

# Using Visualizations for Music Discovery

ISMIR 2009

Justin Donaldson  
Paul Lamere

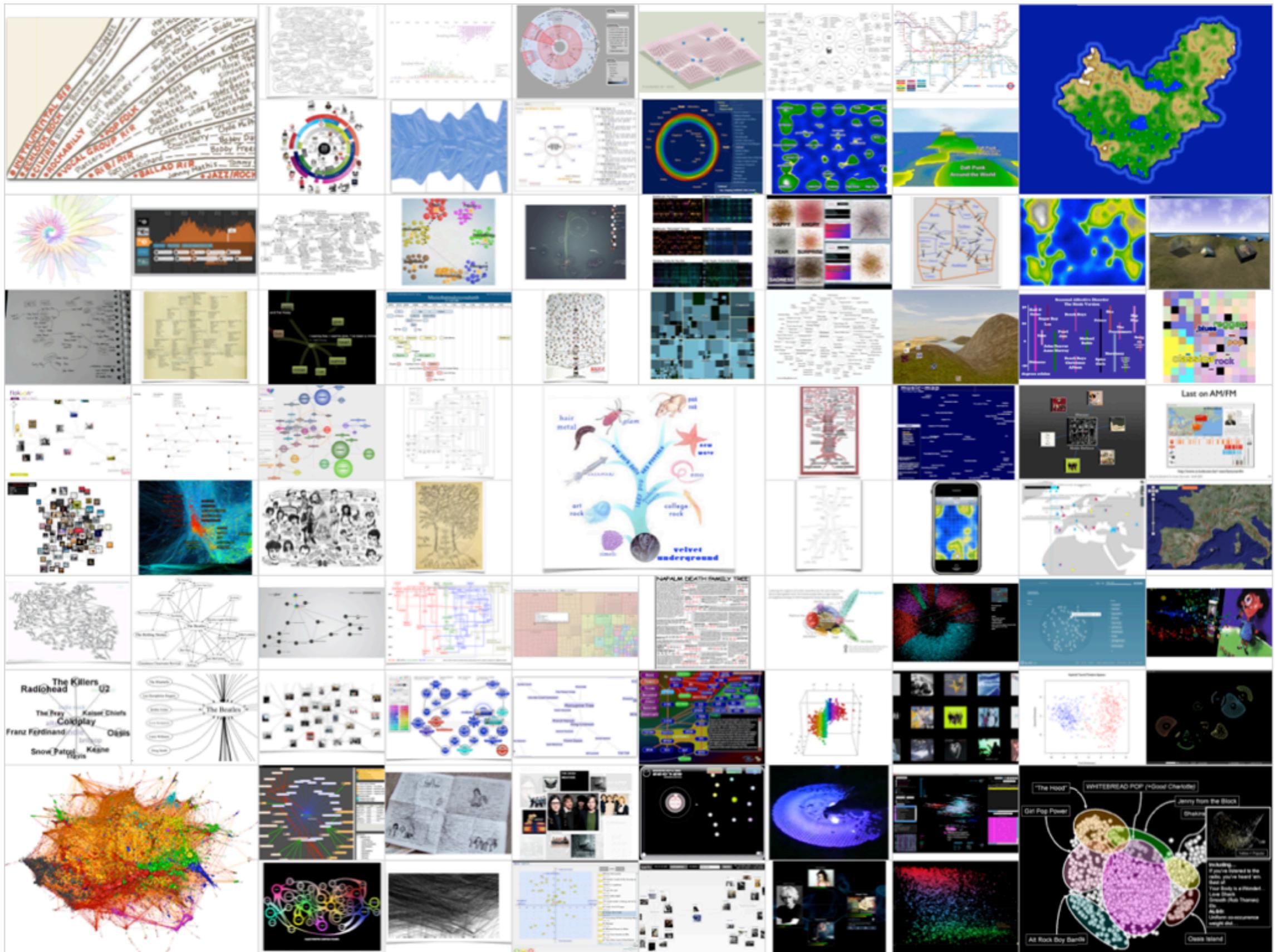
# Using Visualizations for Music Discovery

ISMIR 2009

Or ...

Justin Donaldson  
Paul Lamere

# 85 ways to visualize your music



# Speakers



**Justin Donaldson** is a PhD candidate at Indiana University School of Informatics, as well as a regular research intern at Strands, Inc. Justin is interested with the analyses and visualizations of social sources of data, such as those that are generated from playlists, blogs, and bookmarks.



**Paul Lamere** is the Director of Developer Community at The Echo Nest, a research-focused music intelligence startup that provides music information services to developers and partners through a data mining and machine listening platform. Paul is especially interested in hybrid music recommenders and using visualizations to aid music discovery. Paul also authors '[Music Machinery](#)' a blog focusing on music discovery and recommendation.

# Outline of the talk

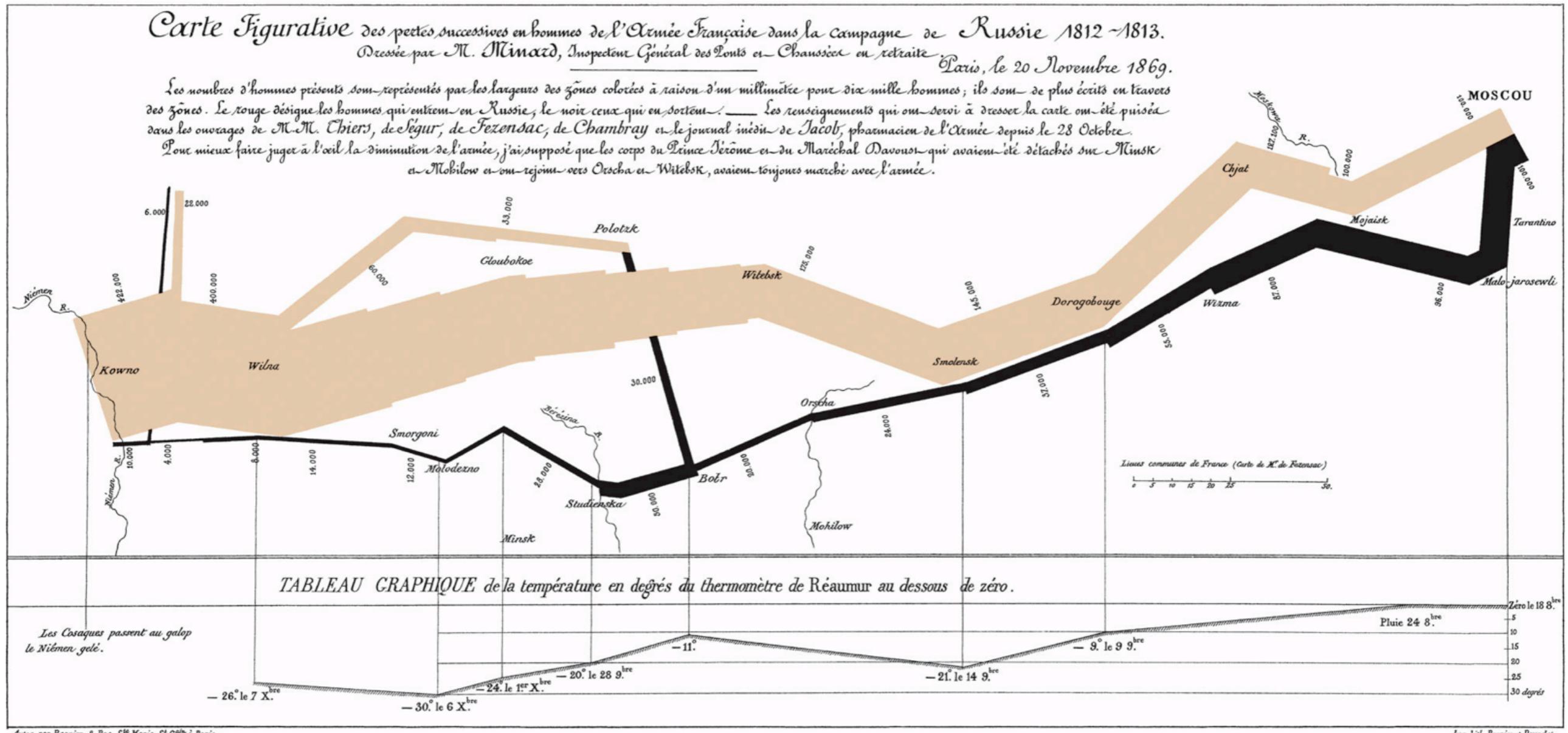
- Why visualize
- Some history
- Core concepts
- Survey of Music Visualizations
- Tools / Resources
- Conclusions

# Music Discovery Challenge

- Millions of songs
- We need tools
  - Recommendation
  - Playlisting
  - **Visualization**



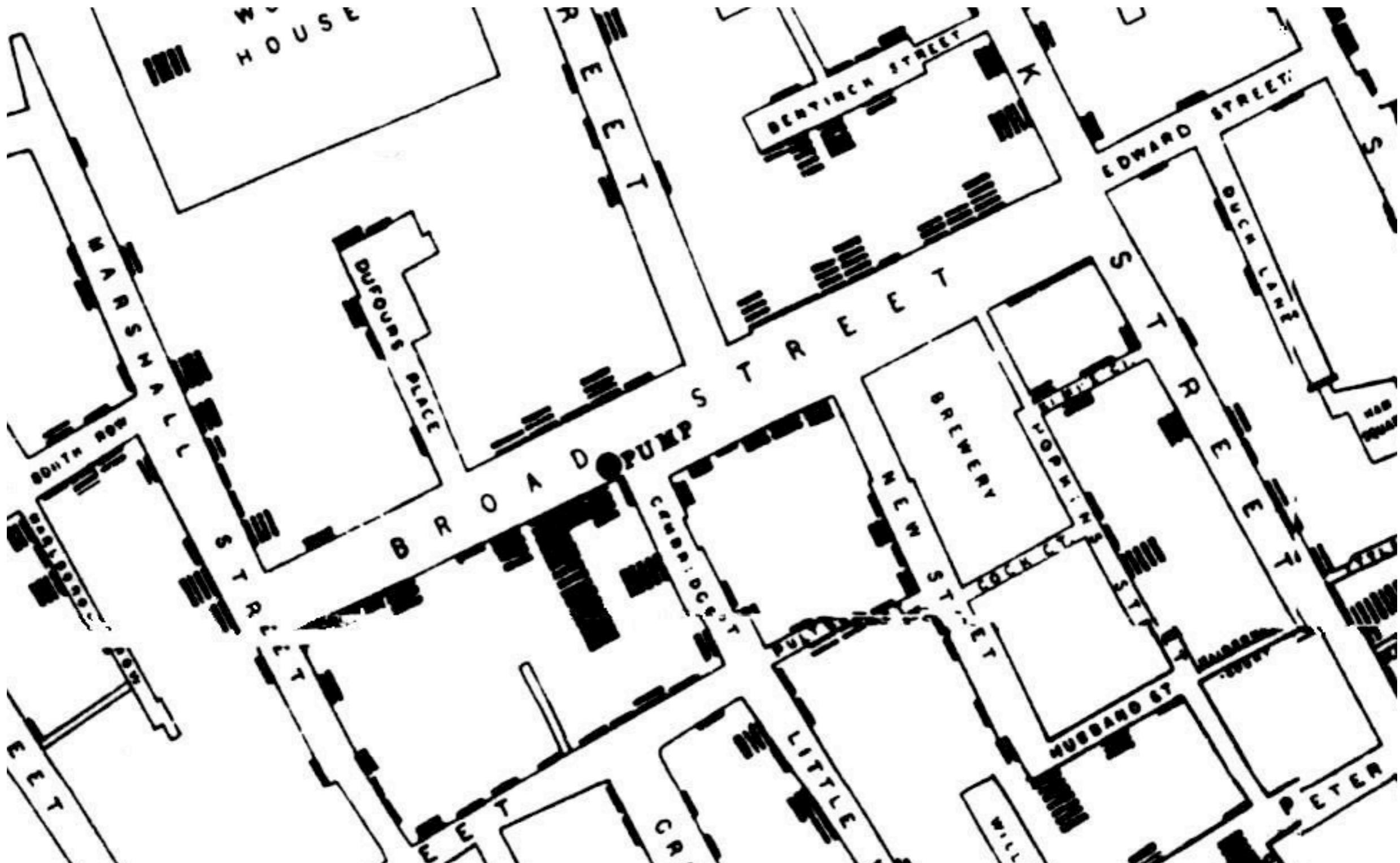
# Why Visualize?



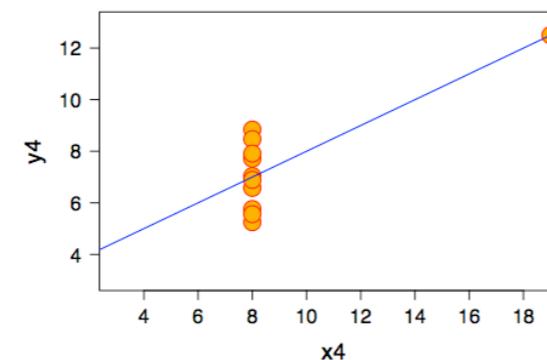
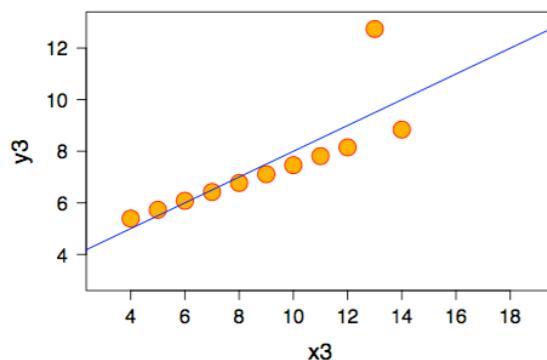
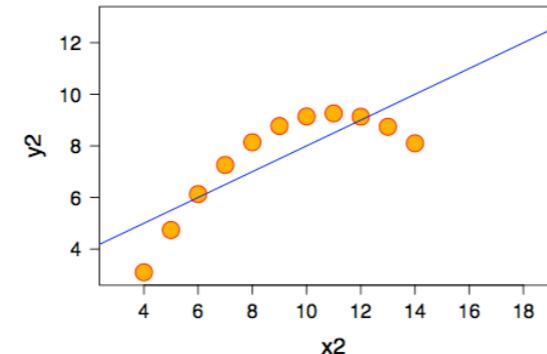
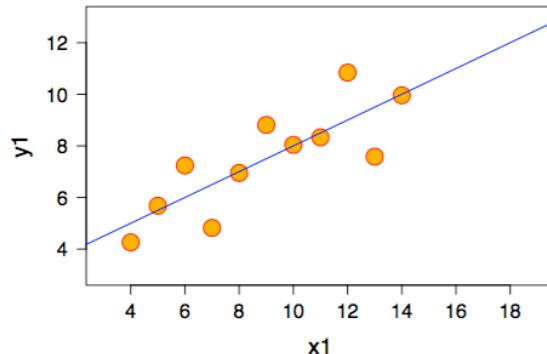
Visualizations can tell a story

# Why Visualize?

Visualizations can engage our pattern-matching brain



# Why Visualize?



property	value
$x$ mean	9
$x$ var	10
$y$ mean	7.5
$y$ var	3.75
$x$ $y$ cor.	0.816
linear reg.	$y = 3 + .5x$

- Anscombe's “Quartet”
- Each distribution has equivalent summary statistics
- Means, correlations, variance: Sometimes one number summaries are deceiving.

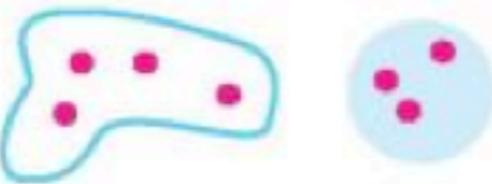
[http://en.wikipedia.org/wiki/Anscombe%27s\\_quartet](http://en.wikipedia.org/wiki/Anscombe%27s_quartet)

# Semantic Pattern Mappings

Graphical Code	Semantics
Small shapes defined by closed contour, texture, color, shaded solid.	 Object, idea, entity, node.
Spatially ordered graphical objects.	 Related information or a sequence. In a sequence the left-to-right ordering convention borrows from the western convention for written language.
Graphical objects in proximity.	 Similar concepts, related information.
Graphical objects having the same shape, color, or texture.	 Similar concepts, related information.
Size of graphical object Height of graphical object.	 Magnitude, quantity, importance.

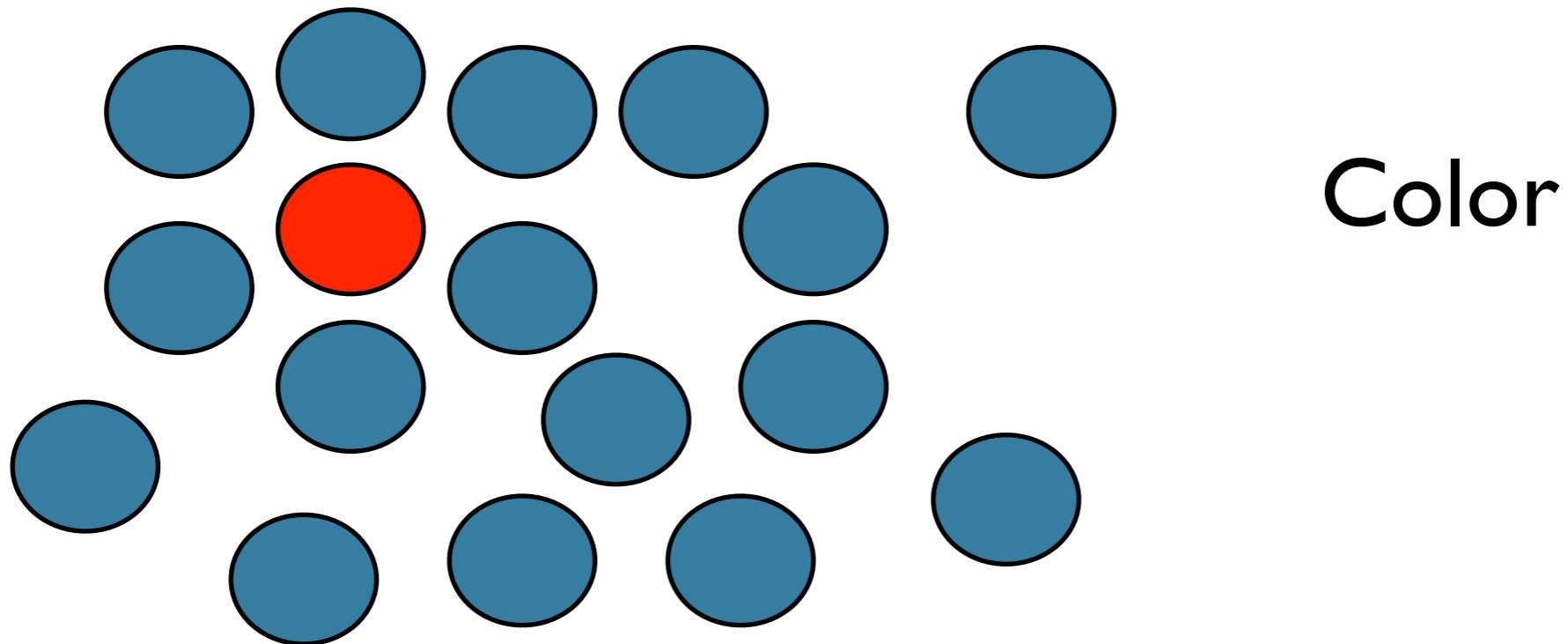
Colin Ware - Visual Thinking for Design

# Semantic Pattern Mappings

Graphical Code	Semantics
Shapes connected by contour.	 Related entities, path between entities.
Thickness of connecting contour.	 Strength of relationship.
Color and texture of connecting contour.	 Type of relationship.
Shapes enclosed by a contour, or a common texture, or a common color.	 Contained entities. Related entities.
Nested regions, partitioned regions.	 Hierarchical concepts.
Attached shapes.	 Parts of a conceptual structure.

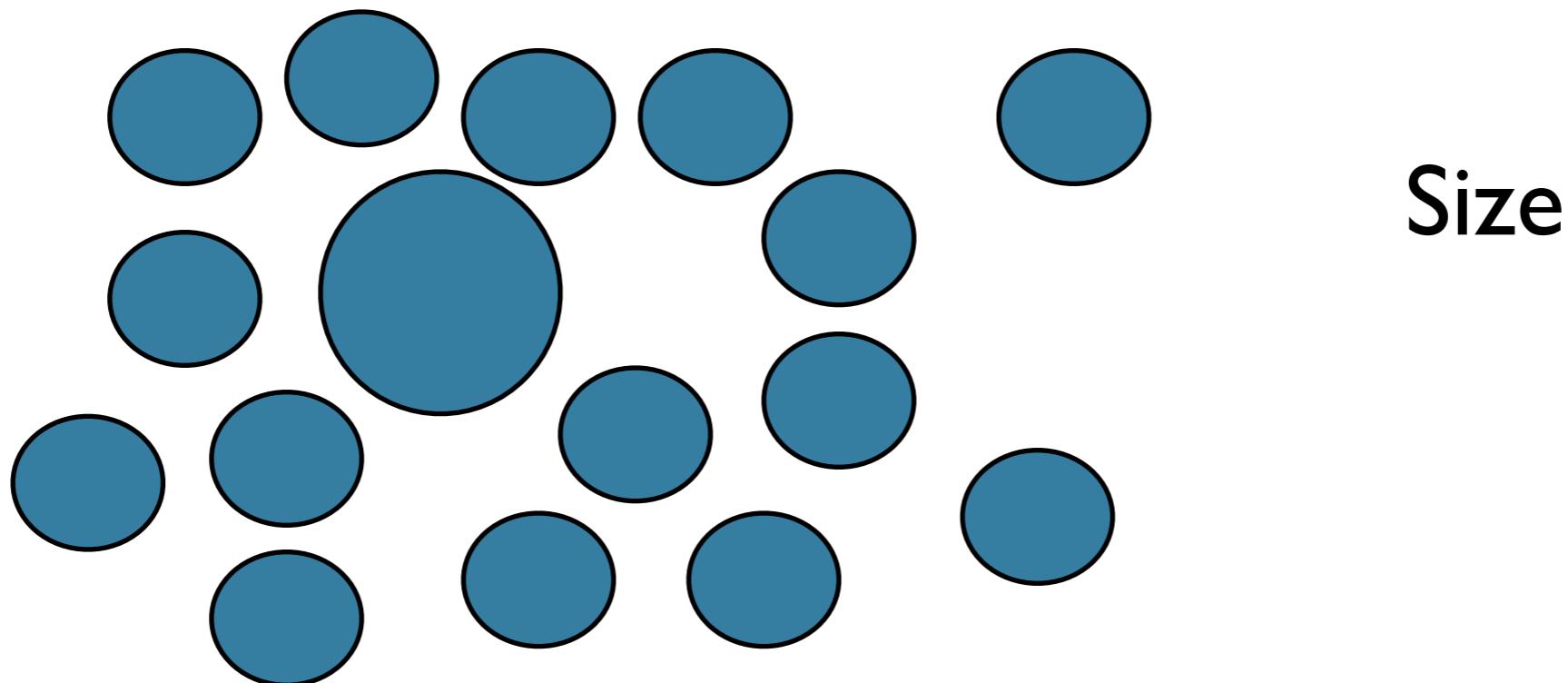
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# Basic Popout Channels



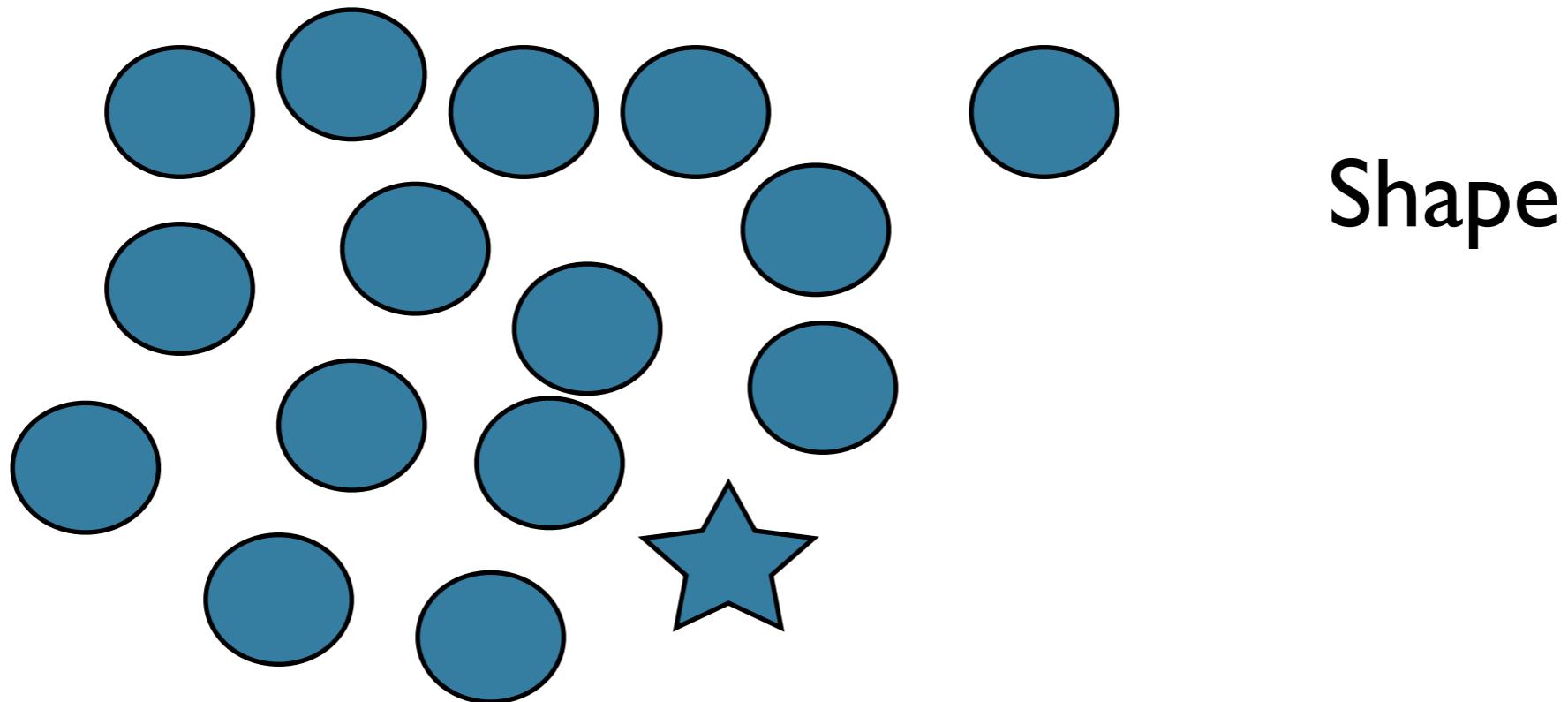
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# Basic Popout Channels



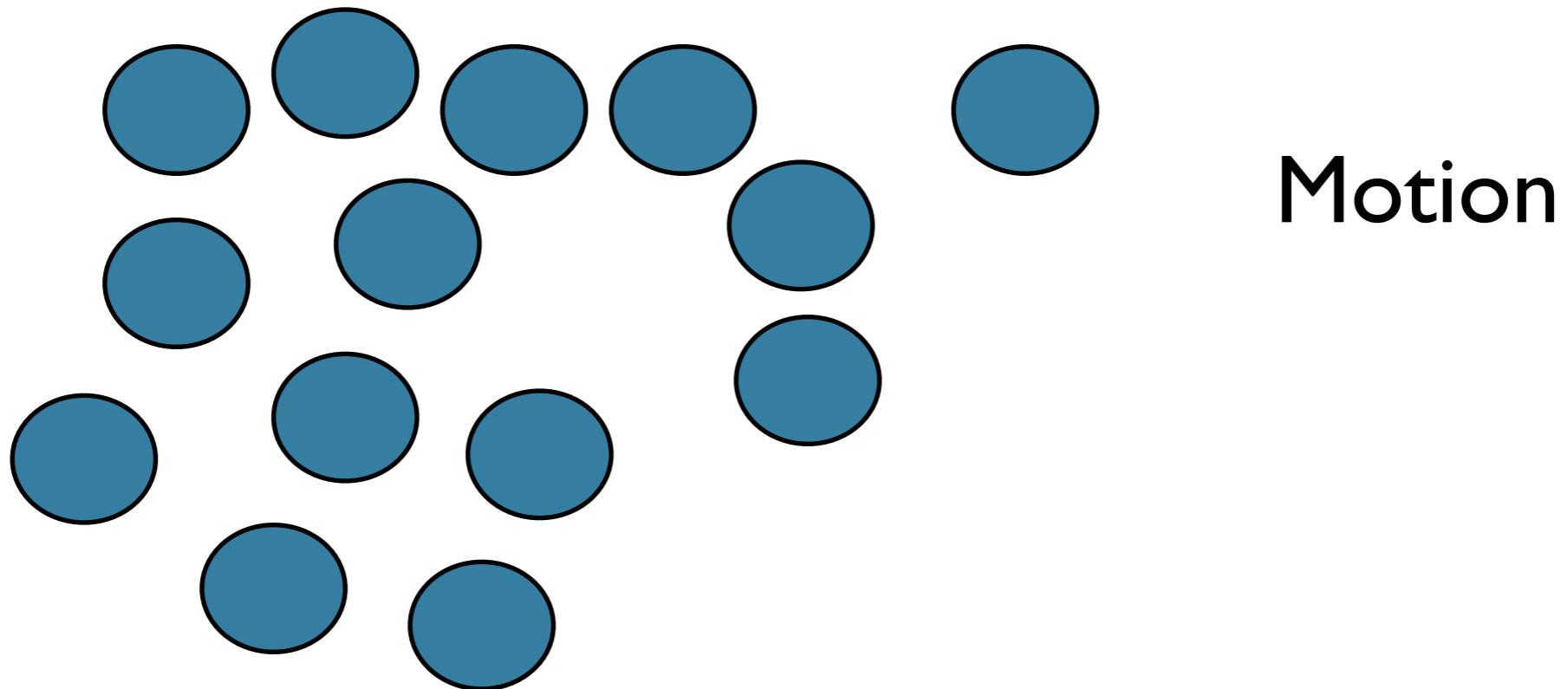
Colin Ware - Visual Thinking for Design

# Basic Popout Channels



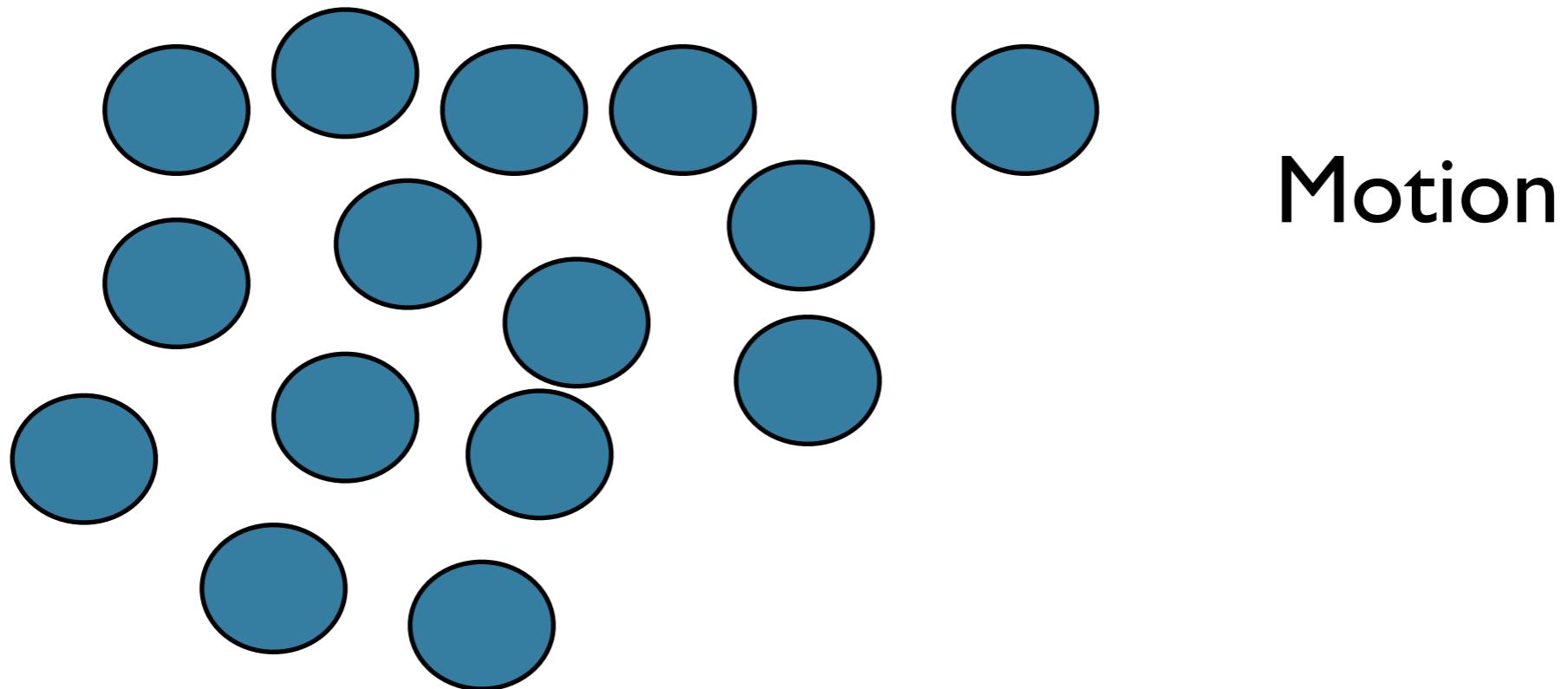
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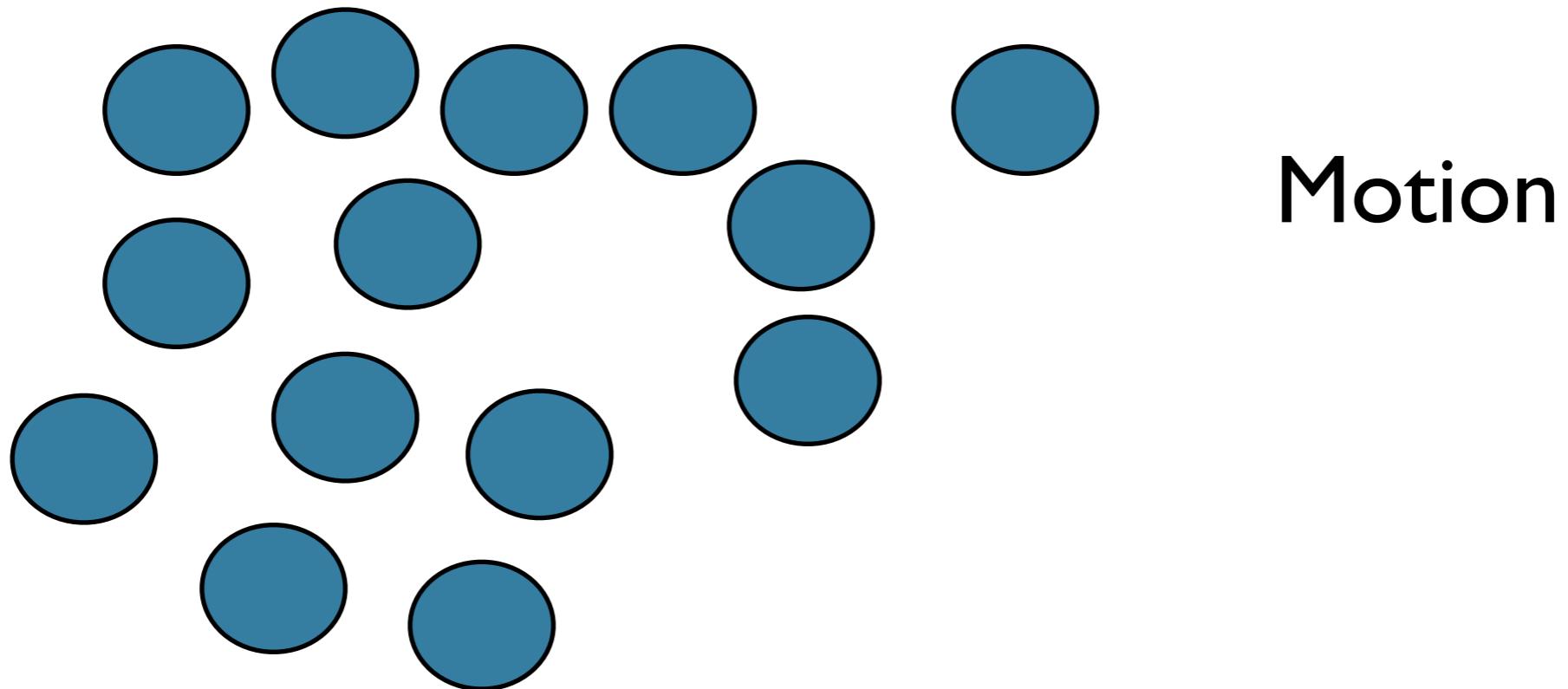
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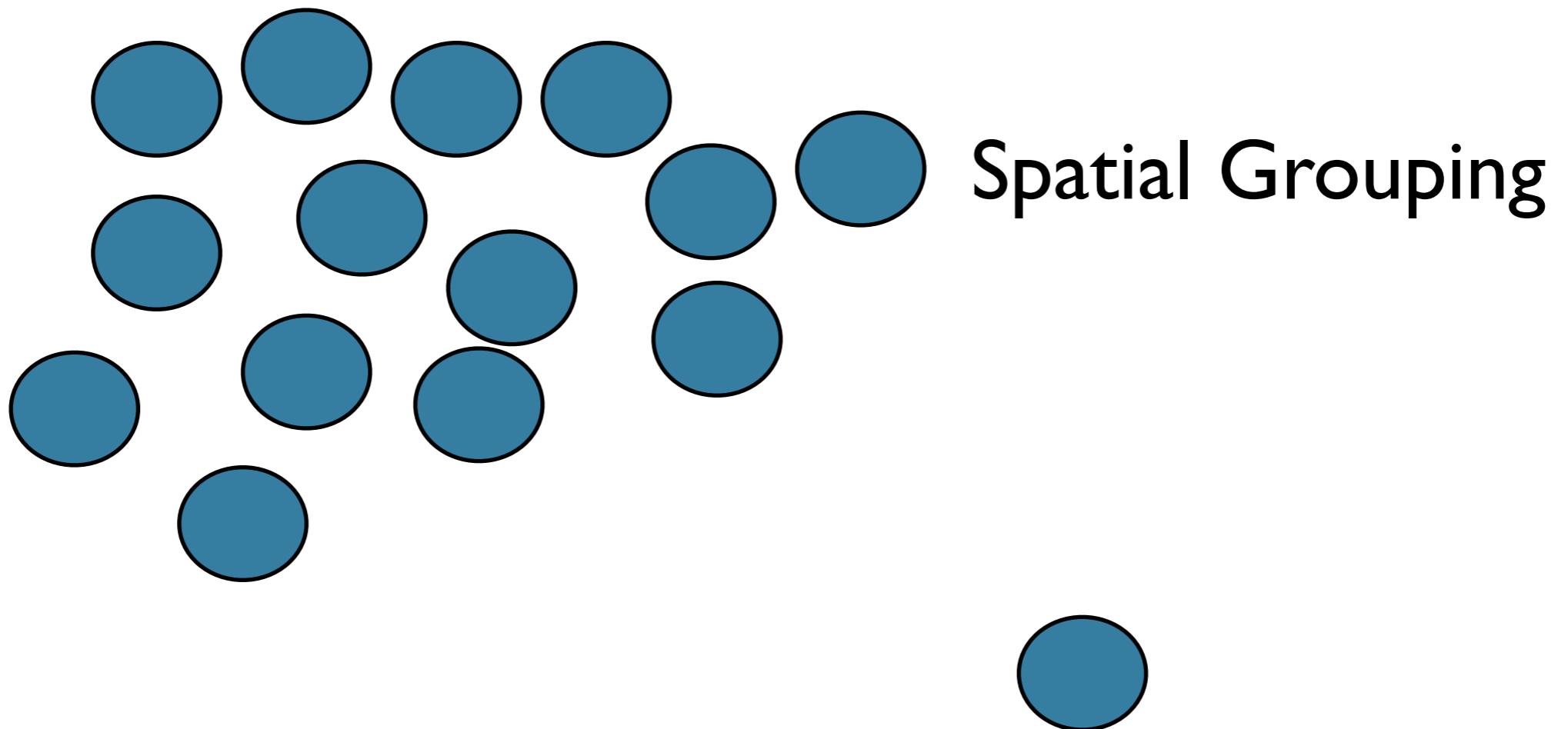
Colin Ware - Visual Thinking for Design

# Basic Popout Channels



Colin Ware - Visual Thinking for Design

# Basic Popout Channels



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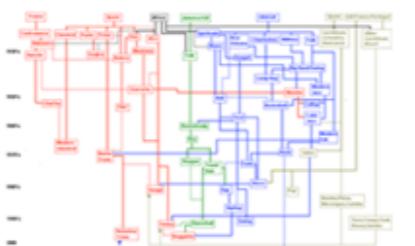
# Overloading the channels



Flickr photo by Stéfan

# Visualization of Visualizations

Authoritative/Researcher/Historian



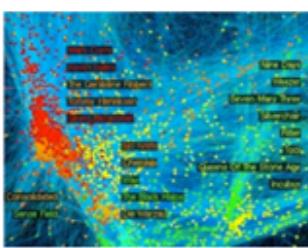
Cuban Music Genealogy



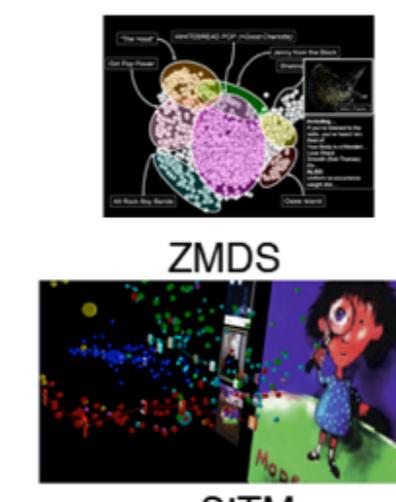
musician map



Michael Jackson Samples



World of Music



ZMDS

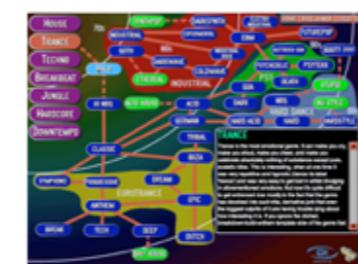
SITM

Acoustic/Social Similarity  
Visualization Name

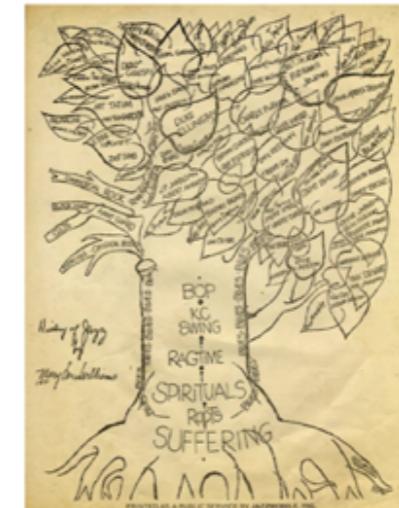
History/Genealogy



Garofalos' genealogy



ishkur's guide



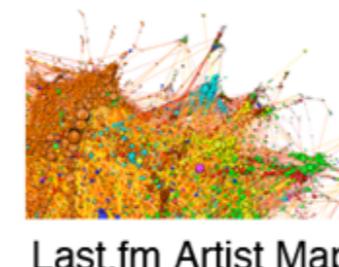
History of Jazz

Casual/Consumer

(dozens more here)



ESOM MusicMiner



Last.fm Artist Map



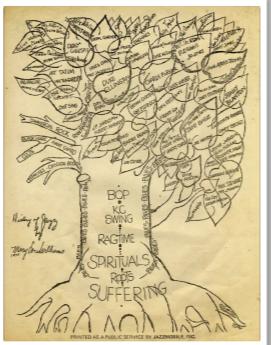
London Tube Map



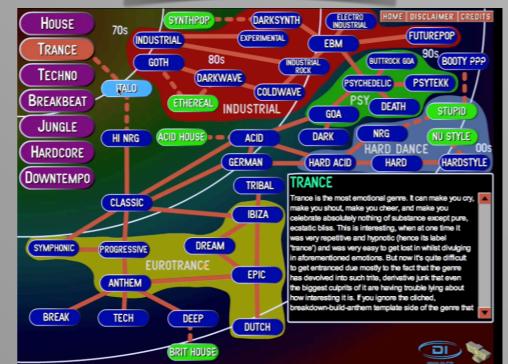
Interacting...

