

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



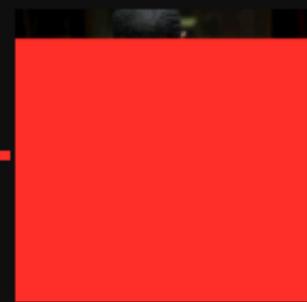
I'll Be Missing You—Puff Daddy And Faith Evans

#1 ON AUGUST 01, '97

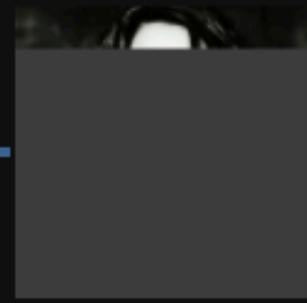
PAUSE / PLA

Find an artist... 

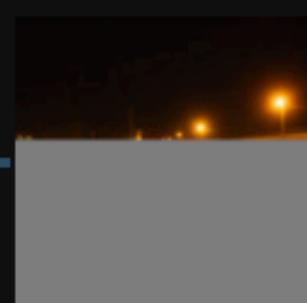
WEEKS AT #1 (TOP 10)

Puff Daddy and Faith Evans:
Hanson:

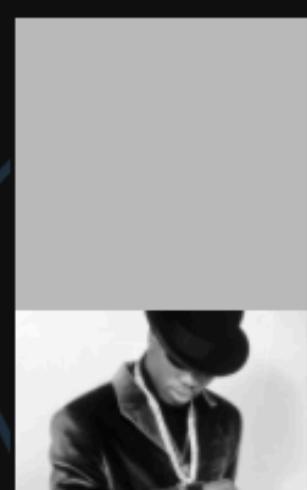
I'LL BE MISSING YOU



BITCH



QUIT PLAYING GAMES



SEMI-CHARMED LIFE

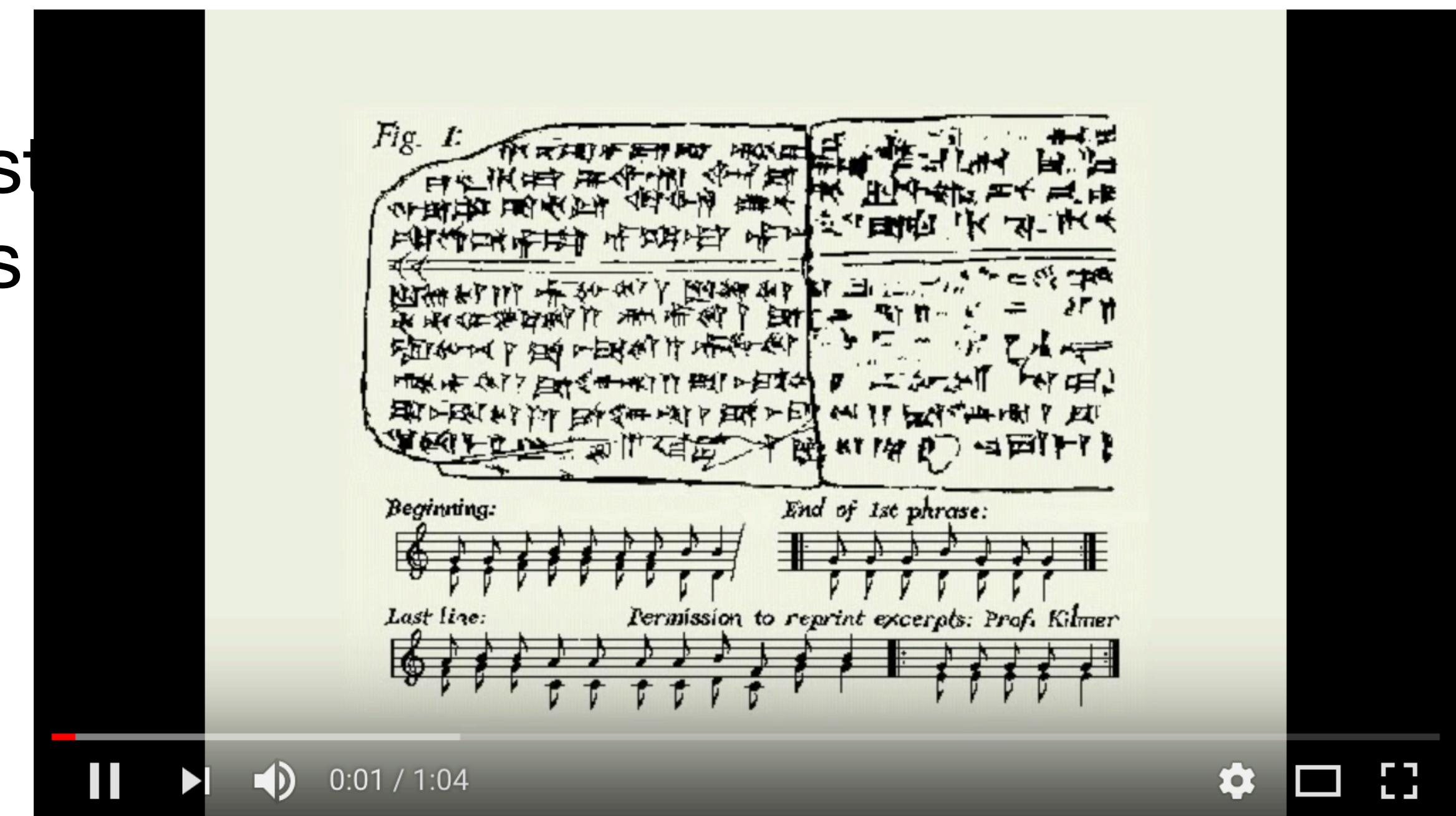


RETURN OF THE MACK

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

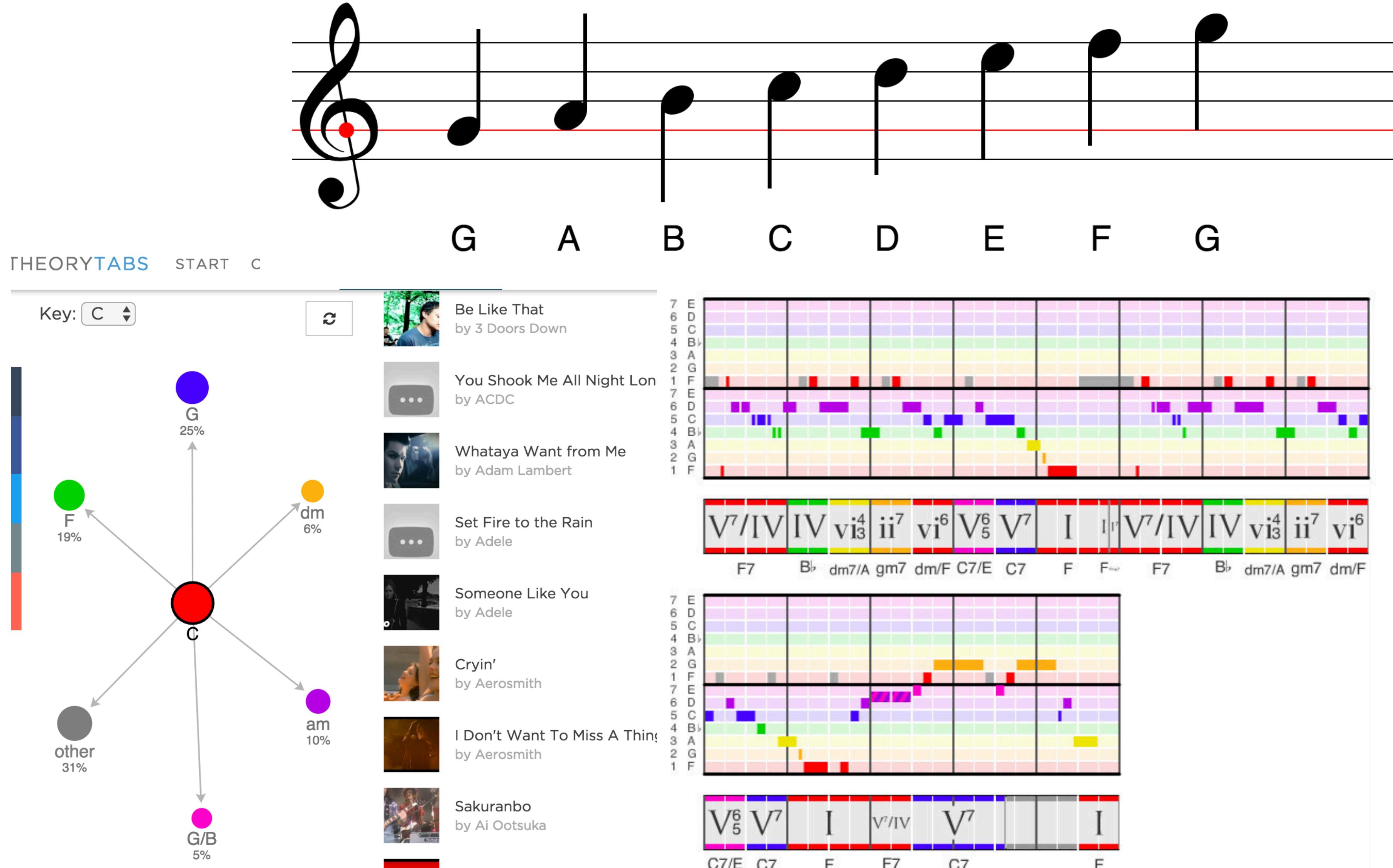
Process of converting information into computer-readable format

