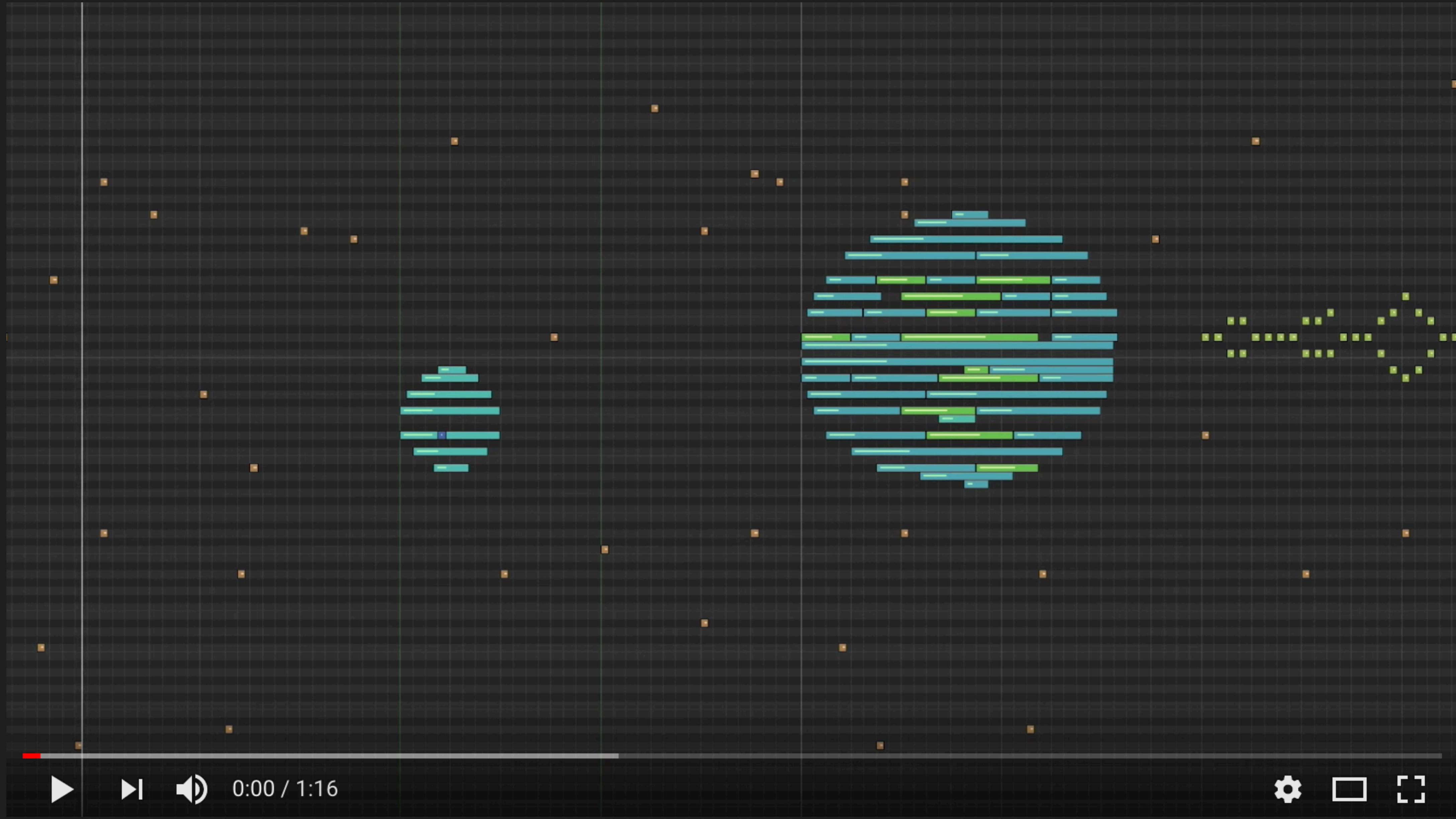
MIDI data structure contains:

notation, pitch and velocity (loudness or
softness)

volume, vibrato, audio panning from left to right

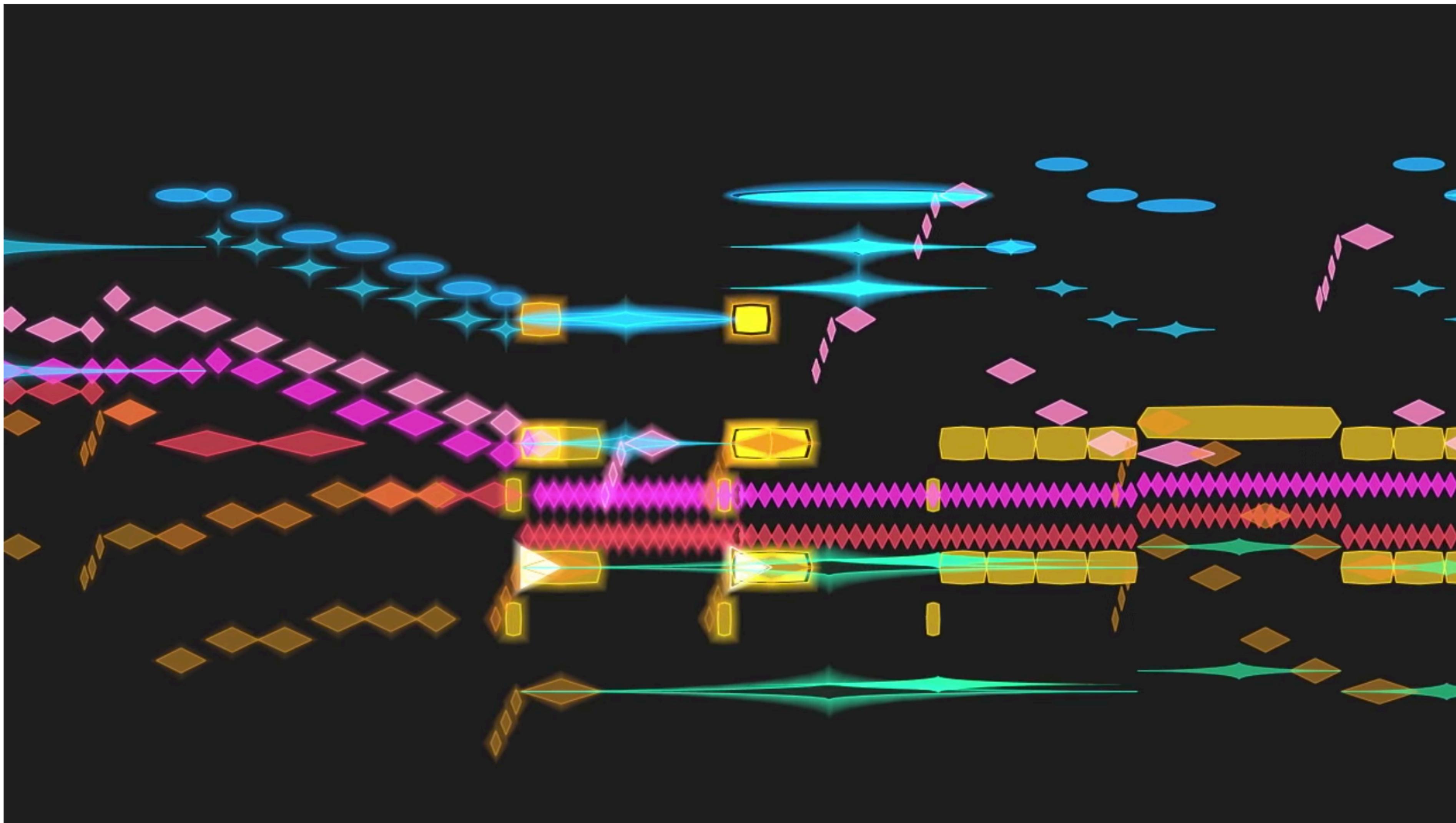


clock signals that set and synchronize tempo
between multiple devices.