# Types of visualizations

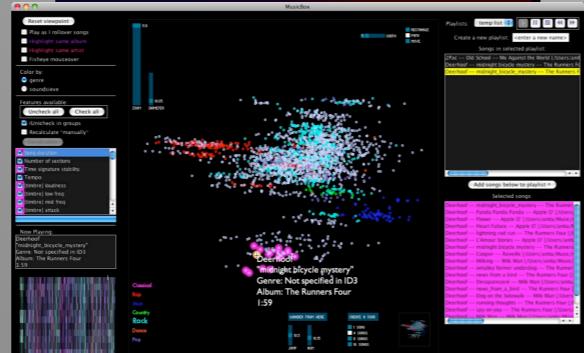
Tree



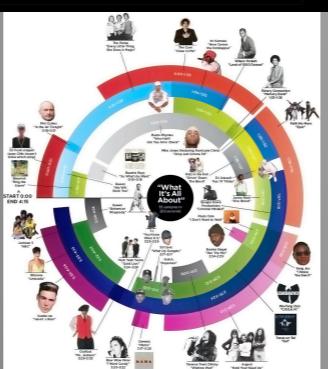
Graph



Scatter



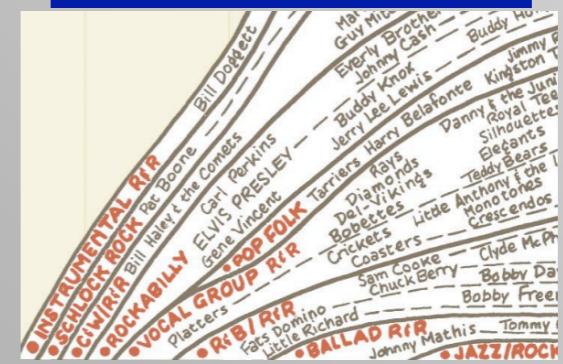
Connections



Map



Time Series



Hybrid



Interactive



# Objects to be discovered

	human	machine
Artists	23	37
Albums	0	6
Tracks	3	17
Samples	3	0
Playlists	0	0
Ordered	0	9
Concerts	0	0
Blogs	0	0
Music	0	0

	human	machine
Genre	18	14
Users	0	4
Radio	0	2
DJs	0	1
Games	0	0
Commu	0	0
Venues	0	0
Taste	2	2
Labels	1	0

26 Human rendered      55 Machine rendered  
visualizations

# Features Used

<b>Content</b>	Beat, tempo, timbre, harmonic content, lyrics
<b>Cultural</b>	web and playlist co-occurrence, purchase/play history, social tags, genre, text aura, expert opinion, appearance, popularity
<b>Relational</b>	member of, collaborated on, supporting musician for, performed as, parent, sibling, married, same label, produced
<b>Mood</b>	happy, sad, angry, relaxed, autumnal
<b>Location</b>	city, country, lat/long,
<b>Time</b>	the hits from the 60s, 70s 80s and today, recent play history
<b>Misc</b>	IQ, Temperature, Name morphology

# More features

A scene from High Fidelity

# More features



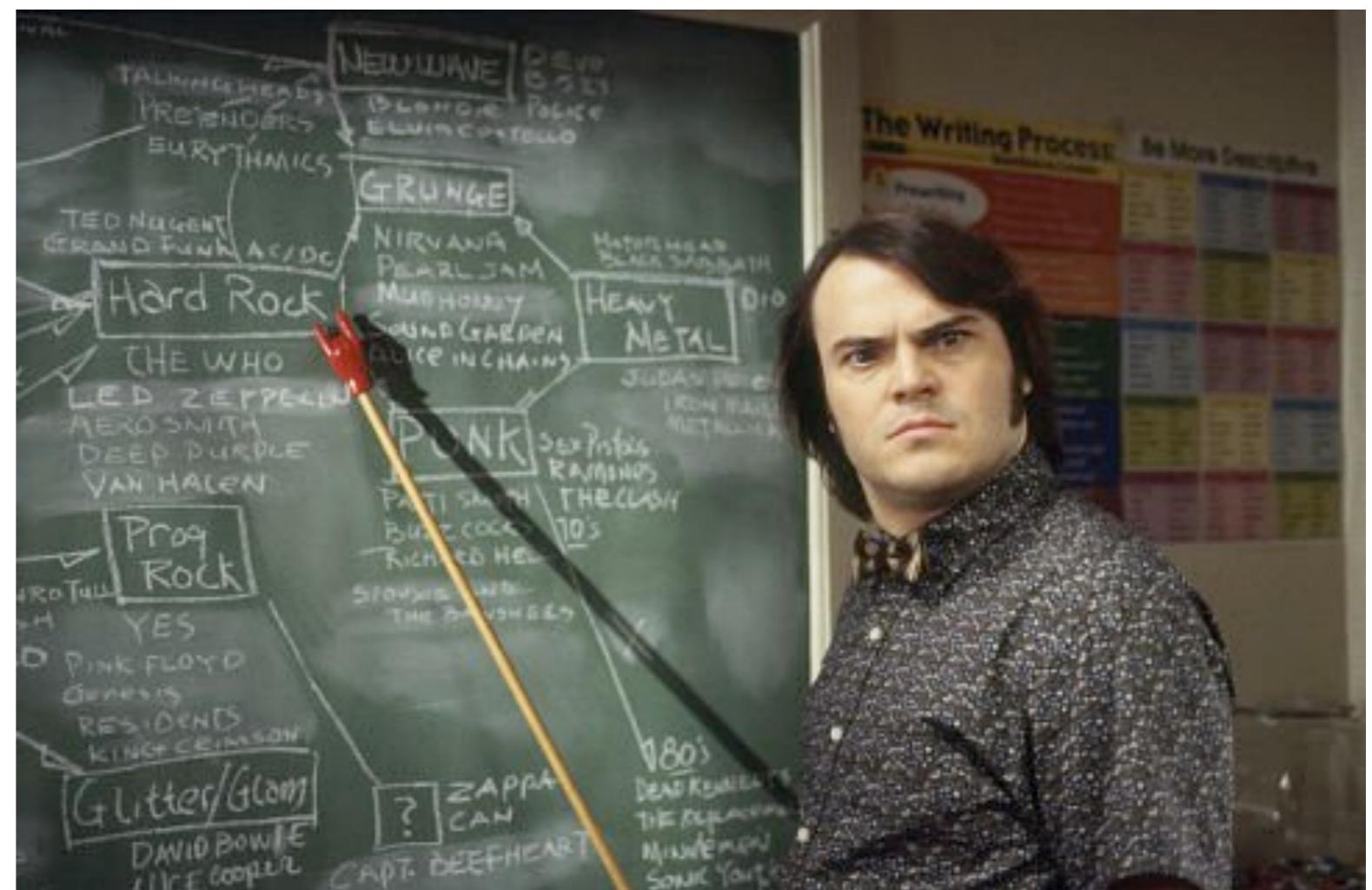
A scene from High Fidelity

# Human rendered visualizations

# Human rendered visualizations

## Some common techniques

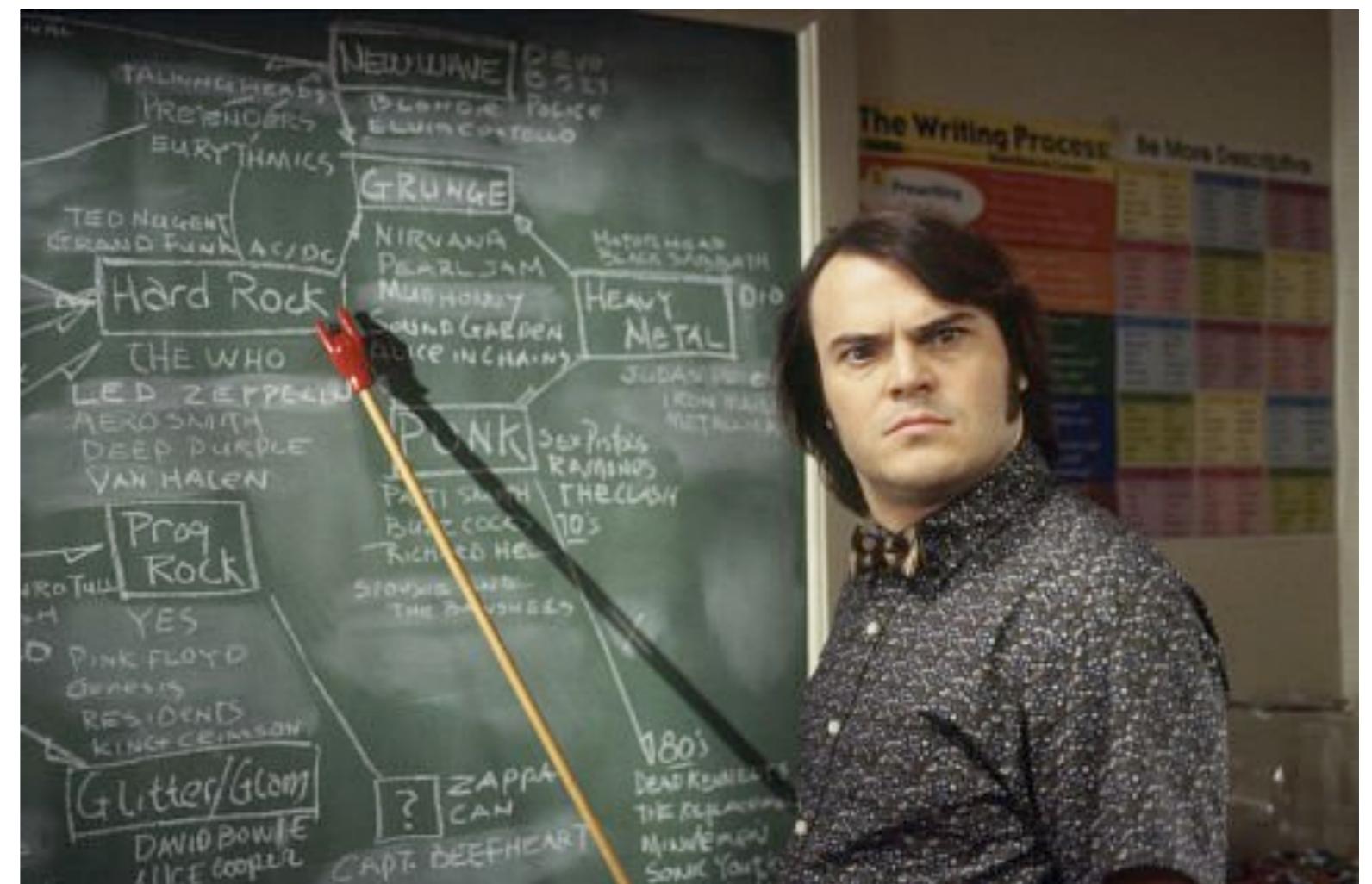
- The Flow
- The Map
- The Tree
- The Graph



# Human rendered visualizations

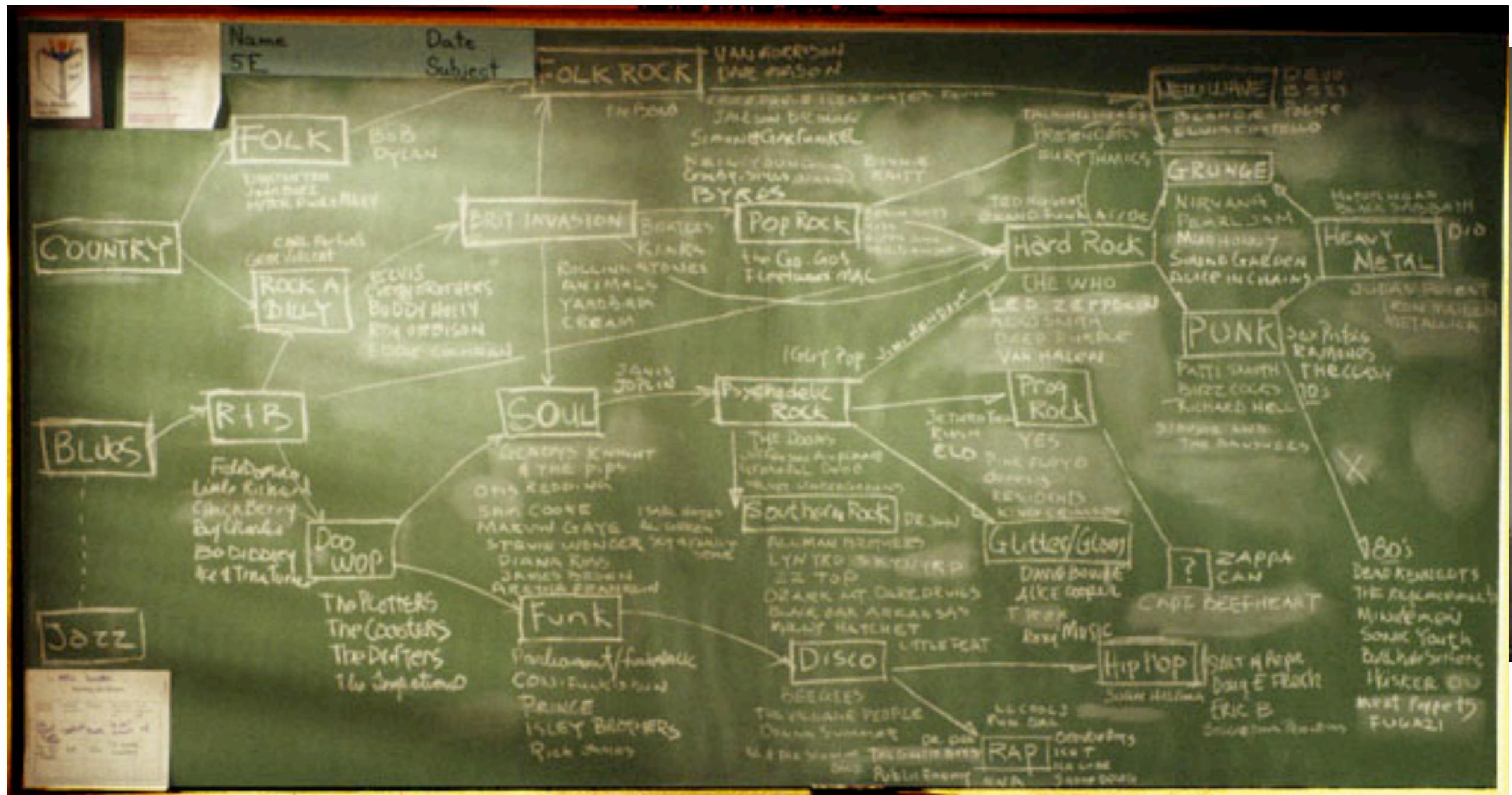
## Some common techniques

- History
- Influences
- Similarity
- Popularity



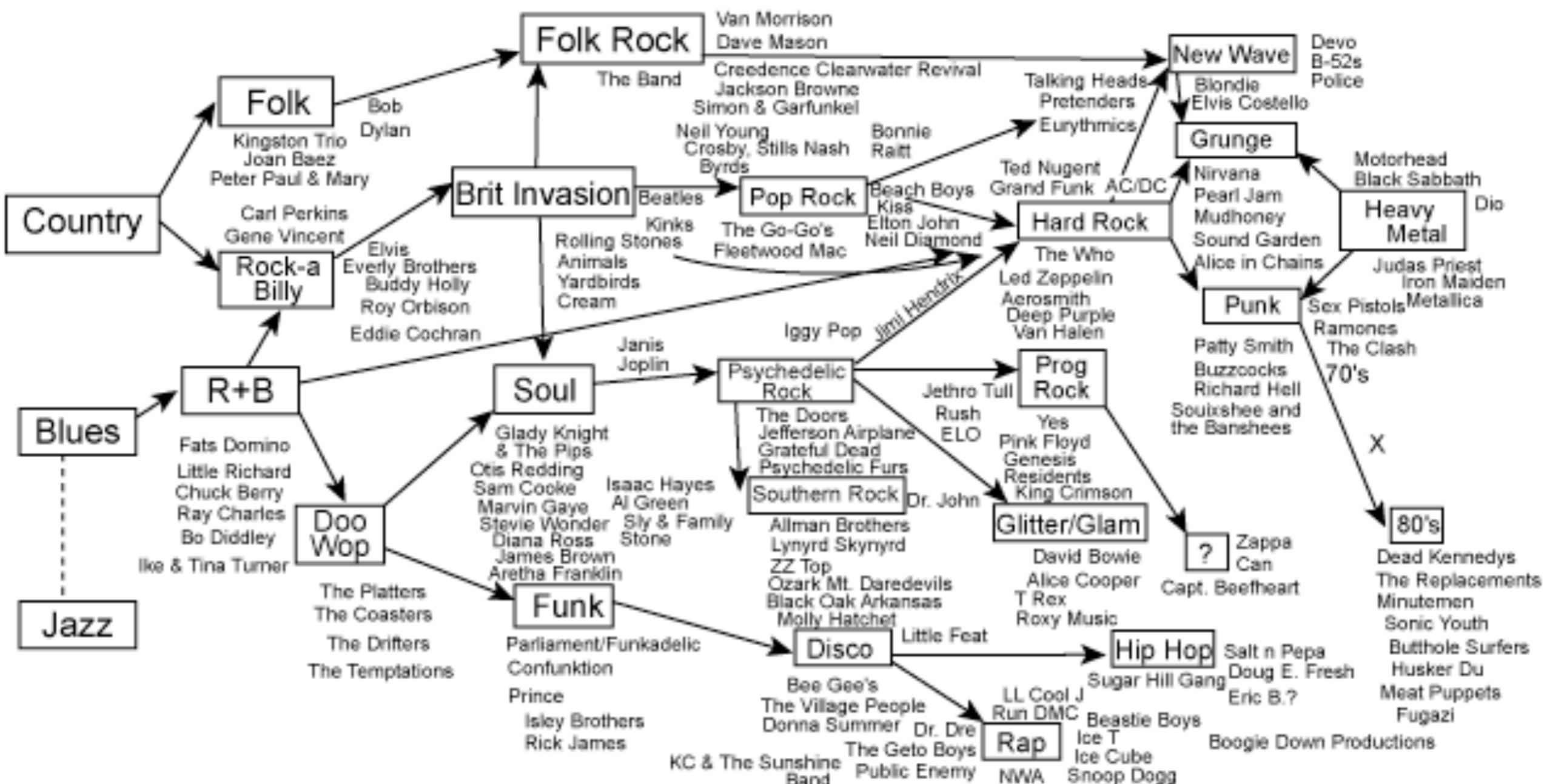
# Human rendered visualizations

## Some common techniques



# Human rendered visualizations

## Some common techniques



# Genealogy of Pop and Rock Music

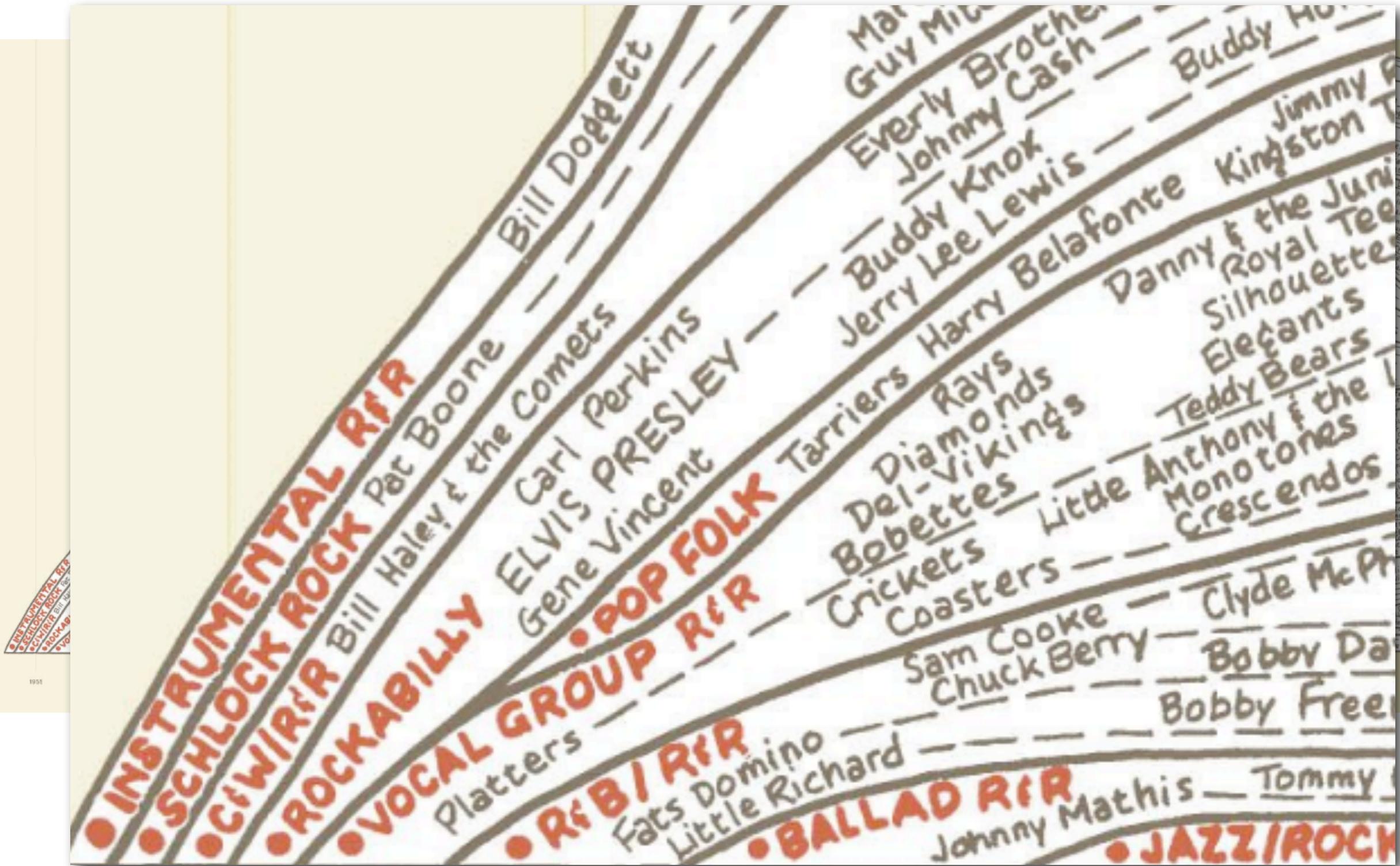
## The Genealogy of Pop/Rock Music

1955-1978  
by Reebee Garofalo



Genealogy of Pop and Rock Music - Reebee Garofalo

# Genealogy of Pop and Rock Music

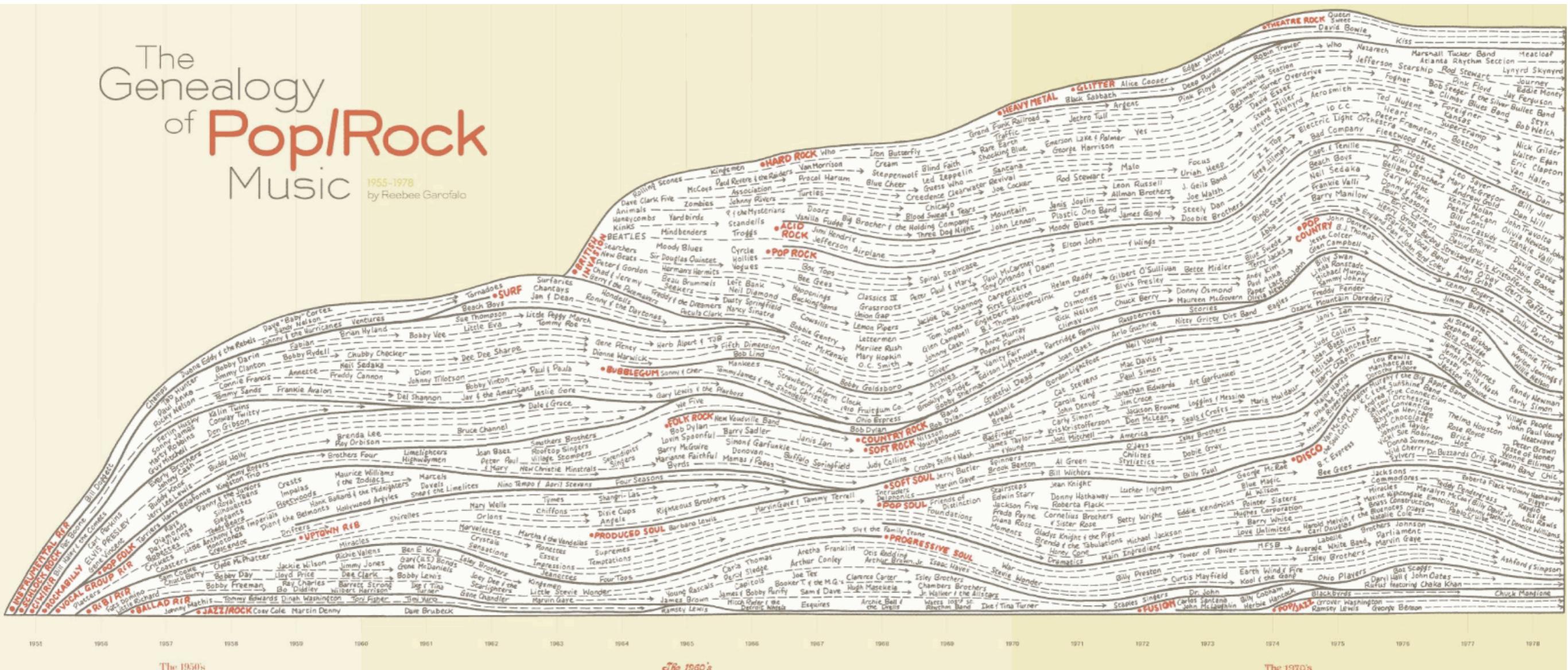


Genealogy of Pop and Rock Music - Reebee Garofalo

# Genealogy of Pop and Rock Music

## The Genealogy of Pop/Rock Music

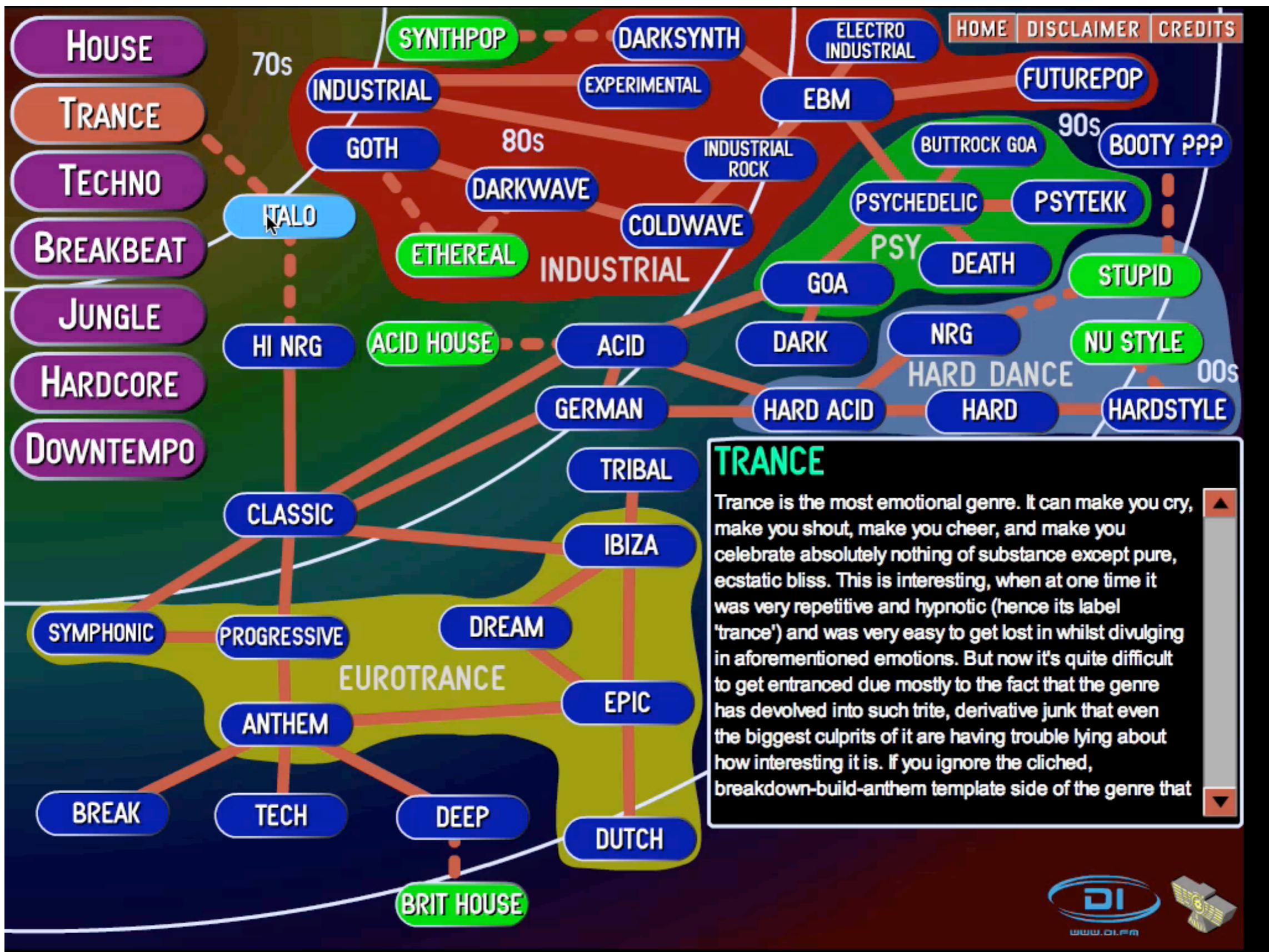
1955-1978  
by Reebee Garofalo



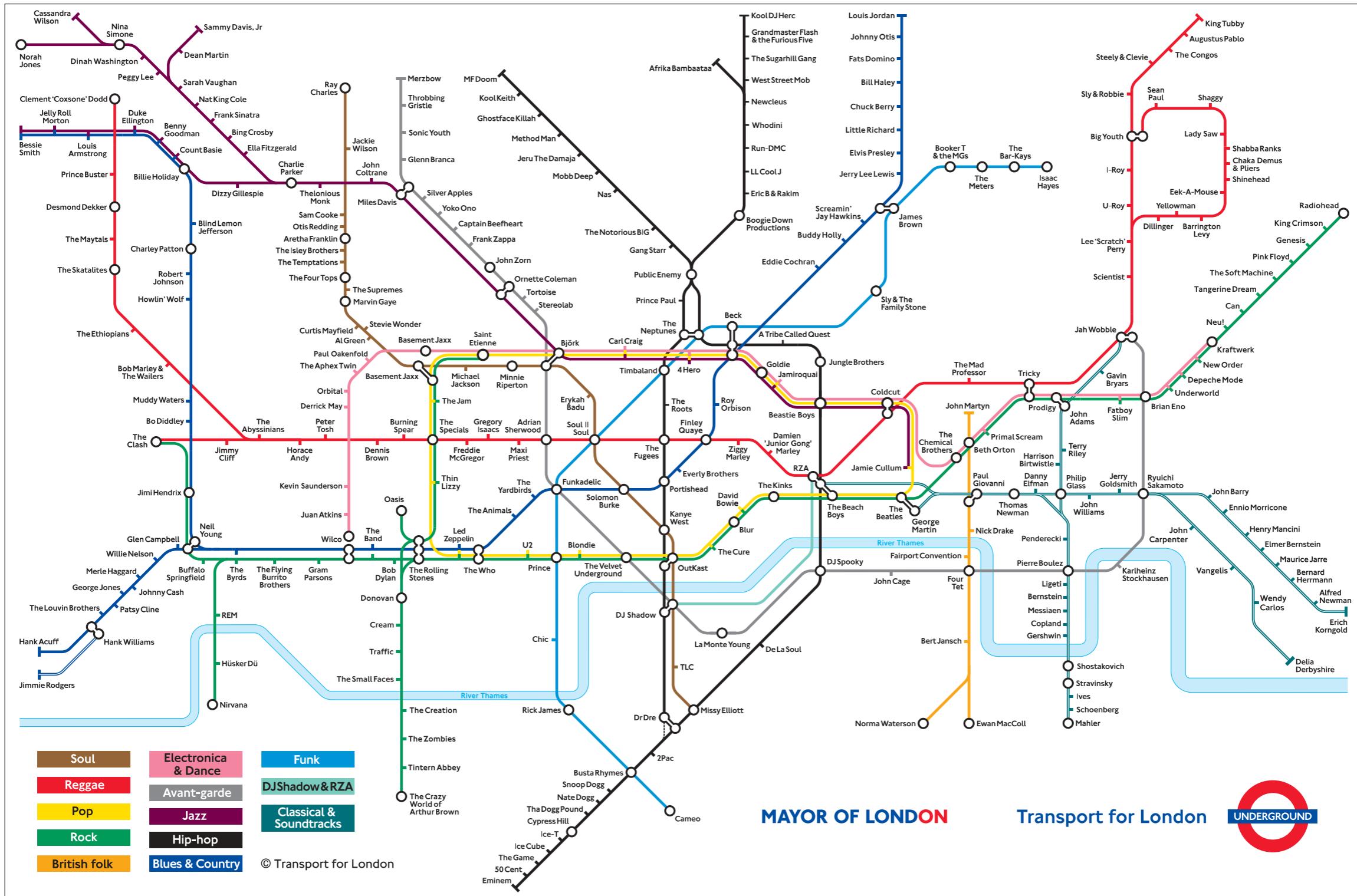
Genealogy of Pop and Rock Music - Reebee Garofalo

# Ishkur's Guide to Electronic Dance Music

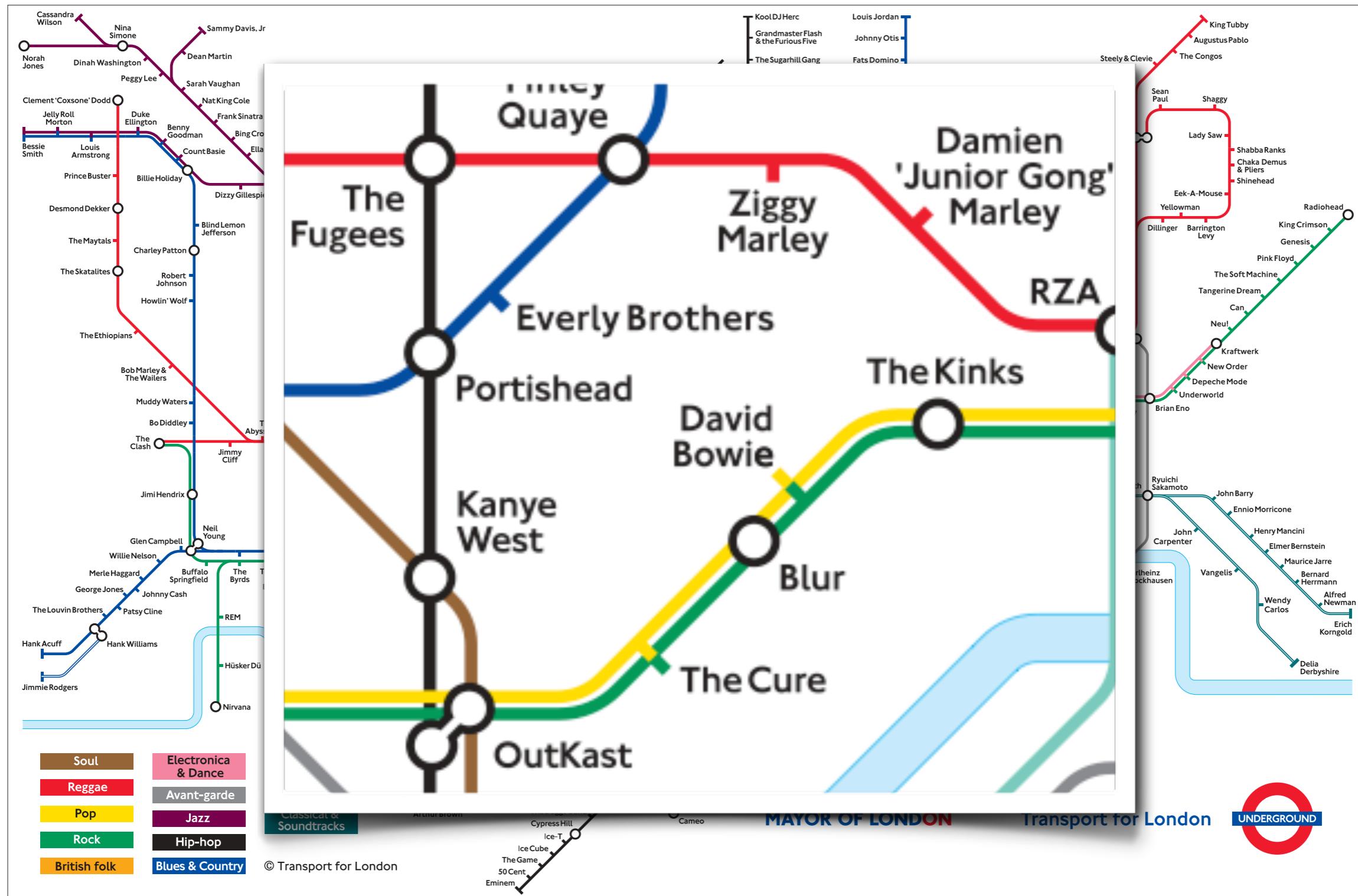
# Ishkur's Guide to Electronic Dance Music