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**

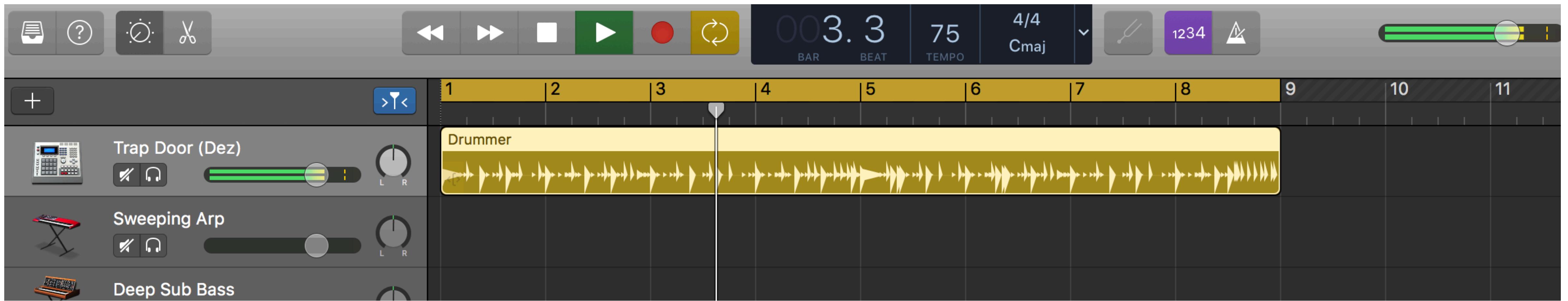
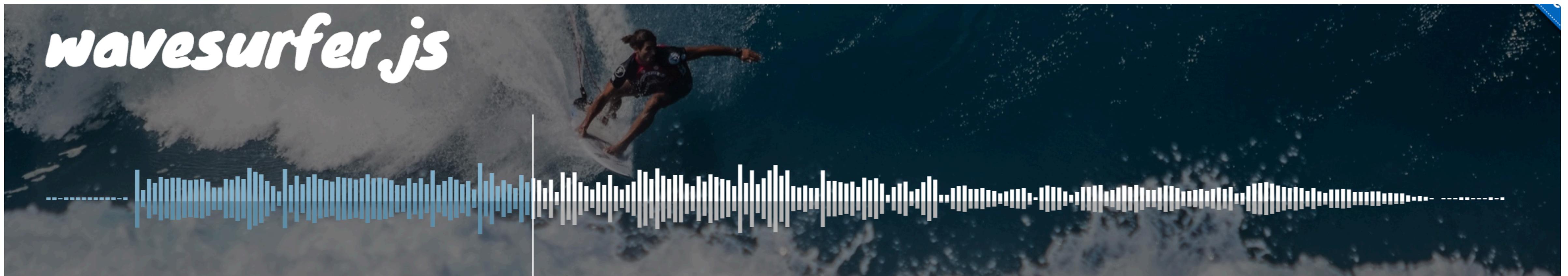
Chroma: {C, C#, D, D#, E ,F, F#, G, G#, A, A#, B}

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]