Sound visualization

Musicanim



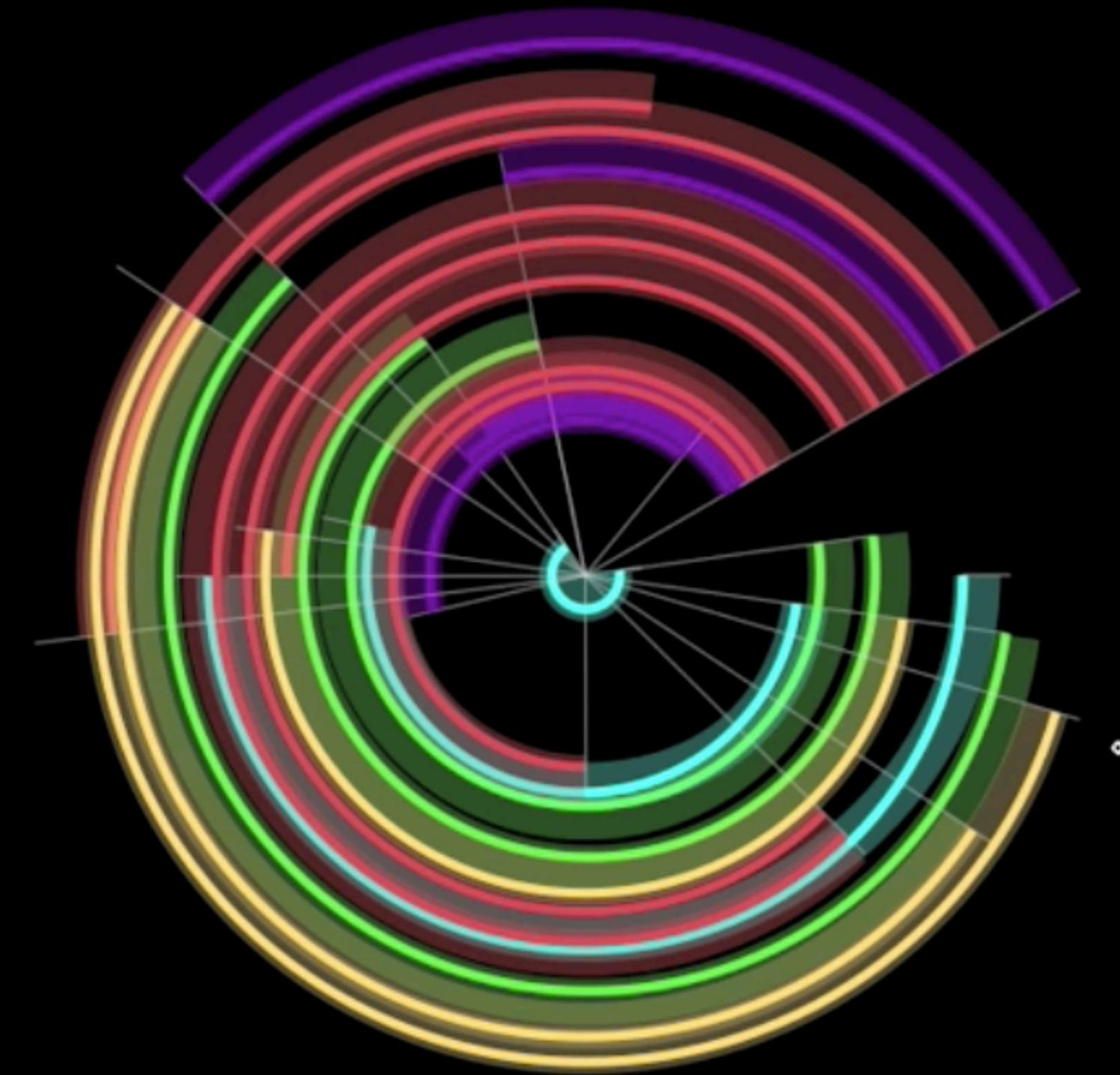
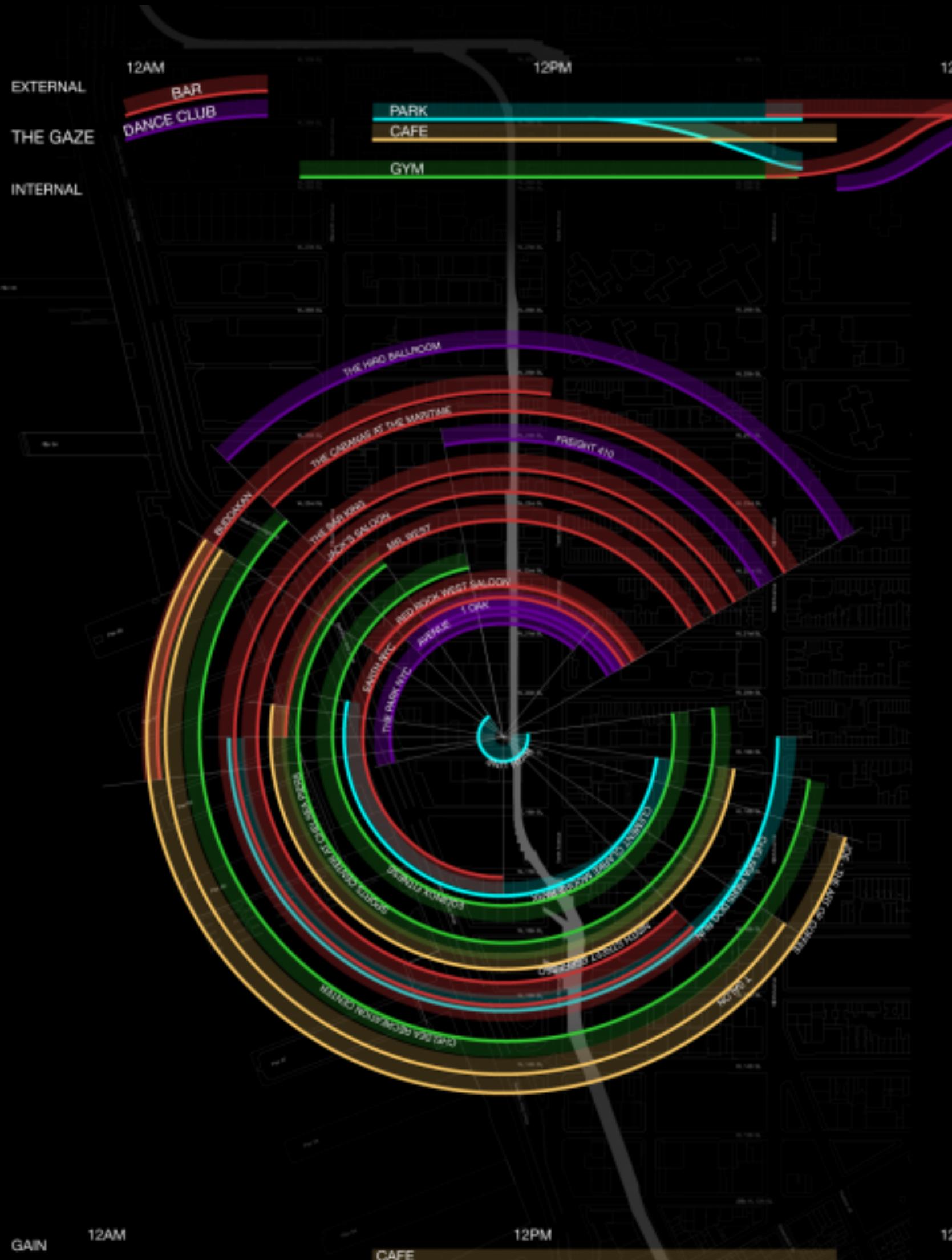
[Stephen Malinowski]