# Music History as a London Tube Map

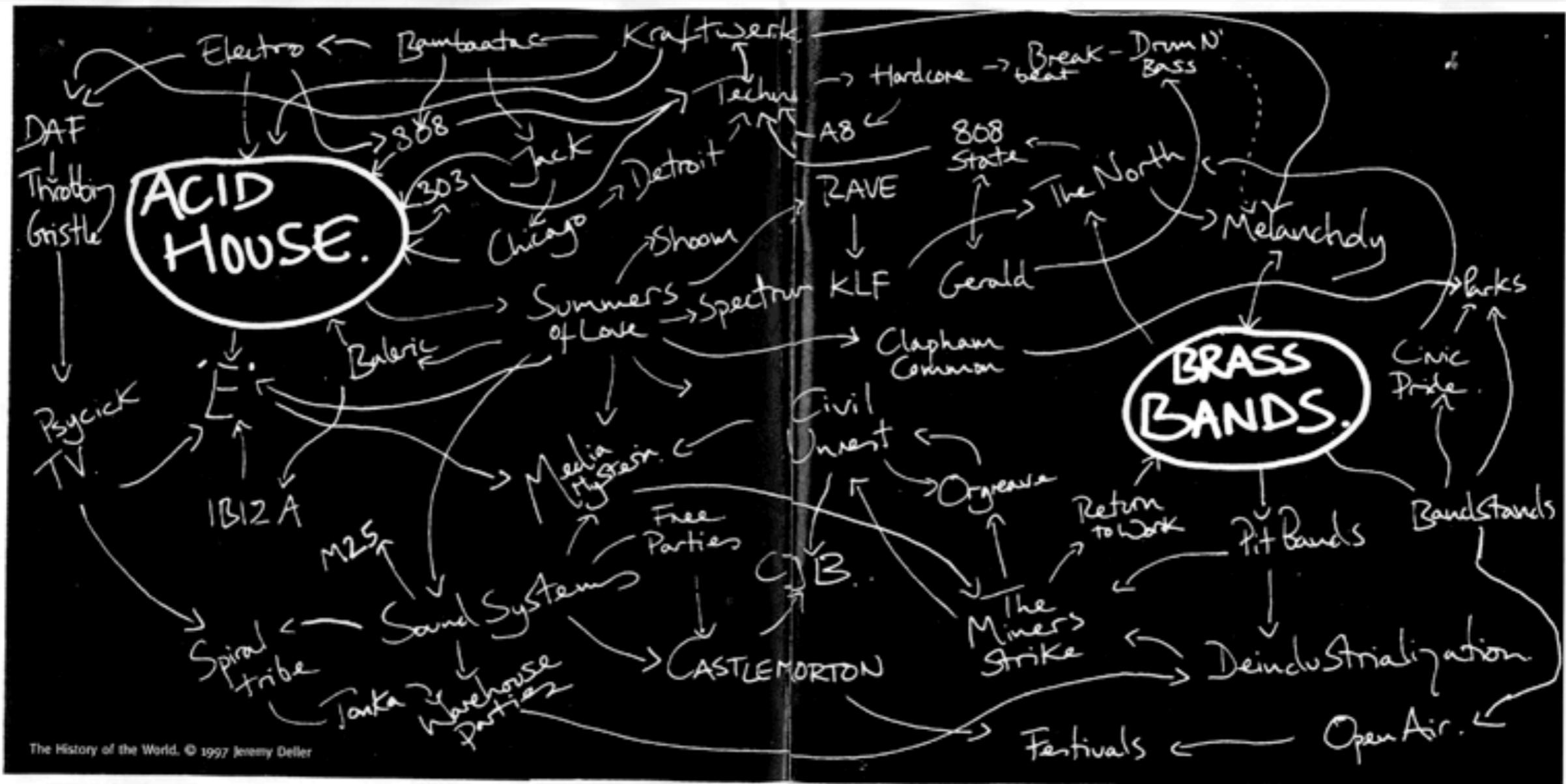


# Music History as a London Tube Map



Dorian Lynskey - The Guardian

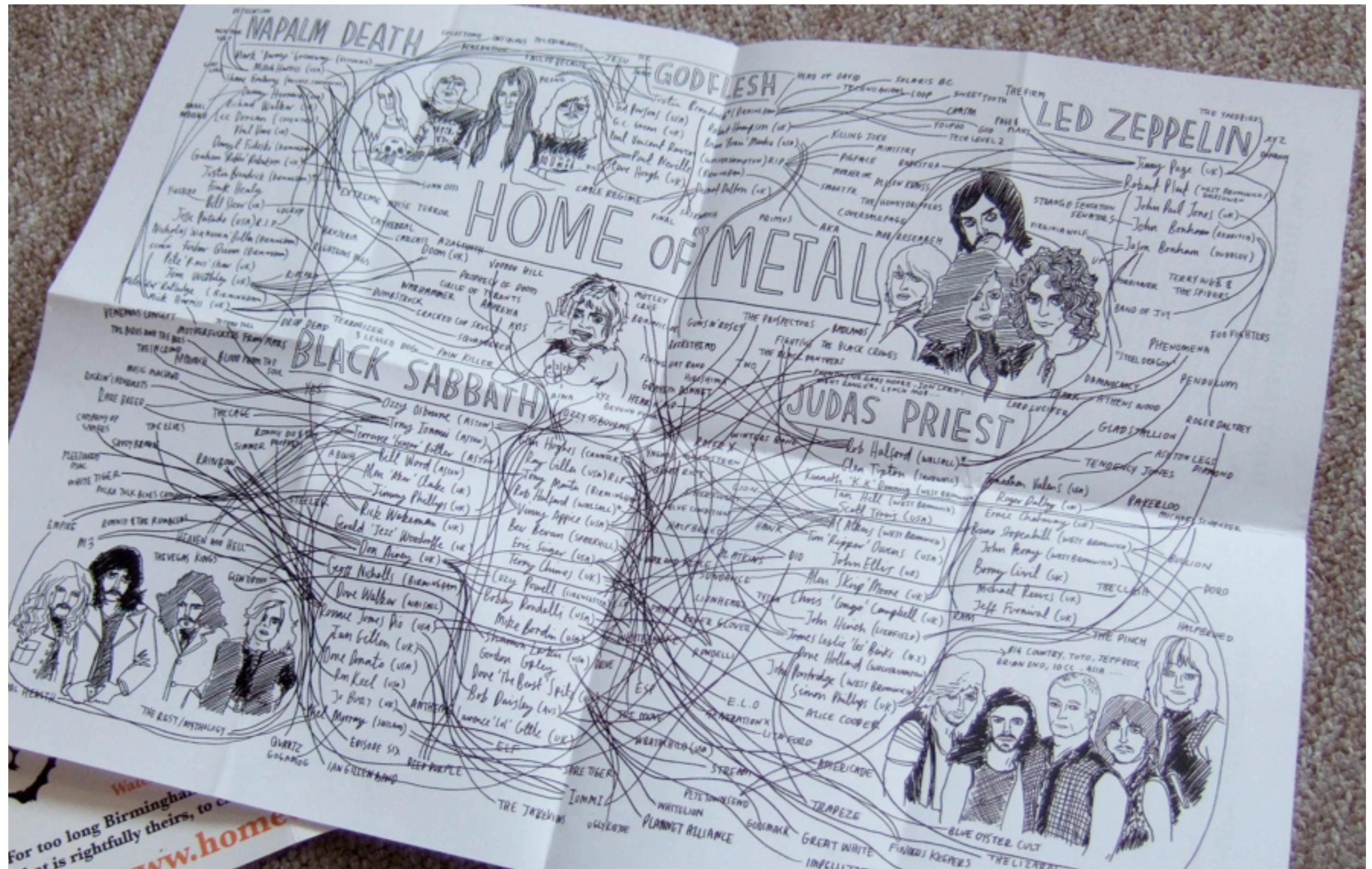
# Visualizations as a graph



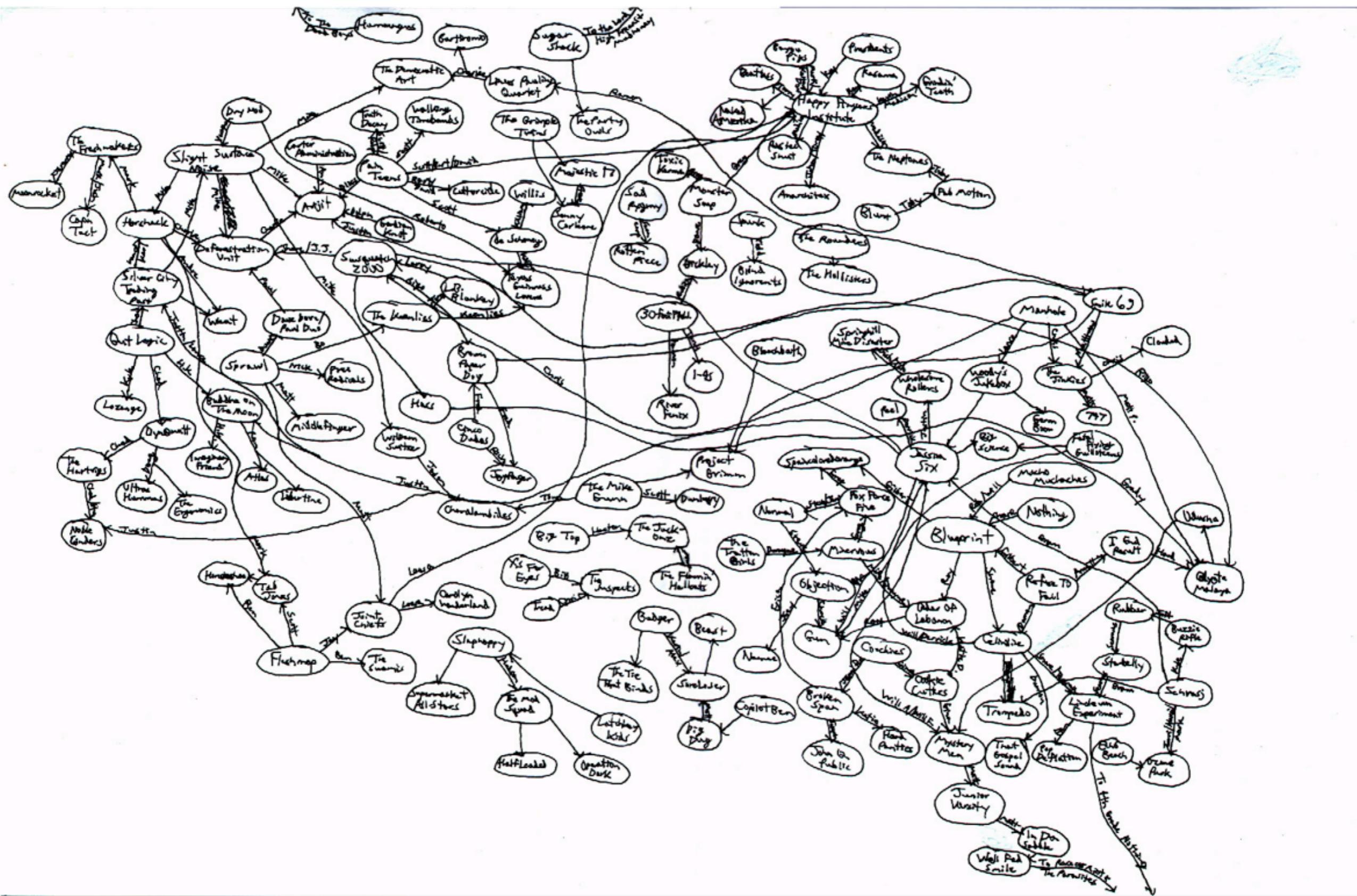
# Visualizations as a graph



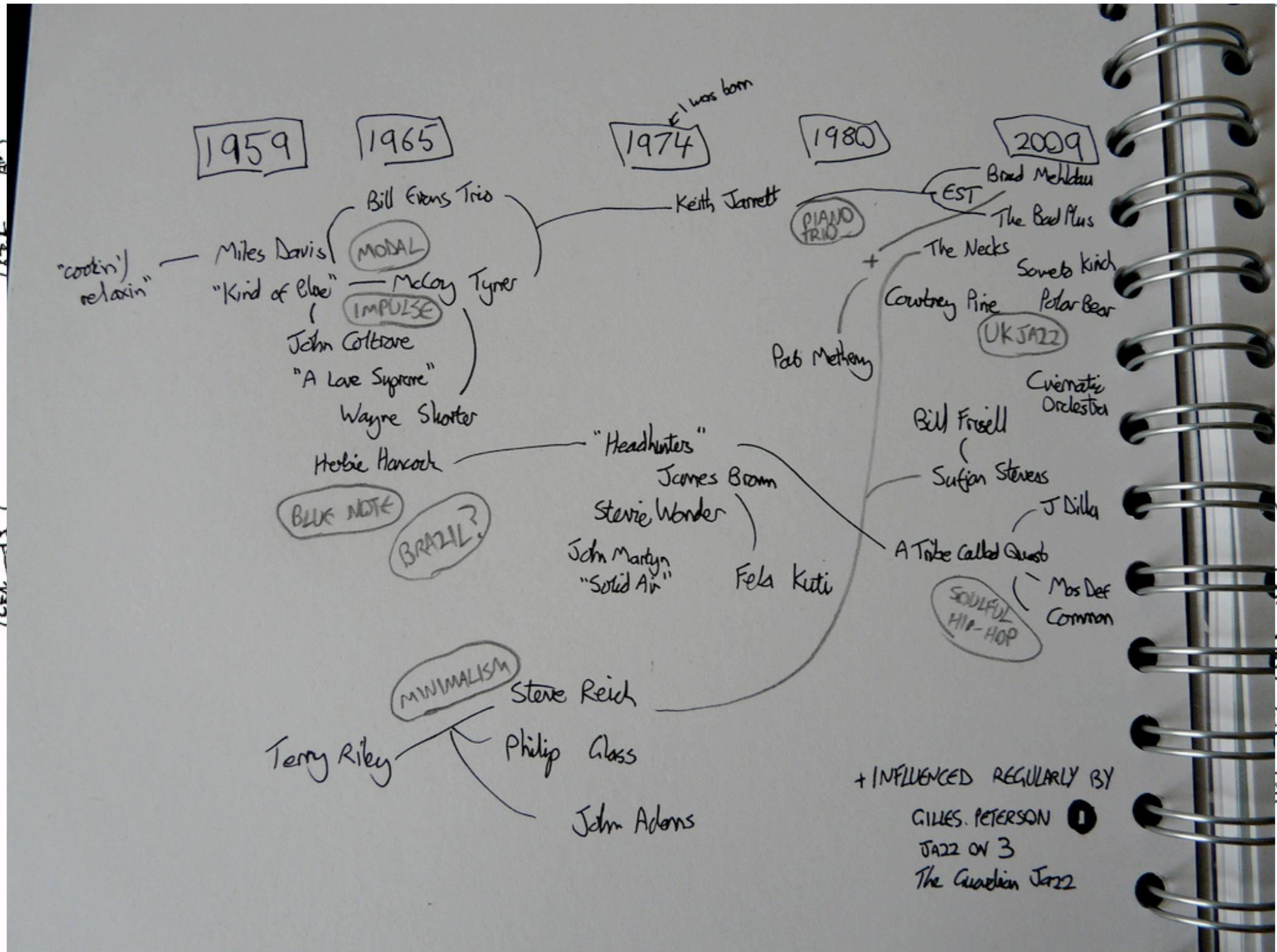
# Visualizations as a graph



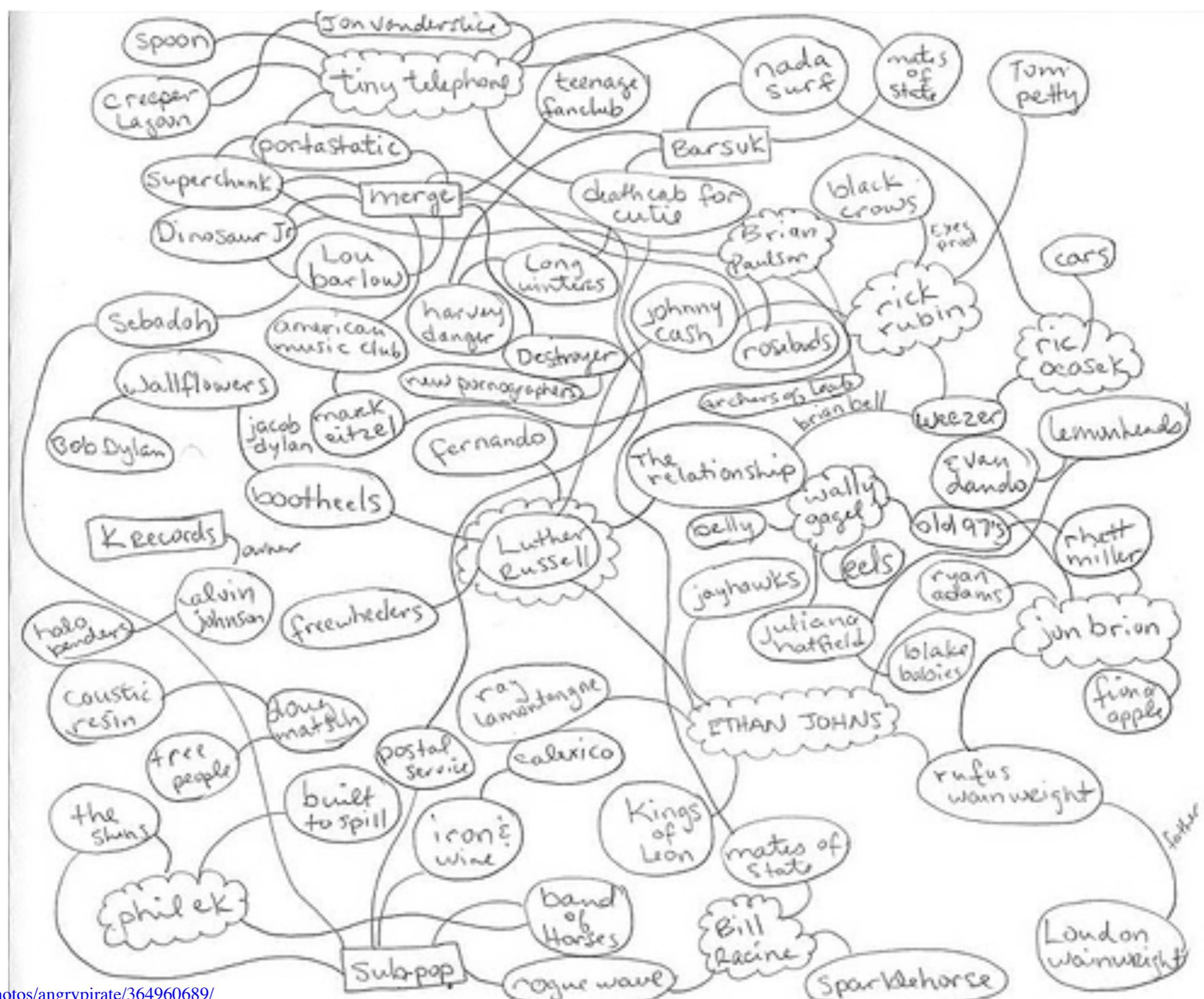
# Visualizations as a graph



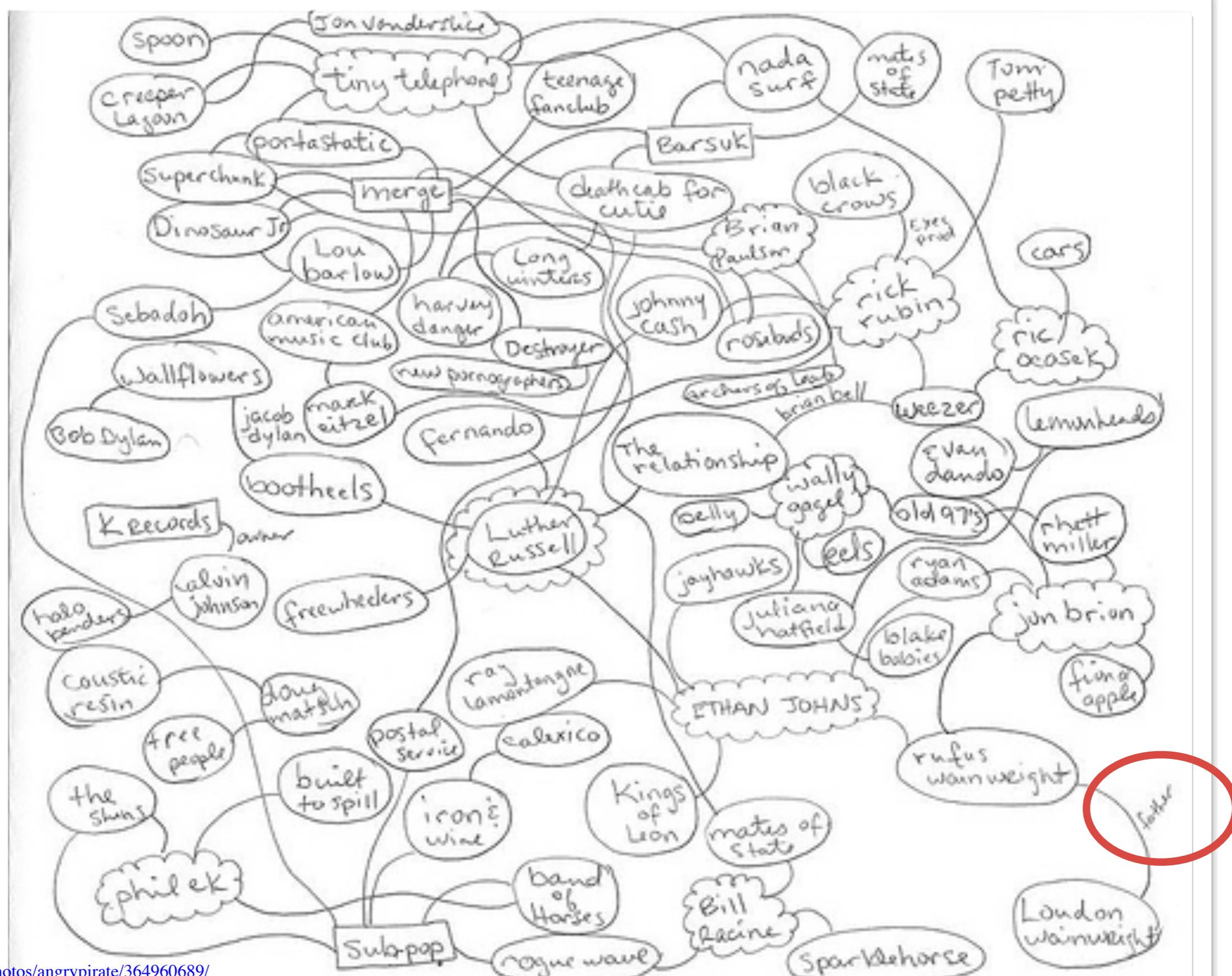
# Visualizations as a graph



# Visualizations as a graph



# Visualizations as a graph



# Visualizations as a graph



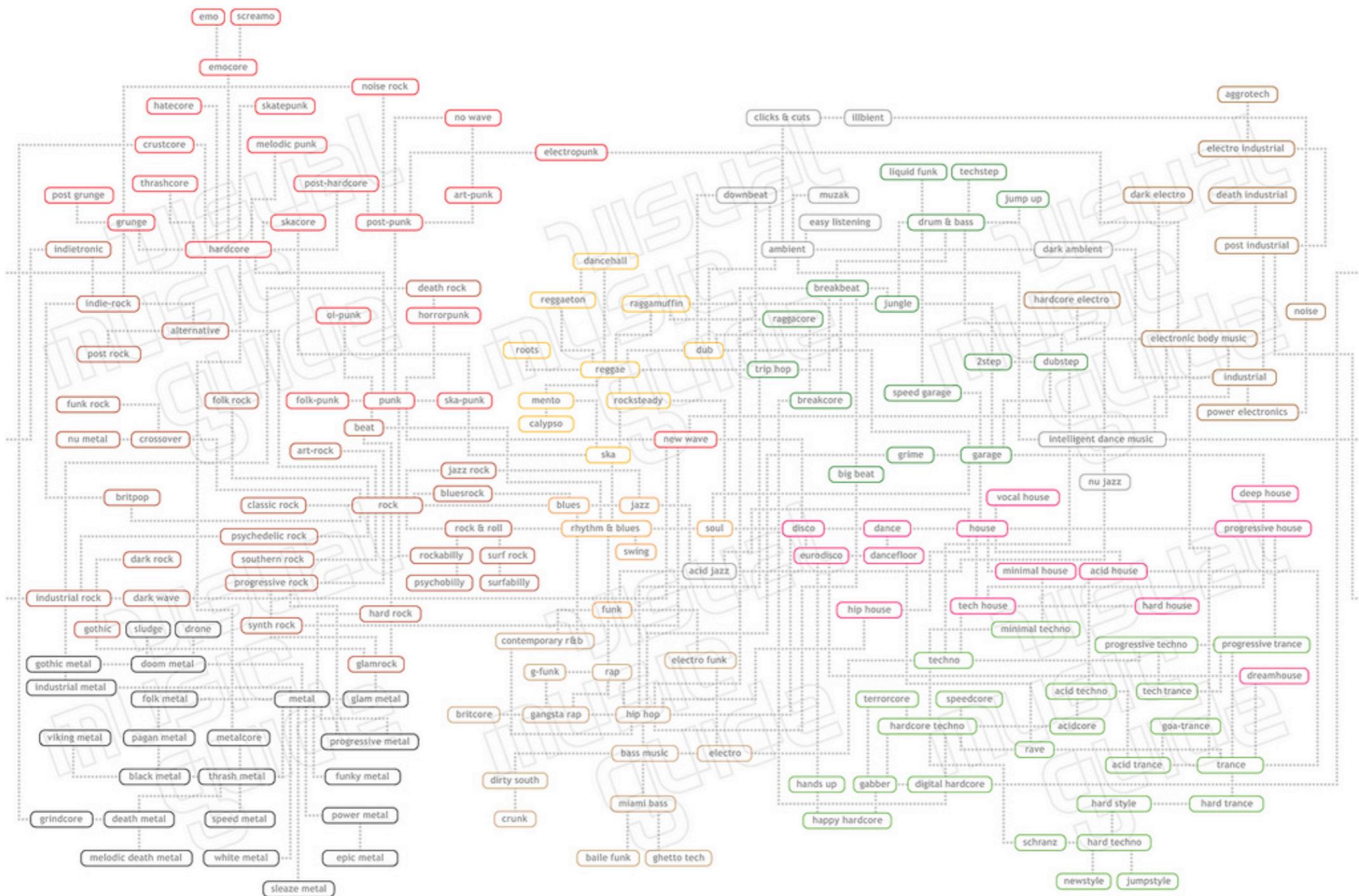
# Visualizations as a graph



# Visualizations as a graph



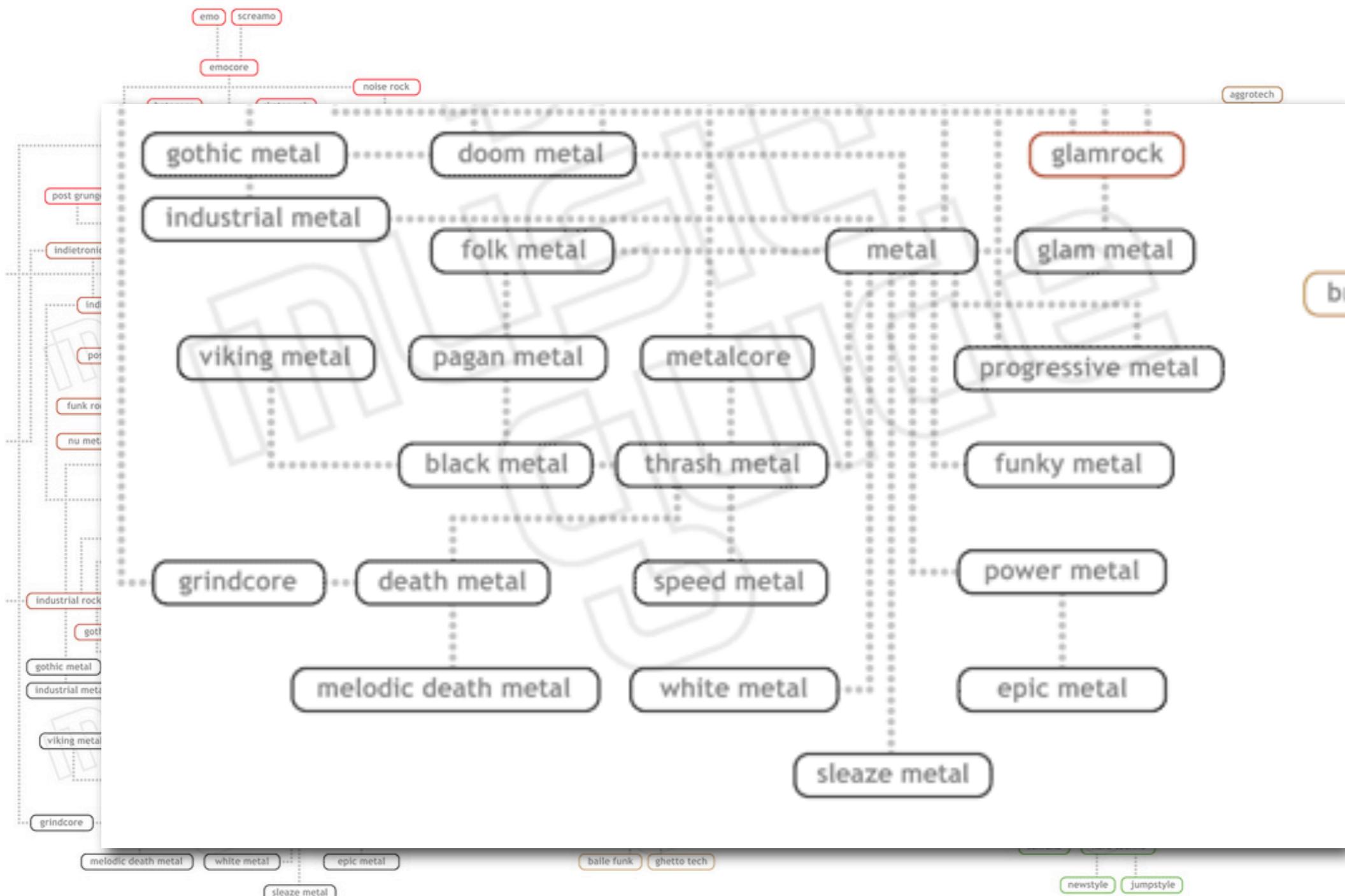
# Visual Music Guiden



Images (cc) Fabian Schneidmadel

Fabian Schneidmadel - <http://www.firutin.de/blog/>

# Visual Music Guiden

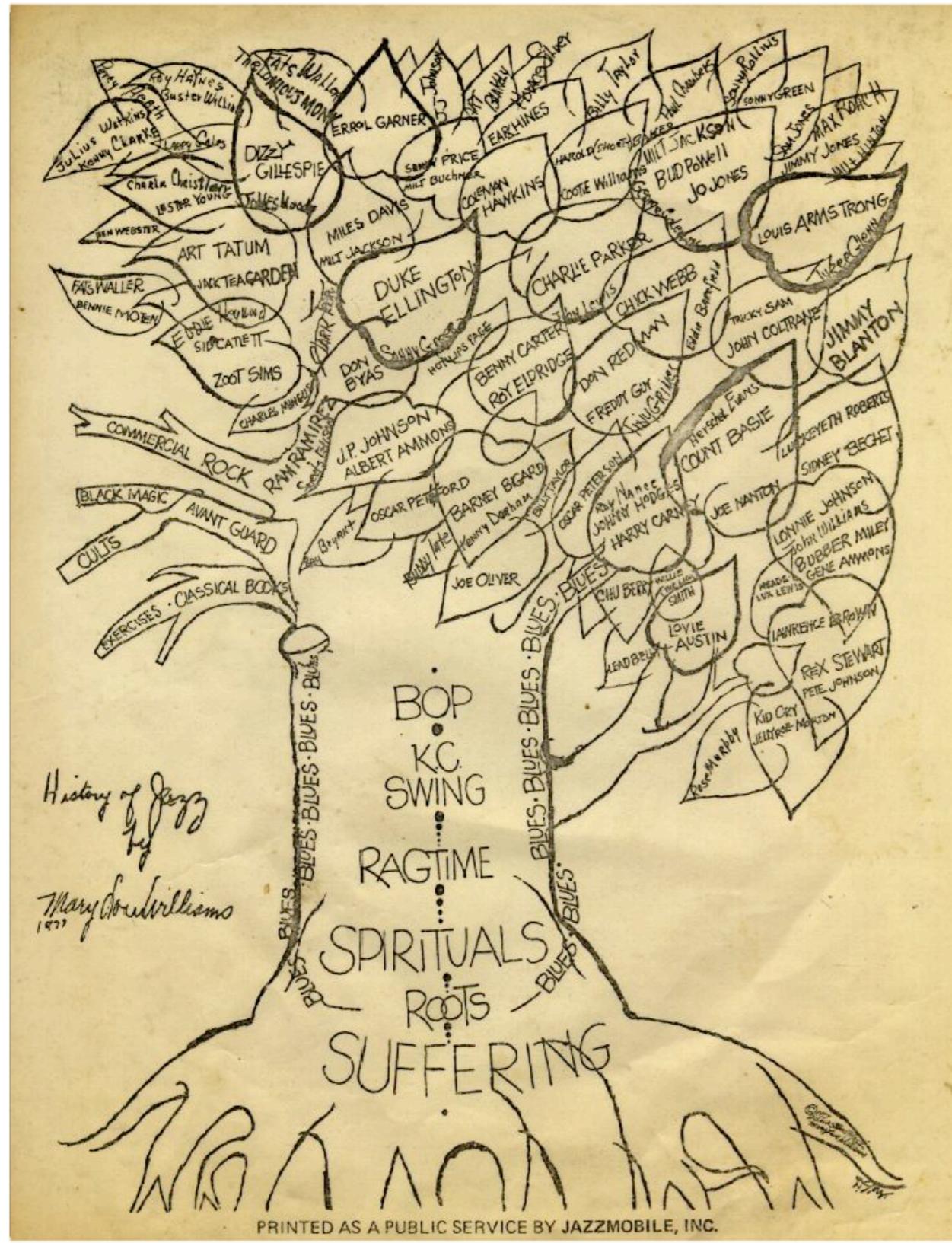


Images (cc) Fabian Schneidmadel

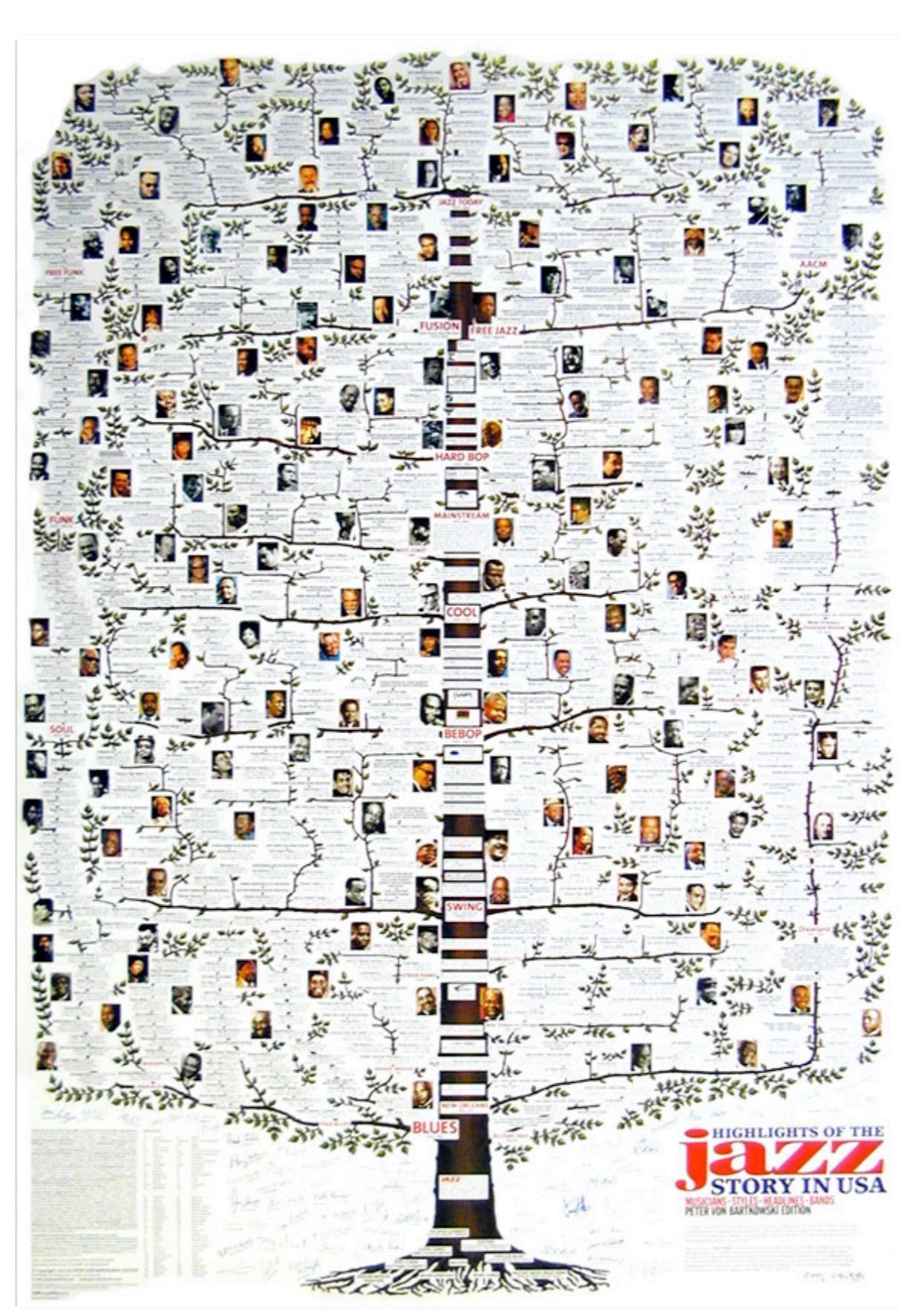
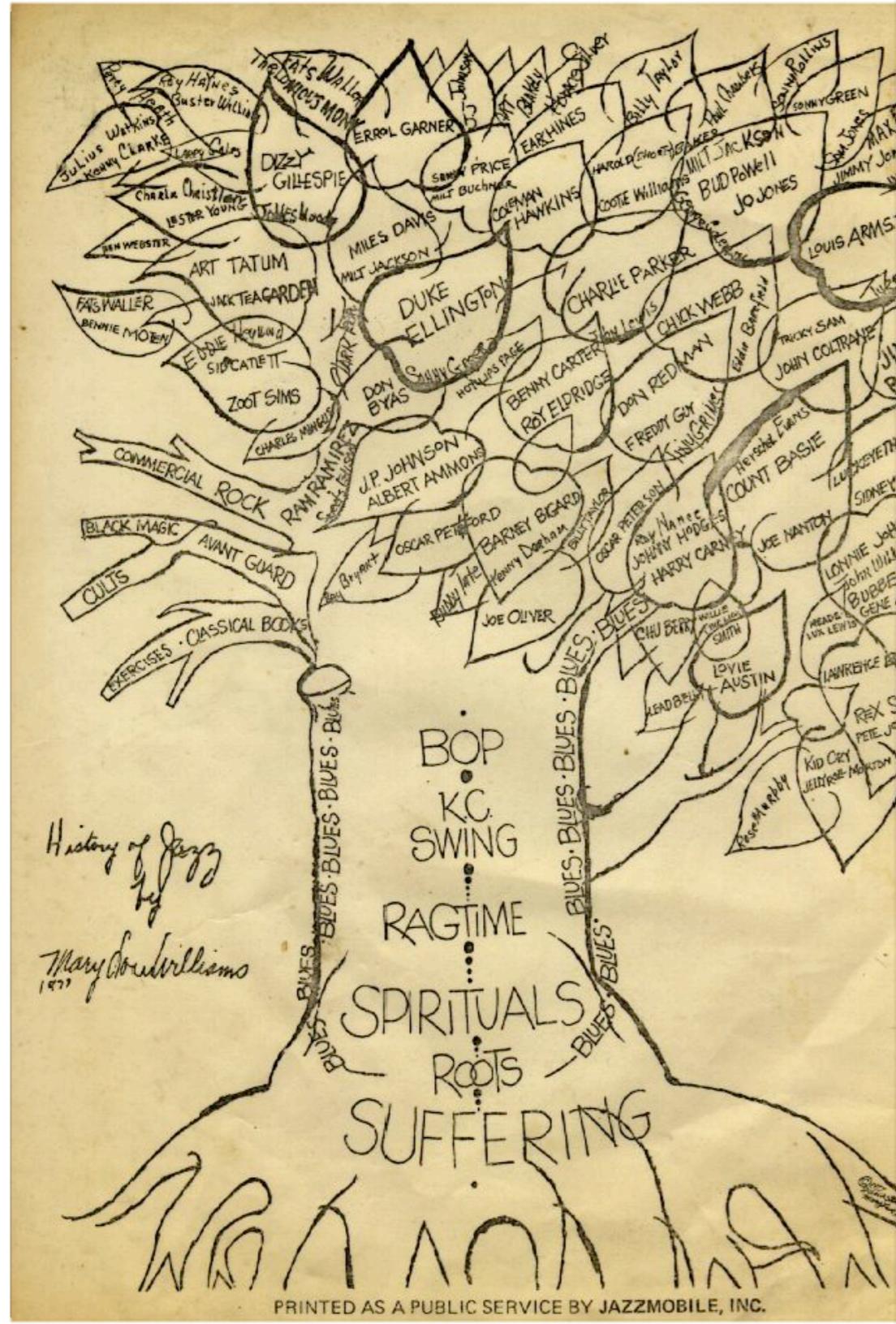
Fabian Schneidmadel - <http://www.firutin.de/blog/>

# Visualizations as a tree

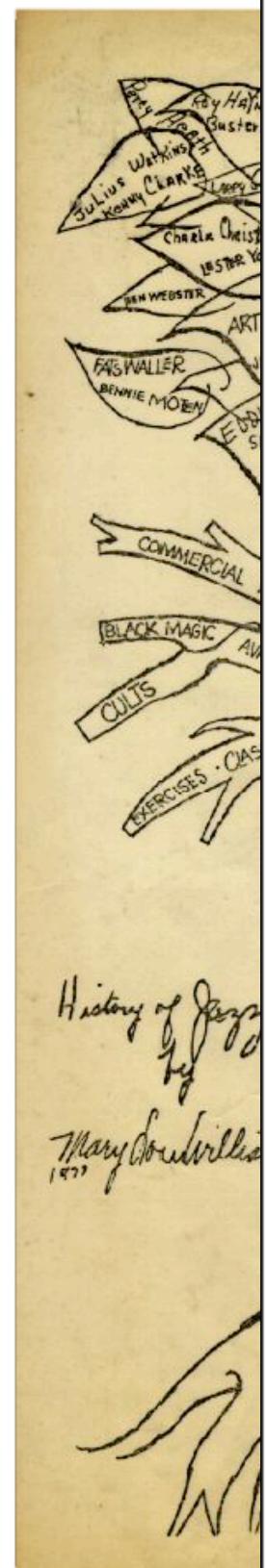
# Visualizations as a tree



# Visualizations as a tree



# Visualizations as a tree



## NAPALM DEATH FAMILY TREE

The history of NAPALM DEATH revolves around a small group of mid-80's teenage musicians in Birmingham, it was a unique period when open minded musicians of a metallic persuasion would mix 'n' match with local anarcho-punks to form bands influenced by the demos coming over from the underground Hardcore and Death metal bands which were happening under the radar in the USA and Europe. Many bands were formed with the single purpose and vision to push the envelope of the then stagnant UK music scene. NAPALM DEATH were originally formed in Meriden, near Birmingham UK by Nik Bullen and Miles Ratledge in 1981 as a Punk band, they recorded various demos including the 'Hatred Surge'. By 1986 founder member Nik Bullen had teamed up with Justin Broadrick. Whirlwind speed drummer Mick Harris replaced Miles Ratledge who had left the band in 1995, (and formed ABERRATION) Nik, Justin and Mick then recorded the "From Enslavement To Obliteration" demo. Nik, Justin and Mick then recorded the "From Enslavement To Obliteration" demo and twelve tracks for an ill fated 12" split with London band ATAVISTIC. The split never happened but these tracks were later to surface as the a-side of 'Scum'. Following the departure of Nik and Justin in late 86, Mick quickly recruited Lee Dorrian and Bill Steer to record the 16 songs for the B-side in early 87 which, together with the demo gained a full release on Earache as the debut LP 'Scum' in June 1987. The album was nothing short of groundbreaking, being by some measure the most extreme album ever released to the public. The musical style later dubbed 'Grindcore' was born, featuring short intense bomb blasts of songs - an amalgam of sludgy metallic riffs with hyperspeed drums.