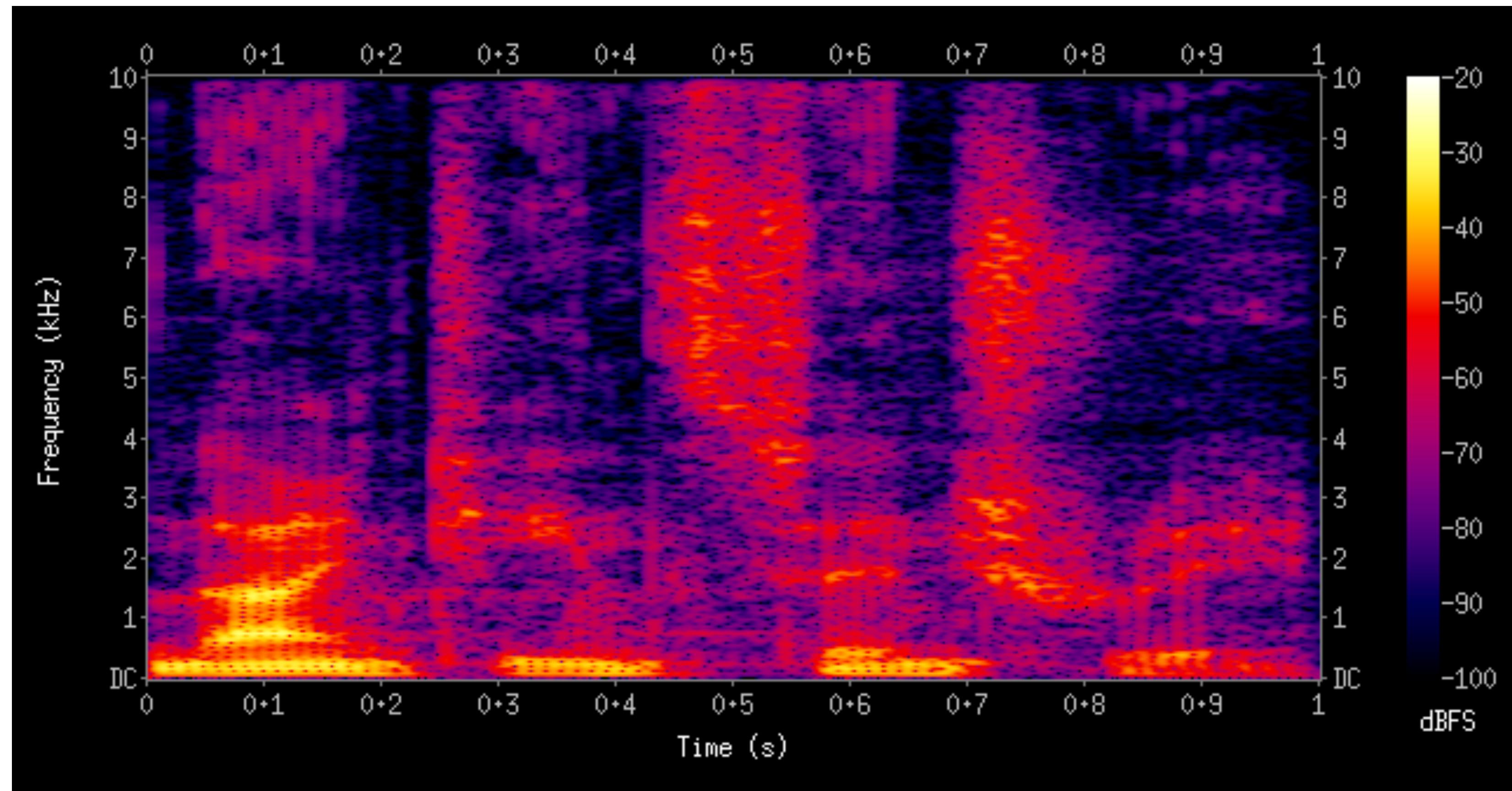
Waveform viz

Waveforms: perceived loudness (sound pressure) over time



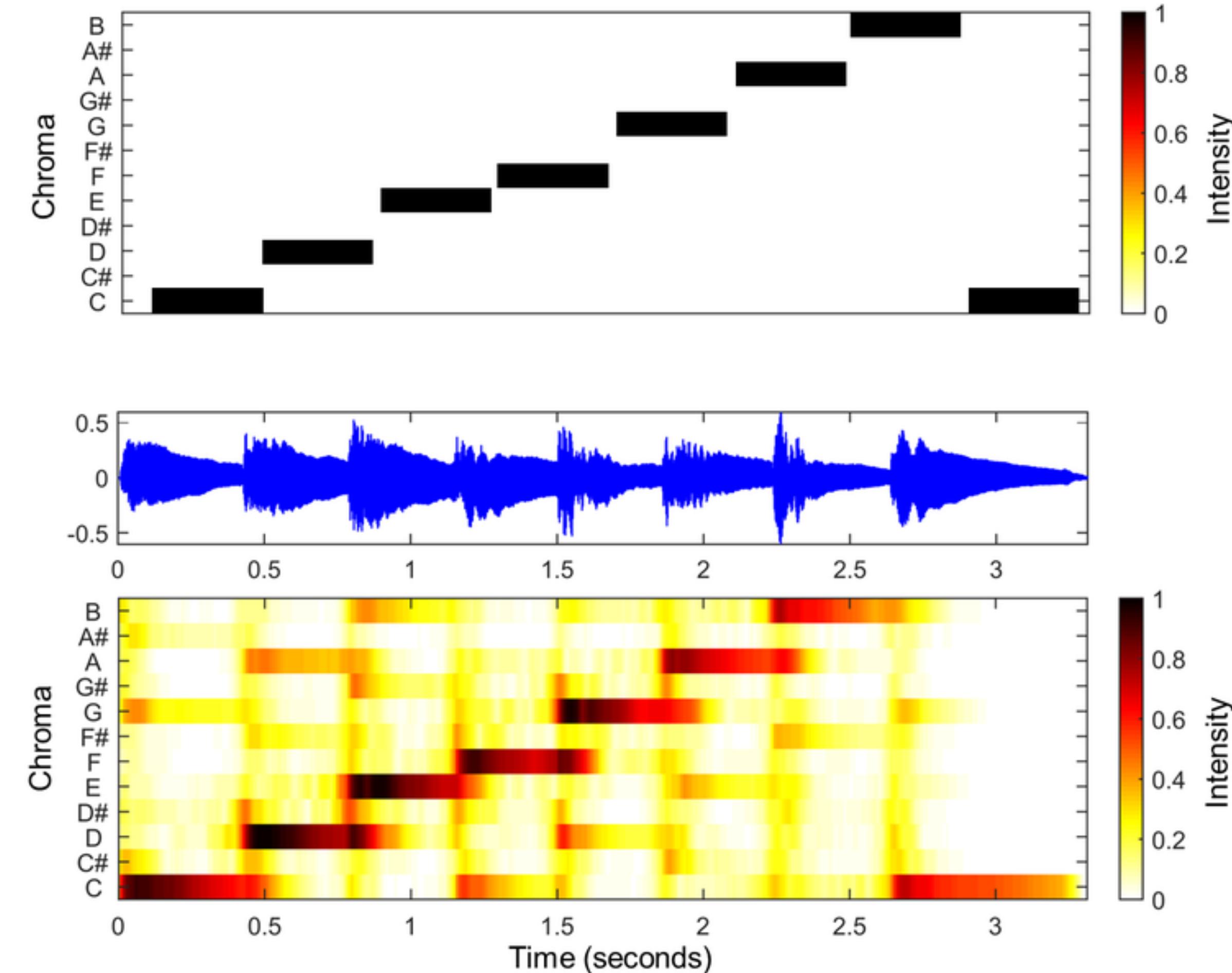
Spectrogram

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



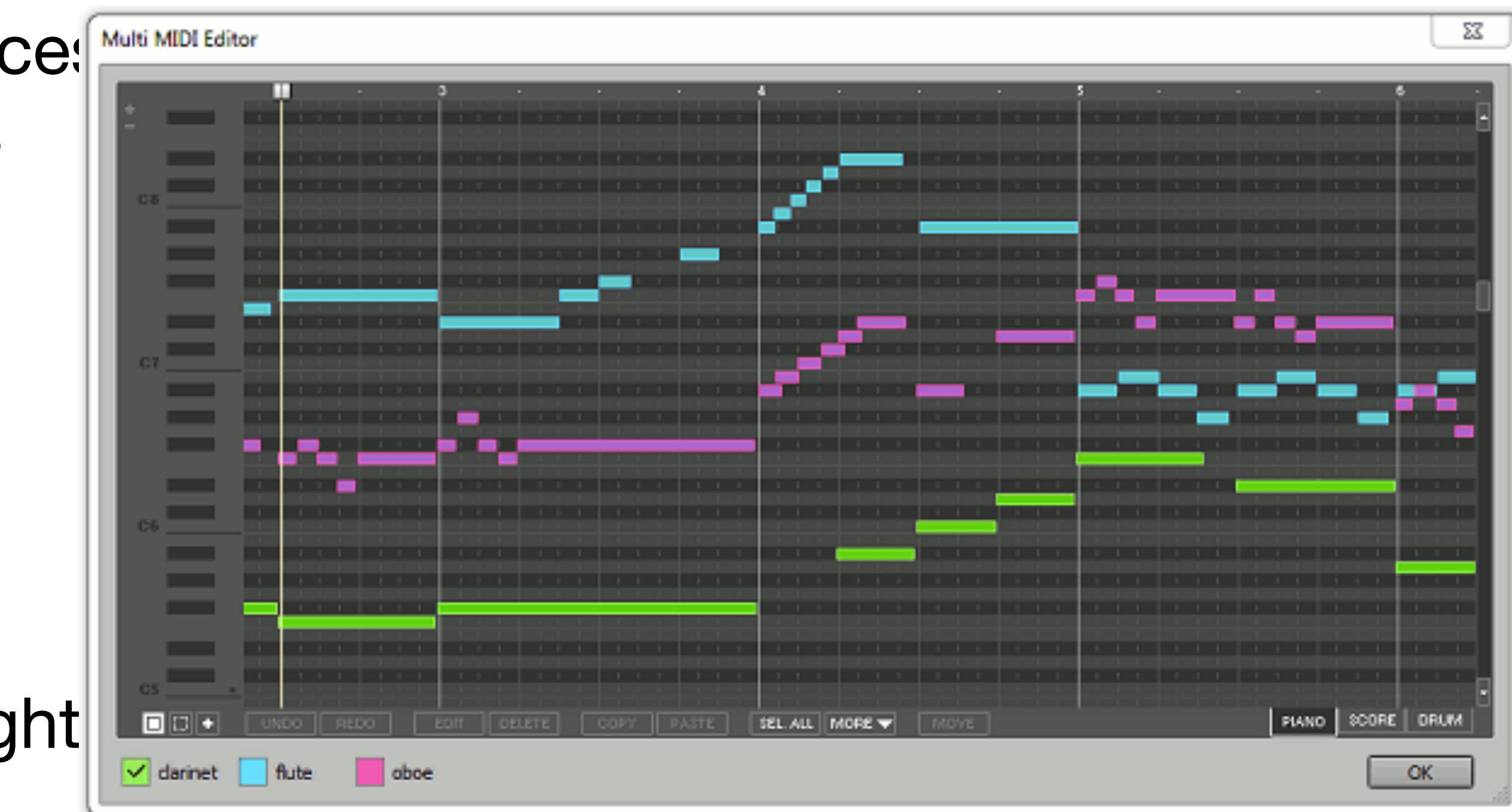
MIDI

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

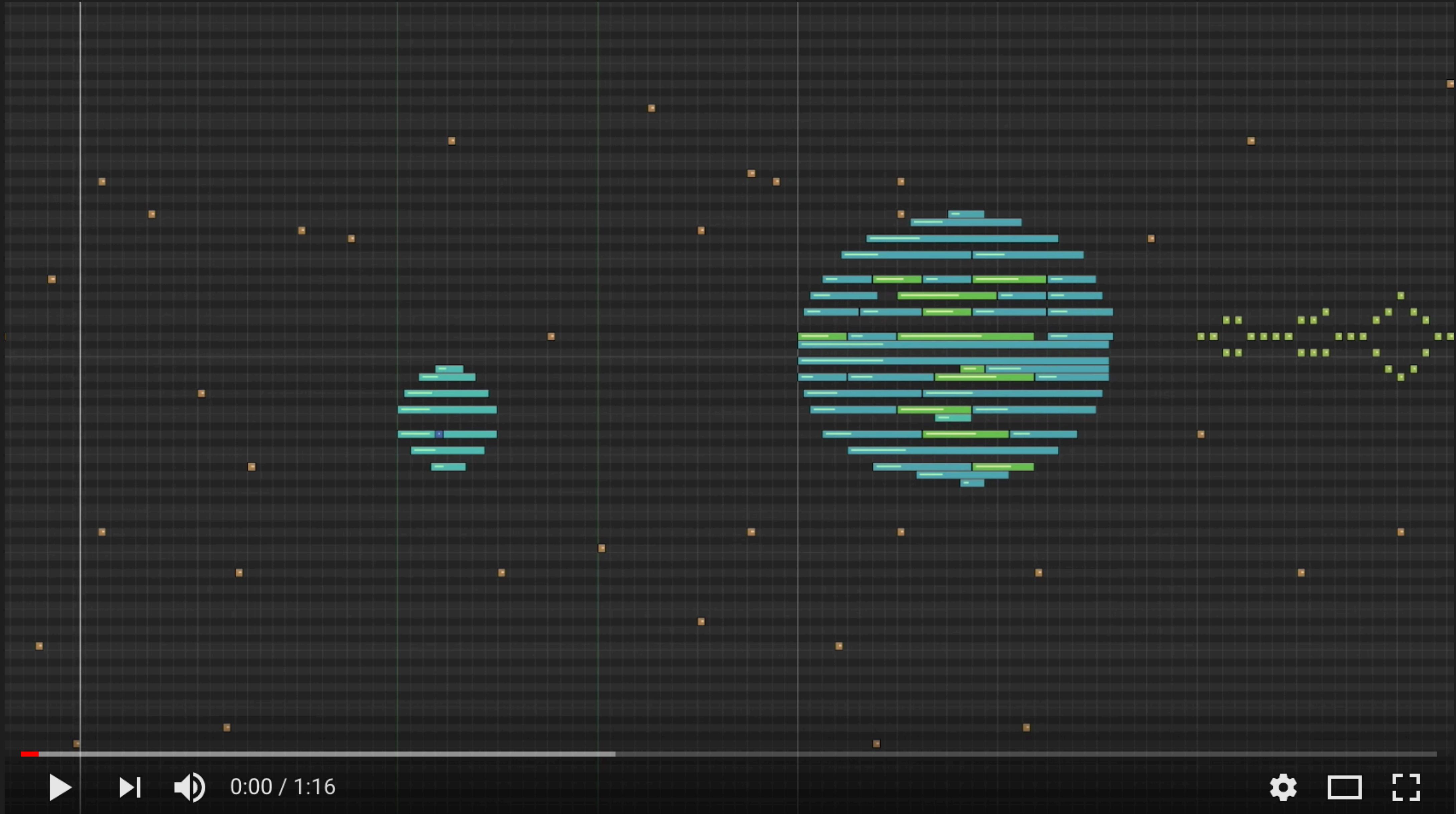
MIDI data structure contains:

notation, pitch and velocity (loudness or softness)