Guitar Hero



RAINING BLOOD ~ 200% SPEED ~ ~~100~~% FC

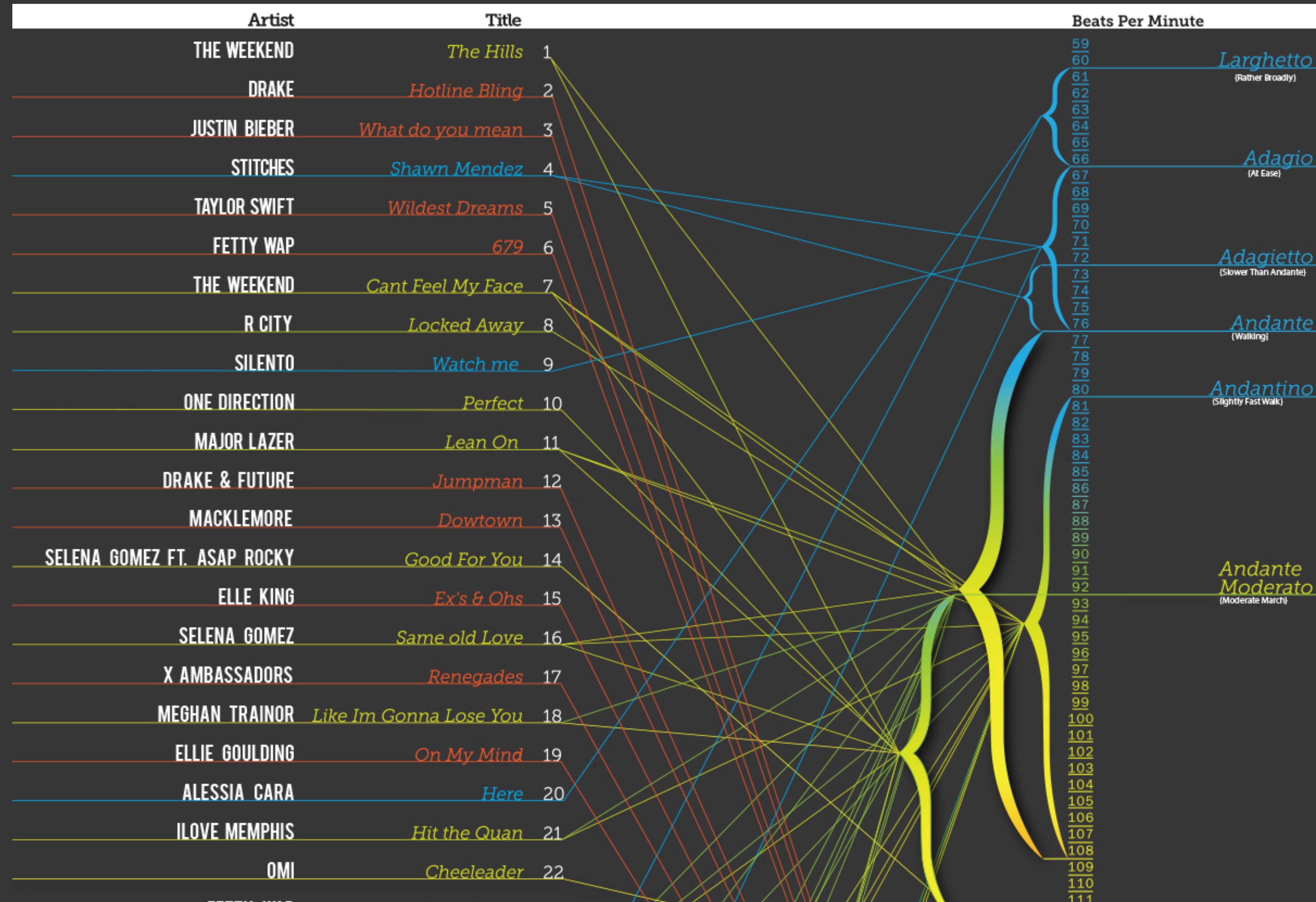
New-York city mapping



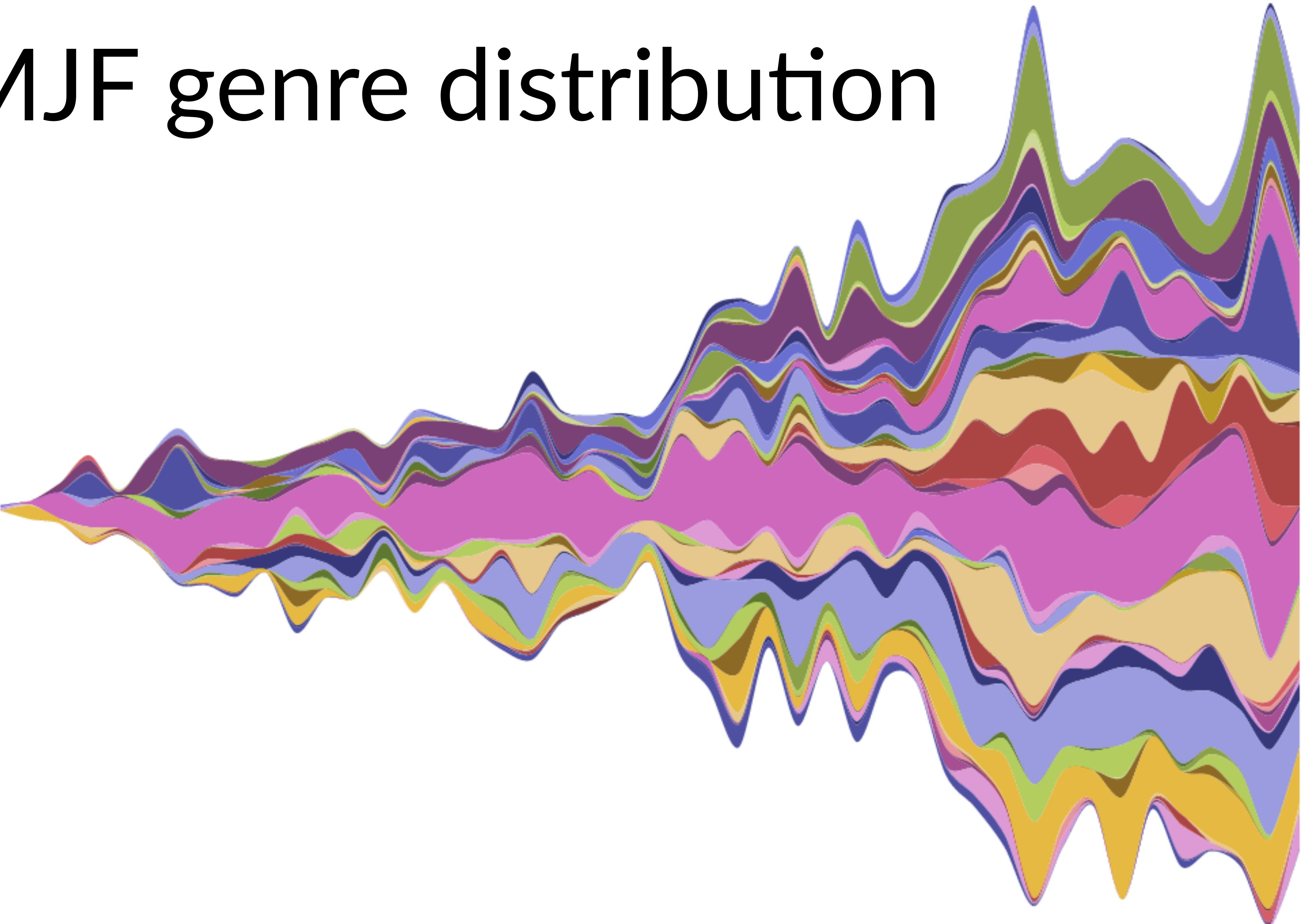
[Mark Edward Campos]

Music related data viz

The Color of Sound



MJF genre distribution



Real-life example

GRAPH-BASED MUSIC RECOMMENDATION



The screenshot shows the Genezik music player interface. At the top, there's a track player with controls for play/pause, volume, and song information: "I Can't Be Satisfied [Album Version]" by "Muddy Waters". Below the player is a navigation bar with tabs: "Getting started", "Library" (which is selected and highlighted in a dark grey box), "Discovery", and "Social". The main area is a table of songs, with columns for Title, Time, Artist, Album, Year, and Genre. The table lists 20 songs, including "Cypress Grove" by Skip James, "Crow Jane" by Skip James, "Sickbed Blues" by Skip James, "Catfish Blues" by Skip James, "Come & Get It" by Selena Gomez, "Brave" by Sara Bareilles, "Travelling Riverside Blues" by Sam Mitchell, "Pile Driver" by Sam Mitchell, "(Baby, Let Me) Follow You Down" by