Whilst working with NAPALM DEATH, Bill Steer maintained his current band, and main concern, CARCASS, recruiting ELECTRO HIPPIES singer Jeff Walker on vocals/bass after Sanjiv quit. For later albums CARNAGE guitarist Michael Amott was brought on second guitar, later to be replaced by DEVOID guitarist Carlo Regadas.

Soon after leaving Nopalm Death Lee Dorrian formed CATHEDRAL with the intention of being the slowest and heaviest band around, recruiting Garry Jennings ex- ACID REIGN on guitar and ex-SACRILEGE drummer Andy Baker, who would promptly be replaced by Ben Mochrie for the debut record. Later, Adam Lehan also ex-ACID REIGN was brought in as second guitar, to be replaced by USA's Scott Carlson ex-REPULSION on bass until Leo Smeet and Brian Dixon (ex-TORINO) answered the bands "musicians wanted" ad in Kerrang and cemented the current long standing line up.

**BENEDICTION** Paul Adams Ian Treacy Darren Brookes Peter Rewinski Barney Greenway - Greenway - Mick Embury - Embury - Mitch Pintado Jesse Pintado

Mark 'Barney' Greenway briefly quit in 1997- citing musical differences - lending his vocal talents to EXTREME NOISE TERROR on the CD 'Damage 381' instead. EXTREME NOISE TERROR singer Phil Vane tried out in the studio with NAPALM DEATH but it didn't work out, so Barney stepped back in.

**EXTREME NOISE TERROR #2** Mick Harris - Drums, Mark Bailey - Bass, Dean Jones - Vocals, Pete Hurley - Guitars, Phil Vane - Vocals

**EXTREME NOISE TERROR #7**

Mick Harris replaced EXTREME NOISE TERROR #1's drummer Pig Killer. The move was short lived, with Tony Dickens replacing Harris in #3. In #4 Mark Bailey was replaced by Disgust's Lee Barrett and Ali Firouzbakht came in as a second guitar. Original drummer Pig Killer returned in #5 only to be replaced by ex CRADLE OF FILTH drummer Was in #6. Version #7 saw Phil Vane depart for NAPALM DEATH to replace the recently departed Barney Greenway, who, in a bizarre twist took on vocals in EXTREME NOISE TERROR. This swap was not to last long and the pair switched back to their old bands.

Napalm Death Family Tree layout by Mick Usher ©Earache Records Ltd 2003

### NAPALM DEATH #1

Nik Bullen - Vocals/Bass, Mick Harris - Drums, Justin Broadrick - Guitar

The a-side of scum was originally gonna be for a split with Atavistic, this never happened and was the basis for the 'Scum' album which boasts two separate line ups. A-side Guitarist Justin Broadrick left to perform the drum duties for fellow Brummies HEAD OF DAVID - at that point a big selling Indie band, he also worked on numerous side projects including SWEET TOOTH. Finally he formed his long standing post NAPALM DEATH band, GODFLESH with G.C. Green who he had worked with FALL OF BECAUSE whilst still in CARCASS as well during his tenure with NAPALM DEATH. Frank Healey of SACRILEGE/CEREBRAL FIX and later BENEDICTION was in the band for a couple of months just prior to Bill joining. Similarly, founder Nik Bullen left shortly after Justin in late 86, both citing boredom with Nopalm's self imposed musical restrictiveness. However, both teamed up again by quickly recruiting local scenesters with no previous band experience: Lee Dorrian came in on vocal duties, Jim Whitley on bass.

### CARCASS #1

Ken Steer - Vocals/Guitar, Bill Sanjiv - Drums

**NAPALM DEATH #2** Mick Harris - Vocals, Jim Whiteley - Bass, Shane Embury - Drums, Andy Whale - Guitar

**DROP DEAD** Bill Steer - Vocals/Guitar, Lee Dorrian - Drums, Mick Harris - Bass, Jim Whiteley - Drums

### NAPALM DEATH #3

Bill Steer - Vocals, Lee Dorrian - Drums, Mick Harris - Drums, Shane Embury - Bass

### UNSEEN TERROR

Shane Embury - Drums, Mitch Dickinson - Drums, Mitch Dickinson - Guitar, Bass, Vocals

NAPALM DEATH #3 featured UNSEEN TERROR drummer Shane Embury on bass, replacing the departing Jim Whiteley- and quickly became noticed by the public at large after their second LP "FETO" entered the UK Indie charts at number 1- also notching up several BBC Peel sessions and appearing on the cover of NME. This 'classic' line up suffered a major blow on returning from a Japanese tour in the summer of 89 - Steer and Dorrian quit on their return to UK. Once again, line up changes didn't upset the momentum of the band. Shane and Mick got on the phone and recruited not one but two new guitarists, both of whom took the plunge and relocated from America to UK. Jesse Pintado of LA's TERRORIZER and Mitch Harris of Las Vegas' RIGHTEOUS PIGS were recruited and Mark 'Barney' Greenway of fellow Brummies BENEDICTION this line up was NAPALM DEATH #4

### CARCASS #2

Michael Amott - Guitar, Jeff Walker - Bass/Vocals, Bill Steer - Drums, Ken Owen - Drums

### CATHEDRAL

Mark Leonard - Drums, Andy Caper - Vocals, Gary Baker - Drums, Jennings - Guitars, Lee Dorrian - Vocals

**NAPALM DEATH #4** Barney Greenway - Drums, Mick Embury - Bass, Shane Embury - Drums, Mitch Pintado - Guitar, Jesse Pintado - Bass

**NAPALM DEATH #5** Barney Greenway - Vocals, Mick Embury - Drums, Danny Herrera - Bass, Shane Embury - Drums, Jesse Pintado - Bass

**NAPALM DEATH #6** Phil Vane - Vocals, Mitch Harris - Drums, Danny Herrera - Bass, Jesse Pintado - Bass, Shane Embury - Drums

**NAPALM DEATH #7** Barney Greenway - Vocals, Shane Embury - Drums, Danny Herrera - Bass, Jesse Pintado - Bass, Mitch Harris - Drums

### RIGHTEOUS PIGS

Scott Leonard - Drums, Joe Caper - Vocals, Steven Chiavichini - Bass, Mitch Harris - Drums

**DEFECATION** Mitch Harris - Drums, Mitch Harris - Drums, Mitch Harris - Drums

**TERRORIZER** Pete Sandoval - Drums, David Vincent - Bass/Vocals

**MEATHOOK SEED** Jesse Pintado - Drums, Shane Embury - Bass, Mitch Harris - Drums

**LOCK UP** Donald Tardy - Drums, Trevor Perez - Vocals, Shane Embury - Drums, Mitch Harris - Drums

**SCORN** Nick Barker - Drums, Tomas Lindberg - Drums, Vocal

**BLOOD FROM THE SOUL** Lou Koller - Bass, Shane Embury - Drums

**JESU** Koller, the SICK OF IT ALL vocalist, teamed up with NAPALM DEATH's Shane Embury for a project, as a way to experiment musically away from their main outfits. The resulting recording appeared as the BLOOD FROM THE SOUL CD

**PAINKILLER** Dermot Dalton - Bass, Paul Neville Parsons - Drums, Ted Parsons - Drums, Justin Broadrick - Drums, John Zorn - Alto Sax, Bill Laswell - Bass, Mick Harris - Drums

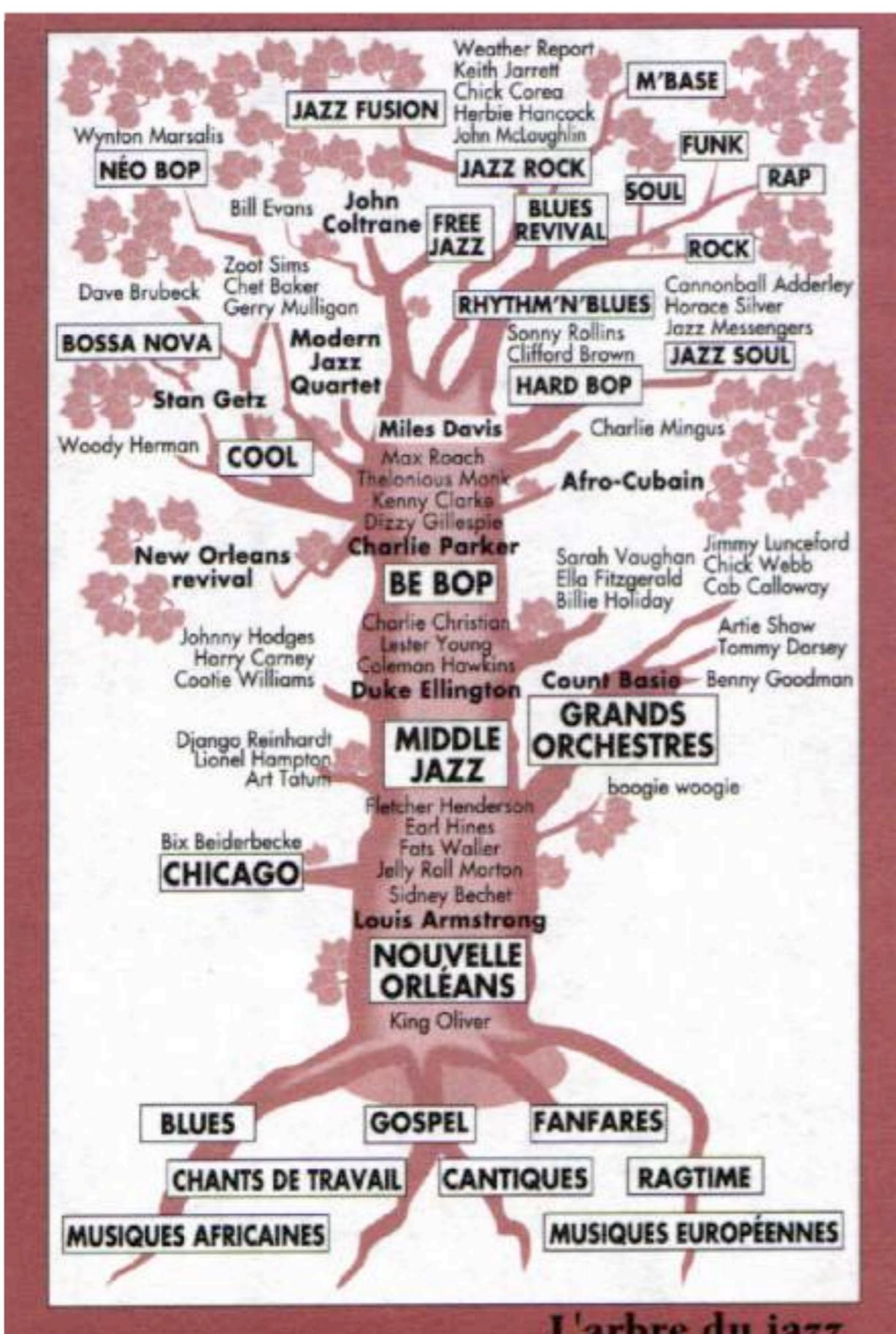
**BRUJERIA** Myths and rumours surround the line up of this band. Let's just say there's possible links to members of NAPALM DEATH, FEAR FACTORY, FAITH NO MORE, DIMMU BORGIR...



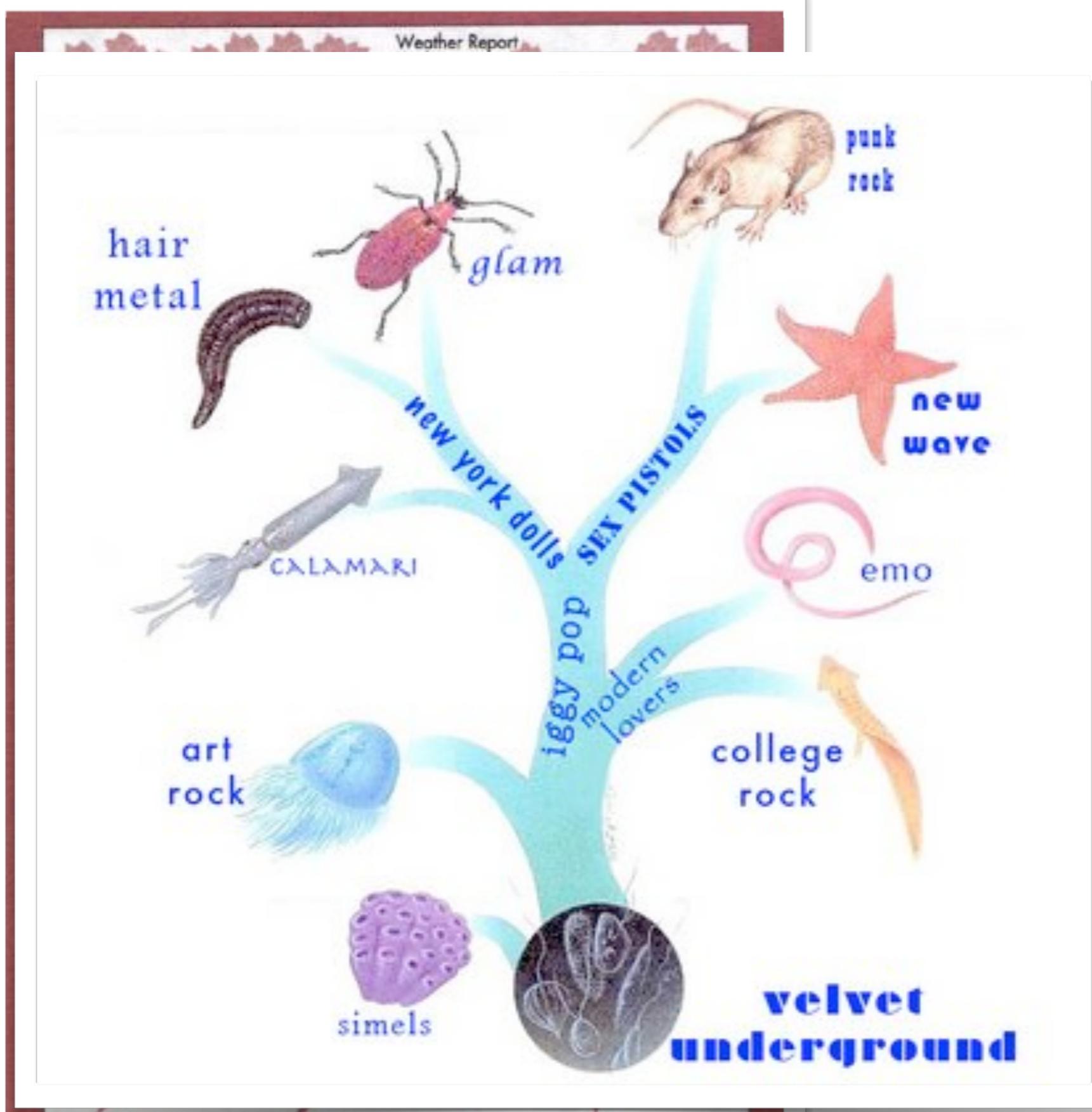
HIGHLIGHTS OF THE  
jazz  
STORY IN USA  
MUSICIANS · STYLES · HEADLINES · BANDS  
PETER VON BARTKOWSKI EDITION

# Handmade Genre Maps and Trees

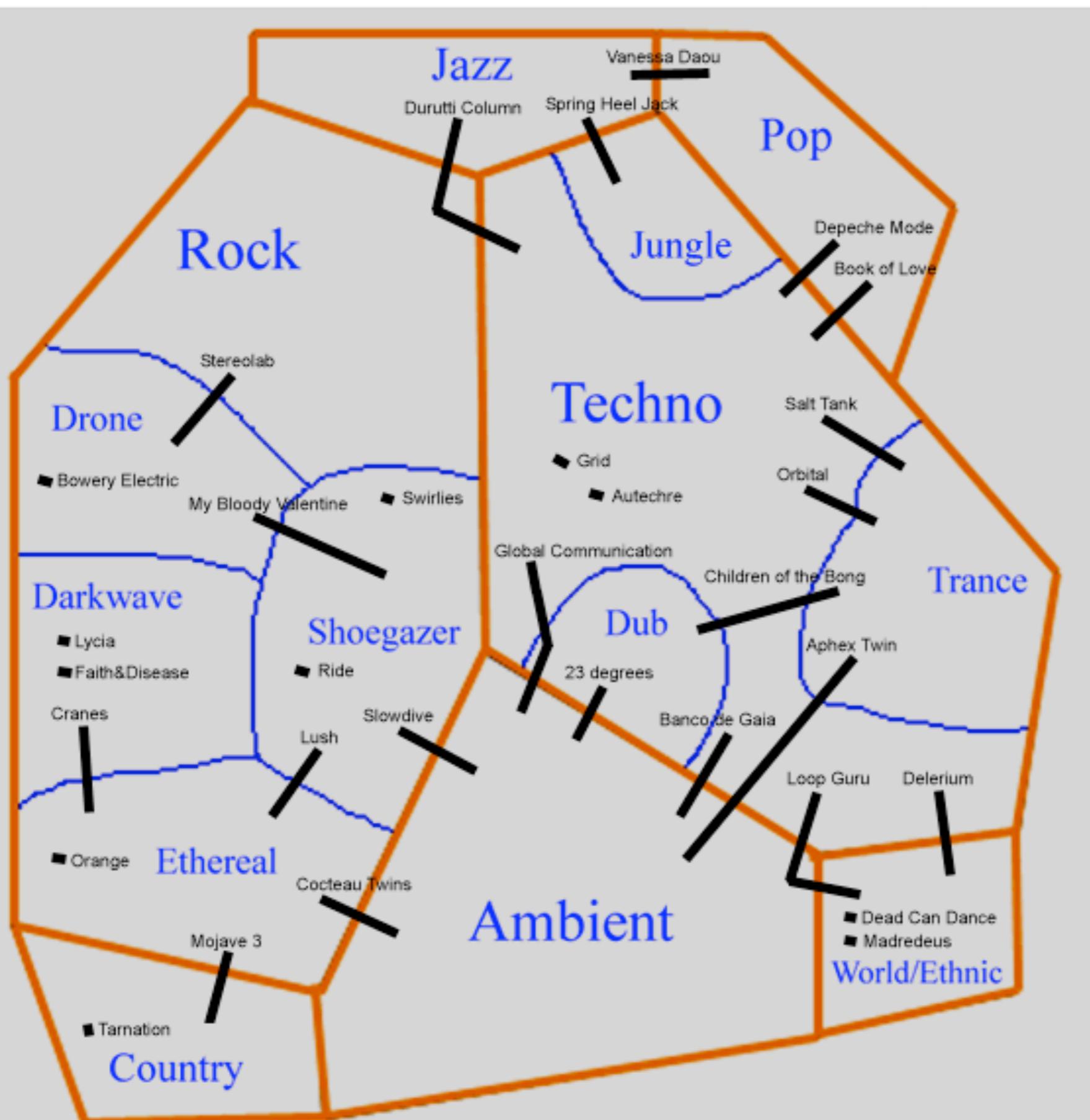
# Handmade Genre Maps and Trees



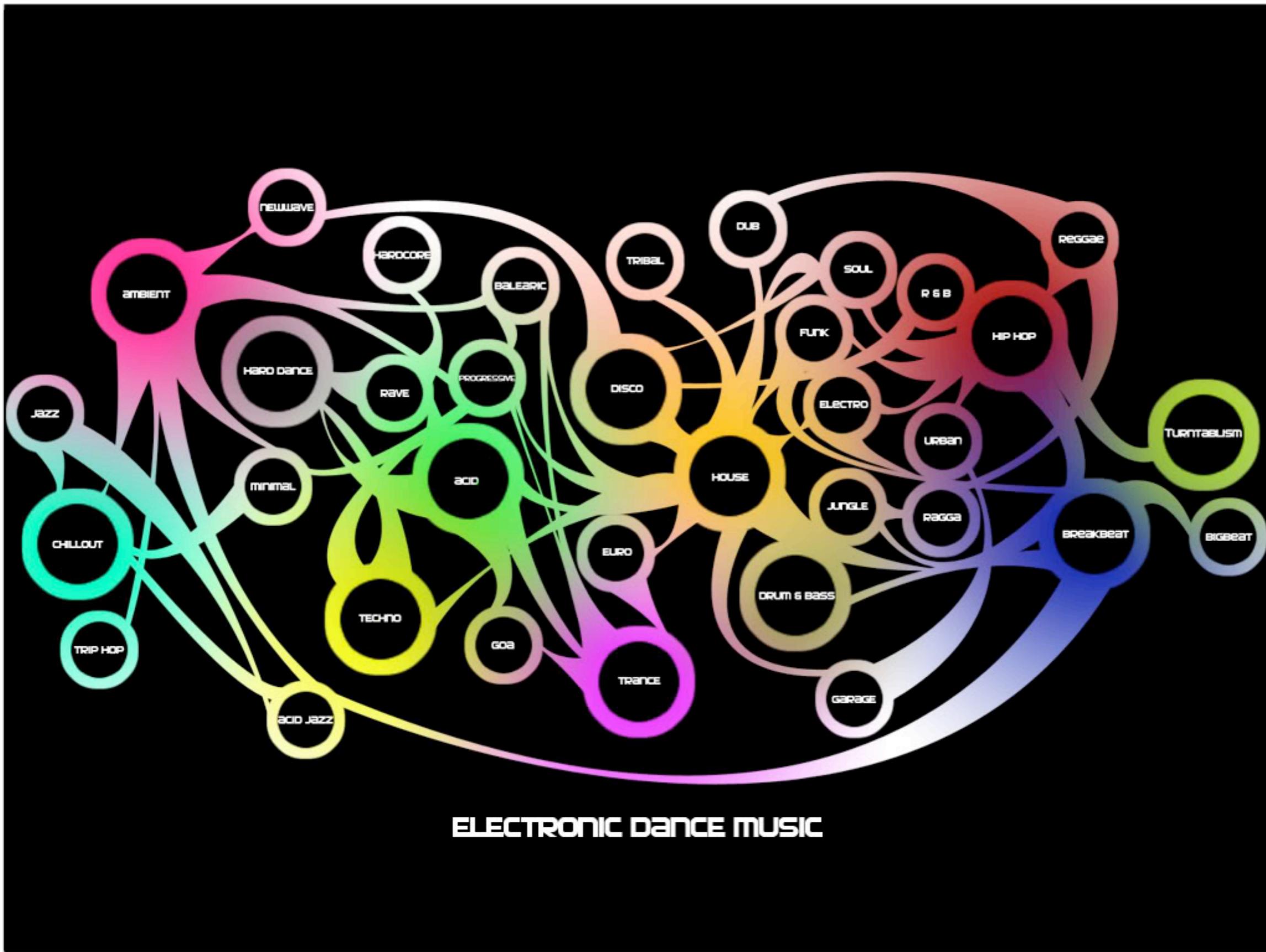
# Handmade Genre Maps and Trees



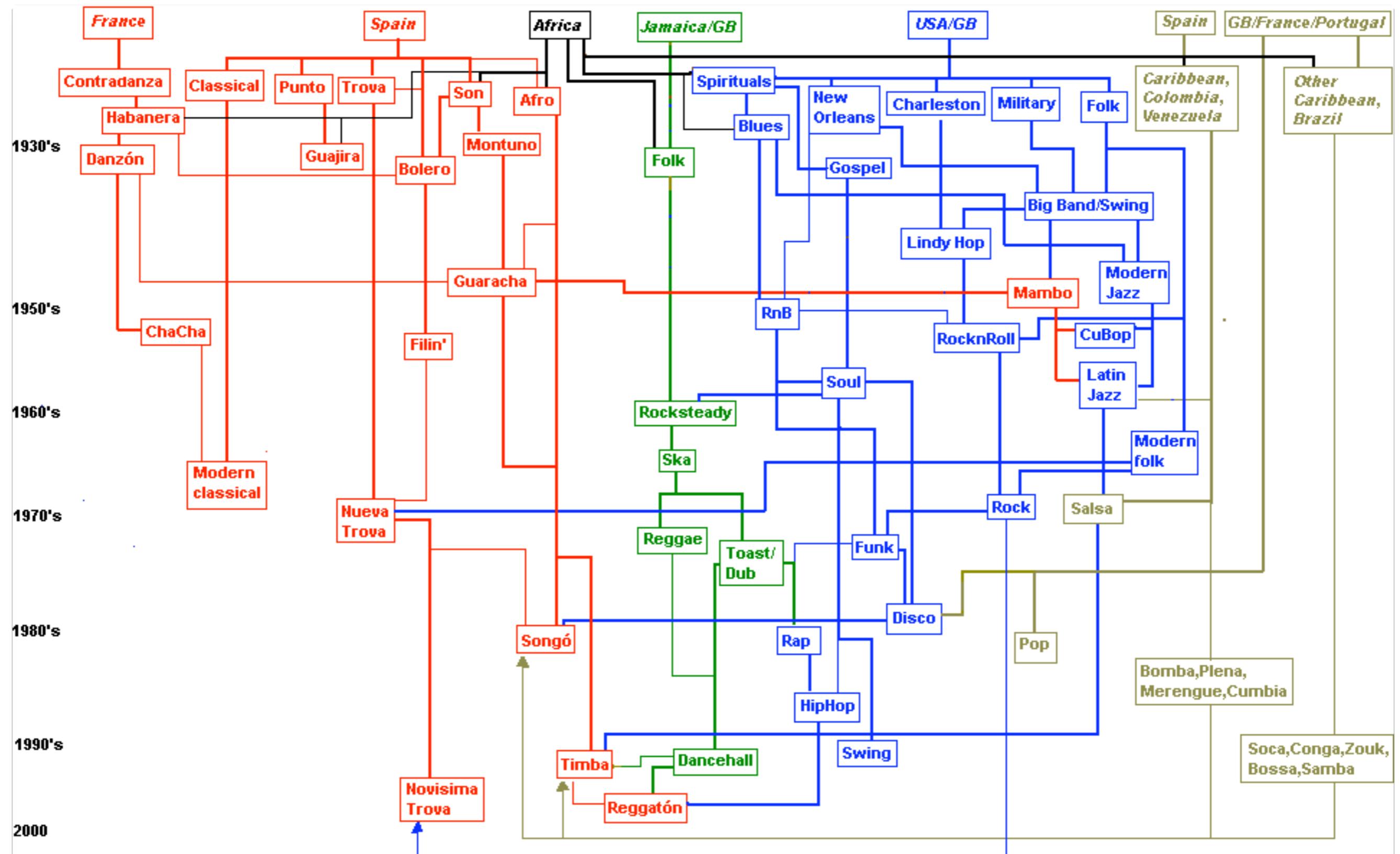
# Handmade Genre Maps and Trees



# Handmade Genre Maps and Trees



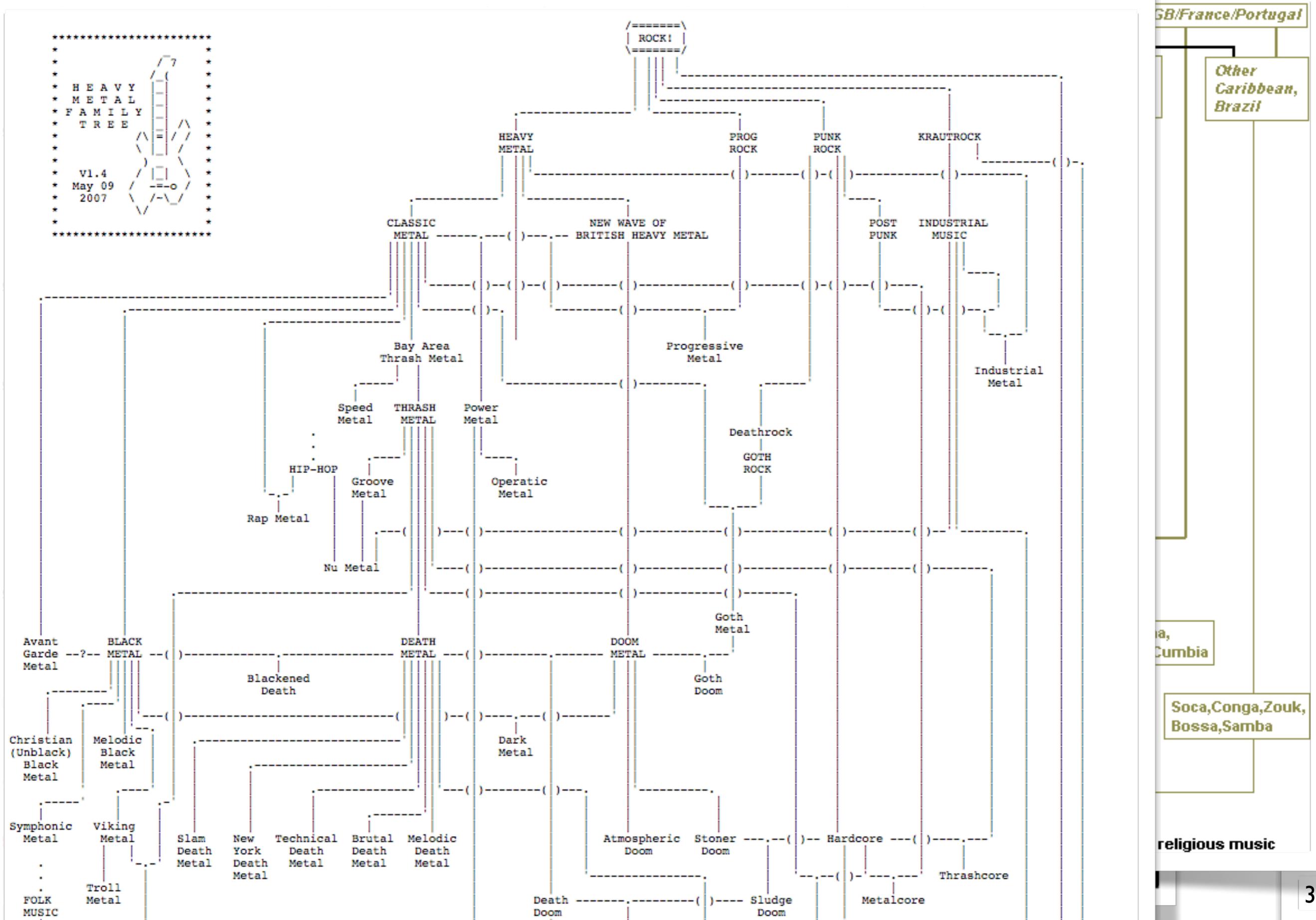
# Handmade Genre Maps and Trees



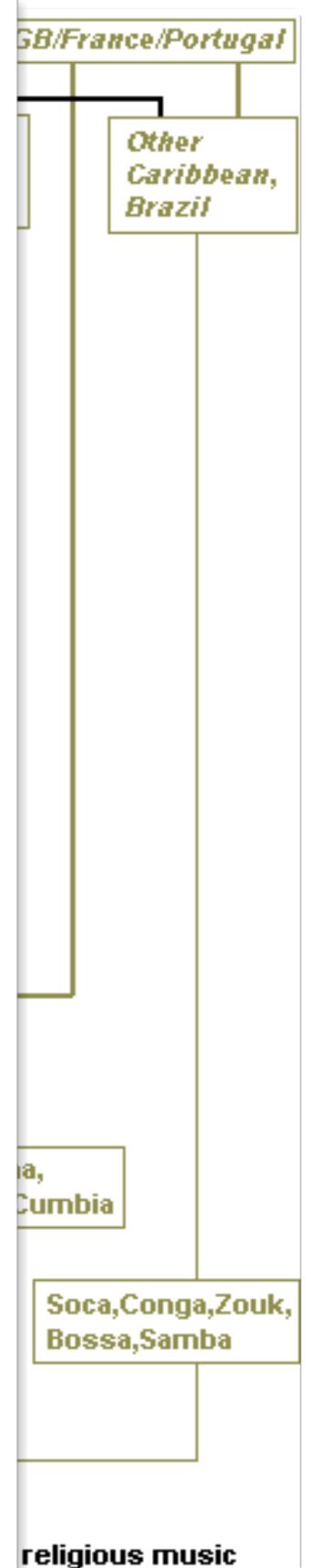
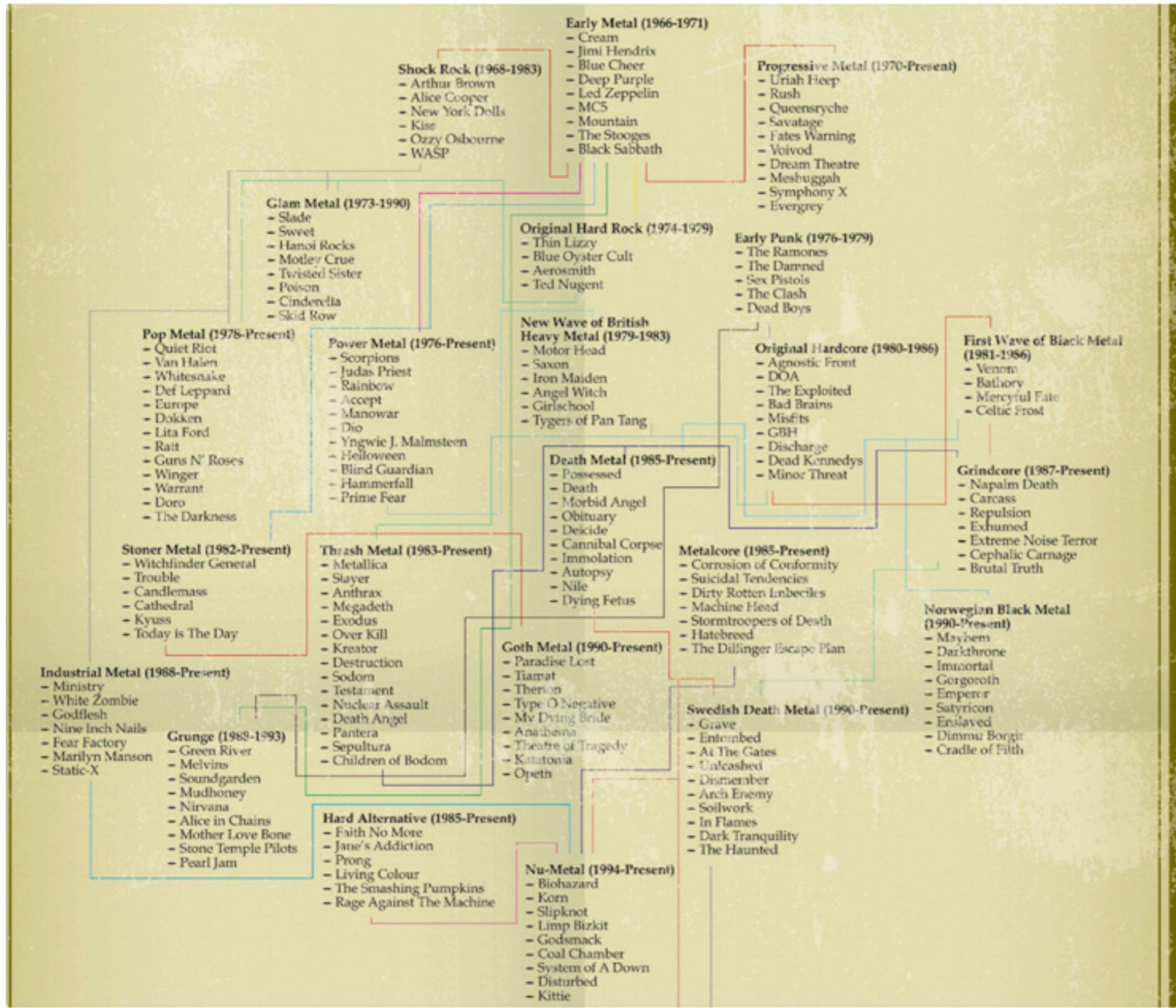
Red=Cuba Black=Africa Green=Jamaica Blue=USA Grey=Other

Note: "Afro" refers to various Afro-Cuban genres incl. rumba, comparsa & religious music