volume, vibrato, audio panning from left to right

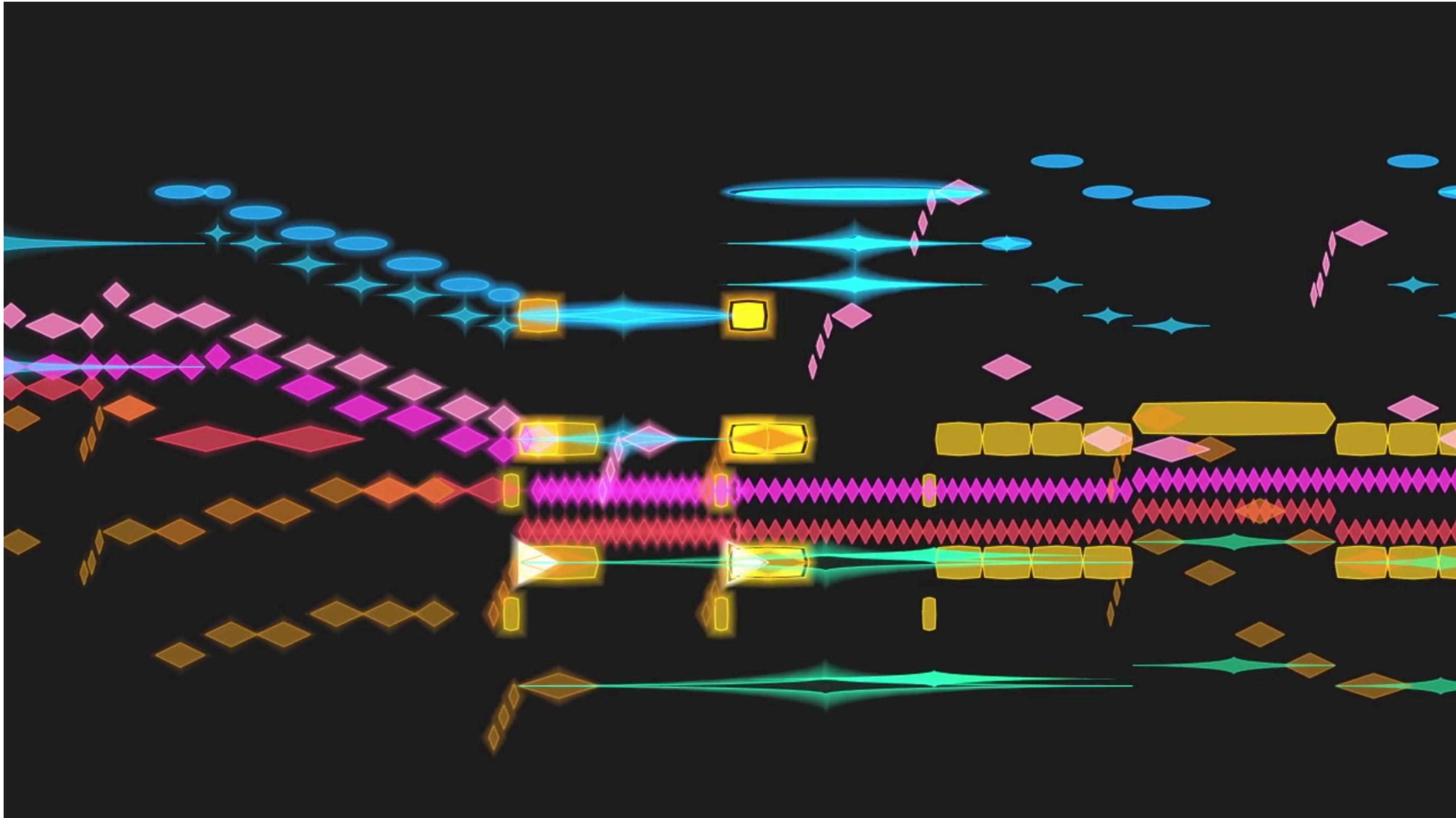


clock signals that set and synchronize tempo between multiple devices.



Sound visualization

Musicanim



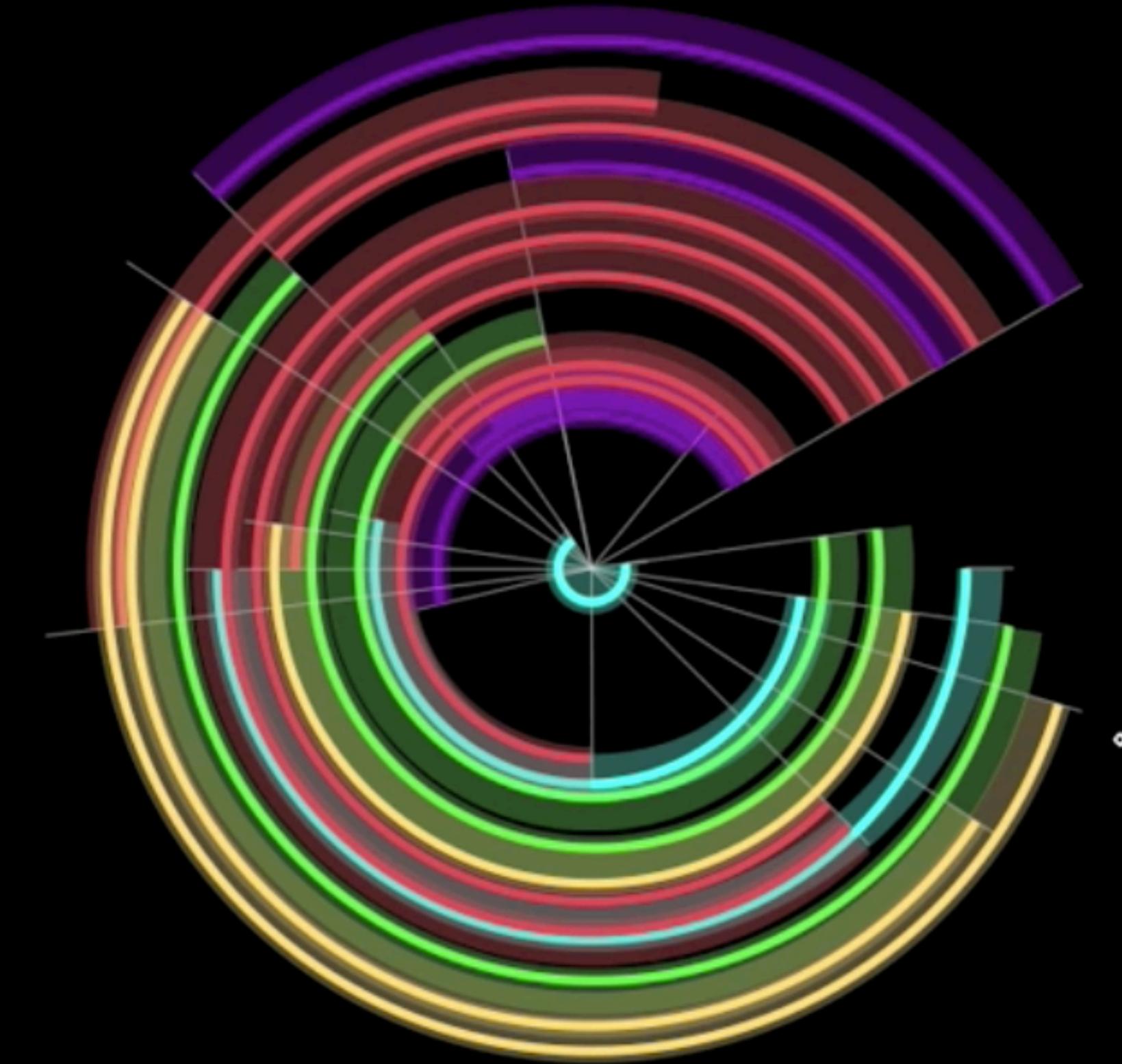
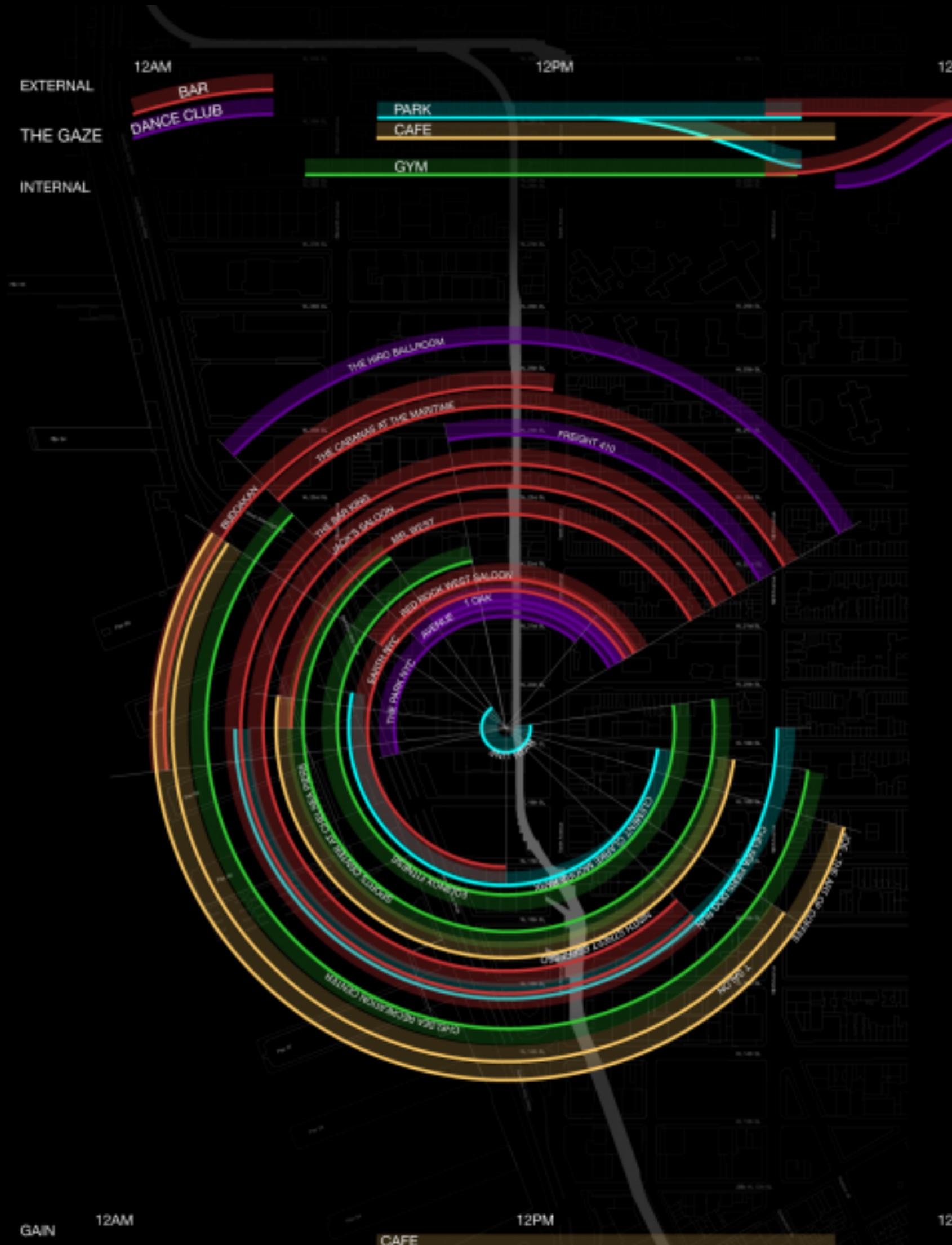
[Stephen Malinowski]