Sam Mitchell, "Rainy Day Blues" by Sam Mitchell, "Motherless Children" by Sam Mitchell, "Crossroad Blues" by Sam Mitchell, "Avalon" by Rory Block, "I'm So Glad" by Rory Block, "U.O.E.N.O." by Rocko ft. Future & R..., "Blurred Lines" by Robin Thicke, and "Come On In My Kitchen" by Robert Johnson. Below the table, there are buttons for "View: Basic" and "Expert", and a timeline showing 03:07, 05:44, and 09:12. The bottom part of the interface features a "Discovery" sidebar with categories: "Discovery" (selected), "Work", "Shake", "Relax", and "Party". A "Discovery" graph is displayed, showing connections between songs: "Crossroad Blues" by Sam Mitchell is connected to "If You Haven't Got An..." by Stefan Grossman, which is connected to "I Can't Be Satisfied [Album Version]" by Muddy Waters. A checkmark and an 'x' are shown near the connection to "I Can't Be Satisfied". The timeline at the bottom shows a progress bar at 00:49.

Genezik

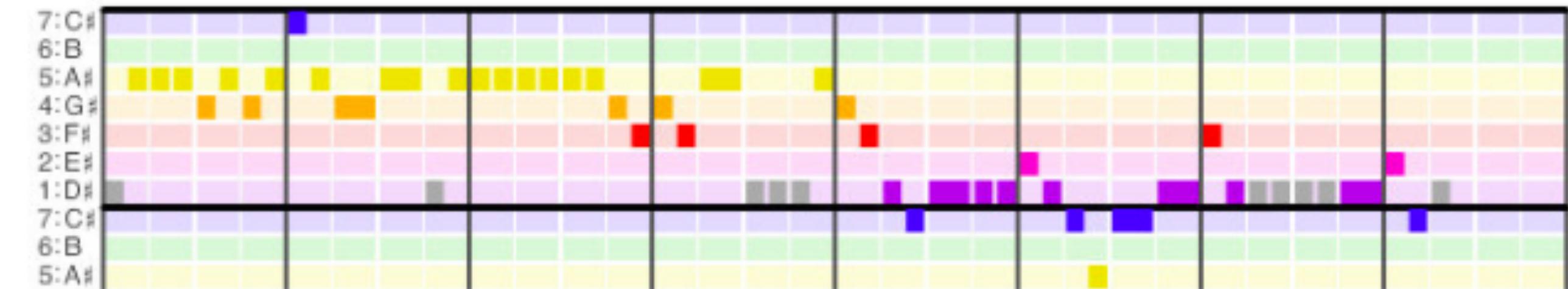
“The ultimate playlist generator”

- Personalized distributed playlist recommender system
- Global song recommender system