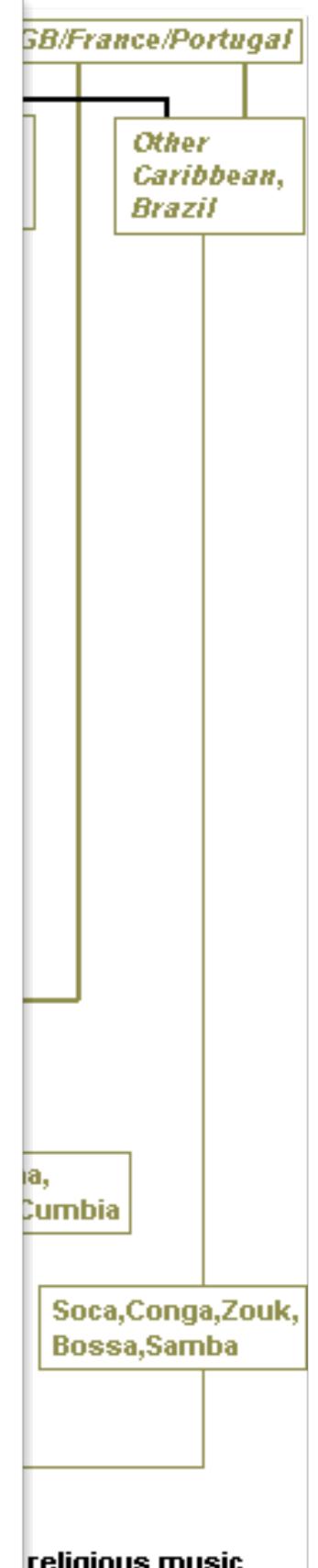
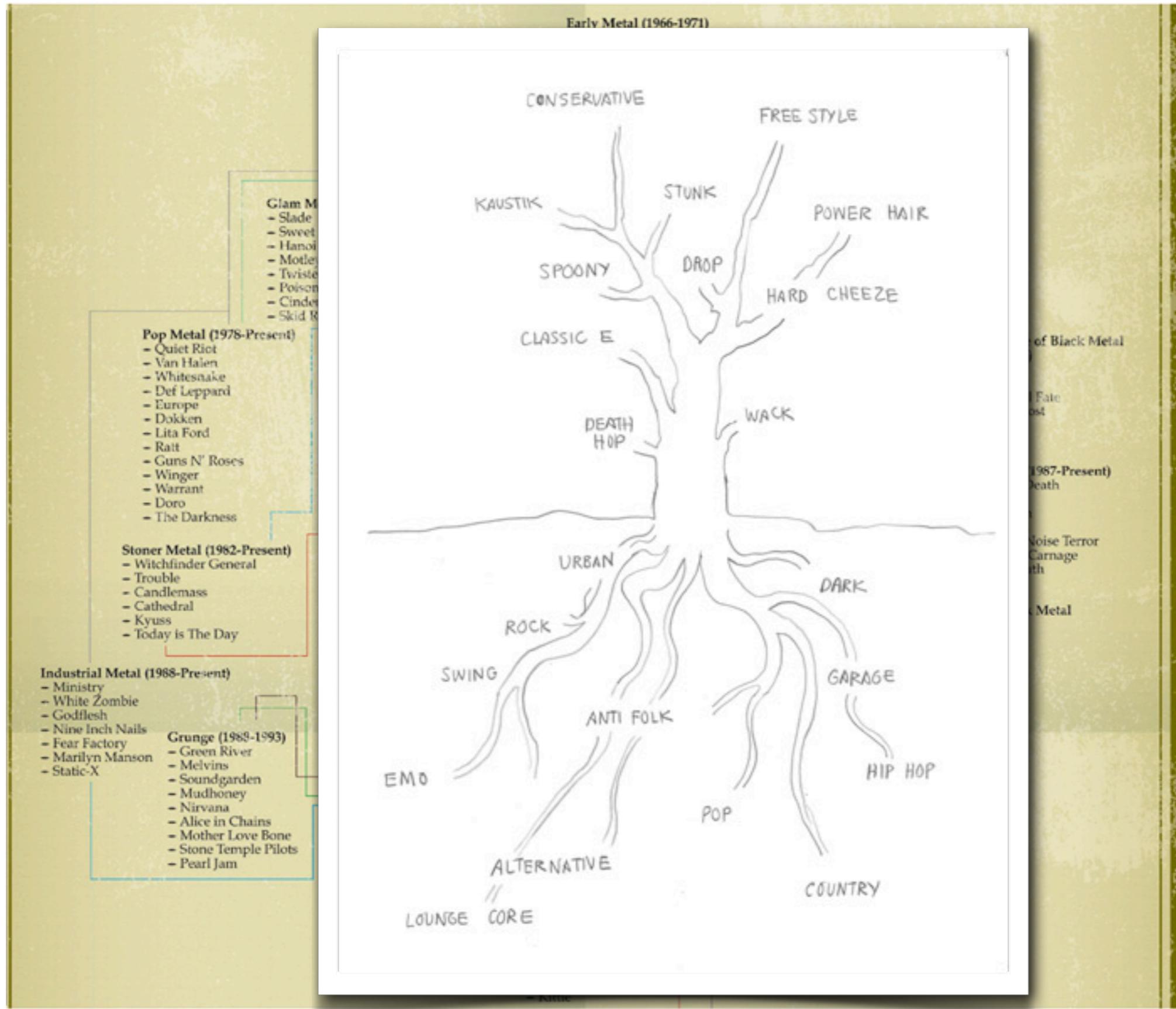
# Handmade Genre Maps and Trees



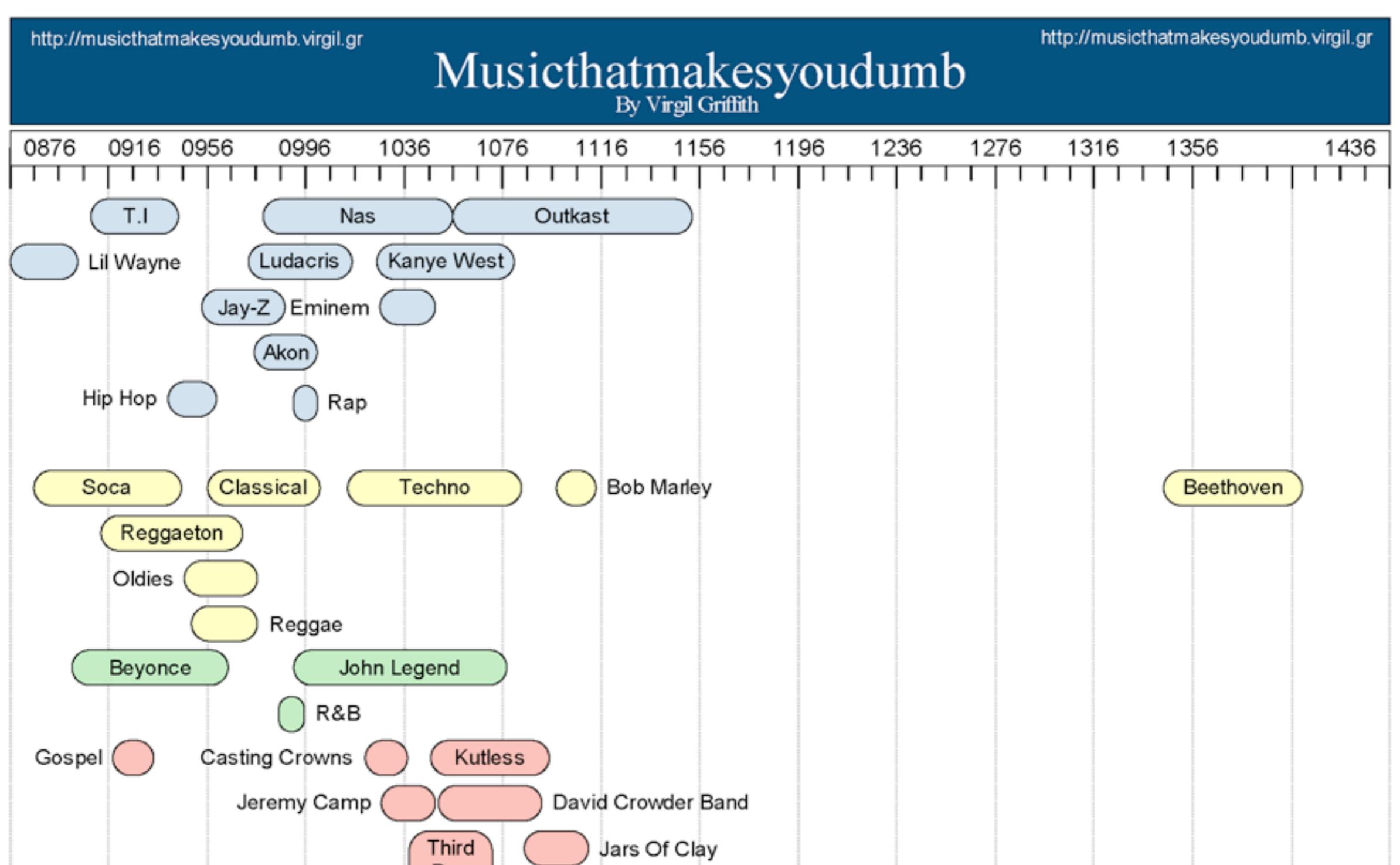
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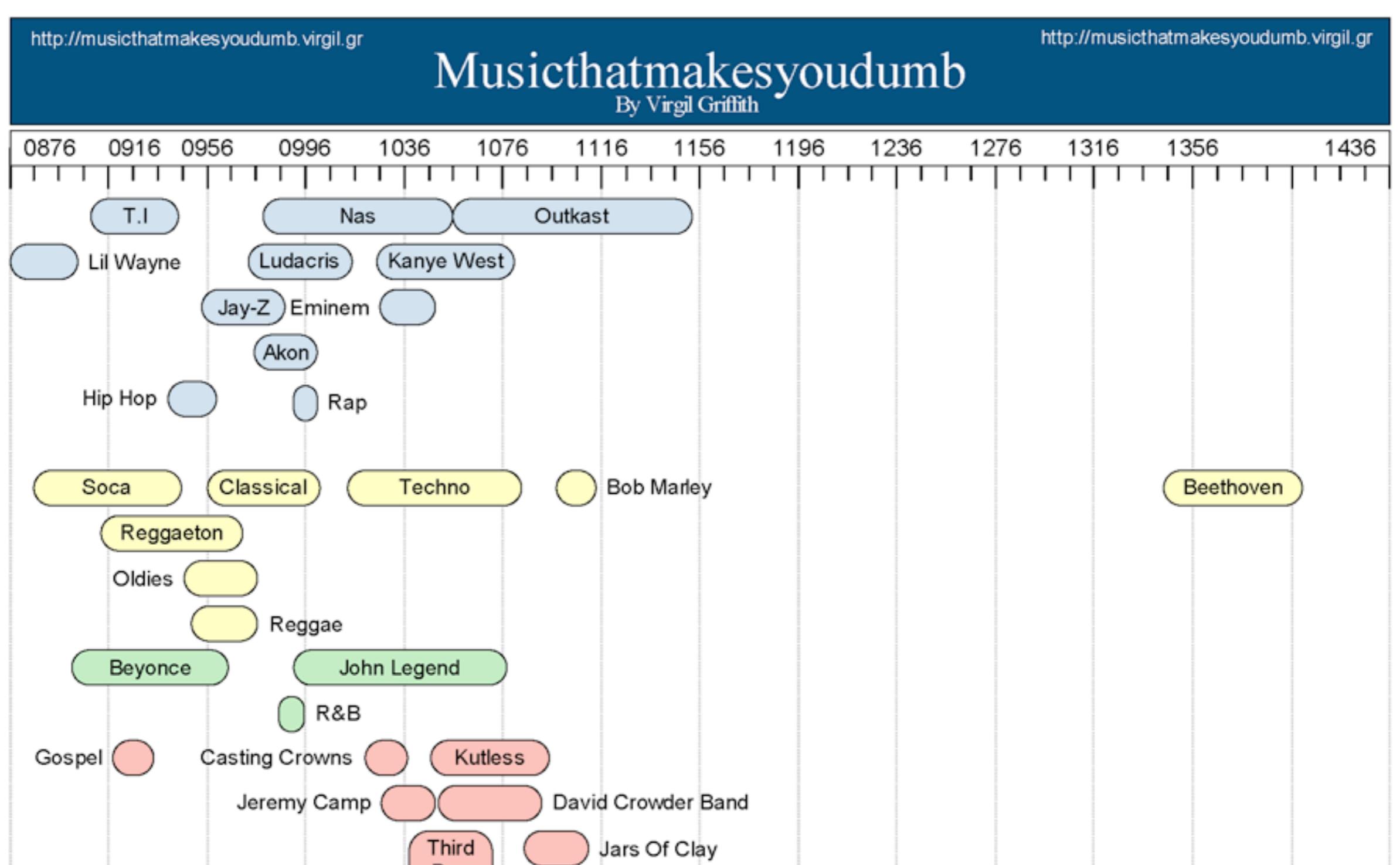
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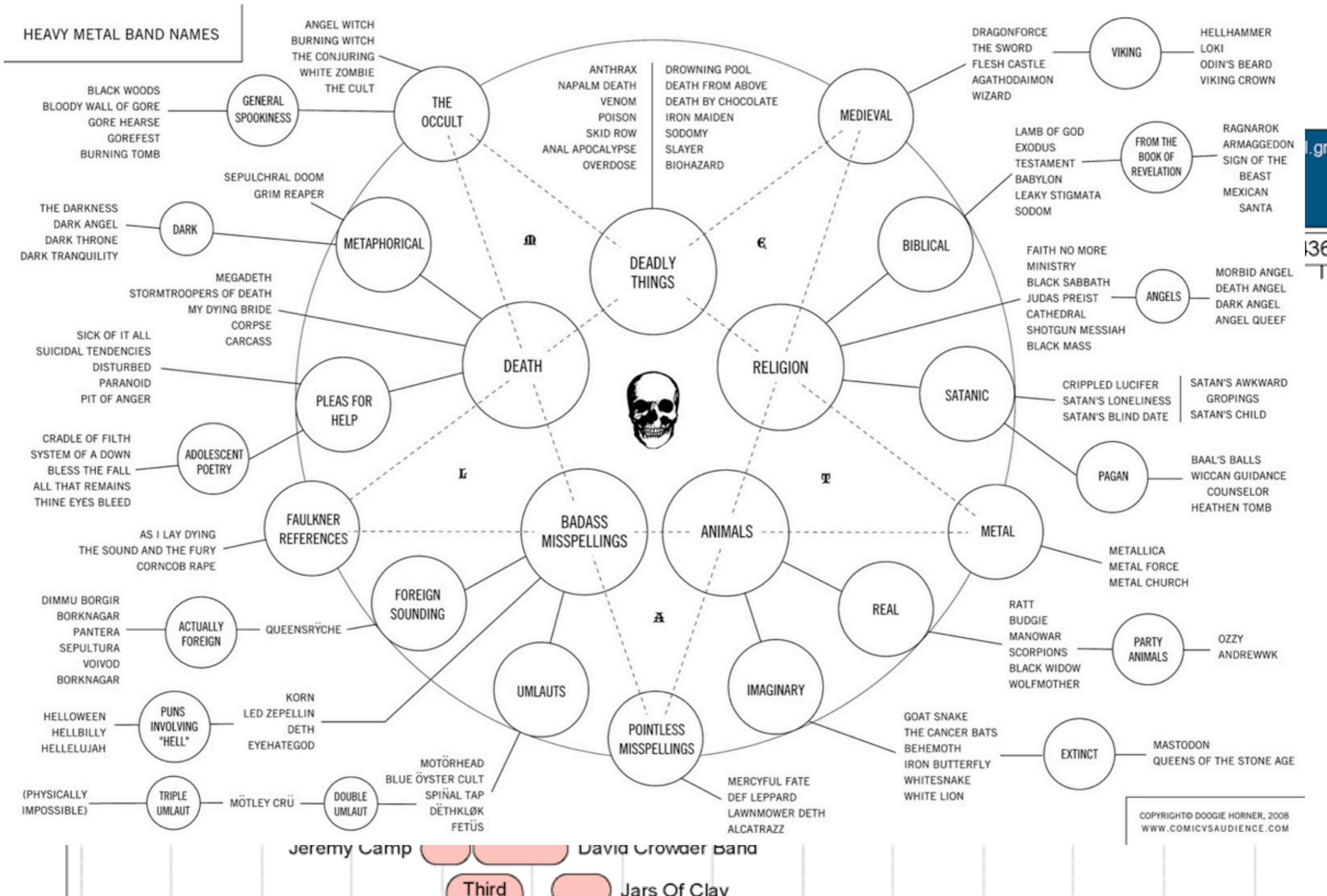
# Other types of visualizations



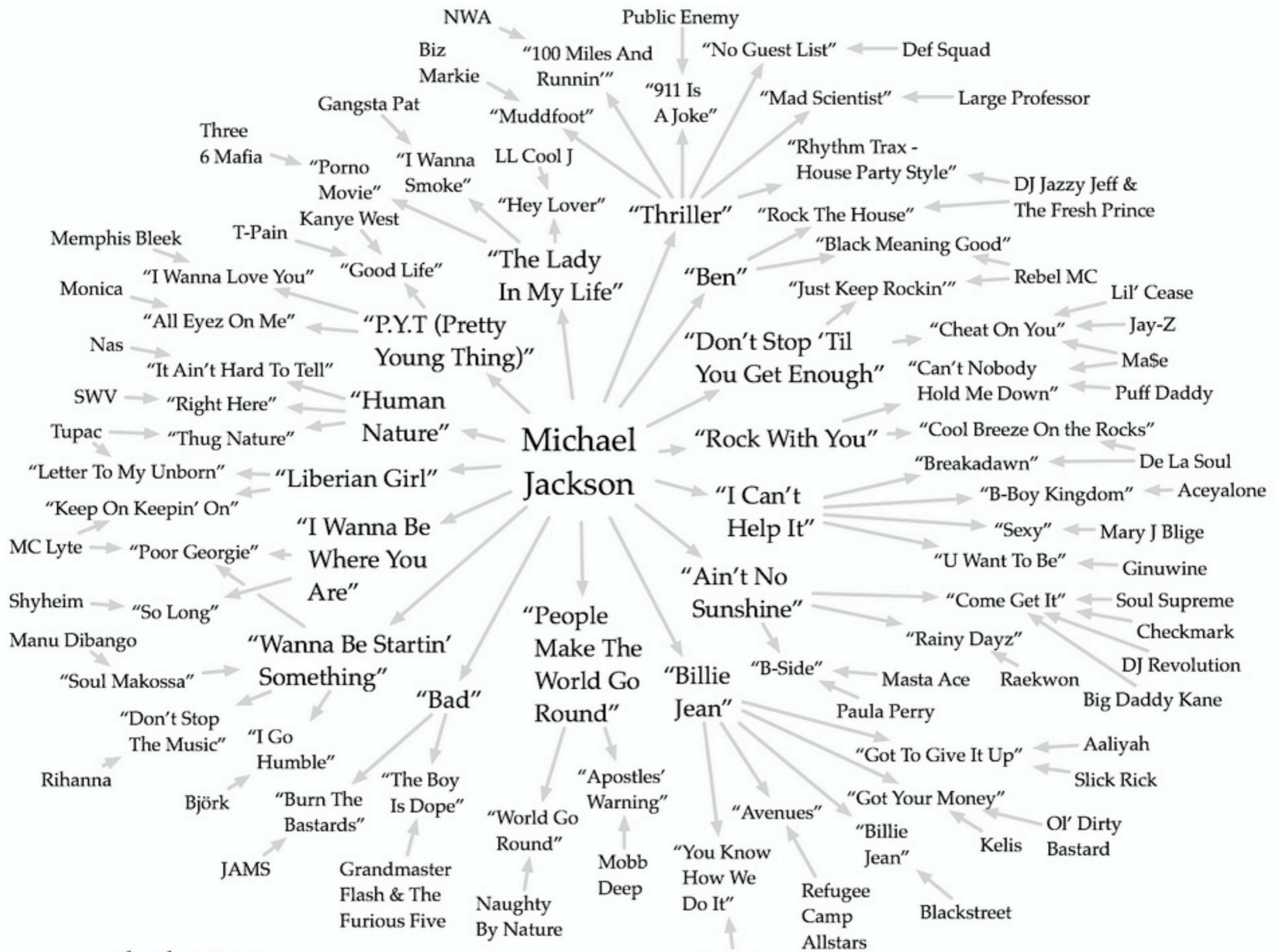
# Other types of visualizations



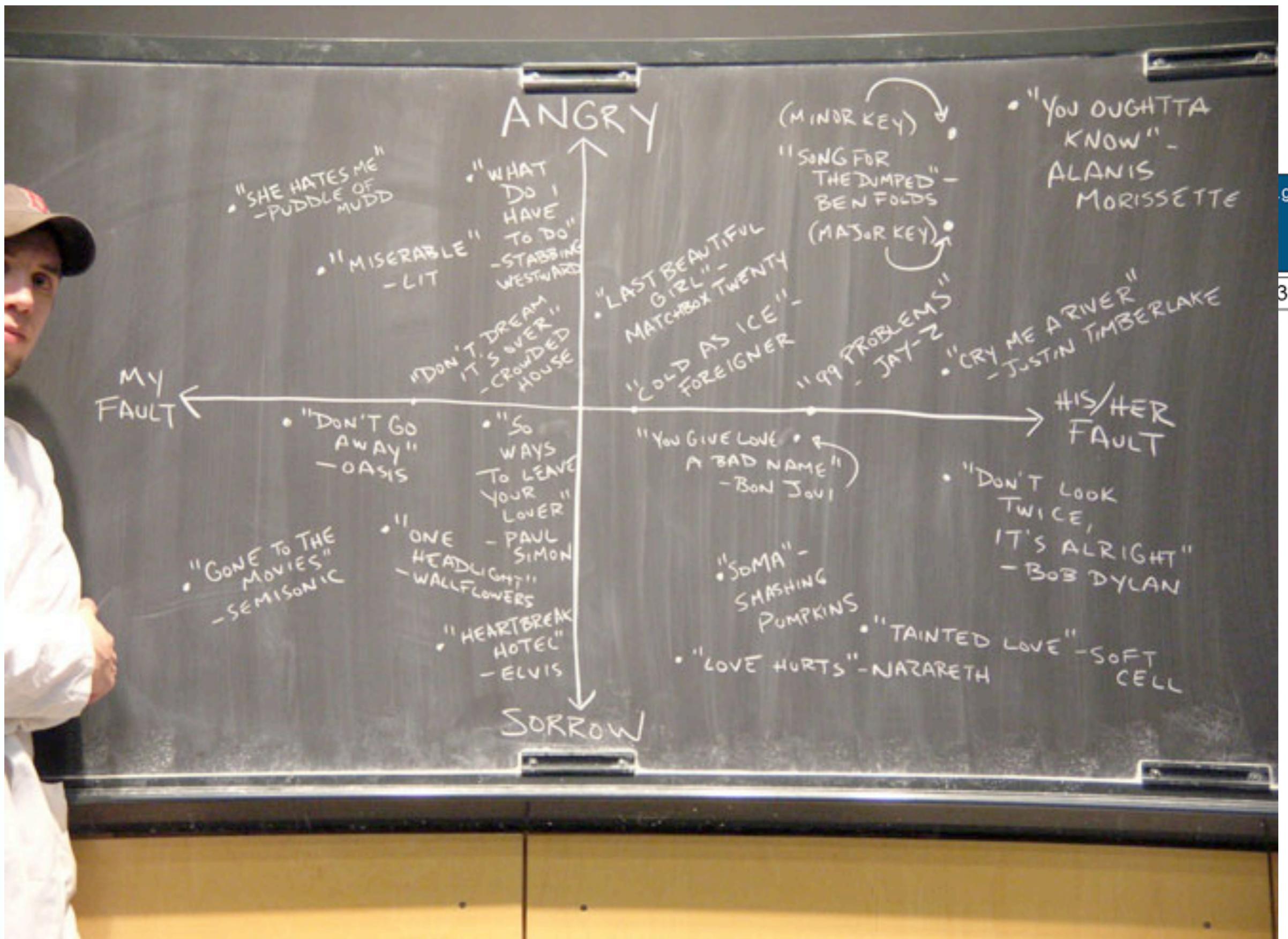
# Other types of visualizations



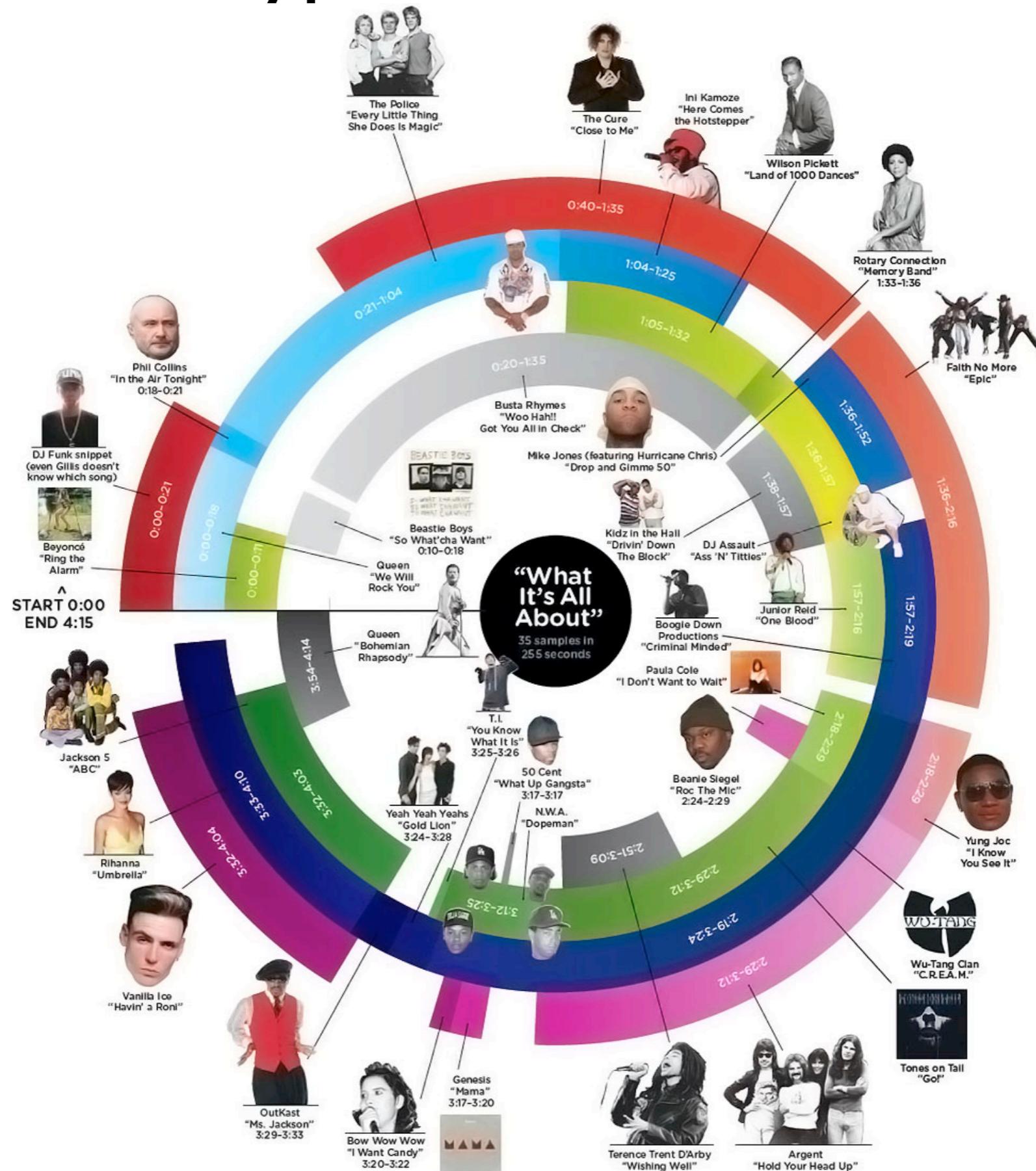
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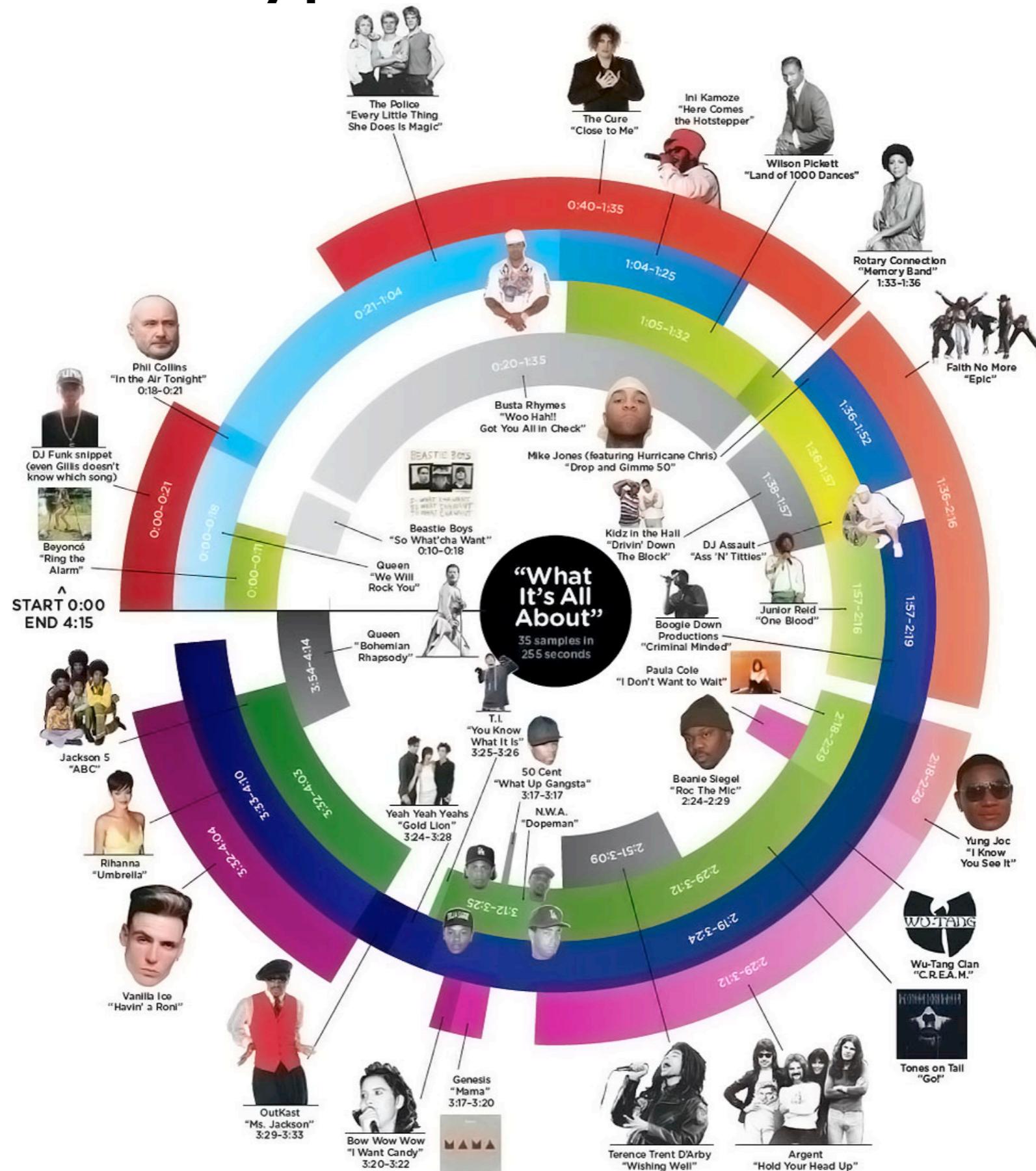
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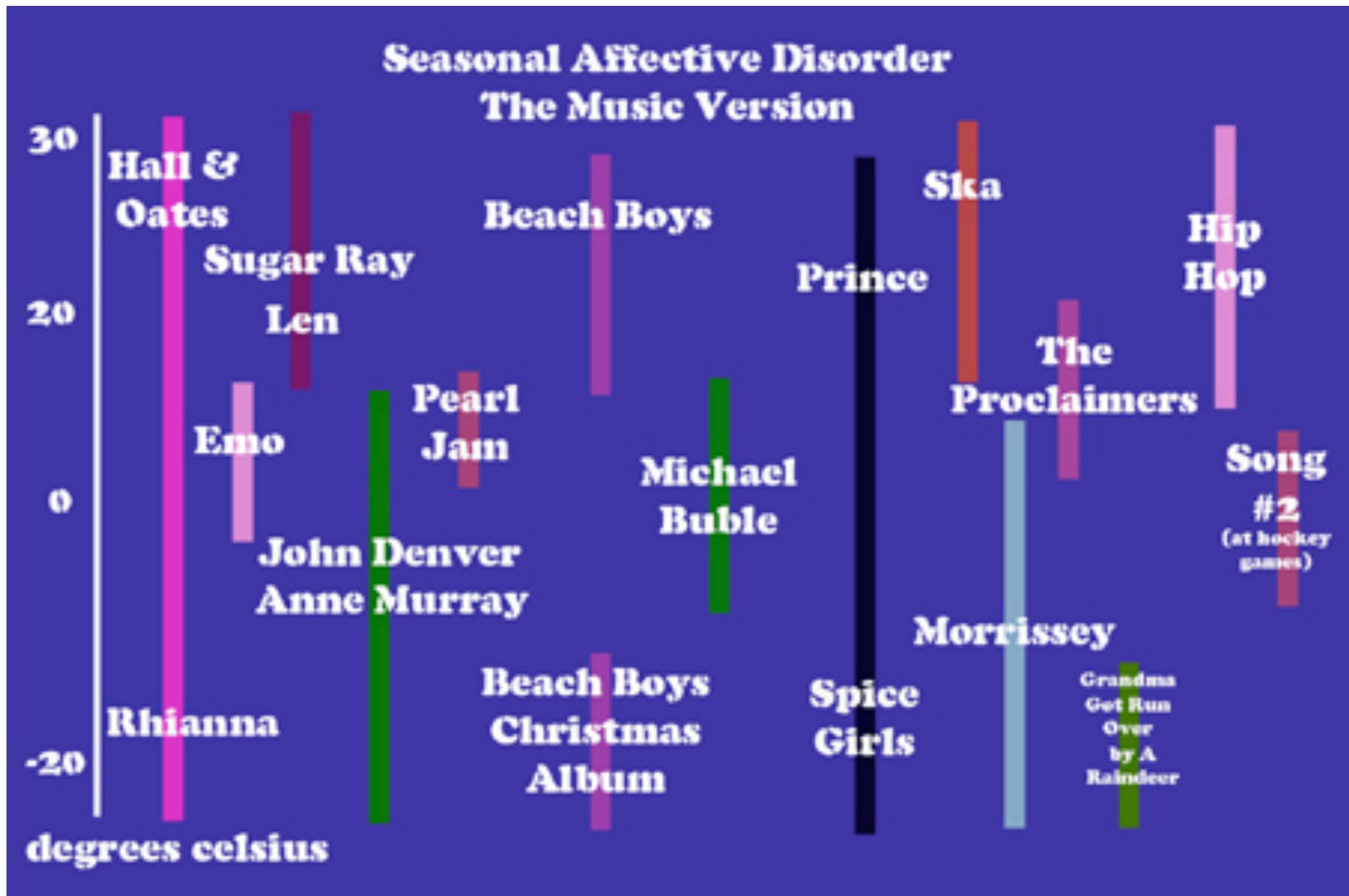
# Other types of visualizations



# Other types of visualizations



# Artist as a function of temperature



# ISMIR Tutorial 2005



## Visualization for Music IR

Tutorial II, part 2  
ISMIR2005 London UK

Stephan.Baumann@dfki.de  
(Thanks to the authors of original contributions!)

Senior Researcher >> German Research Center for AI  
Creative Visionary >>> computationalculture.org

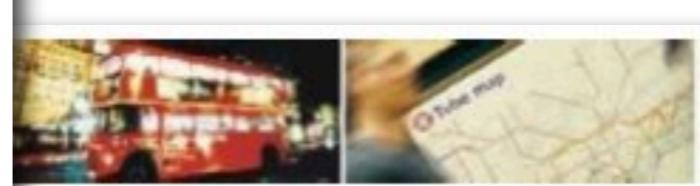
Stephan Bauman -Senior Researcher - German Research Center for AI

# ISMIR Tutorial 2005

## GenreGram



Creative Visionary >>> computationalculture.org



## Music IR

2  
on UK

ki.de  
(contributions!)