Guitar Hero



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

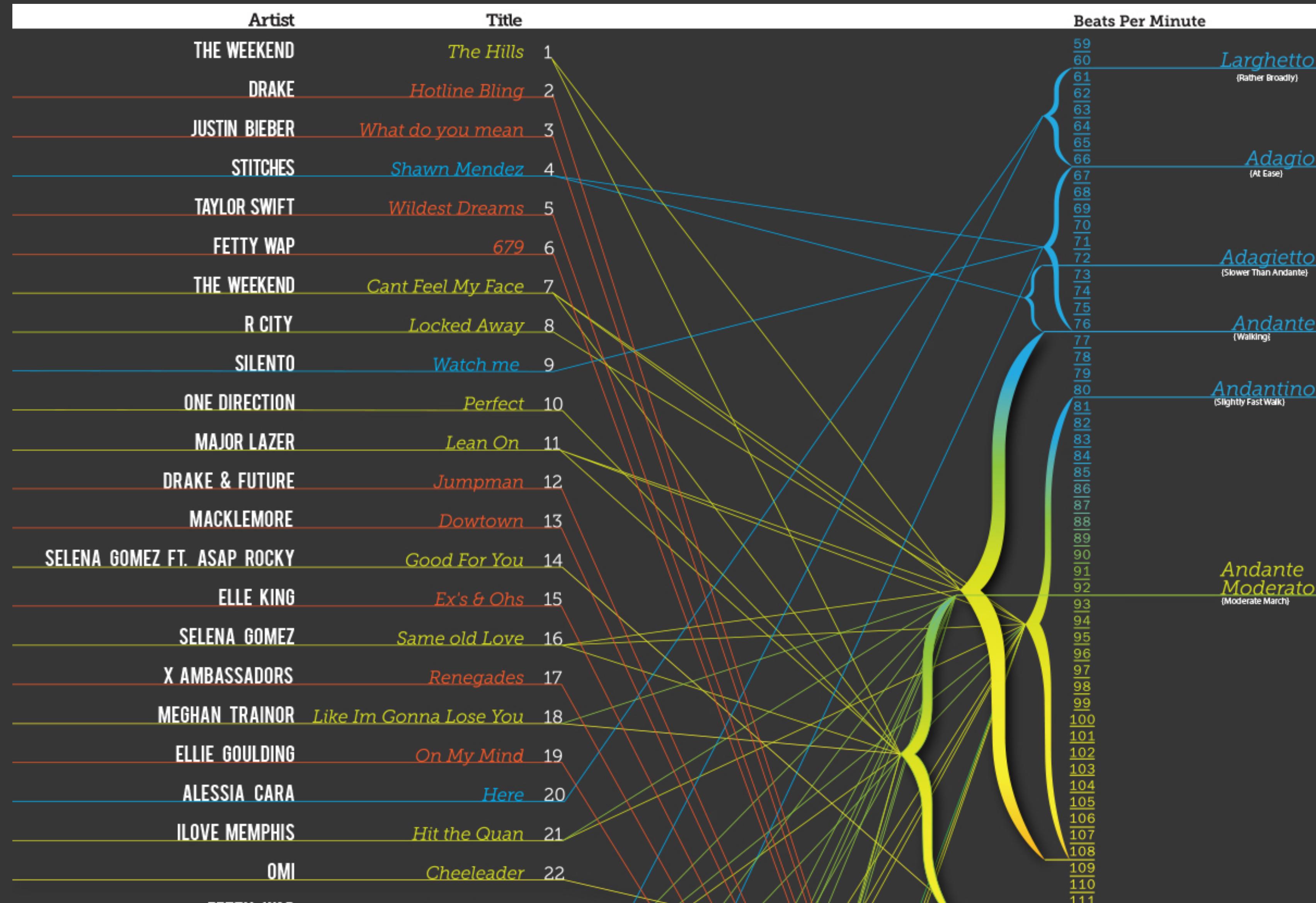
New-York city mapping



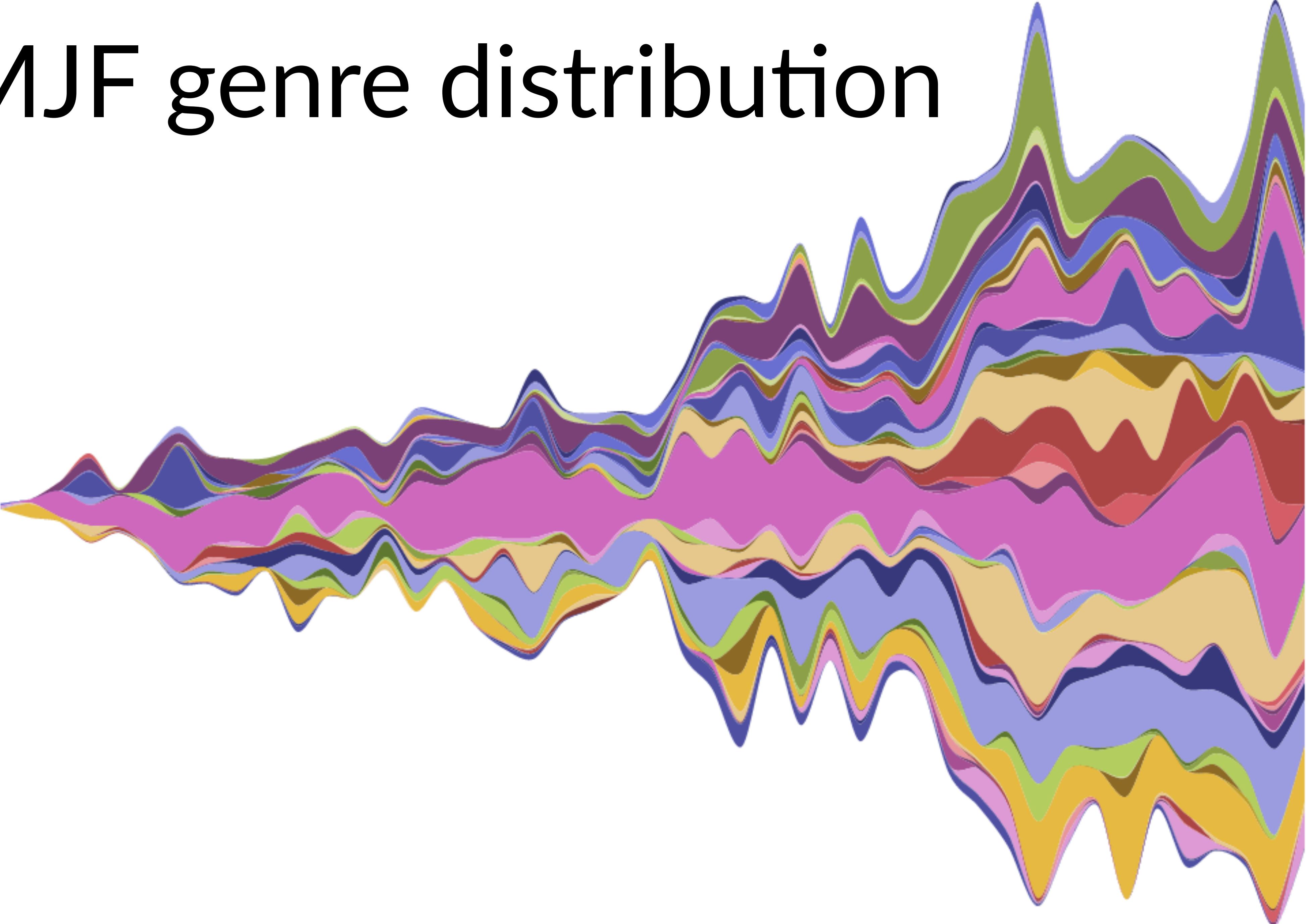
[Mark Edward Campos]

Music related data viz

The Color of Sound



MJF genre distribution



Real-life example



GRAPH-BASED MUSIC RECOMMENDATION

The screenshot shows a music player interface with the following details:

Top bar: I Can't Be Satisfied [Album Version]
Artist: Muddy Waters

Menu tabs: Getting started, Library (selected), Discovery, Social

Table view (Title, Time, Artist, Album, Year, Genre):