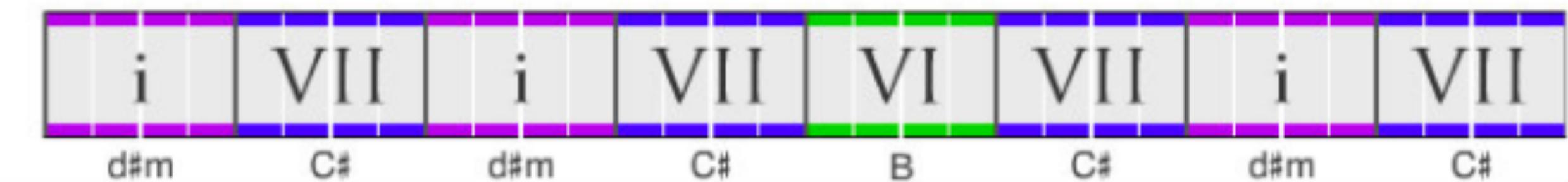
Montreux
Jazz Festival

FEATURE EXTRACTION

- **Audio:** notes, timbre, rhythm



- **Social:** popularity, hotness



207,924,774 views



816,658



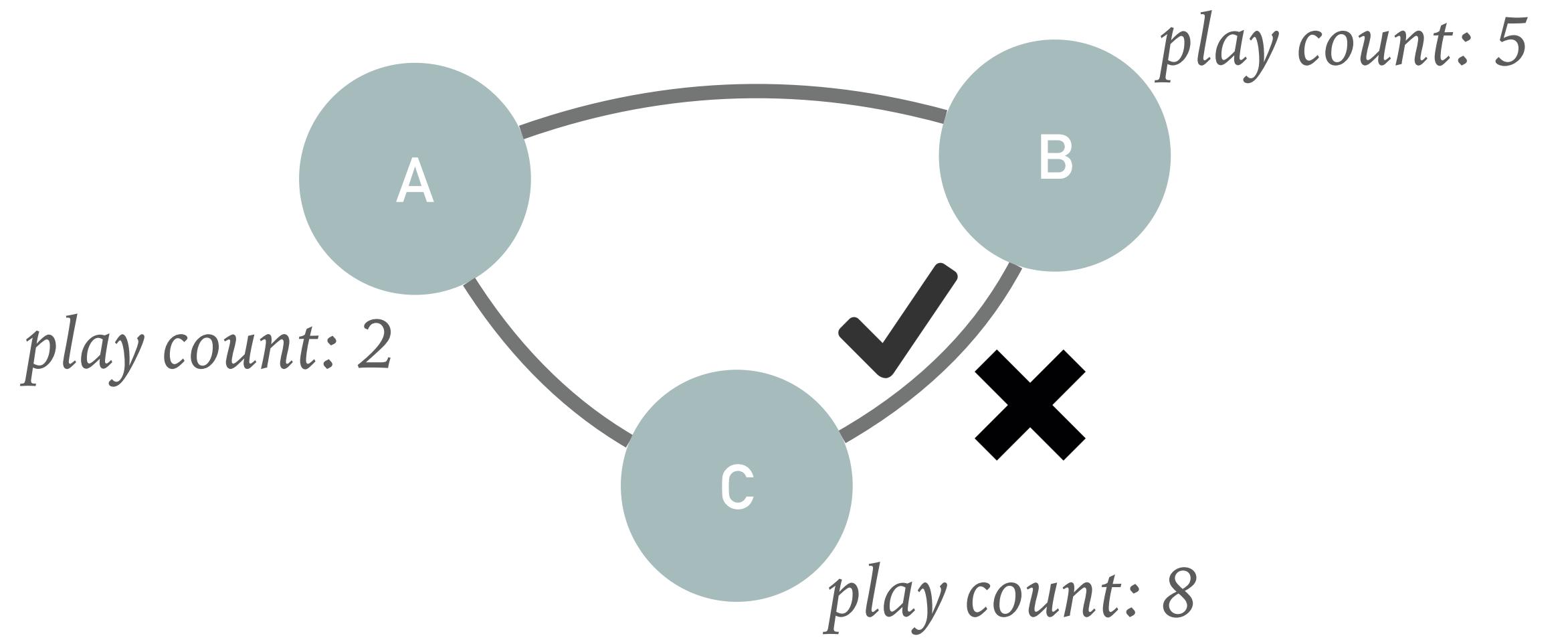
30,675

- **Metadata:** genre, mood, tags

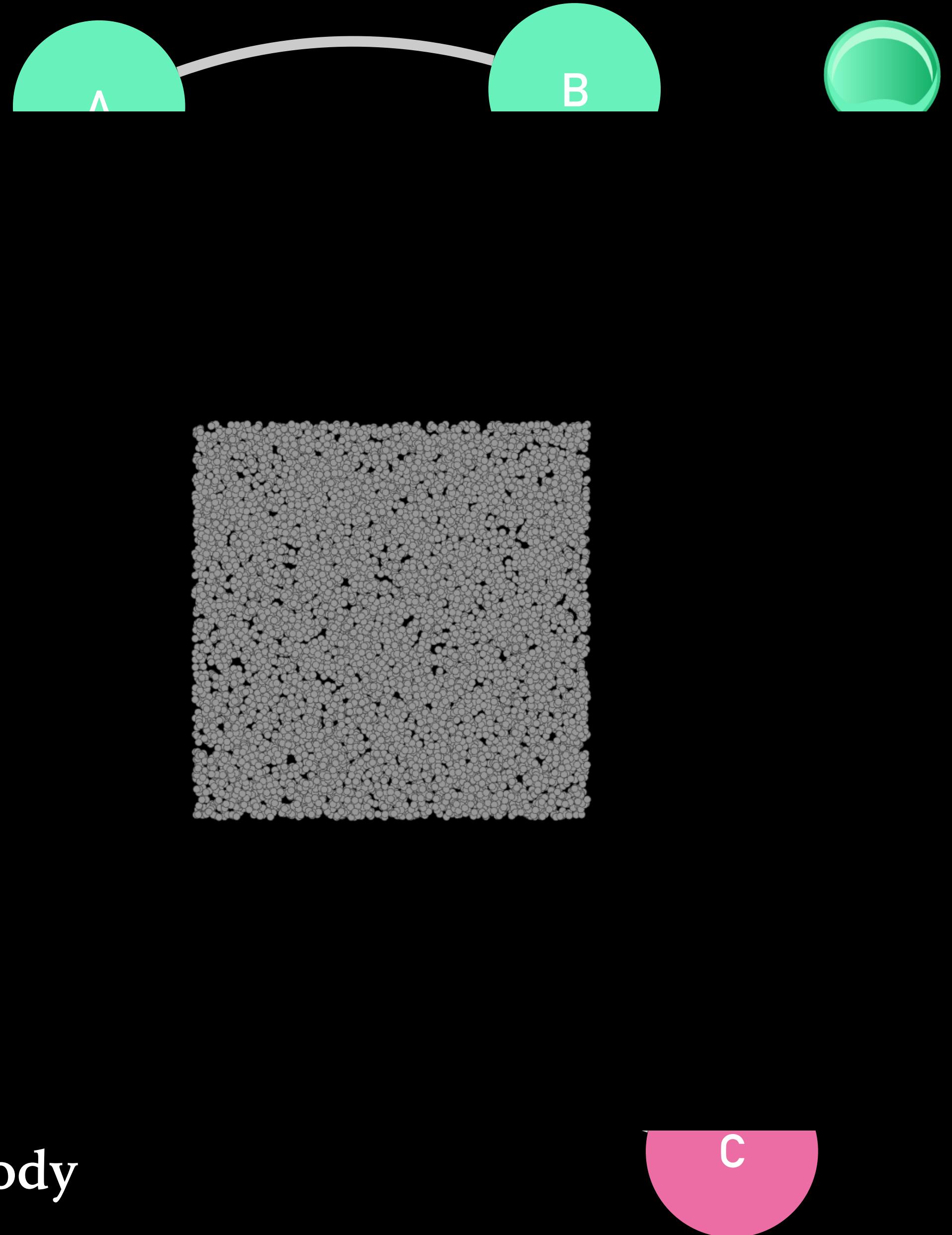
Recorded	1982
Genre	Hard rock ^[1] ^[2] · dance-rock ^[3]
Length	4:18
Label	Epic
Writer(s)	Michael Jackson
Producer(s)	Quincy Jones · Michael Jackson (co-producer)