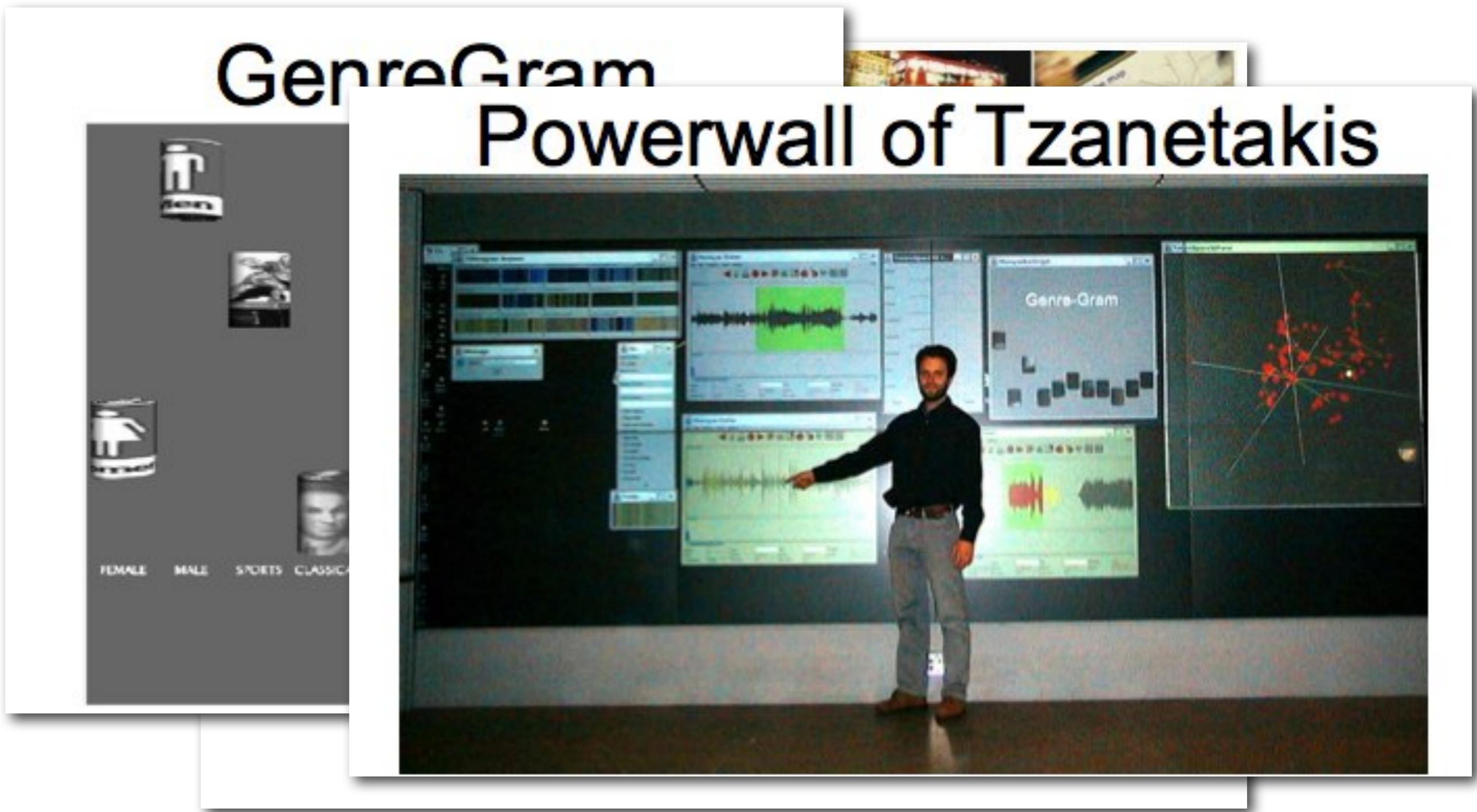
Search Center for AI

Stephan Bauman -Senior Researcher - German Research Center for AI

# ISMIR Tutorial 2005

GenreGram

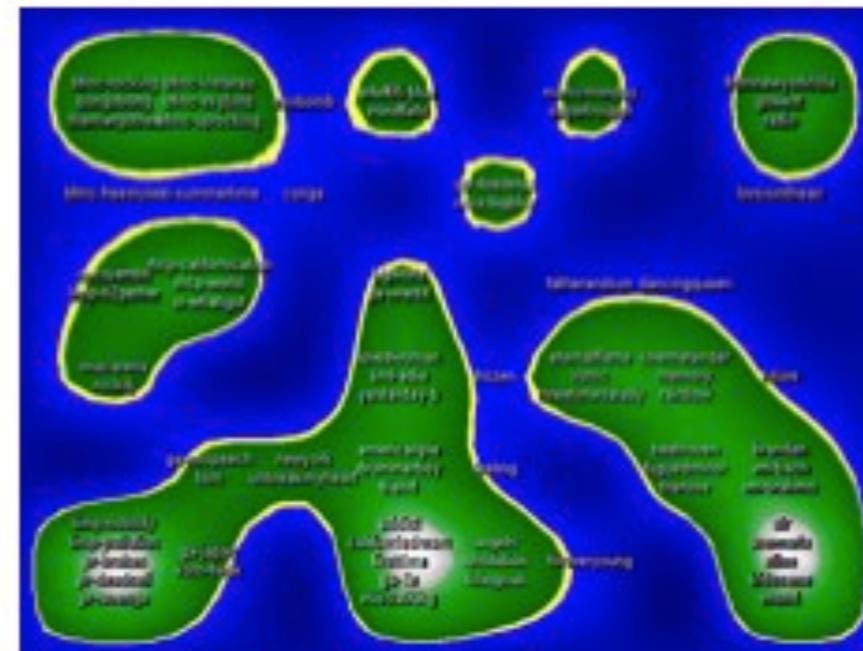
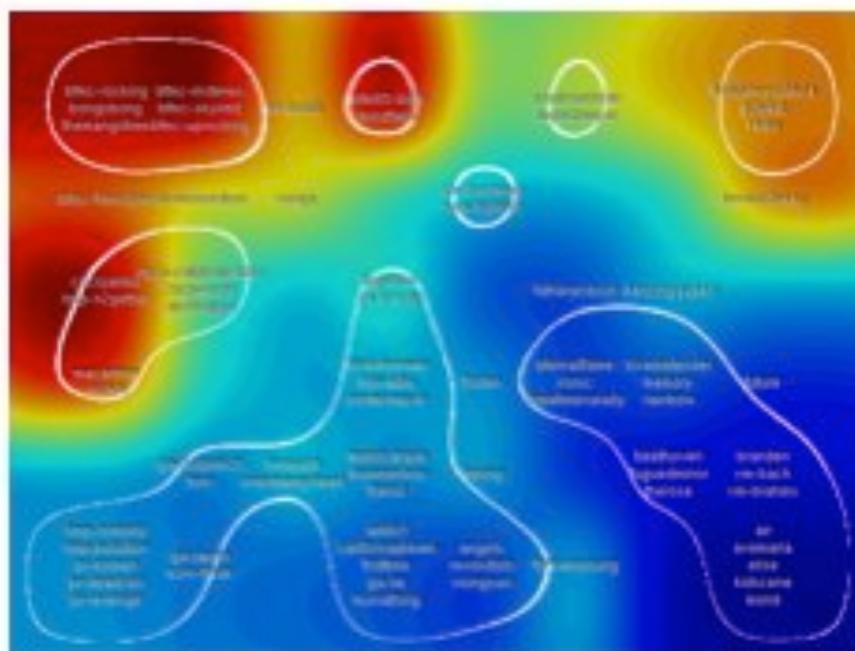
Powerwall of Tzanetakis



Stephan Bauman -Senior Researcher - German Research Center for AI

# ISMIR Tutorial 2005

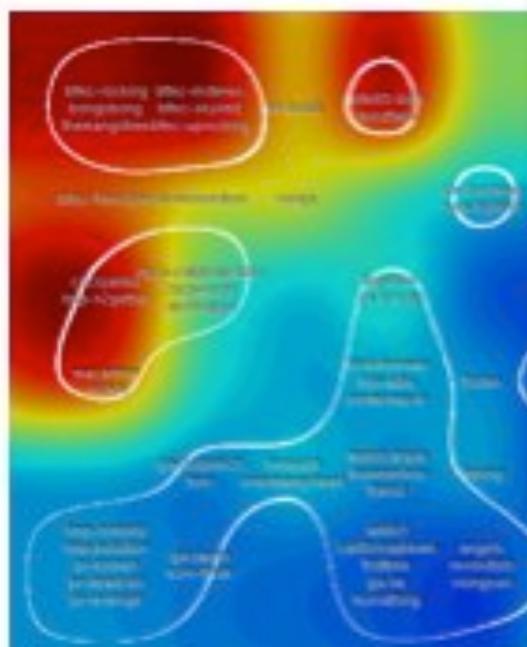
## GenreGram Powerwall of Tzanetakis Weathercharts, Islands of Music



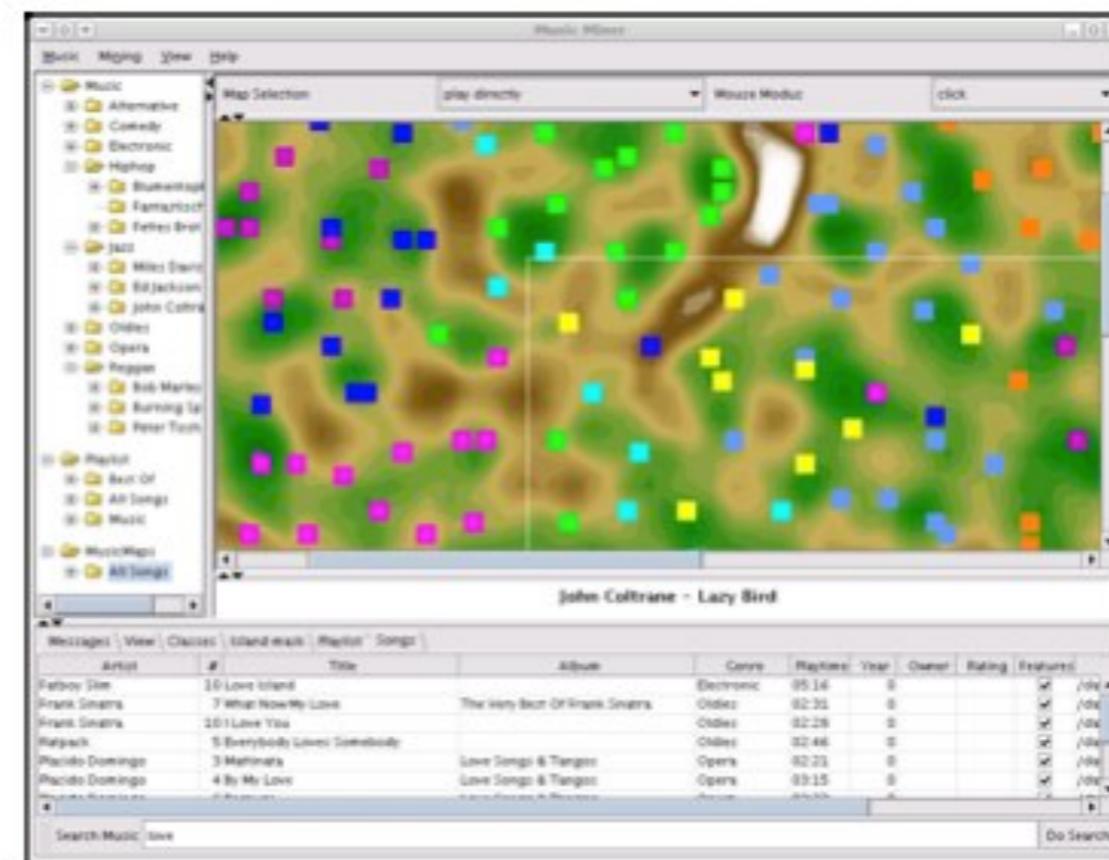
Stephan Bauman -Senior Researcher - German Research Center for AI

# ISMIR Tutorial 2005

GenreGram  
Weather



Visualization tool for ESOMs  
MusicMiner

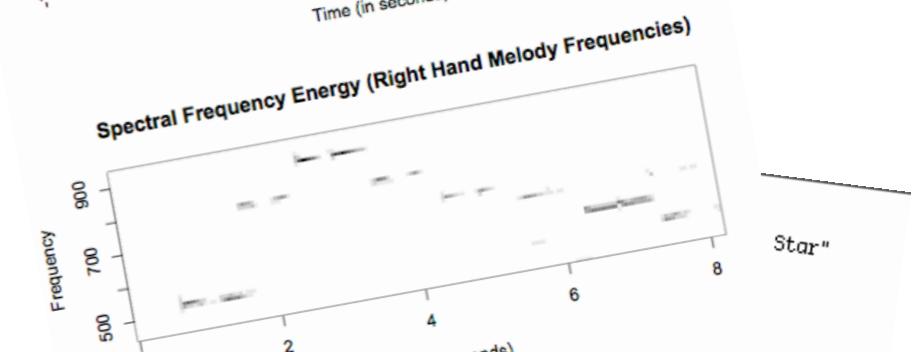
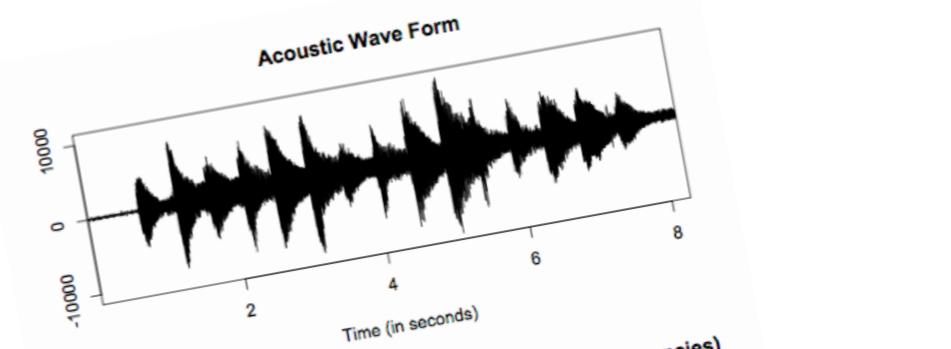
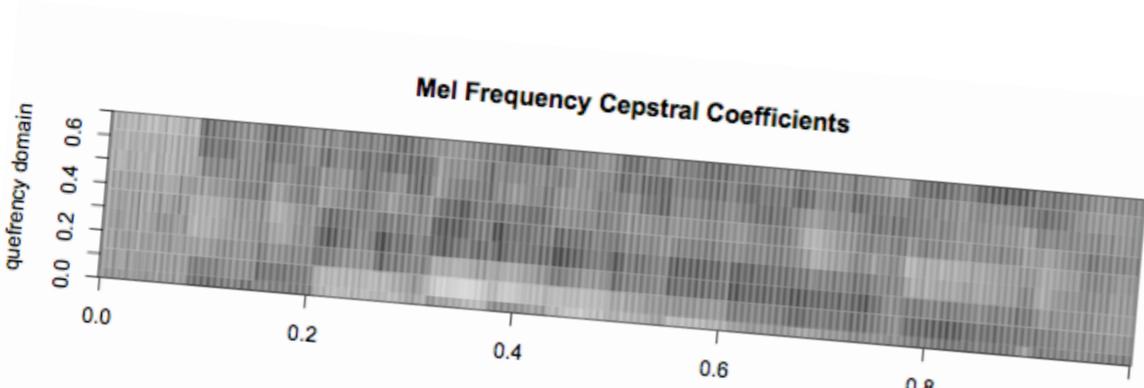


Stephan Bauman -Senior Researcher - German Research Center for AI

# Core Concepts

# How do computers represent music?

- Score - As MIDI data
- Signal - As digital wave form
- Association - Through associations with tags, people, or other songs



0 Par ch=3 c=121 v=0  
0 Par ch=3 c=64 v=0  
0 Par ch=3 c=91 v=62  
0 Par ch=3 c=10 v=81  
0 Par ch=3 c=121 v=0

# (a brief note on) Symbolic score data

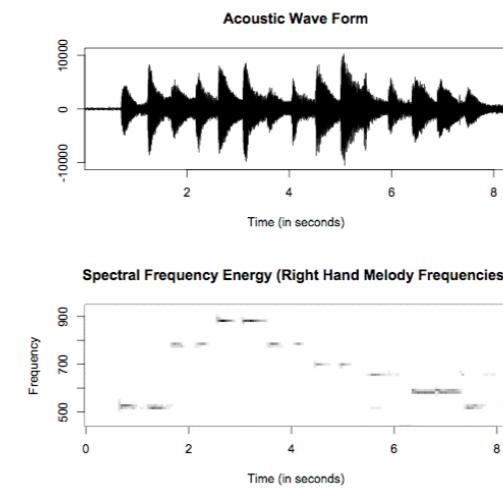
- Typically provides an explicit compositional structure, and sometimes even explicit performance directions.
- “Easy” to analyze/extract meaningful musicological features (time signature, key, etc.)
- Scores are typically not present for most music, so other forms of representation are becoming popular.
- **We won’t cover score based representations of music today.**

# Acoustic Data

- Easy (and even occasionally legal) to find digital wave form representations of music



- New techniques, methods, and even services for music signal analysis.



# Association Data

- Relatively new form of music analysis
- New methods/services as well
- What connections/associations/relationships does music share with tags, people, playlists, other music?

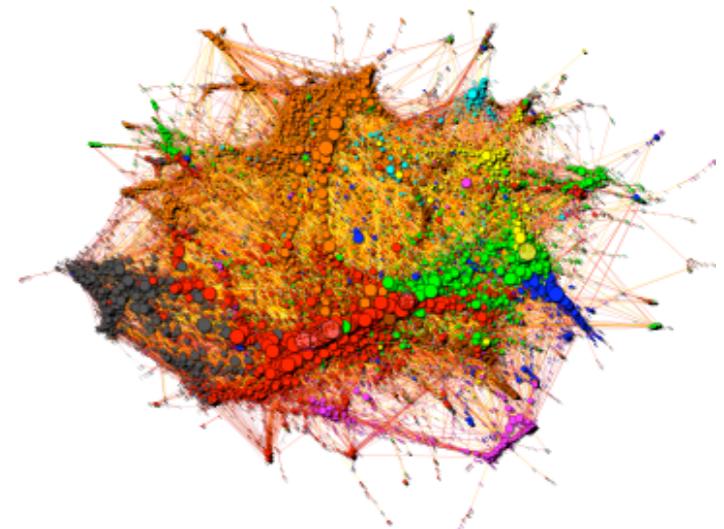
<http://www.last.fm>

<http://sixdegrees.hu/last.fm/>

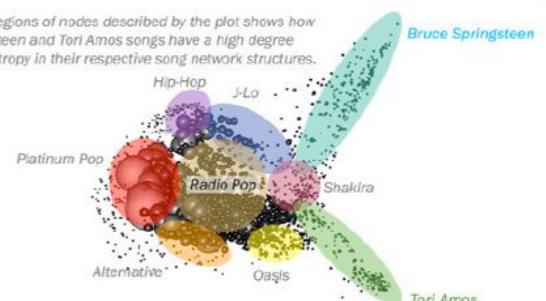
<http://www.flickr.com/photos/scwn/153098444/>

<http://manyeyes.alphaworks.ibm.com/manyeyes/visualizations/matchbox-20-song-lyrics-tag-cloud>

alive angry baby back bad bed believes bet bigger bit black bottle bout bo  
crutch cry cuz damn day days depending direction dirty distance dreami  
ghost girl give giving god gonna good goodbye gotta  
home honey hope hurt hurts inside knew learn learning leave leaving lie lies  
matter miles mind mine move needed nerve nice nursing open pain people pieces pl  
romance room round run rush sat scared screams sensation set shame shine shoul  
strange strong stunned suffer sweet takes talk technicolor thin thing thing  
wait wake wall wanna wanted weak white Whoa wondering



Labeling the regions of nodes described by the plot shows how Bruce Springsteen and Tori Amos songs have a high degree of negative entropy in their respective song network structures.



This work was made possible through a MusicStrands Research Fellowship  
<http://www.musicstrands.com>

# Representing “Lots of Songs”

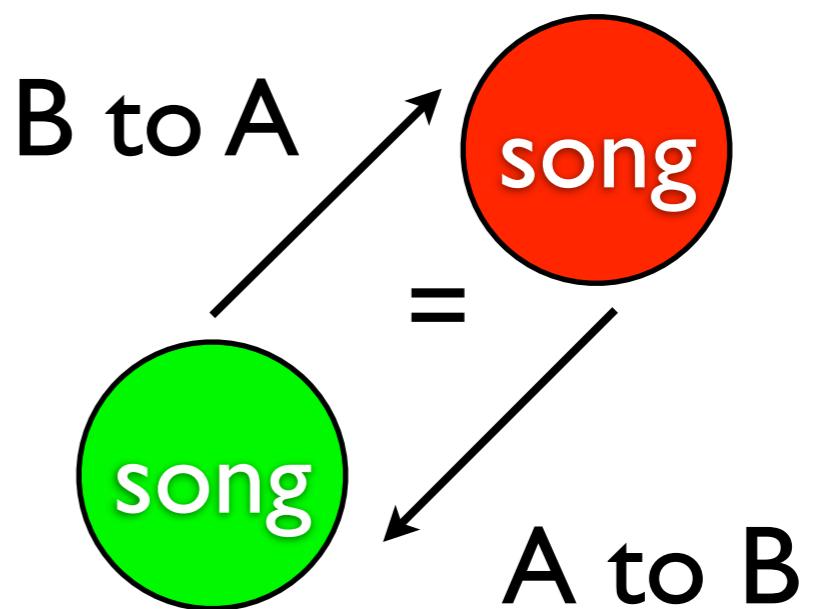
- Many different types of music-related information.
- Problems of sparsity, noise, data set size.
- We need a common appropriate *format of representation* and *method of comparison*.
- We would like to work with matrices.

Song	Feature1	Feature2
“Love me do”	0.4	0.9
“Hound Dog”	3.2	1.4
“Paint it Black”	3.4	1.5

# Distances and Similarity

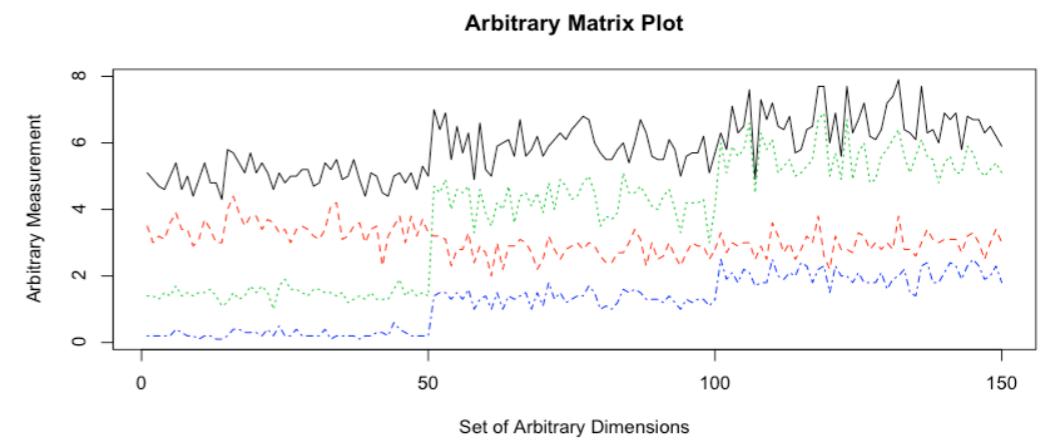
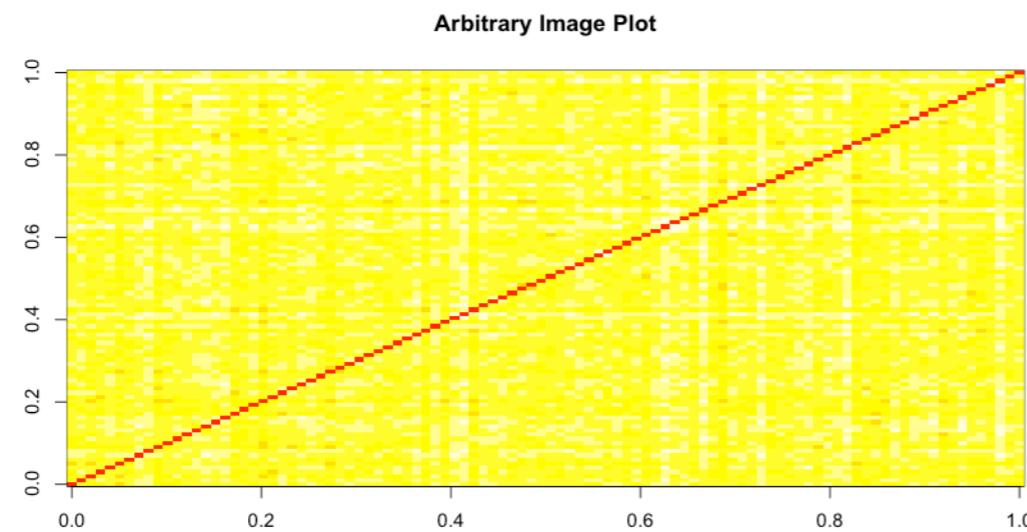
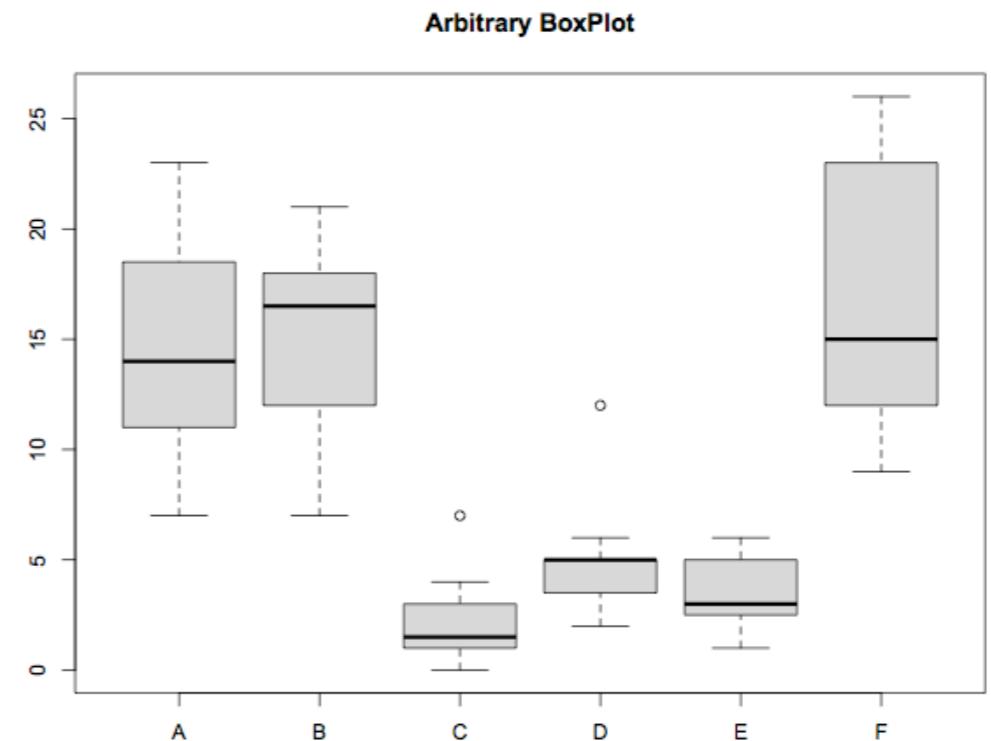
- To form a two/three dimensional visualization, we will need to express a *distance* or *dissimilarity*\* between the songs in vector form.
- Distance *must* be symmetric in order to represent a metric space.
- Distance must be “non-degenerate” (distance from song A to song A == 0)

Song	“Love me do”	“Hound Dog”	“Paint it Black”
“Love me do”	n/a	3.2	3.4
“Hound Dog”	3.2	n/a	1.5
“Paint it Black”	3.4	1.5	n/a



# “Big Picture” Visualization

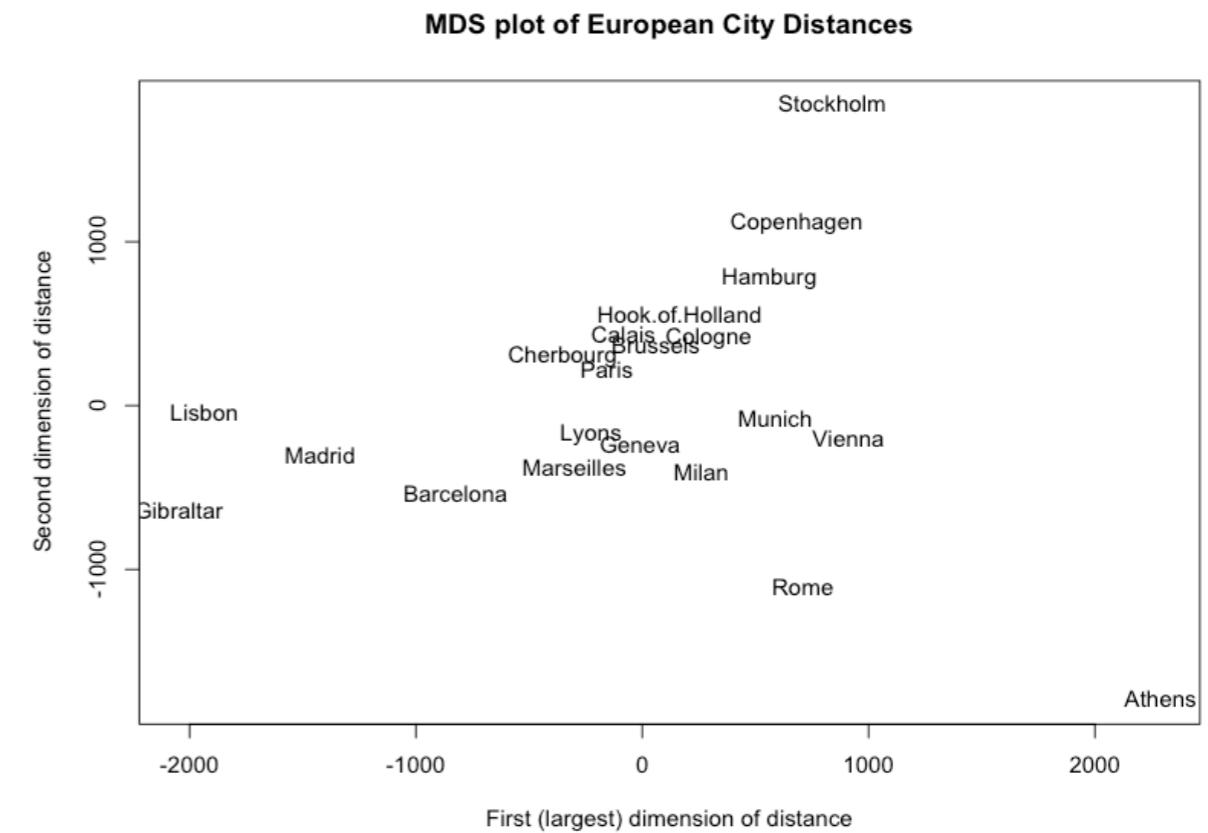
- A couple of “simple” visualizations help to assess variance, etc. across the relevant dimensions.
- Boxplots, matrix plots, image plots, etc.
- Selectively normalizing data at this point to have more control, and removing obvious outlier (points/dimensions).



# Multidimensional Scaling

- Reducing the number of dimensions of the music vector.
- Similar to “rotating” the data to find large dimensions of variation/dissimilarity in the data.

	Athens	Barcelona	Brussels	Calais	Cherbourg
Athens	0	3313	2963	3175	3339
Barcelona	3313	0	1318	1326	1294
Brussels	2963	1318	0	204	583
Calais	3175	1326	204	0	460
Cherbourg	3339	1294	583	460	0
Cologne	2762	1498	206	409	785



# DEMO

# Demo: Acoustic Feature Vectors



- Working with *Magnatagatune dataset*
- Combination of:
  - Magnatune creative commons licensed songs (clips)
  - Tagatune project data
  - **Echo Nest feature data**
- Freely available

The dataset consists of the following files:

<a href="#">clip_info_final.csv.bz2</a>	audio clips information, such as title, artist, album, url, start and end time, download URL for the mp3 file (entire song), and path to the mp3 clip.
<a href="#">annotations_final.csv.bz2</a>	tags associated with each audio clip, and path to the clip mp3 file.
<a href="#">comparisons_final.csv.bz2</a>	similarity judgments (number of people who voted that a particular clip is the most different) associated with a tuple of audio clips, and paths to the mp3 clips.
<a href="#">clips.tar</a>	TAR archive with all the audio clips as 16kHz, 32kbps, mono mp3.
<a href="#">mp3_echonest_xml.zip</a>	The Echo Nest analysis of each of the clips in XML format.

<http://tagatune.org/Magnatagatune.html>

# Demo: Feature Vector

Echonest data includes:

- loudness
- tempo
- segments with:
  - pitch information
  - timbre information

```
- <analysis decoder="Quicktime" version="0x7608000">
- <track duration="29.12331" endOfFadeIn="0.00000" startOfFadeOut="29.12331"
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  + <sections></sections>
  - <segments>
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      </loudness>
      - <pitches>
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        <pitch class="1">0.146</pitch>
        <pitch class="2">0.061</pitch>
        <pitch class="3">0.252</pitch>
        <pitch class="4">0.984</pitch>
        <pitch class="5">0.249</pitch>
        <pitch class="6">1.000</pitch>
        <pitch class="7">0.330</pitch>
        <pitch class="8">0.430</pitch>
        <pitch class="9">0.069</pitch>
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        <coeff dim="2">51.959</coeff>
        <coeff dim="3">-42.123</coeff>
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      </timbre>
```

<http://tagatune.org/Magnatagatune.html>

# Demo: Feature Vector

## Demo motivation

- Genre classification has become a prominent trend in the IR community. Explore the data pertaining to such systems.
- Current approaches can identify “textural” properties of acoustic sound, but can lack cultural or structural properties of music. West & Lamere note that:  
“...a common example might be the confusion of a classical lute timbre, with that of an acoustic guitar string that might be found in folk, pop, or rock music...”

K. West and P. Lamere, “A model-based approach to constructing music similarity functions,” *EURASIP Journal on Advances in Signal Processing* 2007 (2007).

# Demo: Feature Vector

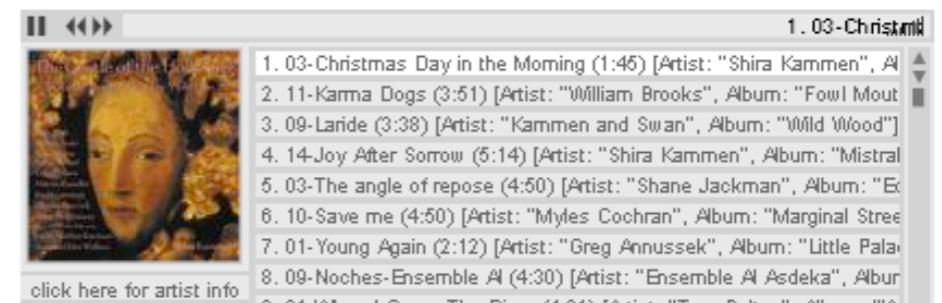
## Demo motivation

- Magnatagatune happens to have a large amount of Classical music, and Classical Lute music to boot.
- We'll try to visualize this part of the magnatagatune data set, along with folk music.

Lute

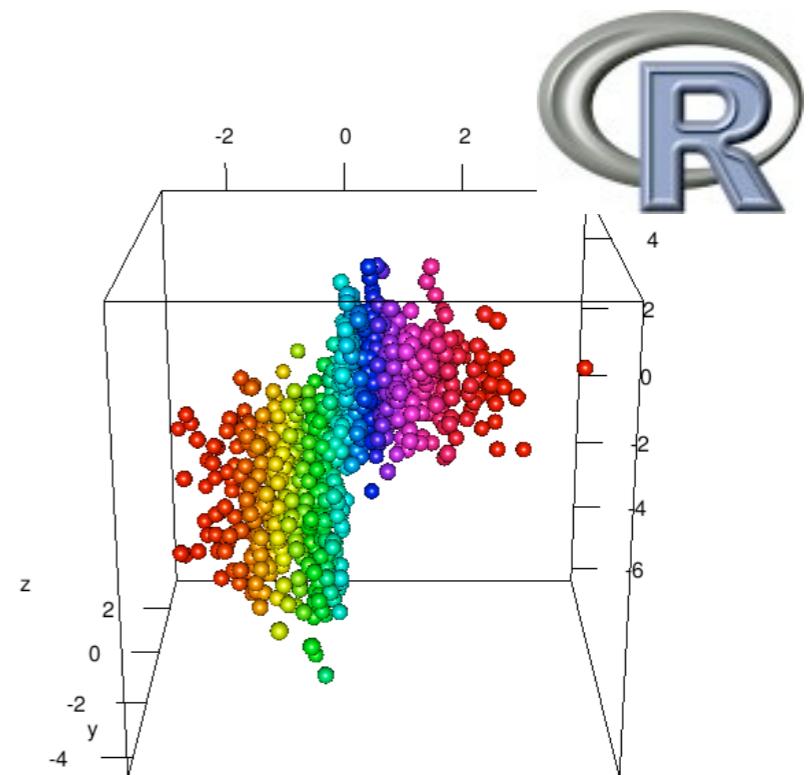
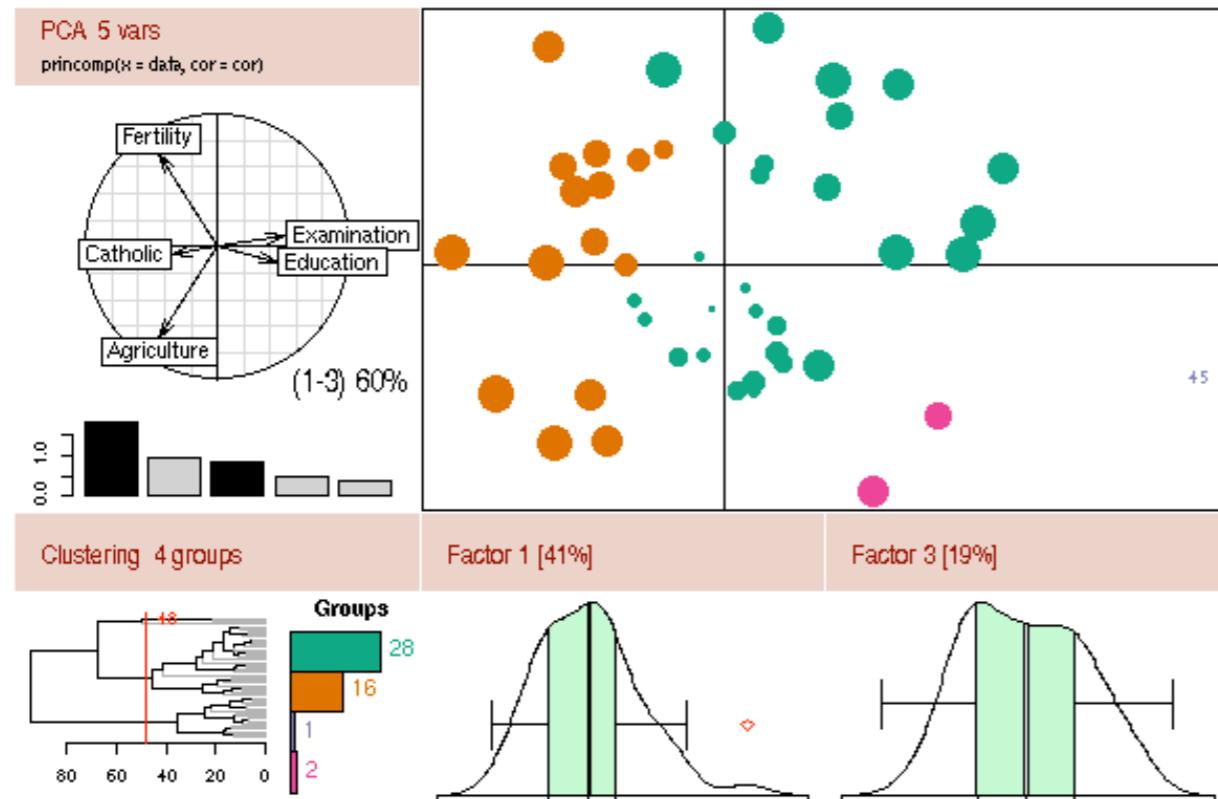


Folk



# Tools

# Tools: Feature Vector



- Download Data
- Use **R** to process, analyze, and visualize data
- Free! (Libre!)