Title	Time	Artist	Album	Year	Genre
Cypress Grove	04:16	Skip James	Today!	1964	Blues
Crow Jane	02:24	Skip James	Skip James Live Vol....	2005	Blues
Sickbed Blues	04:04	Skip James	Devil Got My Woman	1968	Blues
Catfish Blues	04:37	Skip James	Devil Got My Woman	1968	Blues
Come & Get It	03:51	Selena Gomez	Top 100 2013 USA	2013	Hit Single
Brave	03:40	Sara Bareilles	Top 100 2013 USA	2013	Hit Single
Travelling Riverside Blues	02:32	Sam Mitchell	The Art Of Bottleneck...	2013	Blues
Pile Driver	02:54	Sam Mitchell	The Art Of Bottleneck...	2013	Blues
(Baby, Let Me) Follow You Down	02:31	Sam Mitchell	The Art Of Bottleneck...	2013	Blues
Rainy Day Blues	02:41	Sam Mitchell	Bottleneck / Slide G...	2009	Blues
Motherless Children	02:38	Sam Mitchell	Bottleneck / Slide G...	2009	Blues
Crossroad Blues	03:07	Sam Mitchell	Bottleneck / Slide G...	2009	Blues
Avalon	05:14	Rory Block	Avalon: A Tribute To ...	2013	Blues
I'm So Glad	02:44	Rory Block, Stefan ...	Country Blues Guitar	2009	Blues
U.O.E.N.O.	04:20	Rocko ft. Future & R...	Top 100 2013 USA	2013	Hit Single
Blurred Lines	04:23	Robin Thicke	Top 100 2013 USA	2013	Hit Single
Come On In My Kitchen	02:52	Robert Johnson	Robert Johnson - 34...	1937	Blues

Bottom navigation: View: Basic (selected), Expert

Timeline: 03:07, 05:44, 09:12

Discovery sidebar: Discovery, Work, Shake, Relax, Party

Graph visualization: A network of nodes connected by lines. Nodes include: Crossroad Blues (Sam Mitchell), If You Haven't Got An..., I Can't Be Satisfied [Album Ver... (Muddy Waters), Death Com... (Bob Bro...), and others. A checkmark and an X are shown near the connections.

Genezik

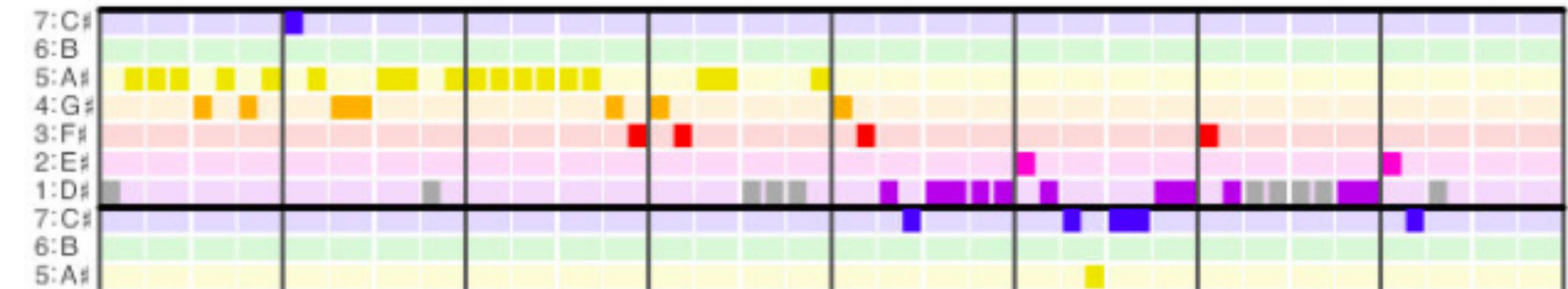
“The ultimate playlist generator”

- Personalized distributed playlist recommender system
- Global song recommender system