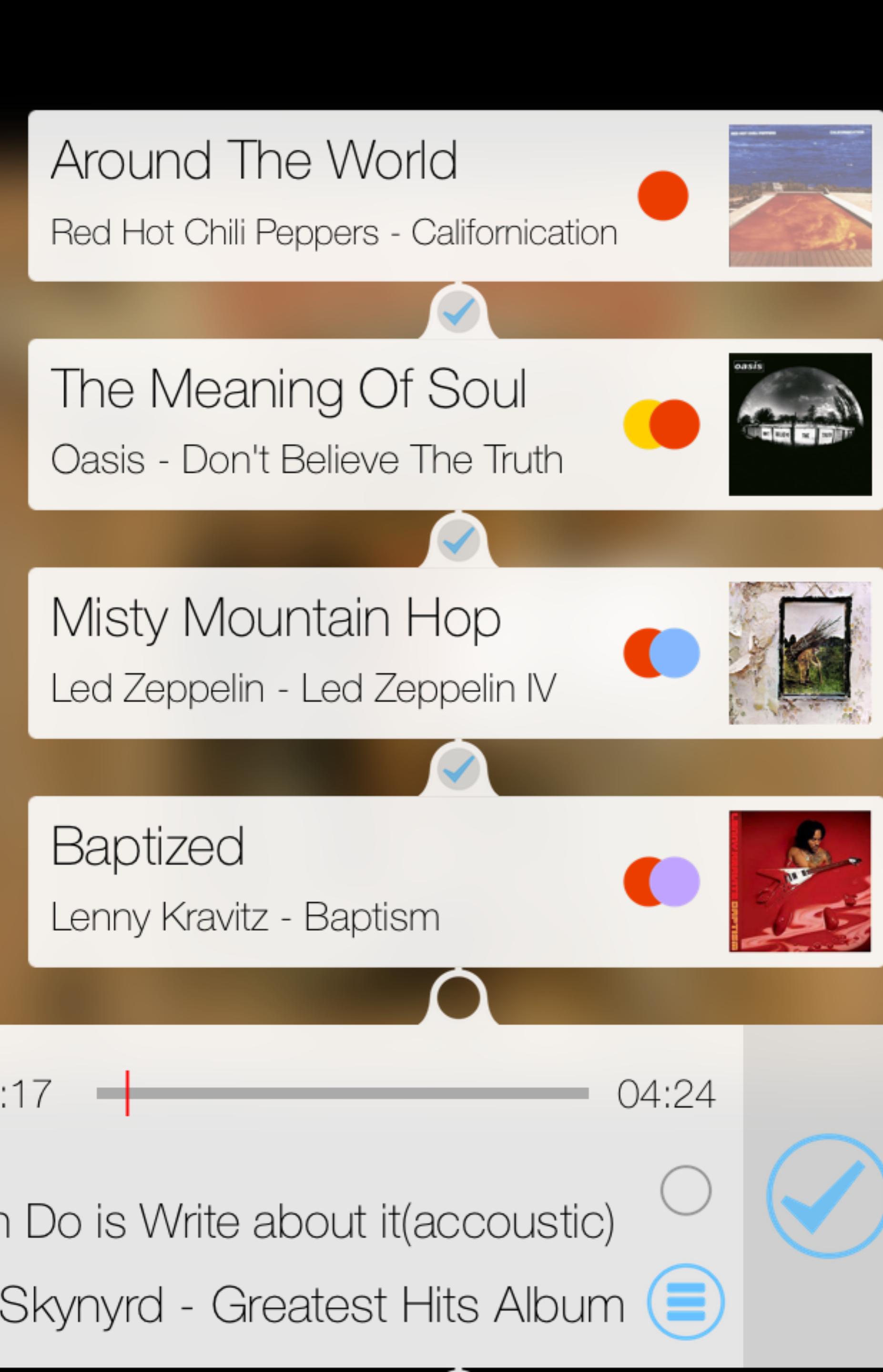
DEFINING MUSICAL DISTANCE

- We create the graph of songs by comparing features together
- Learn an “optimal” mathematical distance to weight the different features
- Ultimately, we want to learn the actual taste of each user but how?