<http://cran.r-project.org/>

<http://www.cyclismo.org/tutorial/R/>

<http://cran.r-project.org/doc/manuals/R-intro.html>

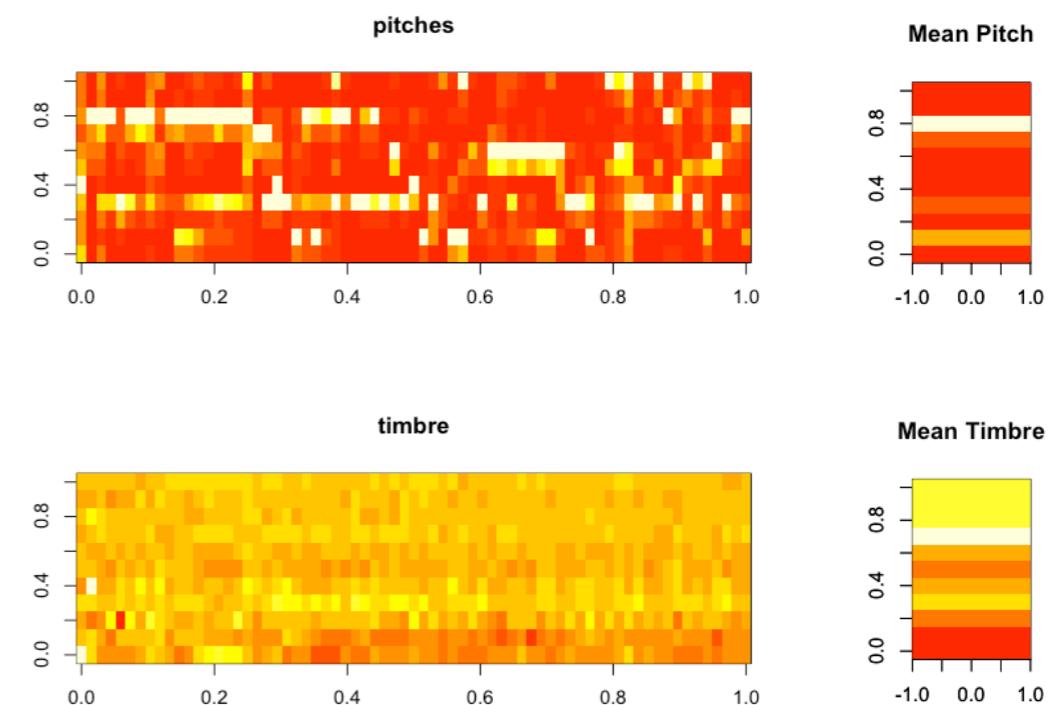
# Demo: Feature Vectors

# Demo: Feature Vector

## Basic Echo Nest Features

- (overall) loudness
- tempo
- pitch means (12) \*
- pitch stdev (12) \*
- timbre means (12) \*
- timber stdev (12) \*

```
- <analysis decoder="Quicktime" version="0x7608000">
- <track duration="29.12331" endOfFadeIn="0.00000" startOfFadeOut="29.12331"
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  + <meter></meter>
  + <sections></sections>
  - <segments>
    - <segment start="0.00000" duration="1.64082">
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      </loudness>
      - <pitches>
        <pitch class="0">0.164</pitch>
        <pitch class="1">0.146</pitch>
        <pitch class="2">0.061</pitch>
        <pitch class="3">0.252</pitch>
        <pitch class="4">0.984</pitch>
        <pitch class="5">0.249</pitch>
```



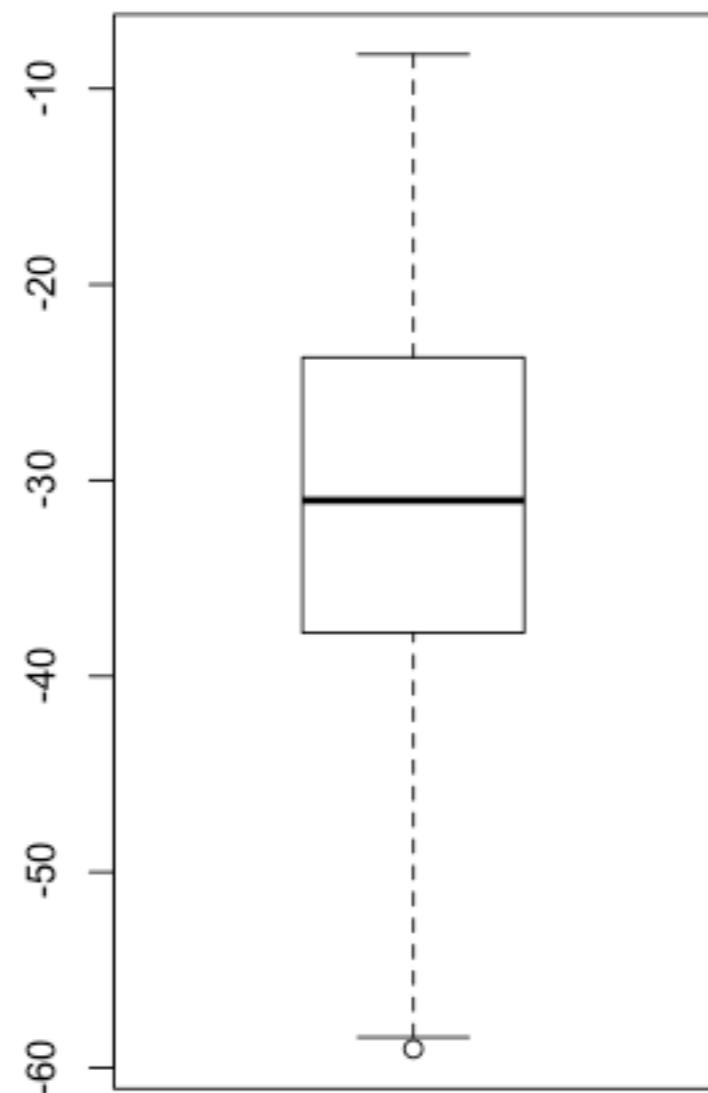
\* weighted by segment onset loudness

# Boxplots

Boxplots show the *five-number summaries* of a distribution:

- sample maximum
- upper quartile
- median
- lower quartile
- sample minimum
- (outliers)

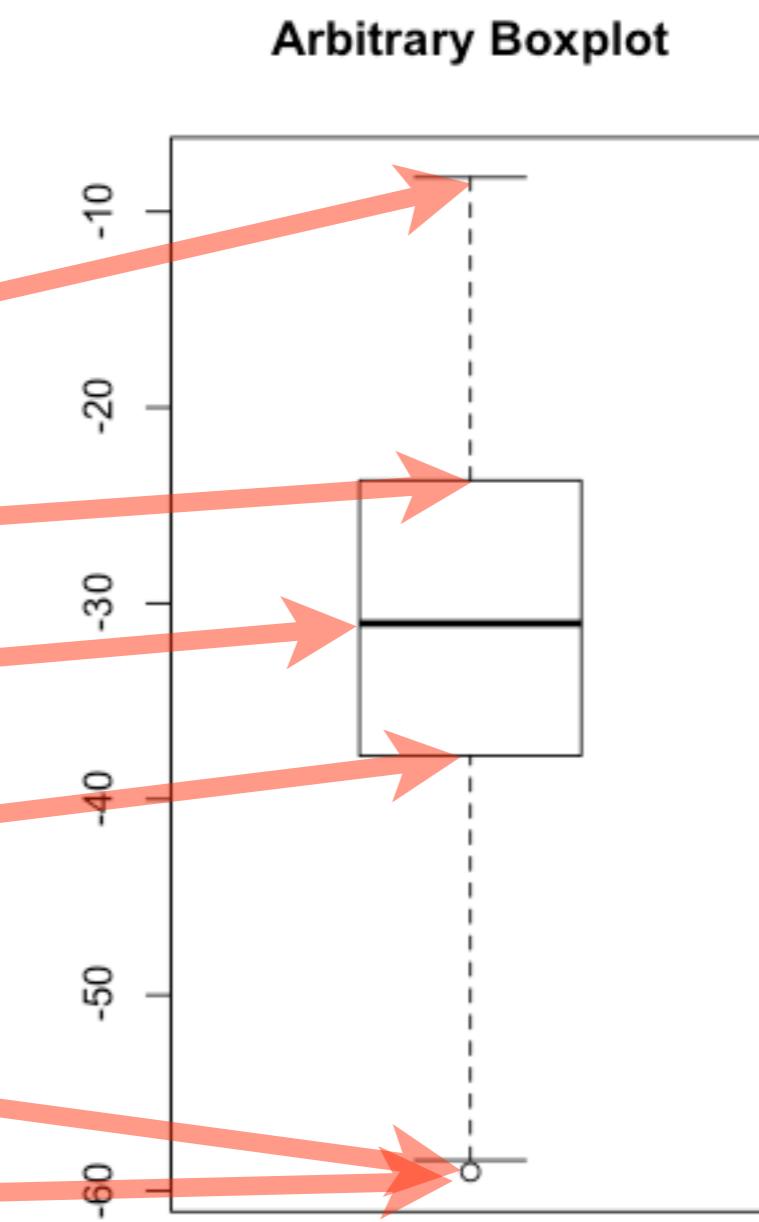
Arbitrary Boxplot



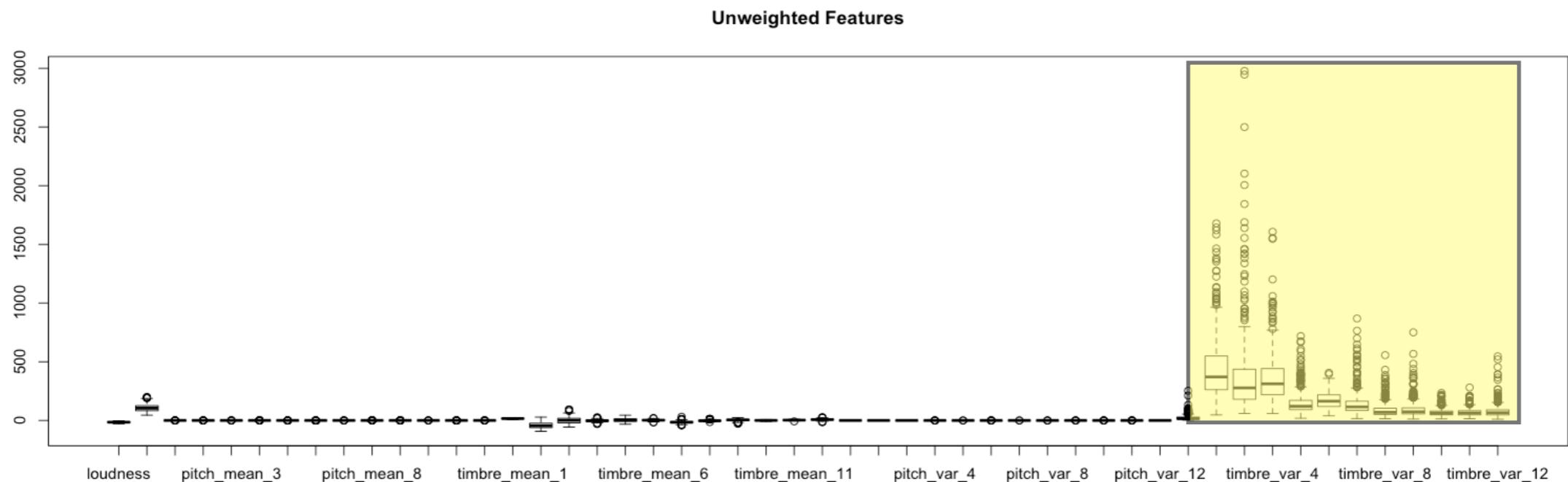
# Boxplots

Boxplots show the *five-number summaries* of a distribution:

- sample maximum
- upper quartile
- median
- lower quartile
- sample minimum
- (outliers)



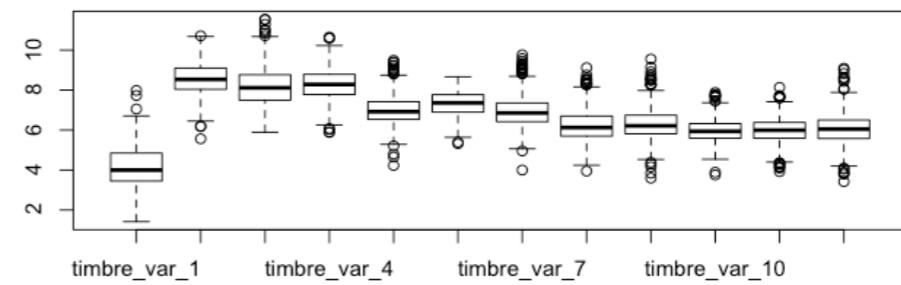
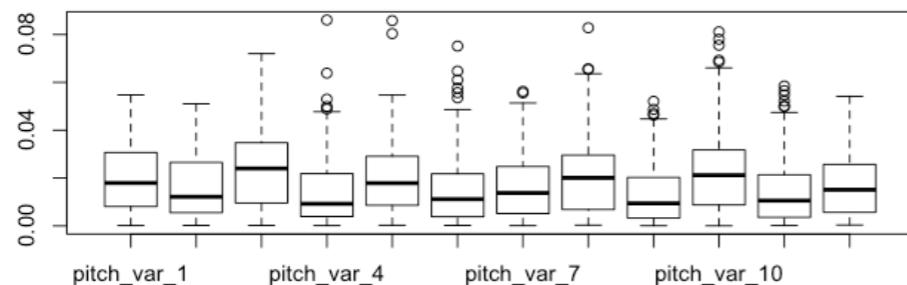
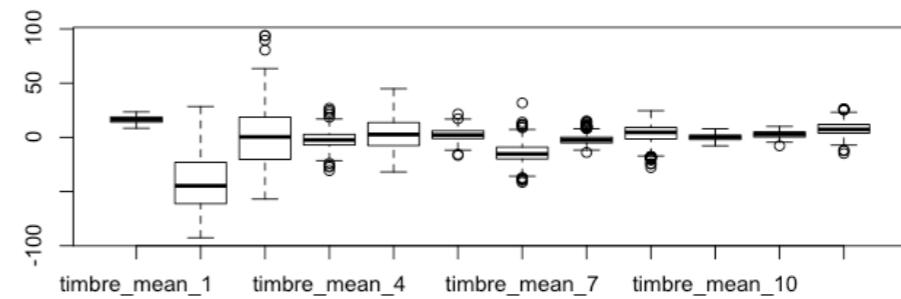
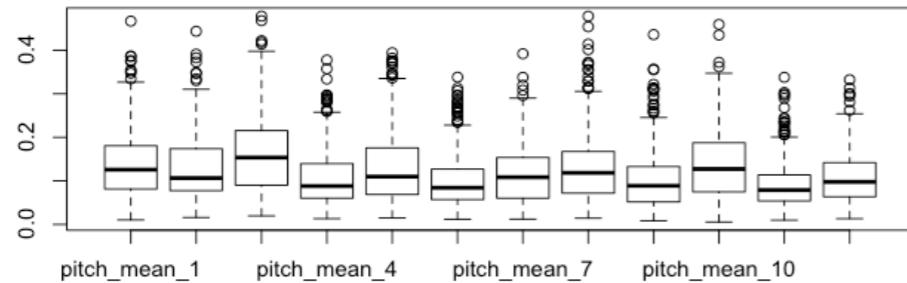
# Demo: Feature Vector



Raw Feature Boxplots...

- Are these all normal distributions?
- Are all of these weighted evenly?
- Scaling becomes important... why?

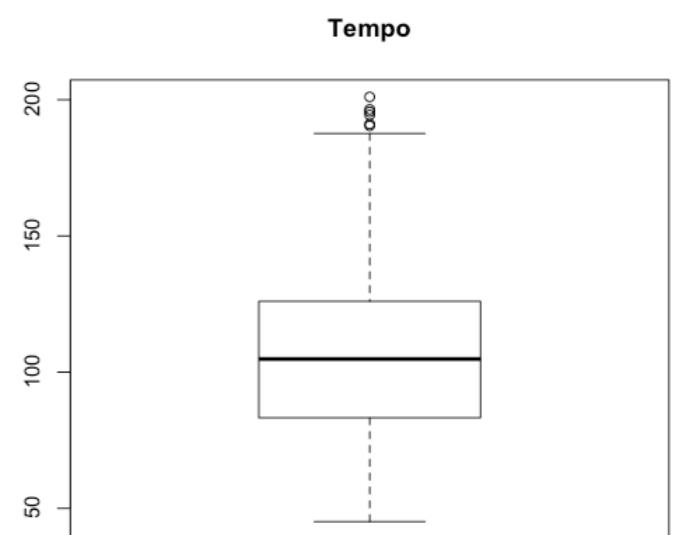
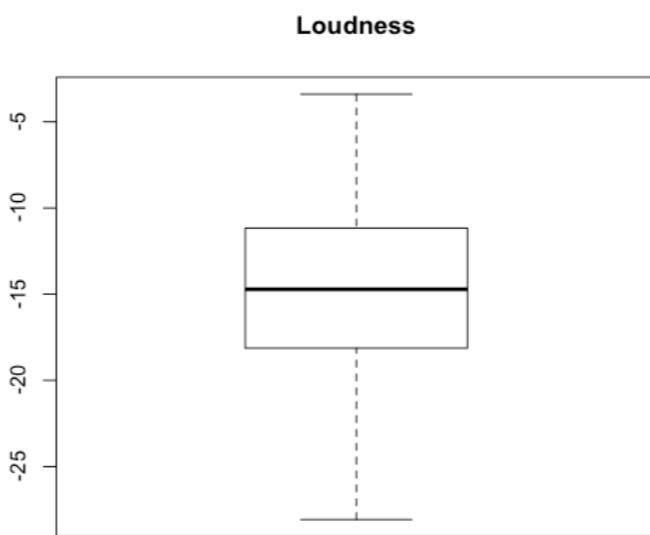
# Demo: Feature Vector



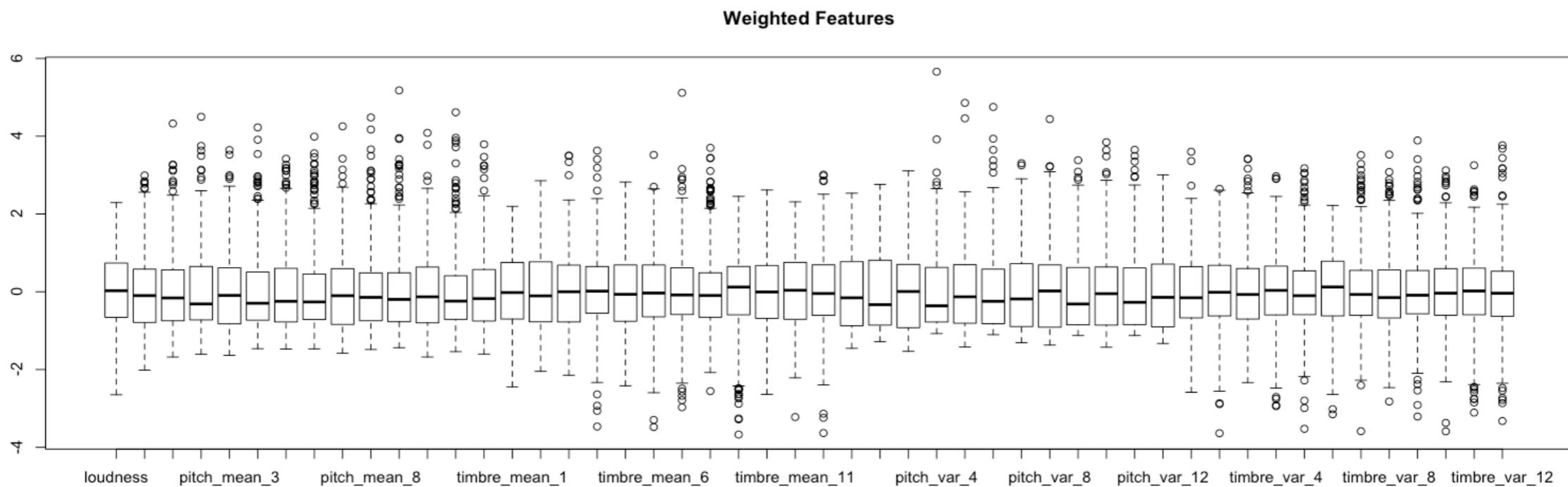
Looking at scaled summary statistics

These are the ‘expected’ values for any song, so they’re ‘normal’ for a song.

We want to enhance relationships between songs that *differ from the norm*.



# Demo: Feature Vector

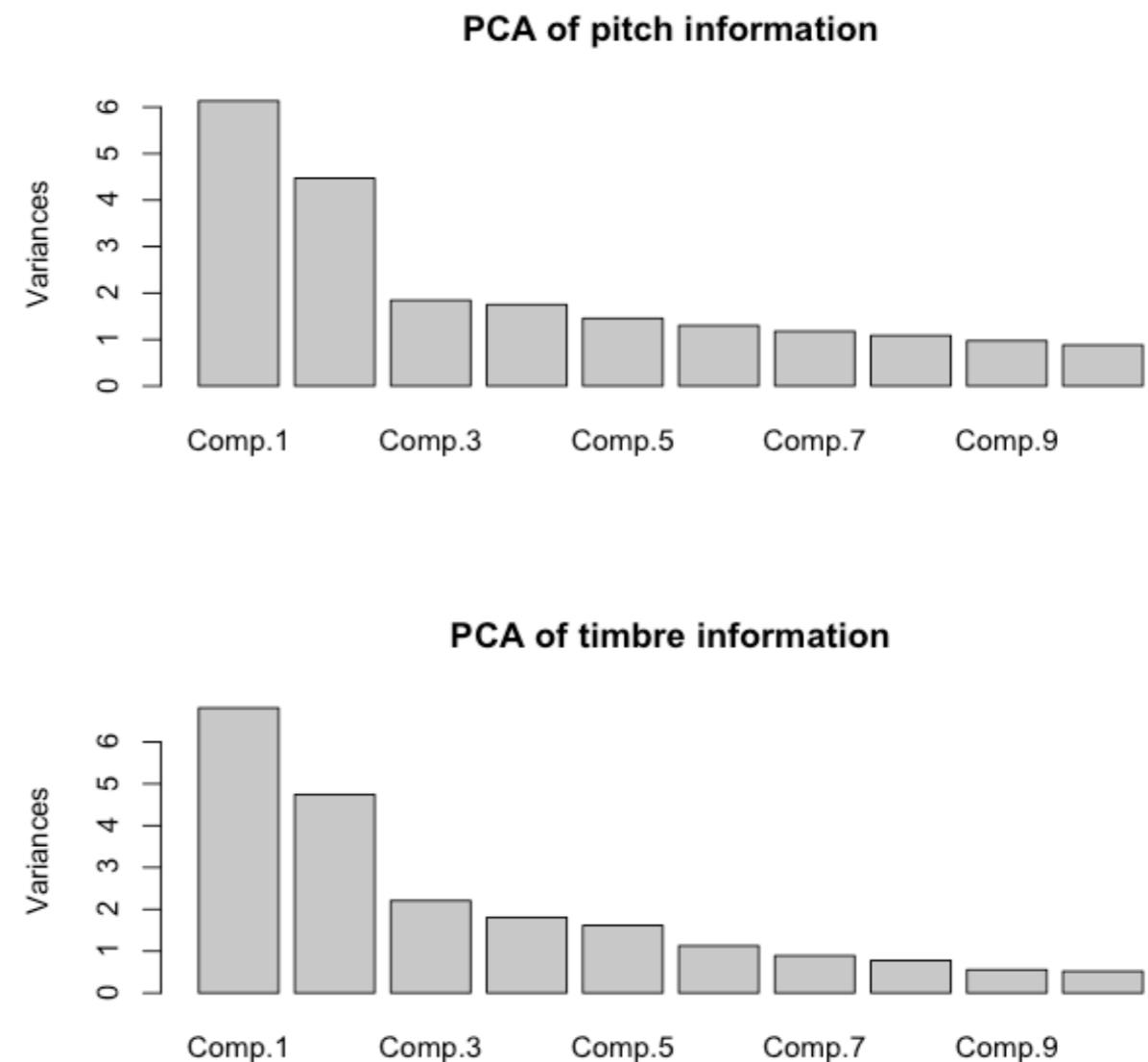


Weighted Feature Boxplots...

- Standard normalized data. All means are 0, all standard deviations are 1.
- We can find ‘interesting’ relationships between songs better this way. Distances can be understood in terms of *standard deviations from the mean*.
- However... 24 pitch and 24 timbre features, vs. just 1 tempo...

# Demo: Feature Vector

Principle Component Analysis (PCA) of timbre and pitch information reveal a high degree of covariance.



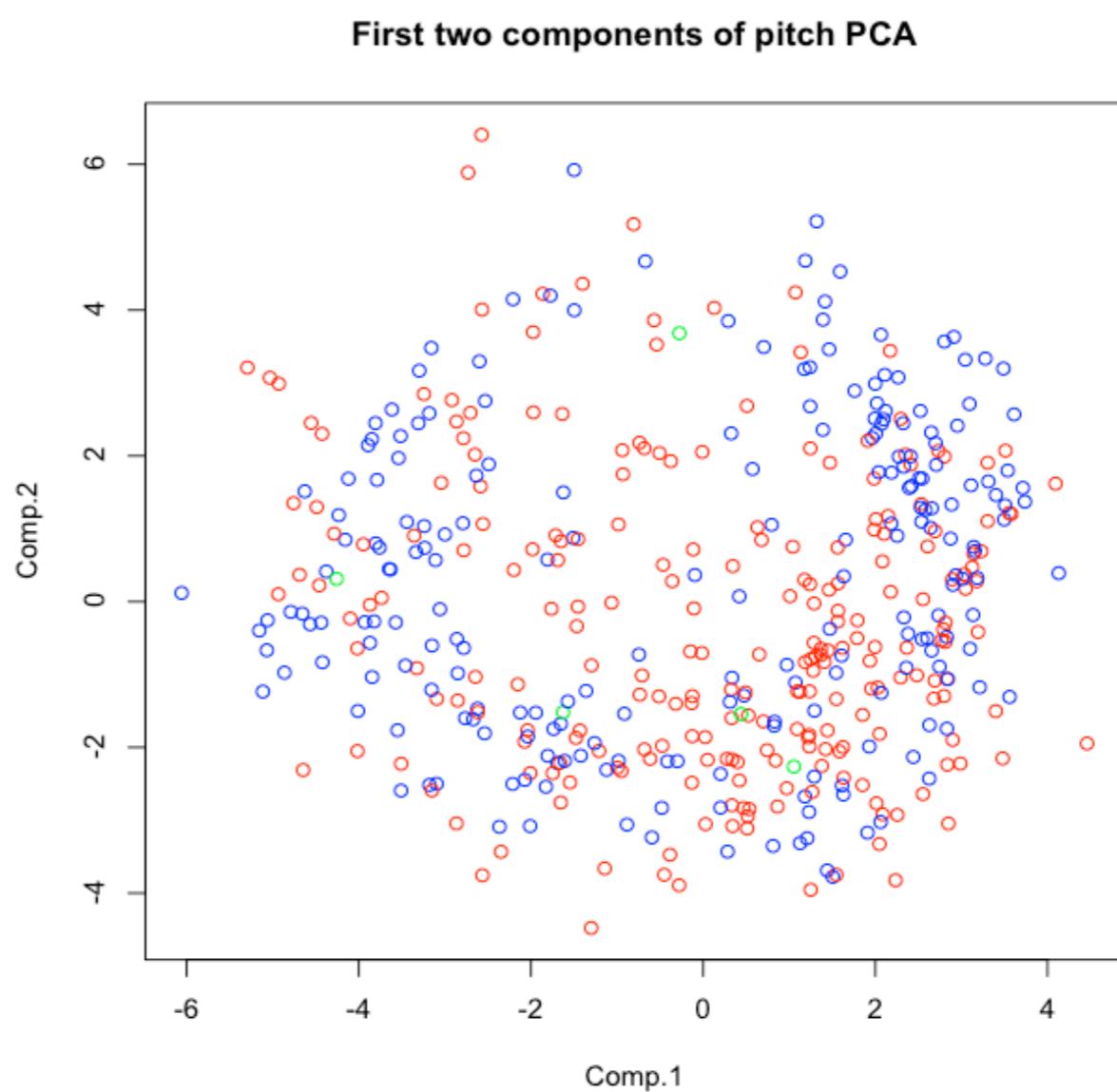
# Demo: Feature Vector

Plotting the PCA loadings show the ‘structure’ of how the pitch profiles co-vary across the music.

Blue = “Classical  
Guitar”  
(almost entirely lute  
music)

Red = “Folk”

Green= “Both”  
(flips and rotations)

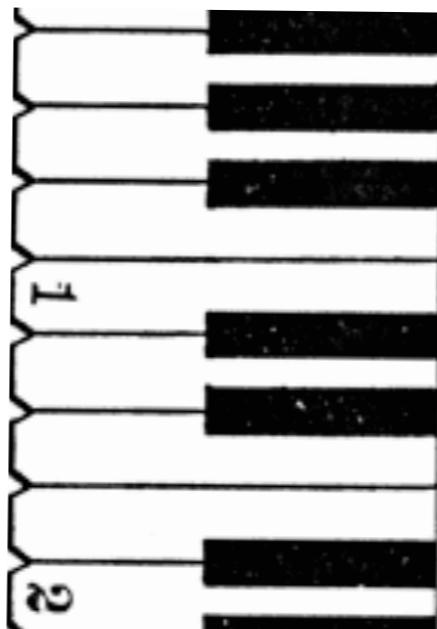
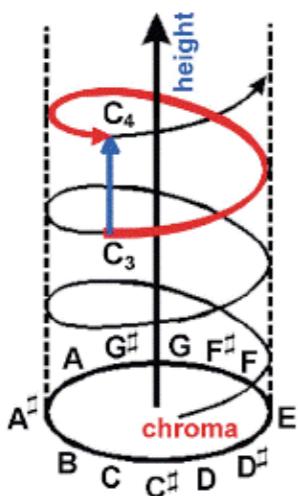


# Demo: Feature Vector

Performing a Factor analysis shows evidence of “musicological” factors.

(alternating positive/negative loadings for both means and variances, indicating certain “keys” are followed for songs)

Should pitch profile distances be figured another way?



Loadings:

	Factor1	Factor2
pitch_mean_1	-0.117	0.625
pitch_mean_2	0.576	-0.270
pitch_mean_3	-0.585	
pitch_mean_4	0.677	0.126
pitch_mean_5	-0.103	-0.487
pitch_mean_6		0.473
pitch_mean_7	0.332	-0.504
pitch_mean_8	-0.512	0.217
pitch_mean_9	0.527	-0.124
pitch_mean_10	-0.520	-0.274
pitch_mean_11	0.475	0.452
pitch_mean_12	0.216	-0.359
pitch_var_1	-0.318	0.689
pitch_var_2	0.638	-0.377
pitch_var_3	-0.661	0.100
pitch_var_4	0.695	0.289
pitch_var_5	-0.169	-0.536
pitch_var_6		0.658
pitch_var_7	0.363	-0.550
pitch_var_8	-0.660	0.315
pitch_var_9	0.669	-0.104
pitch_var_10	-0.620	-0.213
pitch_var_11	0.385	0.593
pitch_var_12	0.124	-0.399

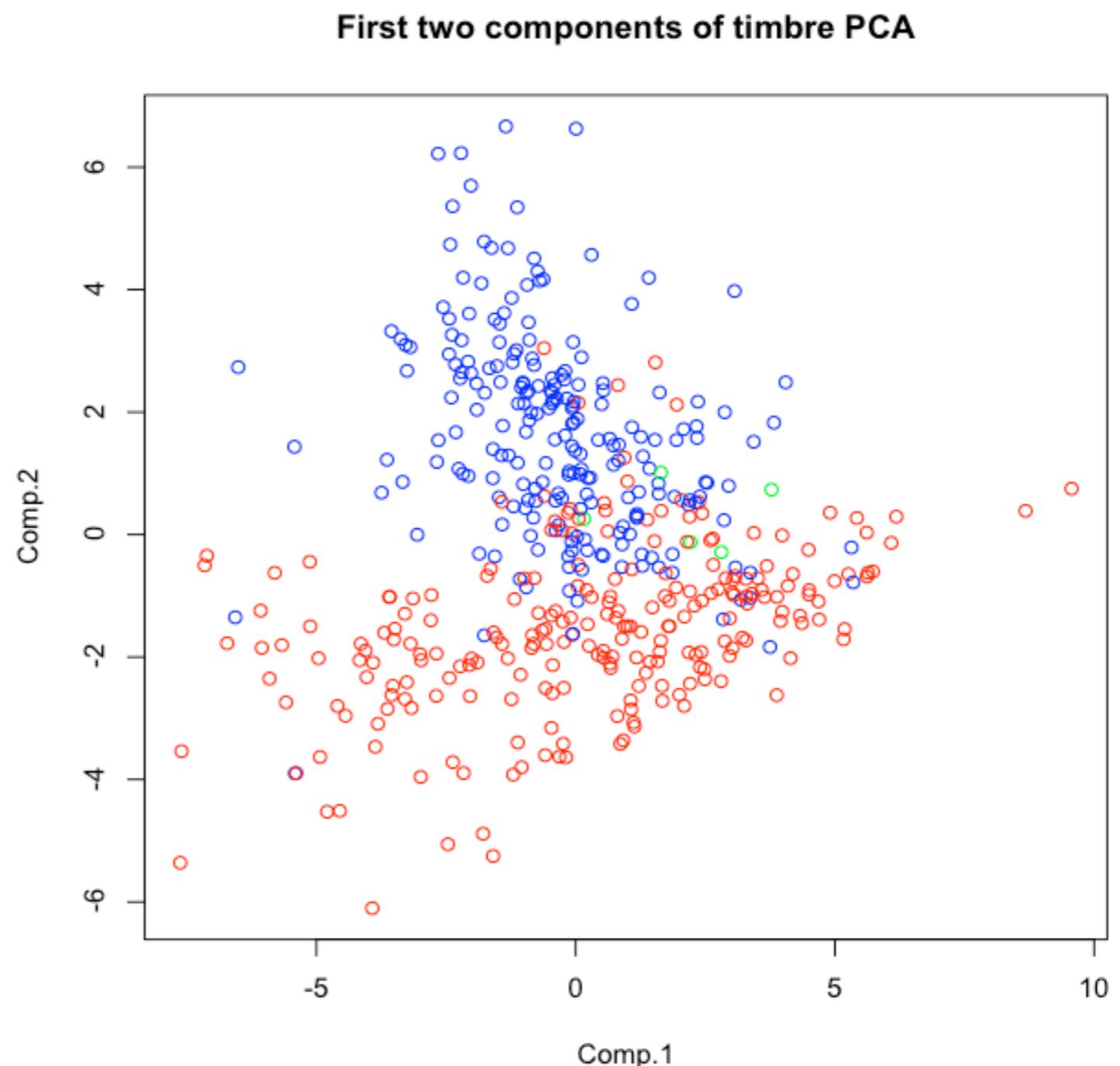
# Demo: Feature Vector

Timbre features clearly split the different tags we were concerned with.

Blue = “Classical Guitar”

Red = “Folk”

Green= “Both”



# Demo: Feature Vector

Timbral factors are a lot more straightforward. Certain songs have a lot of timbral variance. Other songs simply have strong overall timbral means.

Loadings:

	Factor1	Factor2
timbre_mean_1		0.987
timbre_mean_2		0.489
timbre_mean_3	0.151	0.728
timbre_mean_4	-0.139	0.349
timbre_mean_5		-0.570
timbre_mean_6		
timbre_mean_7	-0.126	0.248
timbre_mean_8	0.175	-0.556
timbre_mean_9	0.122	0.589
timbre_mean_10	0.257	-0.461
timbre_mean_11	-0.363	-0.238
timbre_mean_12		
timbre_var_1	0.582	0.614
timbre_var_2	0.681	-0.286
timbre_var_3	0.822	-0.114
timbre_var_4	0.680	-0.387
timbre_var_5	0.779	
timbre_var_6	0.241	-0.690
timbre_var_7	0.810	
timbre_var_8	0.712	
timbre_var_9	0.792	
timbre_var_10	0.591	-0.358
timbre_var_11	0.667	-0.140
timbre_var_12	0.736	

# Demo: Association Data

# Demo: Association Data

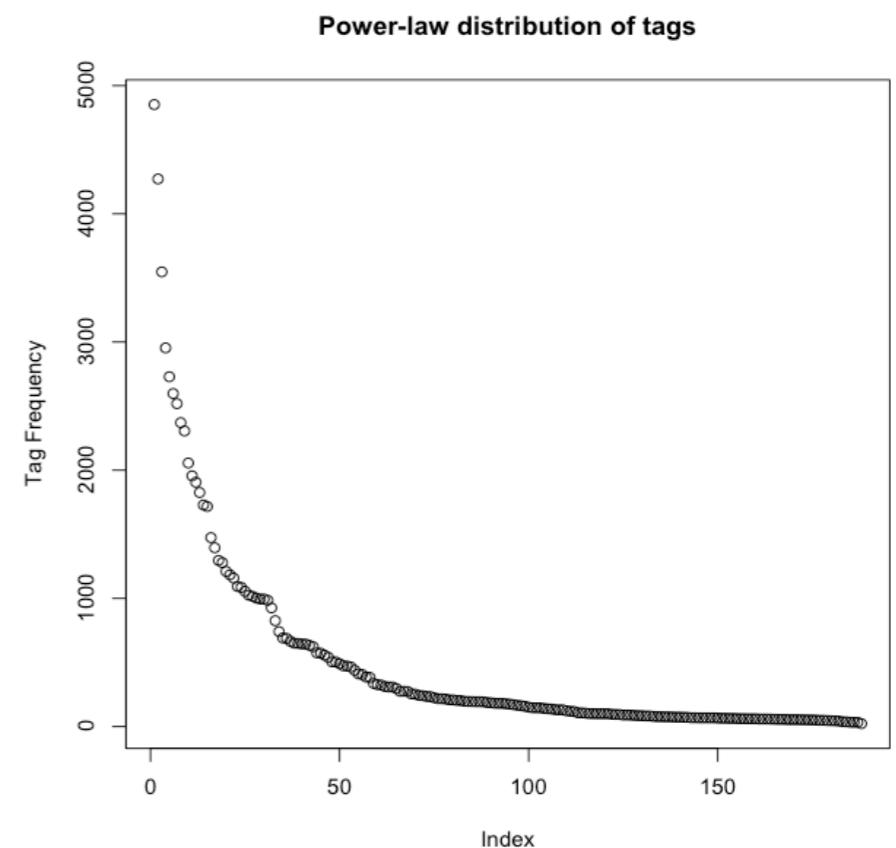
	clip_id	no.voice	singer	duet	plucking	hard.rock	world	bongos	harpsichord	female.singing	classical
1	2	0	0	0	0	0	0	0	0	0	0
2	6	0	0	0	0	0	0	0	1	0	0
3	10	0	0	0	1	0	0	0	0	0	0
4	11	0	0	0	0	0	0	0	0	0	0
5	12	0	1	0	0	0	0	1	0	0	1
6	14	0	0	0	0	0	0	0	0	0	0

- Magnatagatune has ‘tag’ data for songs
- Tags only exist if two people used the same tag for the same song
- 188 total tags

# Demo: Association Data

guitar 4852	classical 4272	slow 3547	techno 2954	strings 2729	drums 2598	electronic 2519	rock 2371
fast 2306	piano 2056	ambient 1956	beat 1906	violin 1826	vocal 1729	synth 1717	female 1474
indian 1395	opera 1296	male 1279	singing 1211	vocals 1184	no.vocals 1158	harpsichord 1093	loud 1086

- Tags are distributed by a *power-law*
- It's not as meaningful to share a “guitar” tag. A “soprano” tag is far more informative.
- We need to form a comparison of tags based on the *weighted relevance* of the terms.



# Demo: Association Data

- TF/IDF (term frequency/document frequency)
- $n(i,j)$  = number of times a term  $i$  appears in a ‘document’  $j$ .
- $n(k,j)$  = total number of terms in ‘document’  $j$ .
- $|D|$  = total number of ‘documents’
- $\{d: \dots\}$  = total documents containing  $i$
- documents = tags for song

$$tf_{i,j} = \frac{n_{i,j}}{\sum_k n_{k,j}}$$

$$idf_i = \log \frac{|D|}{|\{d : t_i \in d\}|}$$

# Demo: Association Data

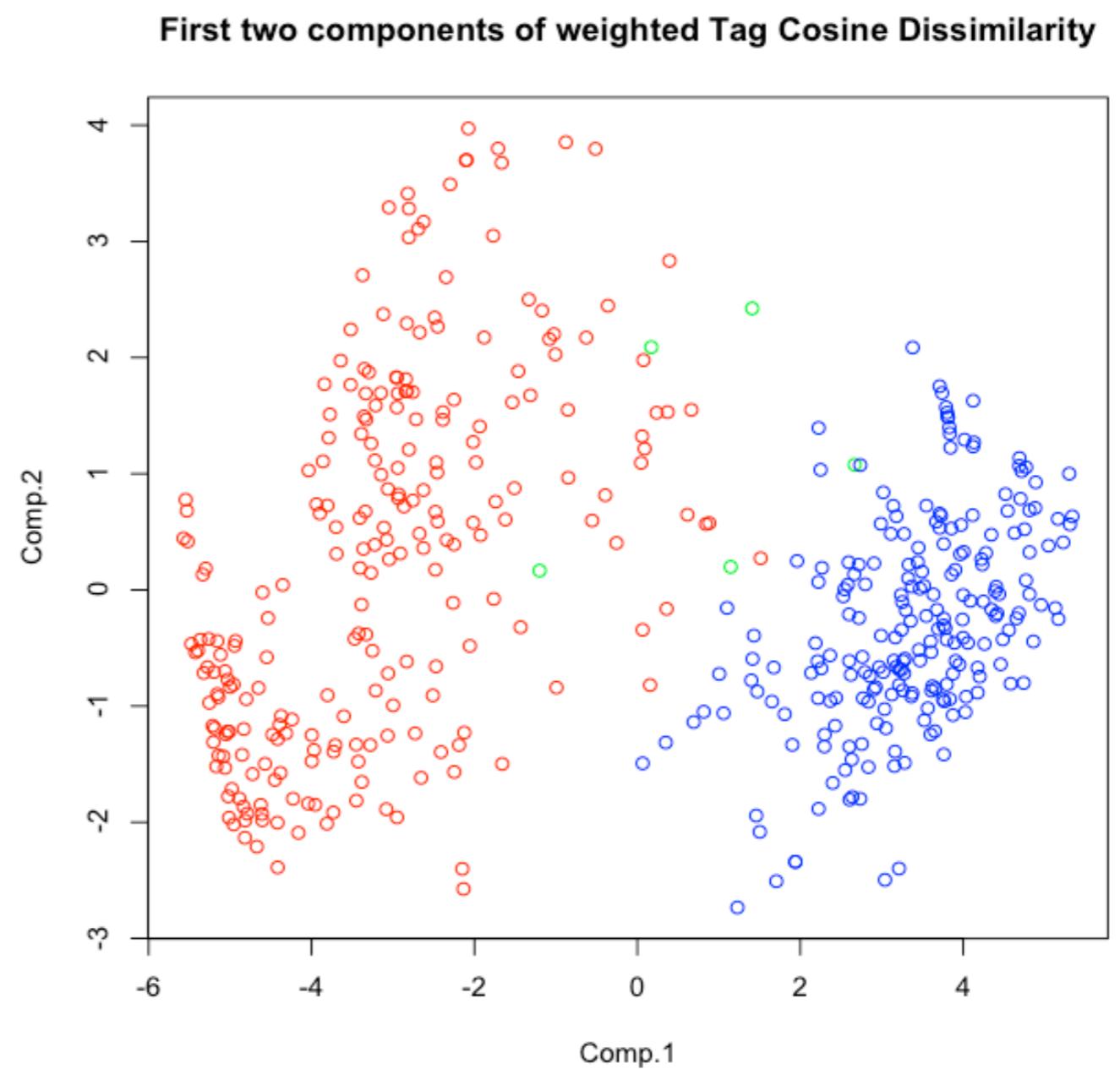
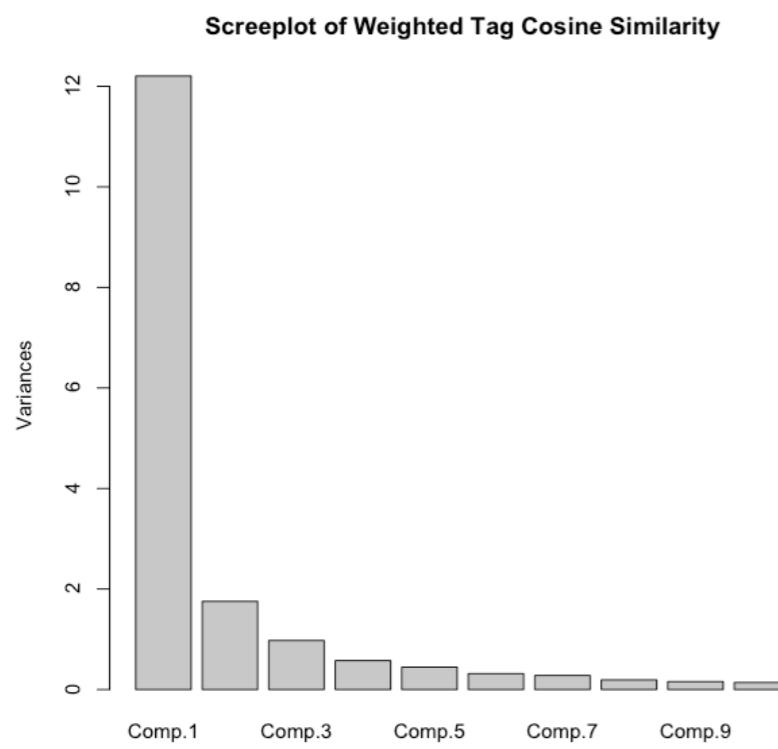
- Forming a similarity/dissimilarity between weighted tags commonly involves finding the angle between two vectors.
- Cosine dissimilarity is one (of many) ways of expressing a distance between vectors.
- $A, B$  = vectors of attributes
- $\|A\|, \|B\|$  = magnitudes of vectors

$$\text{similarity} = \cos(\theta) = \frac{A \cdot B}{\|A\|\|B\|}.$$

$$\|\mathbf{x}\| := \sqrt{x_1^2 + \cdots + x_n^2}.$$

# Demo: Association Data

Cosine similarity of tags  
also (not surprisingly)  
clearly separates the  
two tags



# Demo: Hybrid

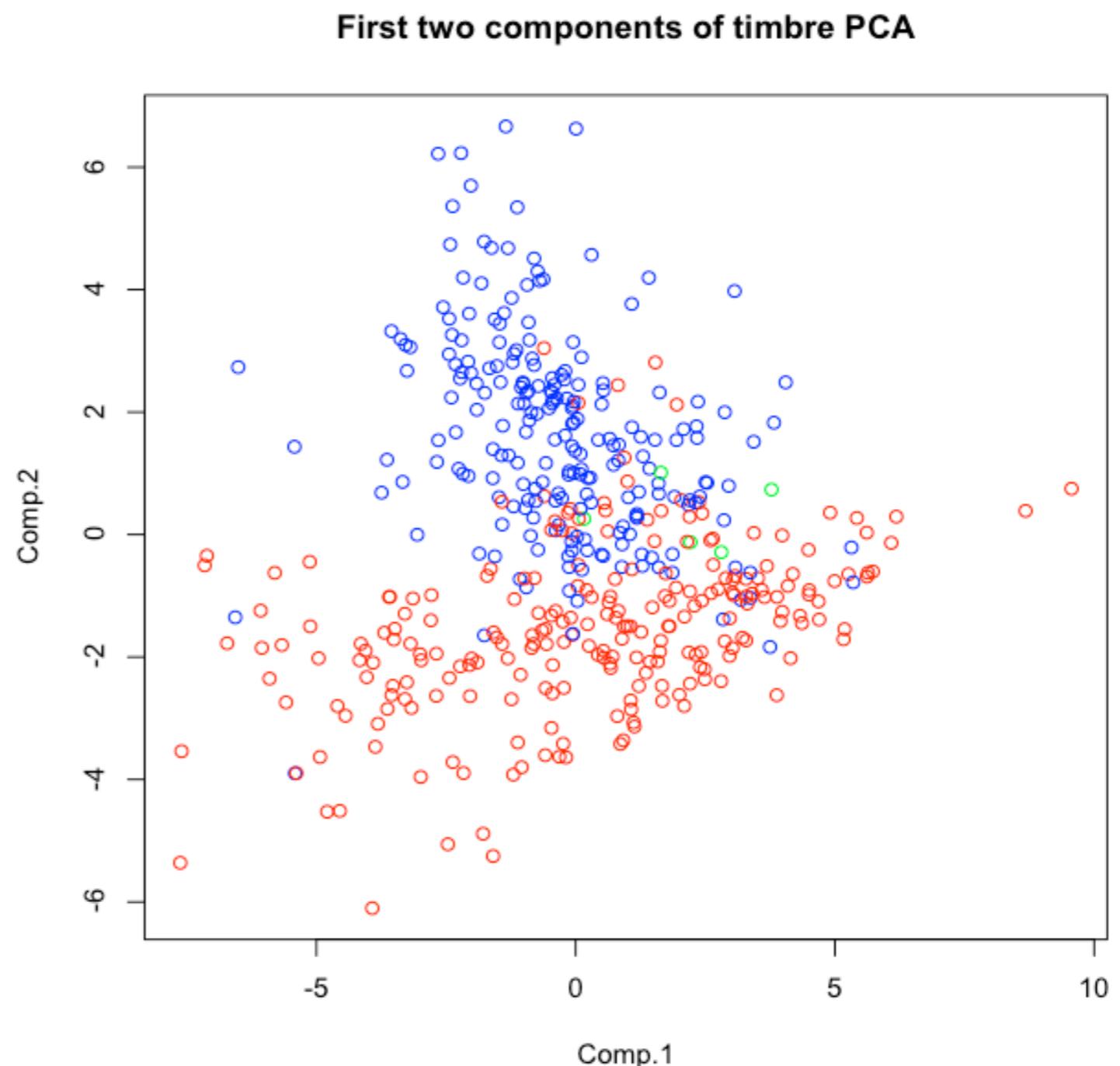
# Demo: Feature Vector

Timbre features clearly split the different tags we were concerned with.