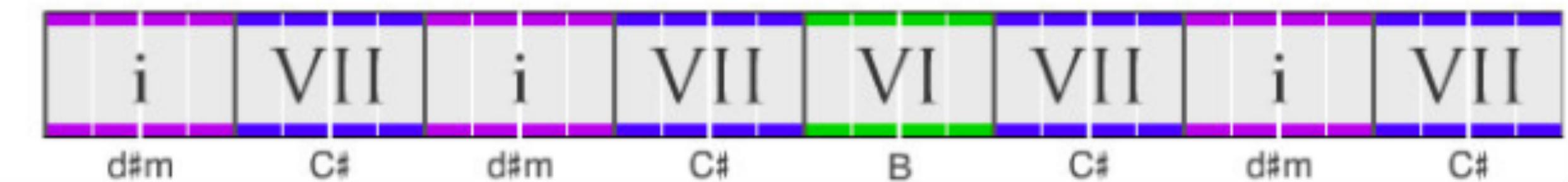


FEATURE EXTRACTION

- Audio: notes, timbre, rhythm



- Social: popularity, hotness



207,924,774 views



816,658



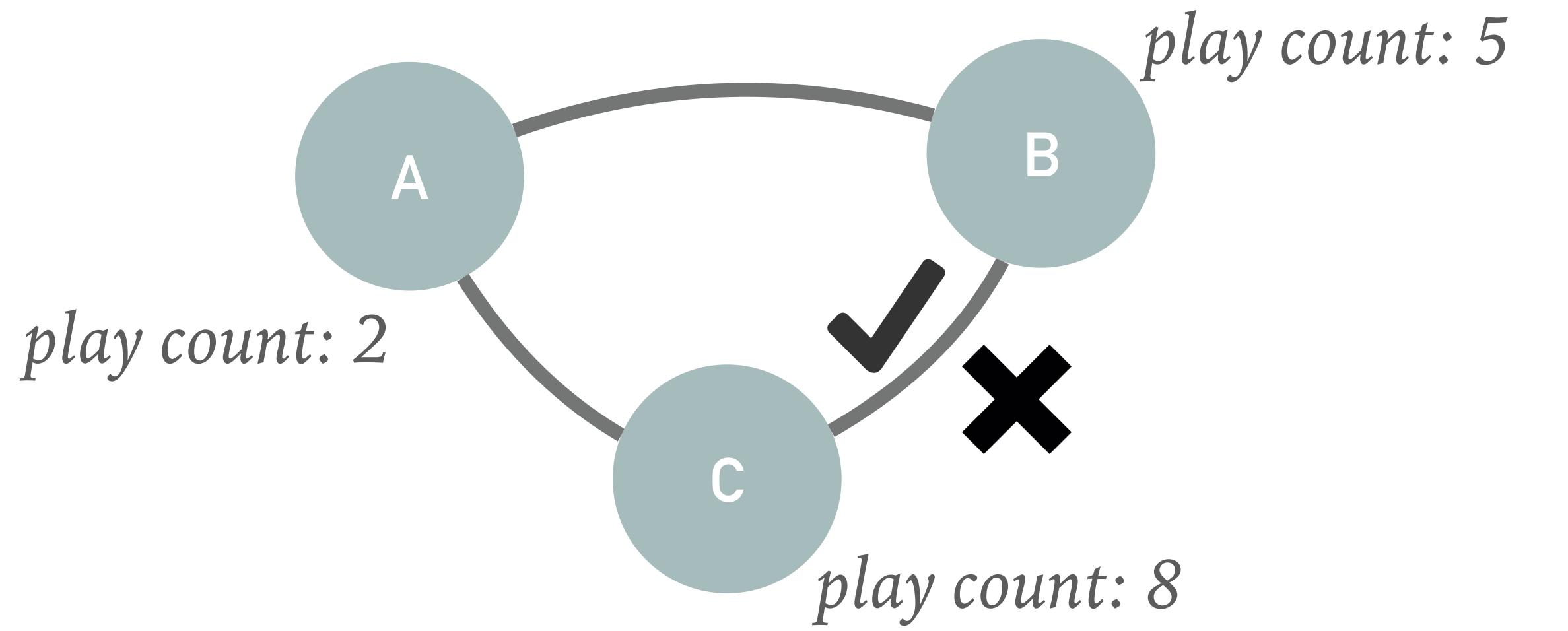
30,675

- Metadata: genre, mood, tags

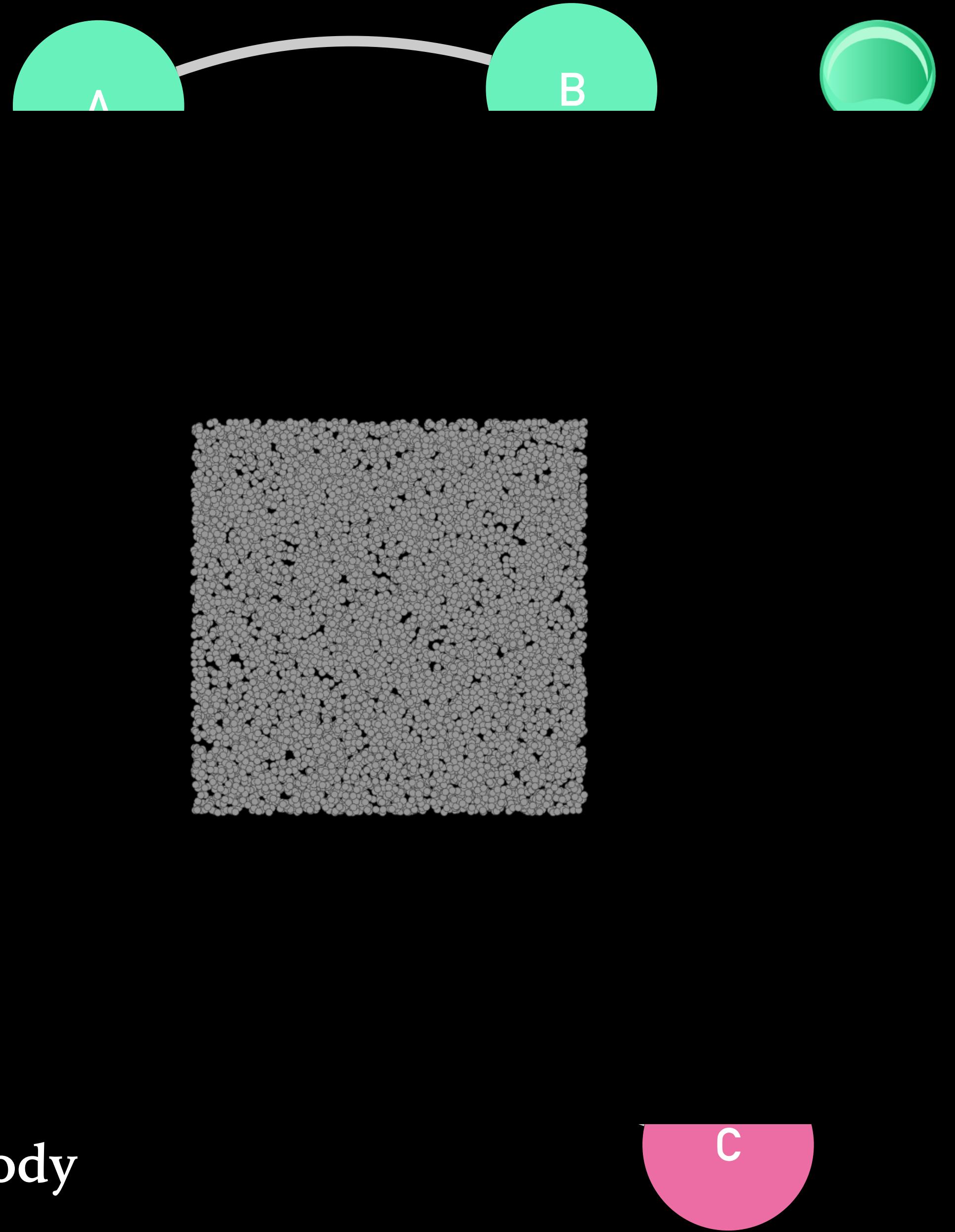
Recorded	1982
Genre	Hard rock ^[1] ^[2] · dance-rock ^[3]
Length	4:18
Label	Epic
Writer(s)	Michael Jackson
Producer(s)	Quincy Jones · Michael Jackson (co-producer)

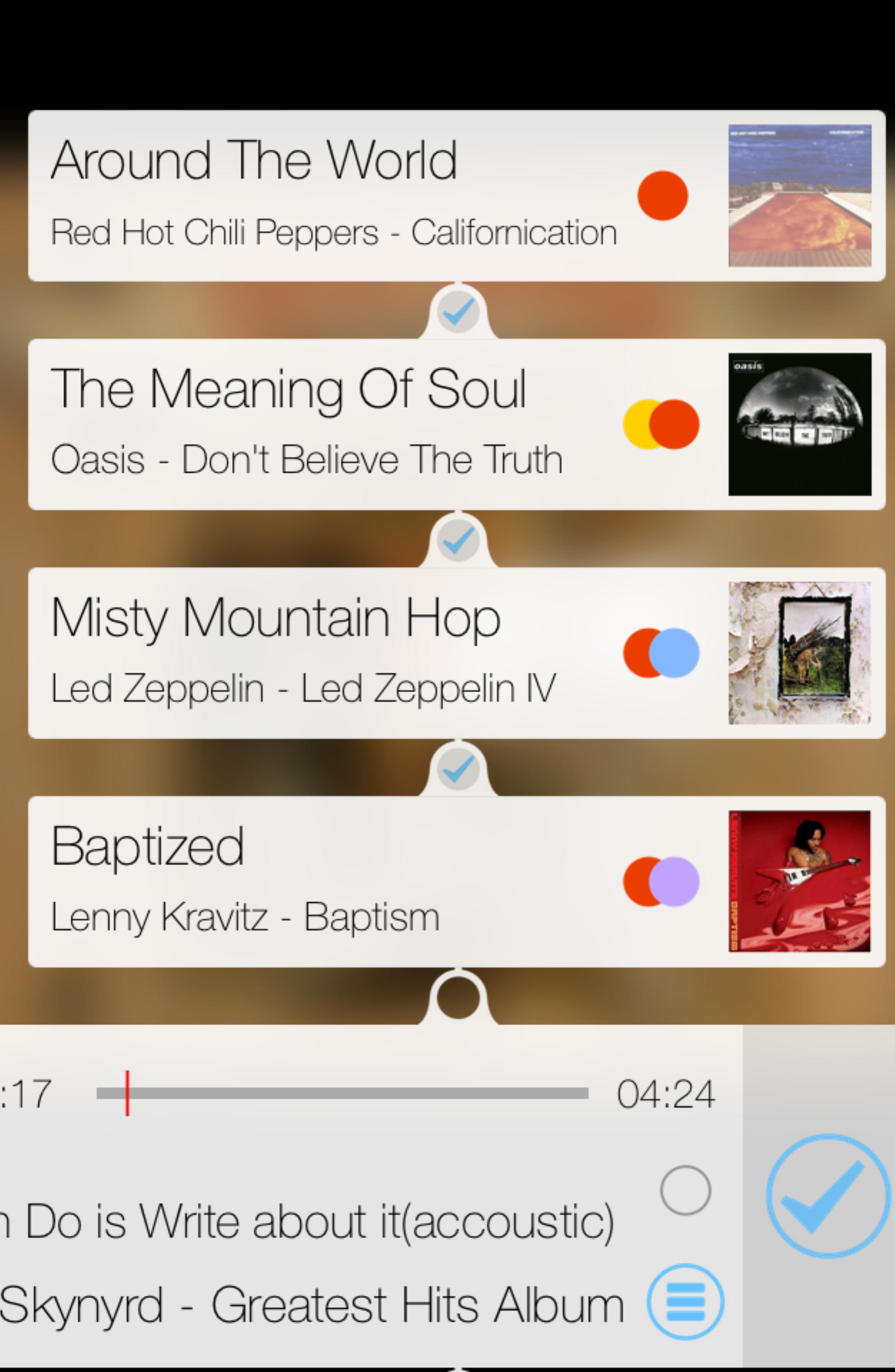
DEFINING MUSICAL DISTANCE

- 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?