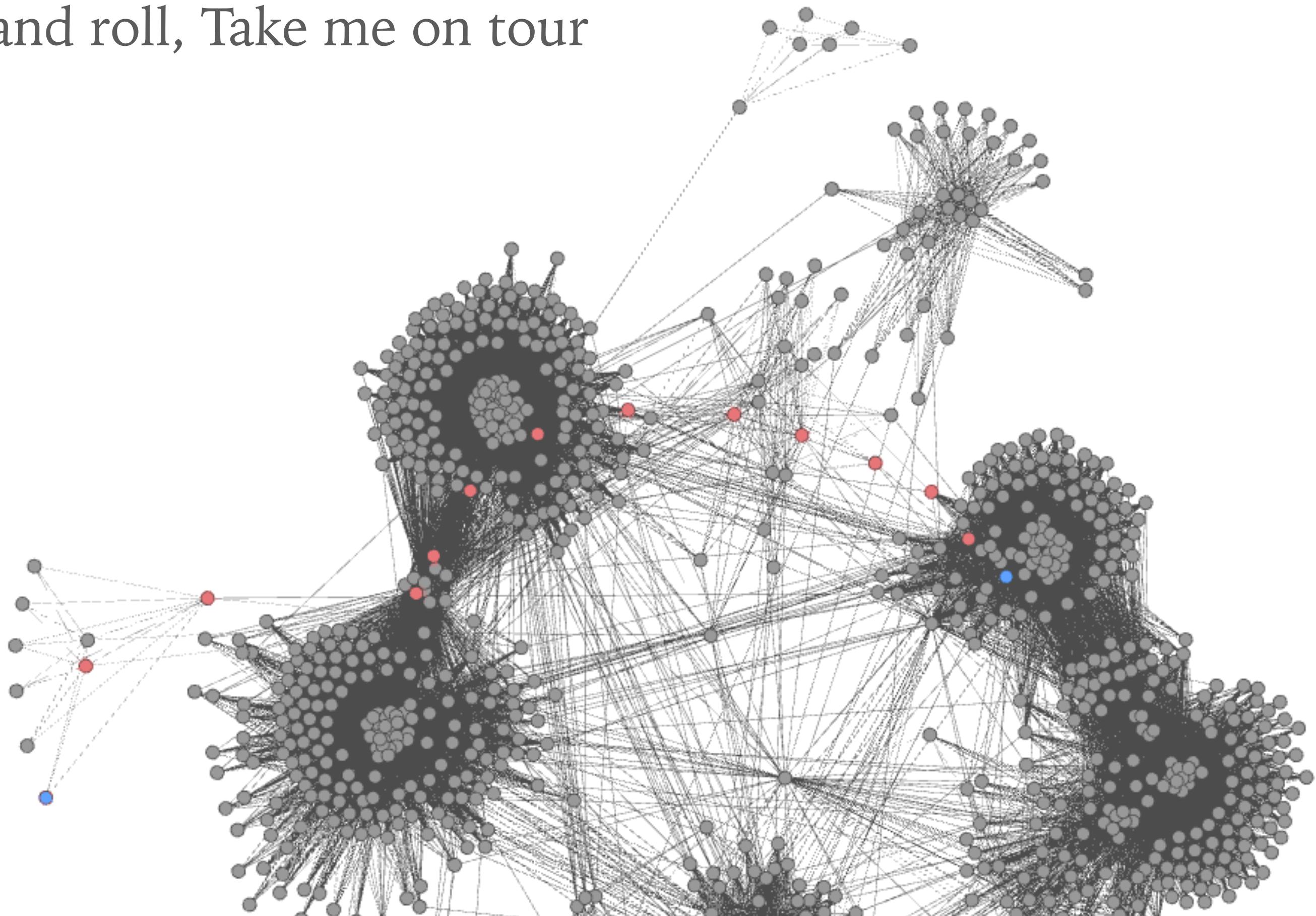
melody

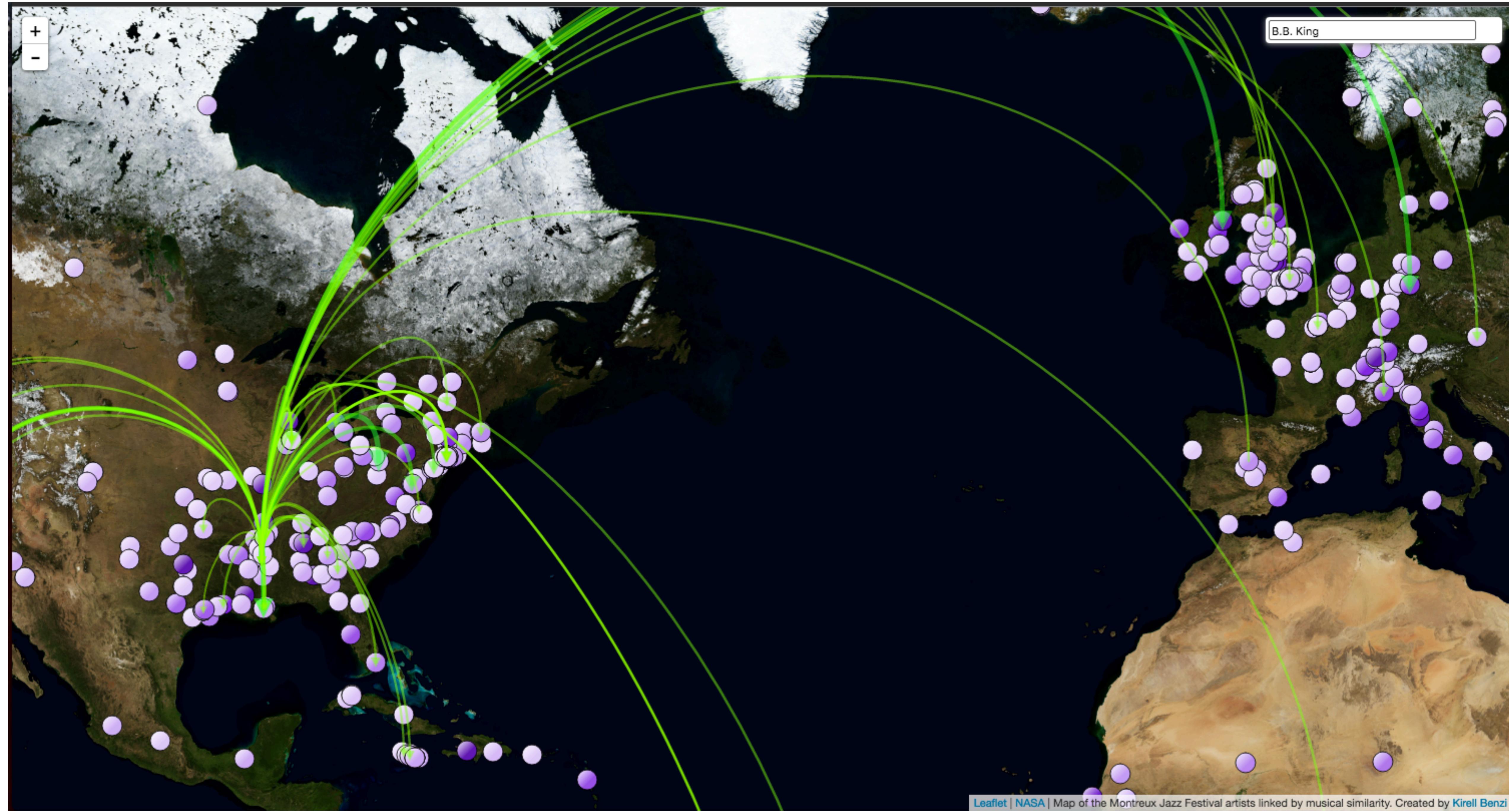




PLAYLIST GENERATION

- Follow the links of the graph according to our adaptive algorithms
- Different modes such as Lead me on, Ride and roll, Take me on tour





Data sonification

Data sonification

Pros

Useful for visually-impaired users

Well suited to representing temporal or sequential data.

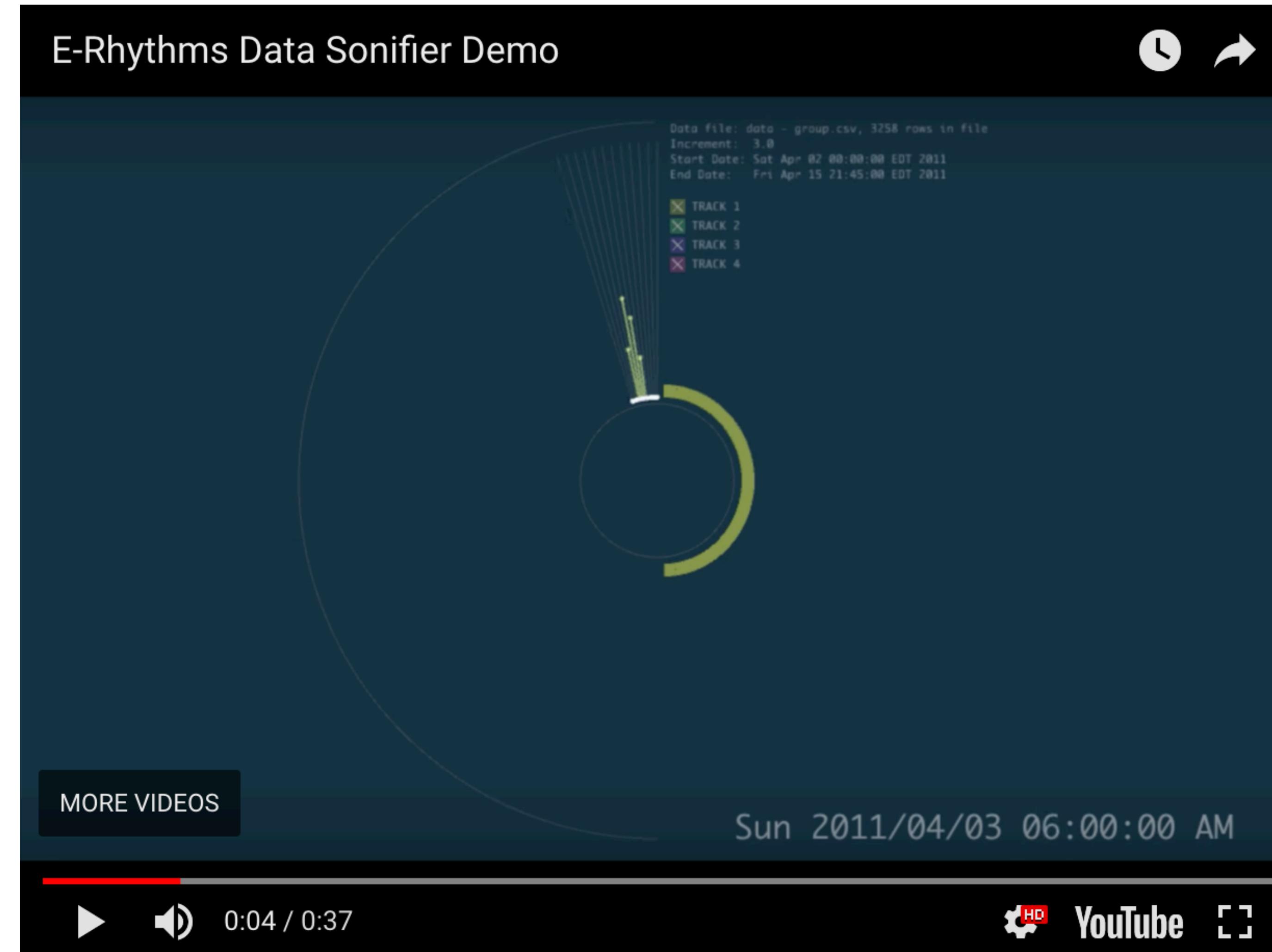
Cons

Cannot be used to represent complex datasets

Hearing bandwidth is low



E-Rhythms Data Sonifier



Network Activity Renderer

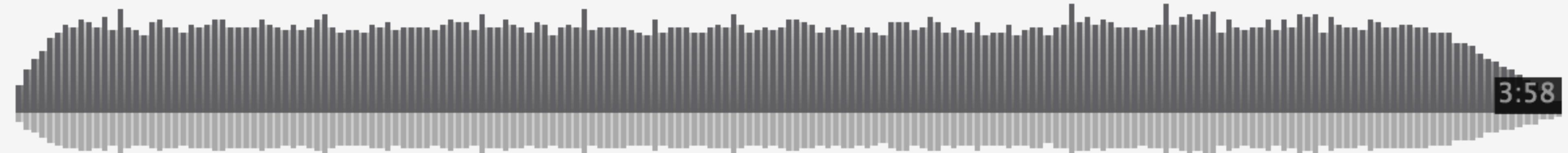


Listen to solar wind



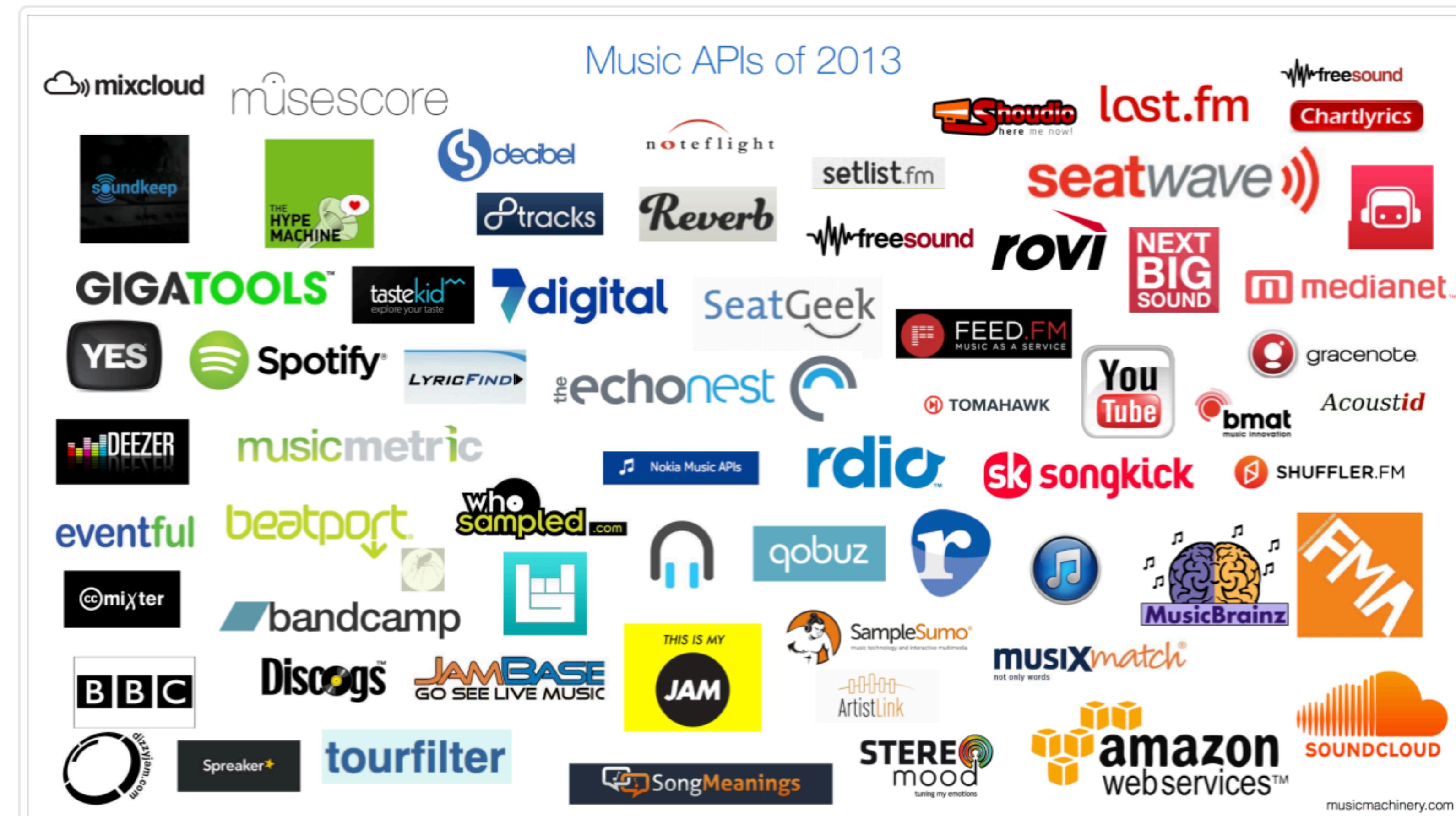
SciFri
Sun Song

 SOUNDCLOUD



Music APIs

Here's a categorized list of all the Music APIs. Notice one that is missing or miscategorized? Let me know.



Homework

Read Visualization Analysis and Design
Chapter 7

Read Making sense of streamgraphs