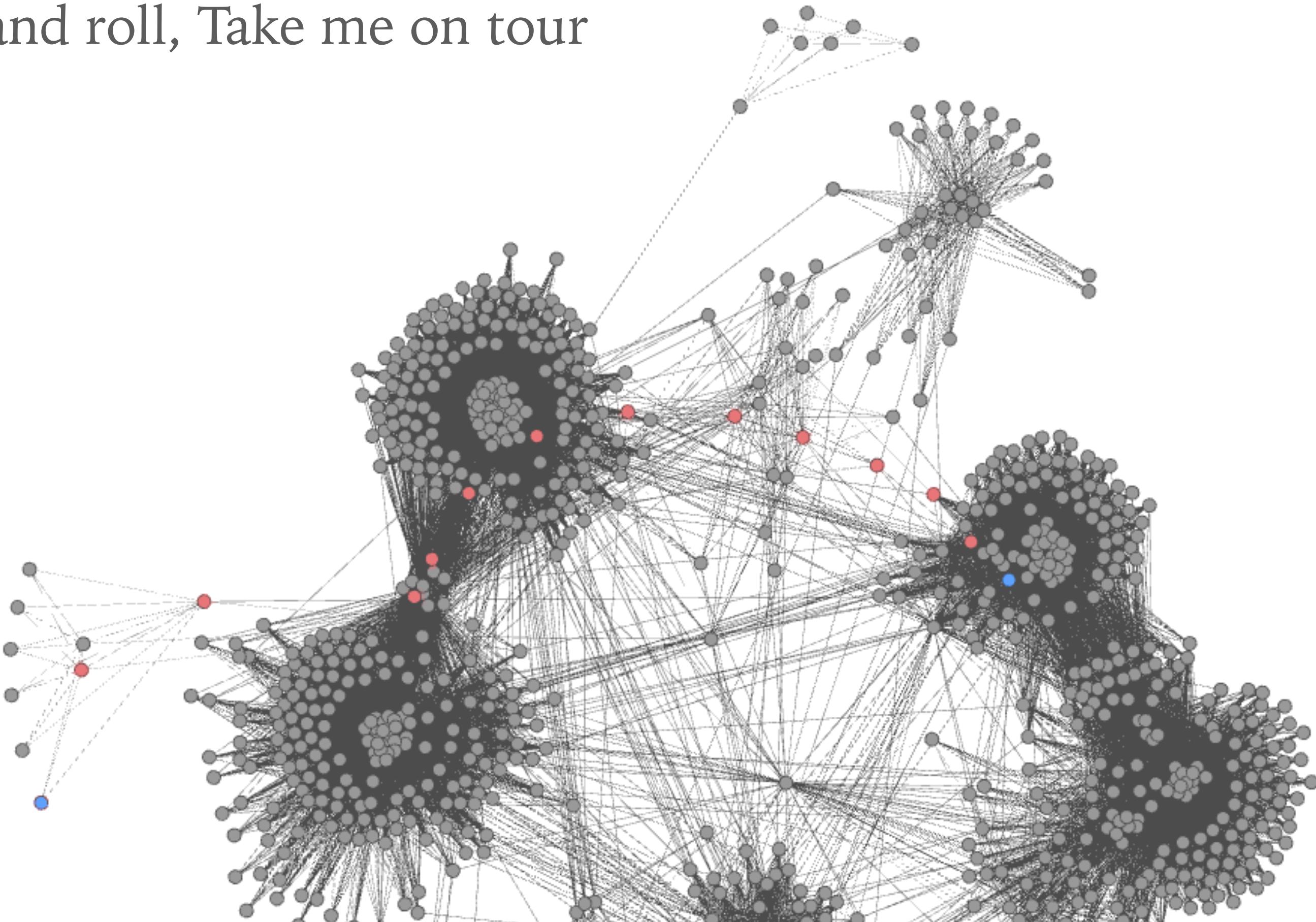
melody





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



B.B. King



Data sonification

Data sonification

Pros

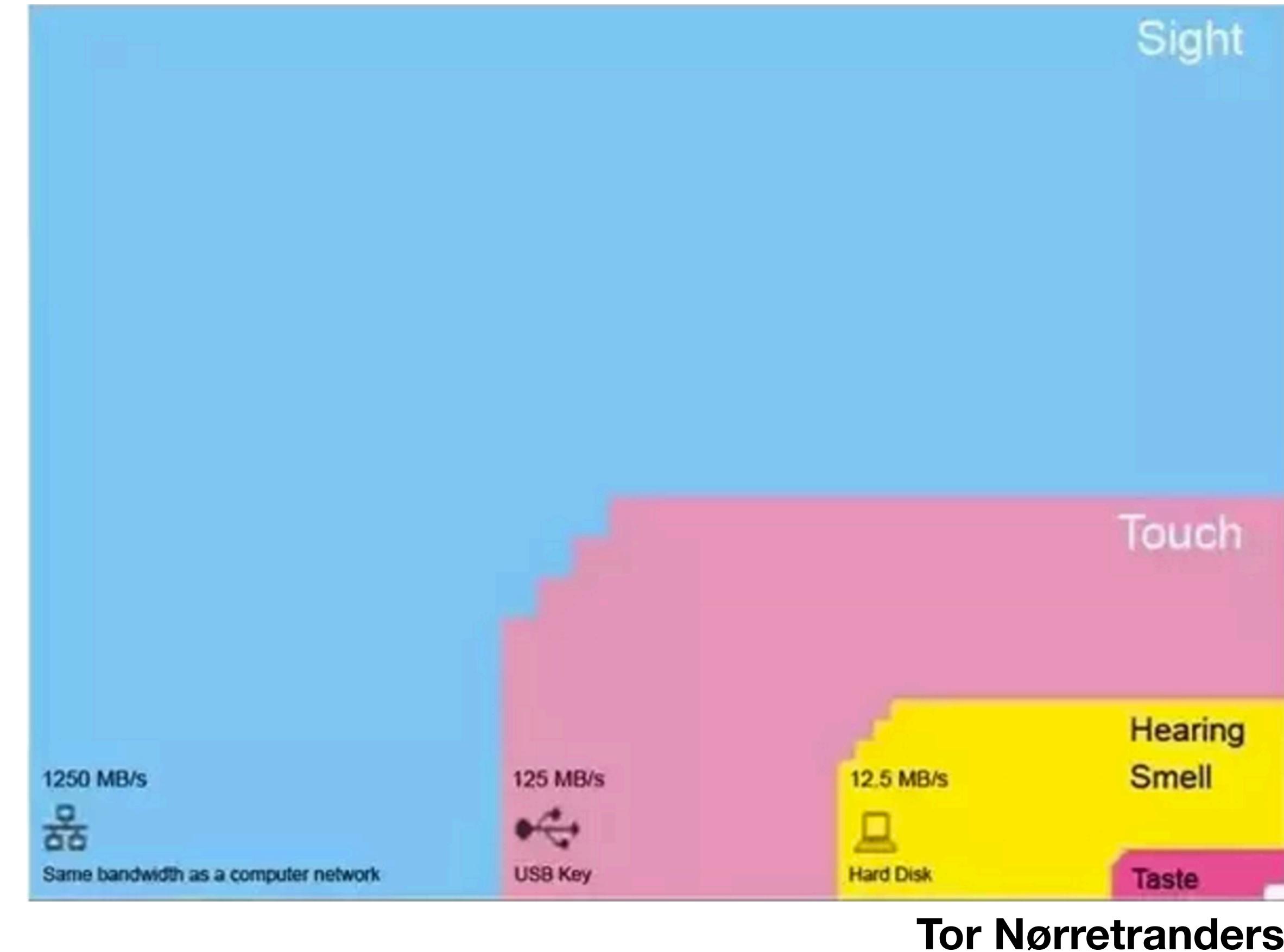
Useful for visually-impaired users

Well suited to representing temporal or sequential data.

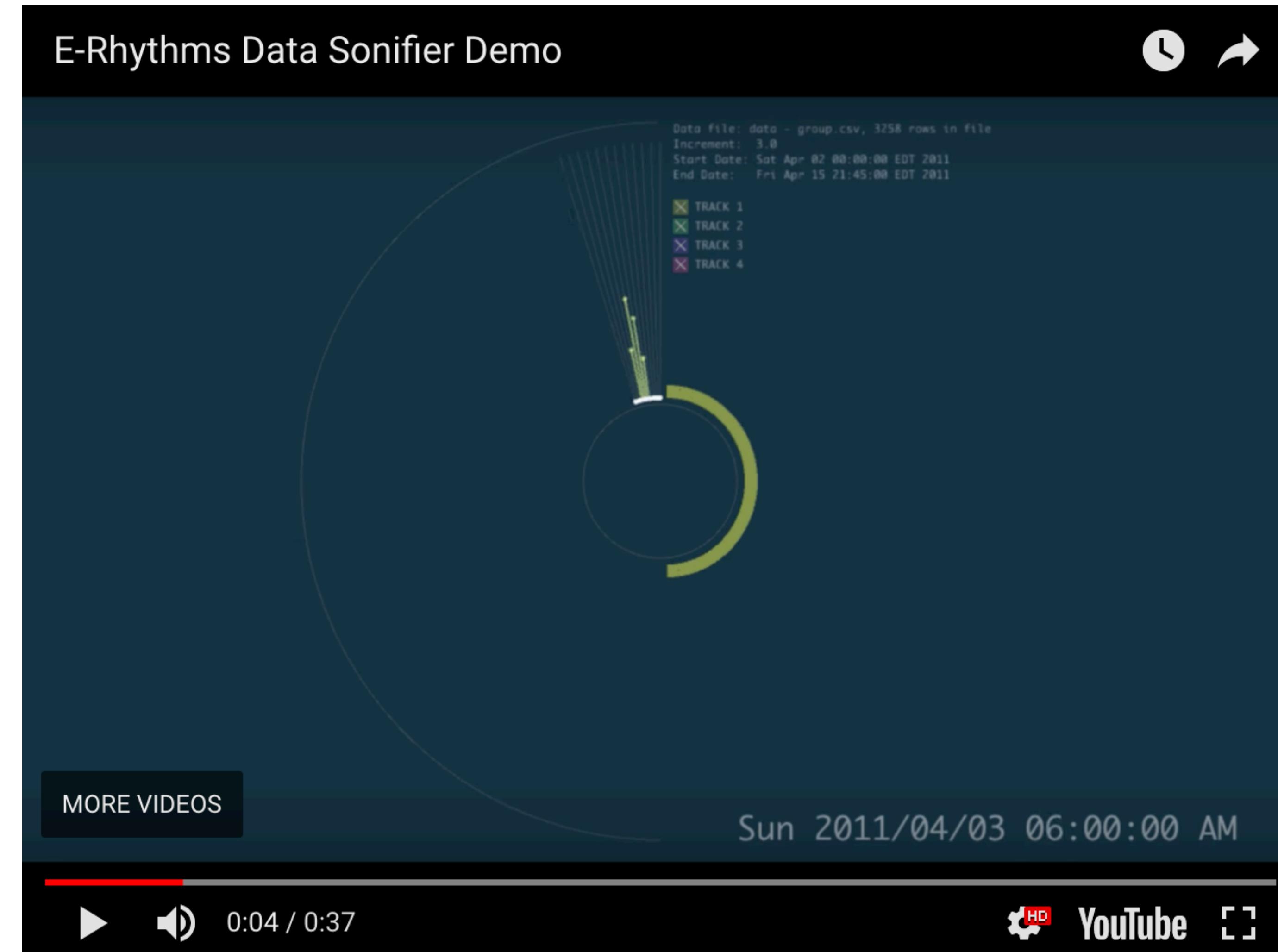
Cons

Cannot be used to represent complex datasets

Hearing bandwidth is low



E-Rhythms Data Sonifier



Network Activity Renderer



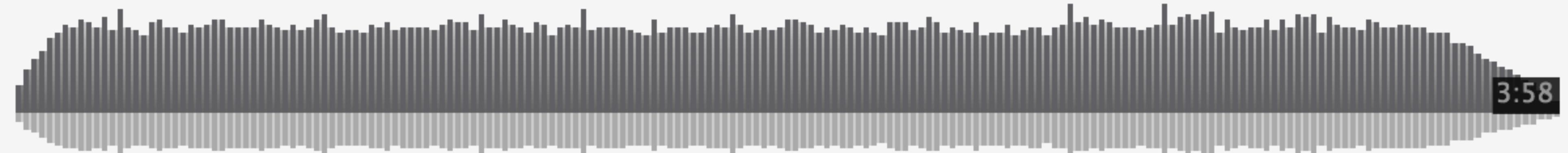
Connect your device to MoOS HotSpot

Listen to solar wind



SciFri
Sun Song

SOUNDCLOUD



▶ 1.1K

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