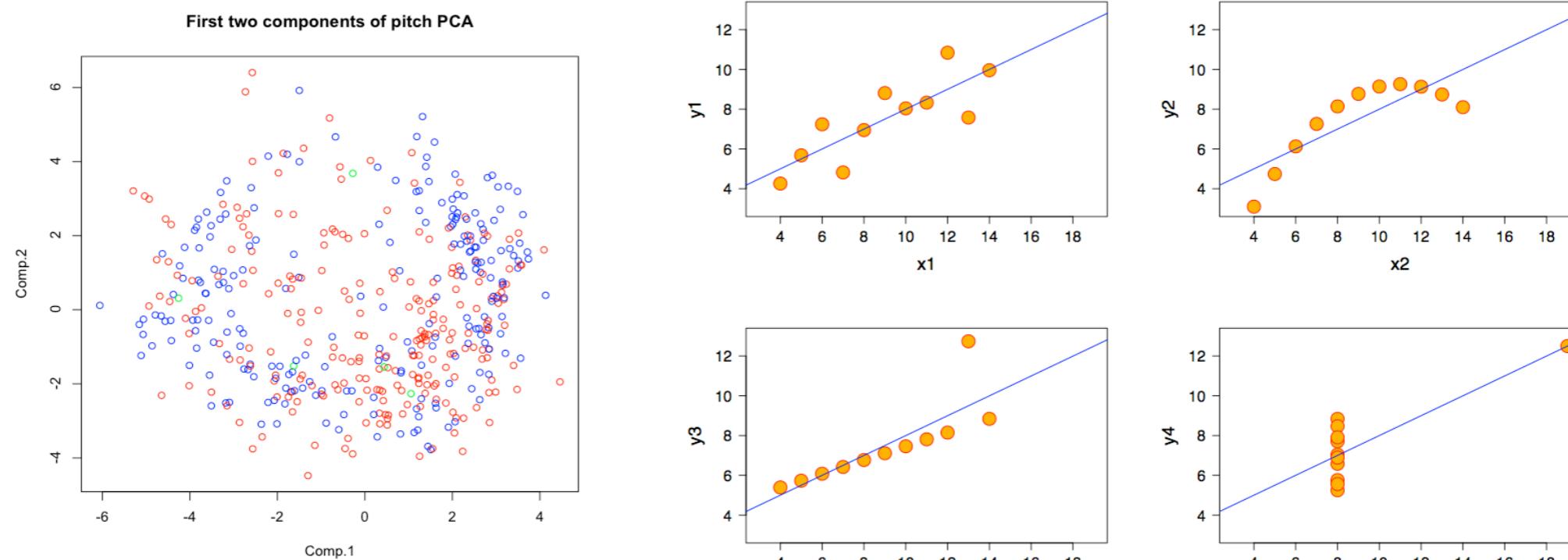
Blue = “Classical Guitar”

Red = “Folk”

Green= “Both”



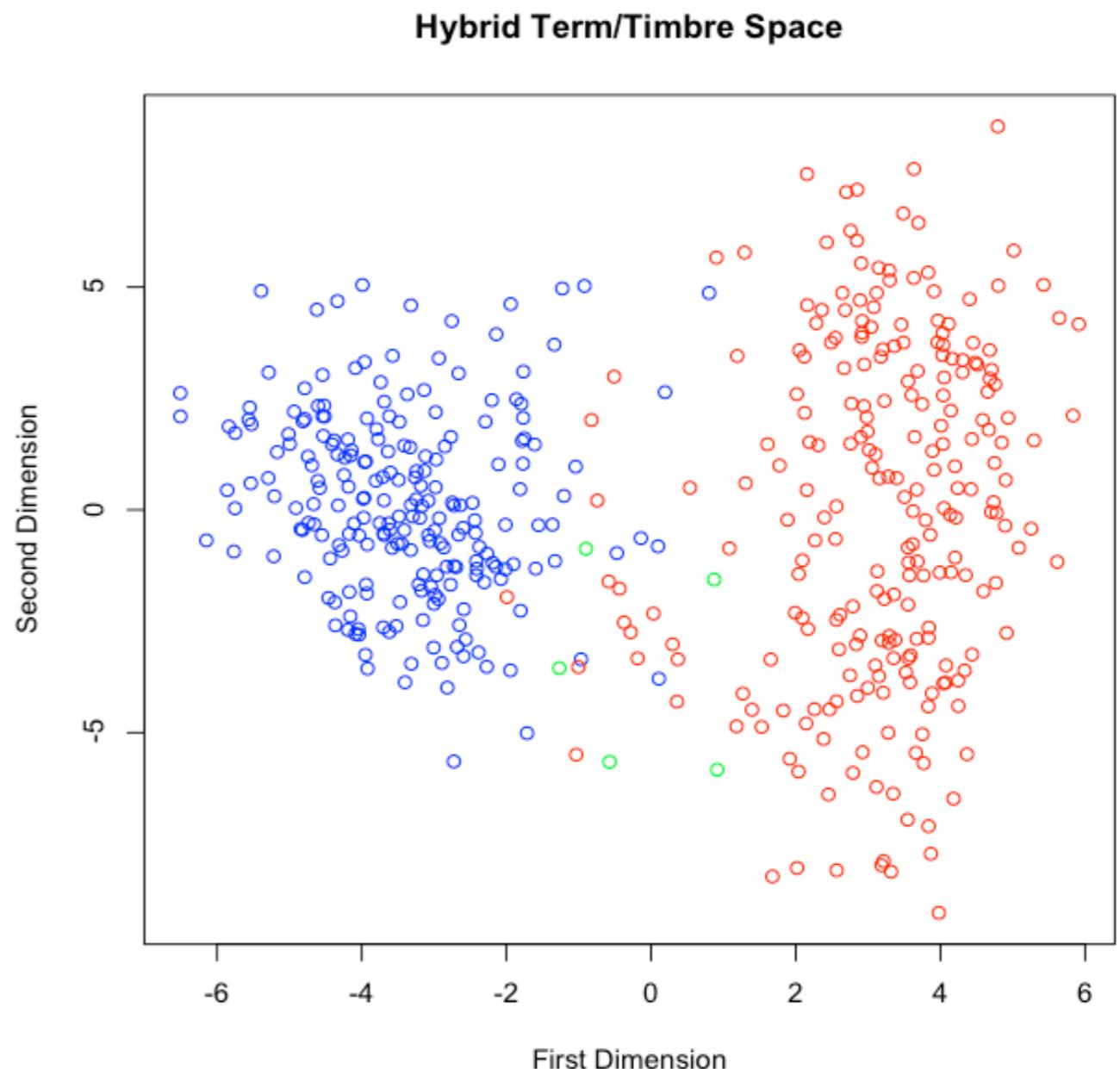
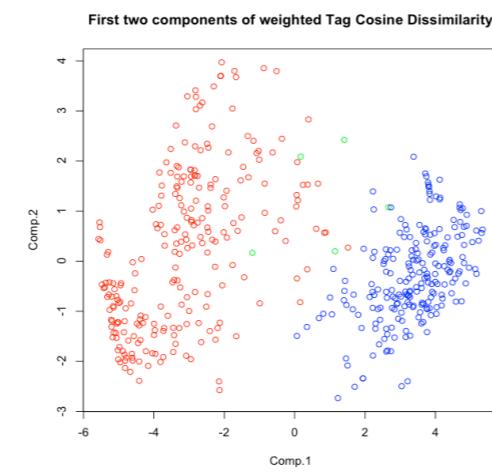
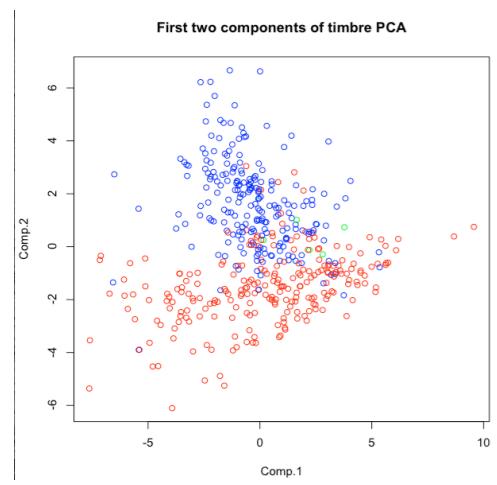
# Conclusions (demo)



- Visualizations can help understand “big picture” relationships among songs, and support that the relationships are meaningful. (left plot)
- Visualizations can help understand “mismatches” in modeling/clustering/classification approaches. ( $x_2$ )
- Visualizations can help detect noise ( $x_1$ ) and outliers. ( $x_3, x_4$ )
- Visualizations can help find a way to *improve the underlying model*.

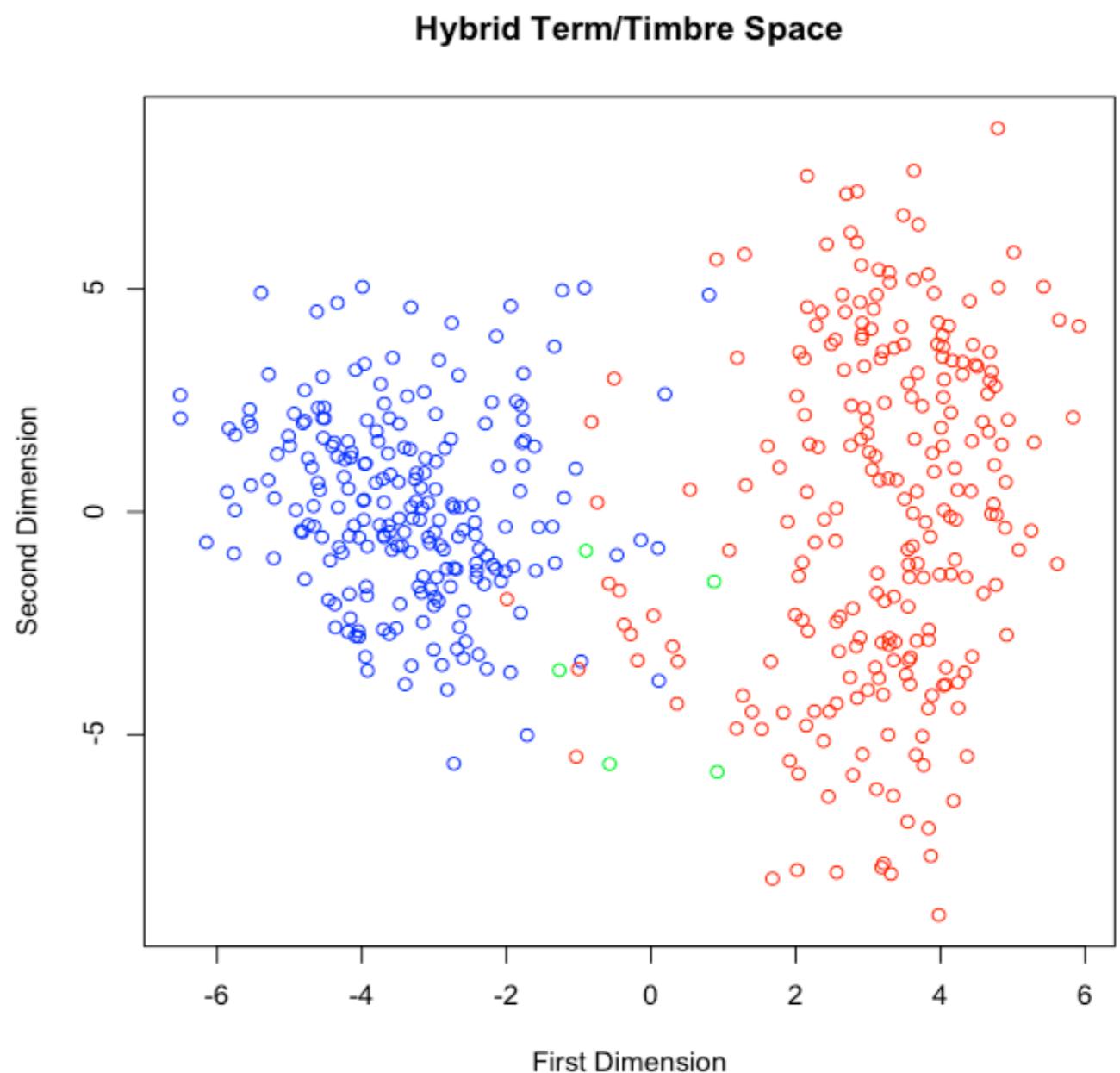
# Opportunity: Hybrid Maps

Mixing information from both timbre & term spaces has a great opportunity for forming a ‘better’ representation of genre



# “Reading” Conventional Dimensionality Reductions

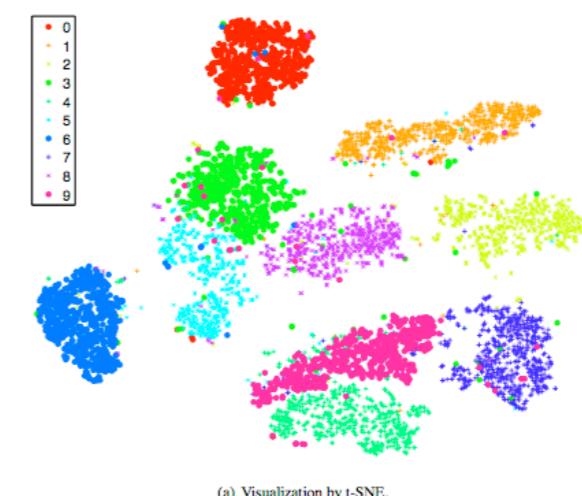
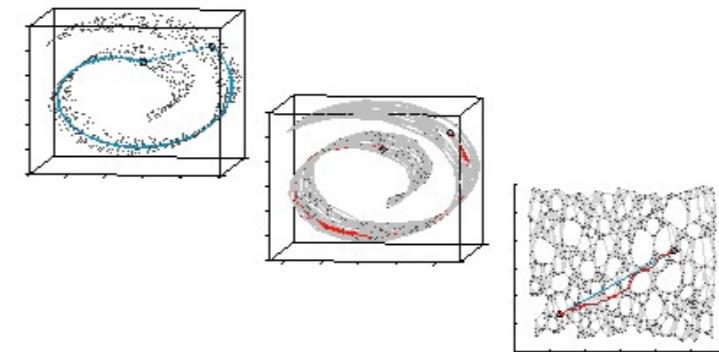
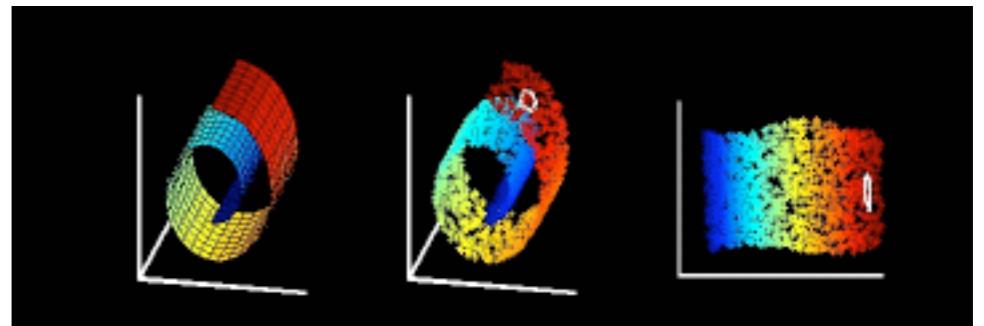
- Large dissimilarity is preserved over *small dissimilarity*.
- Try to understand the plot in terms of its two biggest *orthogonal* distances. If those don’t make sense, then the plot is suspect.
- Next, look for local structure, clustering, etc.



# Other Techniques

# Other Techniques

- Locally Linear Embedding : Only consider ‘close’ points in distance matrix. Good at recovering from “kinks”, “folds”, and “spirals” in data (chroma)
- Isomap : Establish geodesic “neighborhood” distances using Dijkstra’s algorithm, and solve with mds.
- T-SNE : Convert neighbor distances to conditional probabilities. Perform gradient descent on Kullback-Leibler Divergence. Good at recovering clusters at different scales.



(a) Visualization by t-SNE.

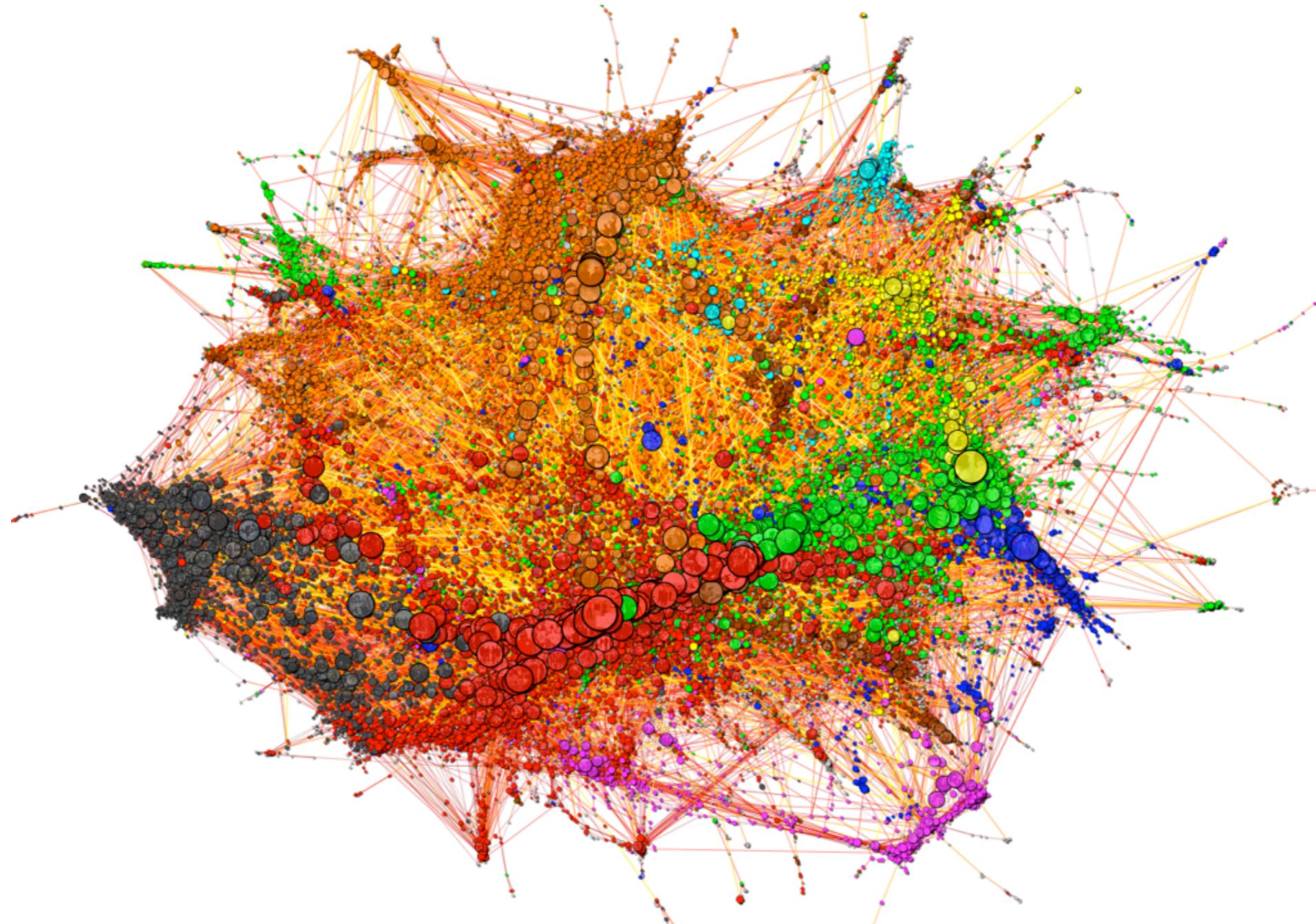
# Other Techniques

## (observations)

- Many advanced techniques sacrifice “large scale” dissimilarities in order to preserve/enhance “local” features.
- Sometimes large scale information is useful (to determine if scales are wrong, or if there are significant outliers)
- Interpretation of advanced techniques is much more complicated. (What are the loadings, factors, of features etc.?)
- It can be harder to use advanced dimensionality reduction techniques to inform classifier design.

# Building an artist map

The Goal - build an artist graph suitable for music exploration



**Problem: The artist space is very complex**

# The Data

- Crawled The Echo Nest API for:
  - Artist names
  - Artist hotness
  - Artist familiarity
  - 15 most similar artists
- 70,000 artists
- 250,000 artist-artist links
- Available at [musicviz.googlecode.com](http://musicviz.googlecode.com)



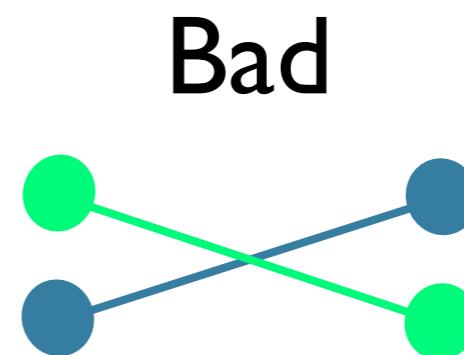
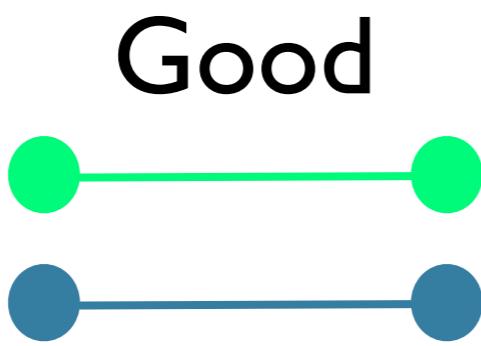
**Version 3**  
[Overview](#)  
[Data Types](#)  
[Version History](#)

## API Methods

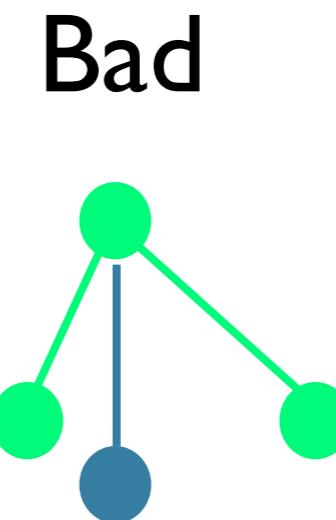
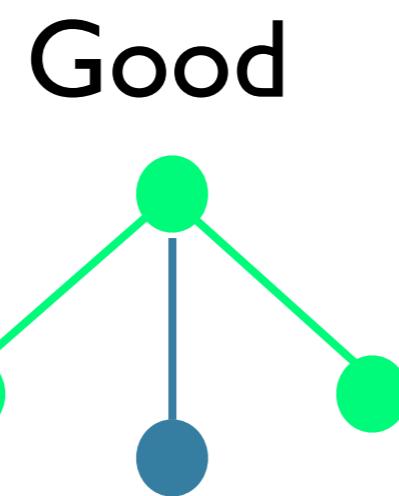
**Artist:**  
[get\\_audio](#)  
[get\\_bios](#)  
[get\\_blogs](#)  
[get\\_familiarity](#)  
[get\\_hotttnesss](#)  
[get\\_image](#)  
[get\\_news](#)  
[get\\_profile](#)  
[get\\_reviews](#)  
[get\\_similar](#)  
[get\\_top\\_terms](#)  
[get\\_urls](#)  
[get\\_video](#)

# Making a good graph

- Minimize edge crossings, bends and curves

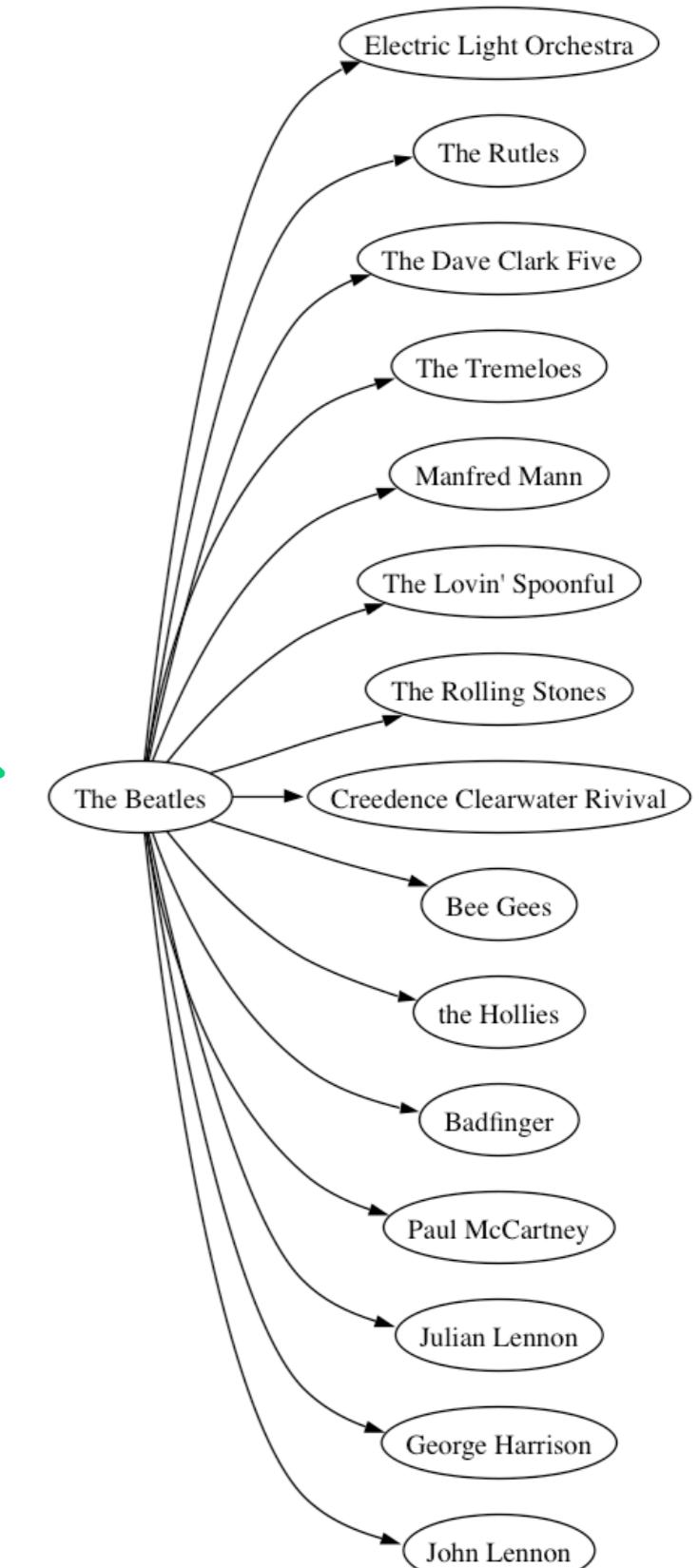
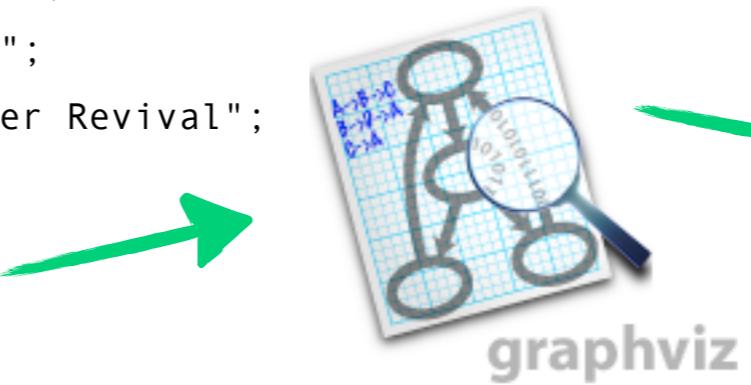


- Maximize angular resolution, symmetry



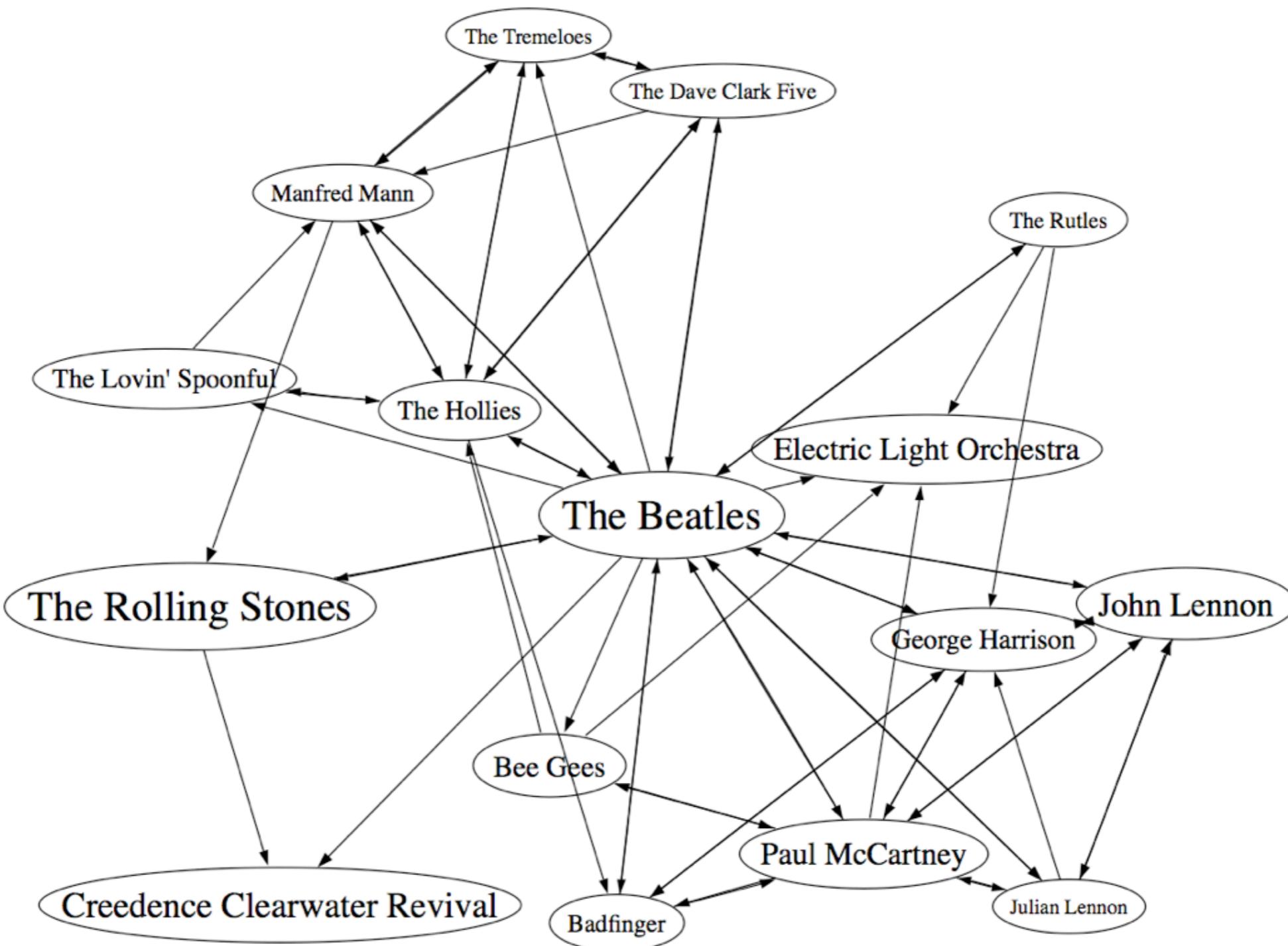
# Graphing the Beatles Neighborhood

```
digraph {  
    "The Beatles" -> "Electric Light Orchestra";  
    "The Beatles" -> "The Rutles";  
    "The Beatles" -> "The Dave Clark Five";  
    "The Beatles" -> "The Tremeloes";  
    "The Beatles" -> "Manfred Mann";  
    "The Beatles" -> "The Lovin' Spoonful";  
    "The Beatles" -> "The Rolling Stones";  
    "The Beatles" -> "Creedence Clearwater Revival";  
    "The Beatles" -> "Bee Gees";  
    "The Beatles" -> "the Hollies";  
    "The Beatles" -> "Badfinger";  
    "The Beatles" -> "Paul McCartney";  
    "The Beatles" -> "Julian Lennon";  
    "The Beatles" -> "George Harrison";  
    "The Beatles" -> "John Lennon";  
}
```



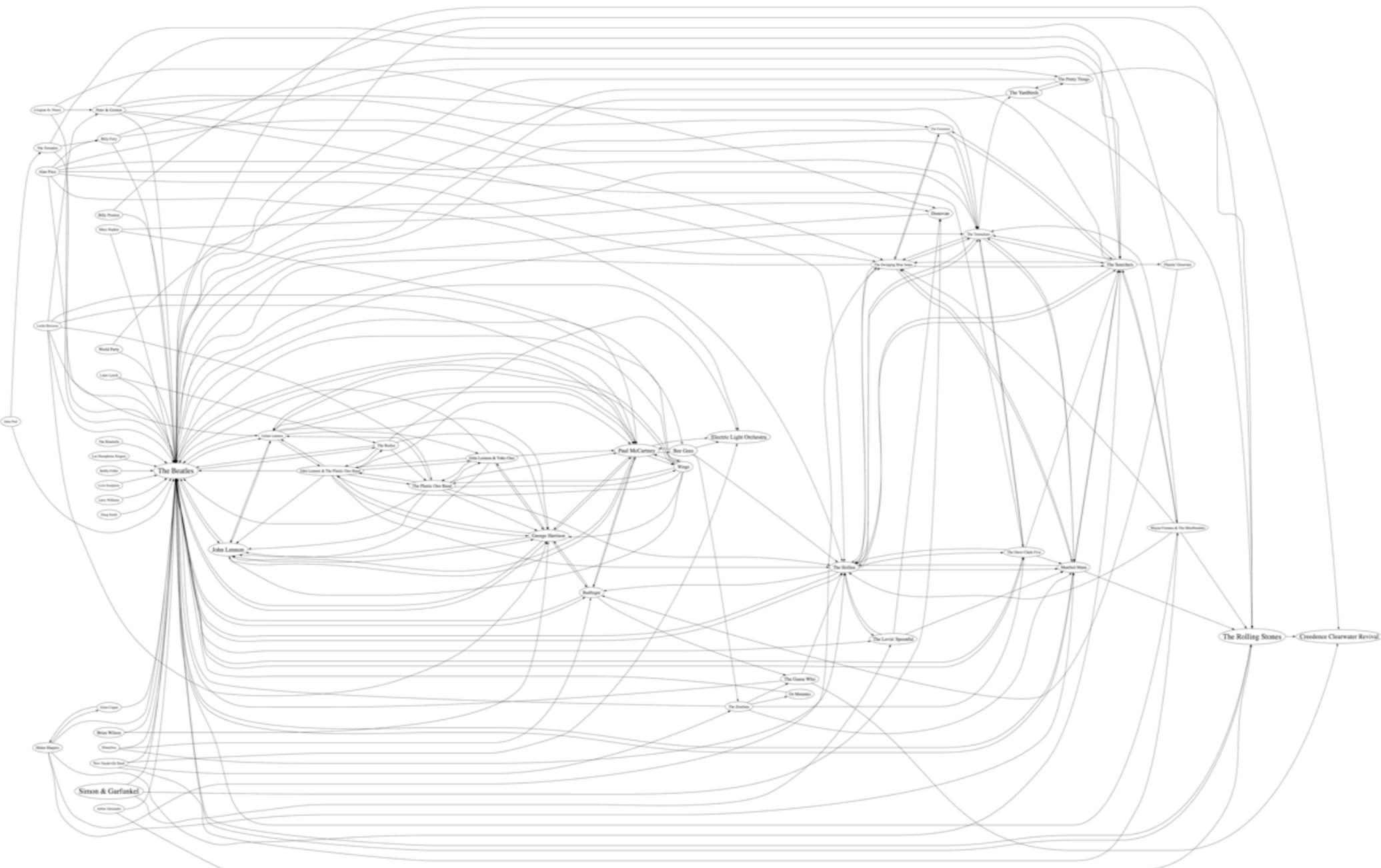
<http://www.graphviz.org/>

# Artist map - level I out

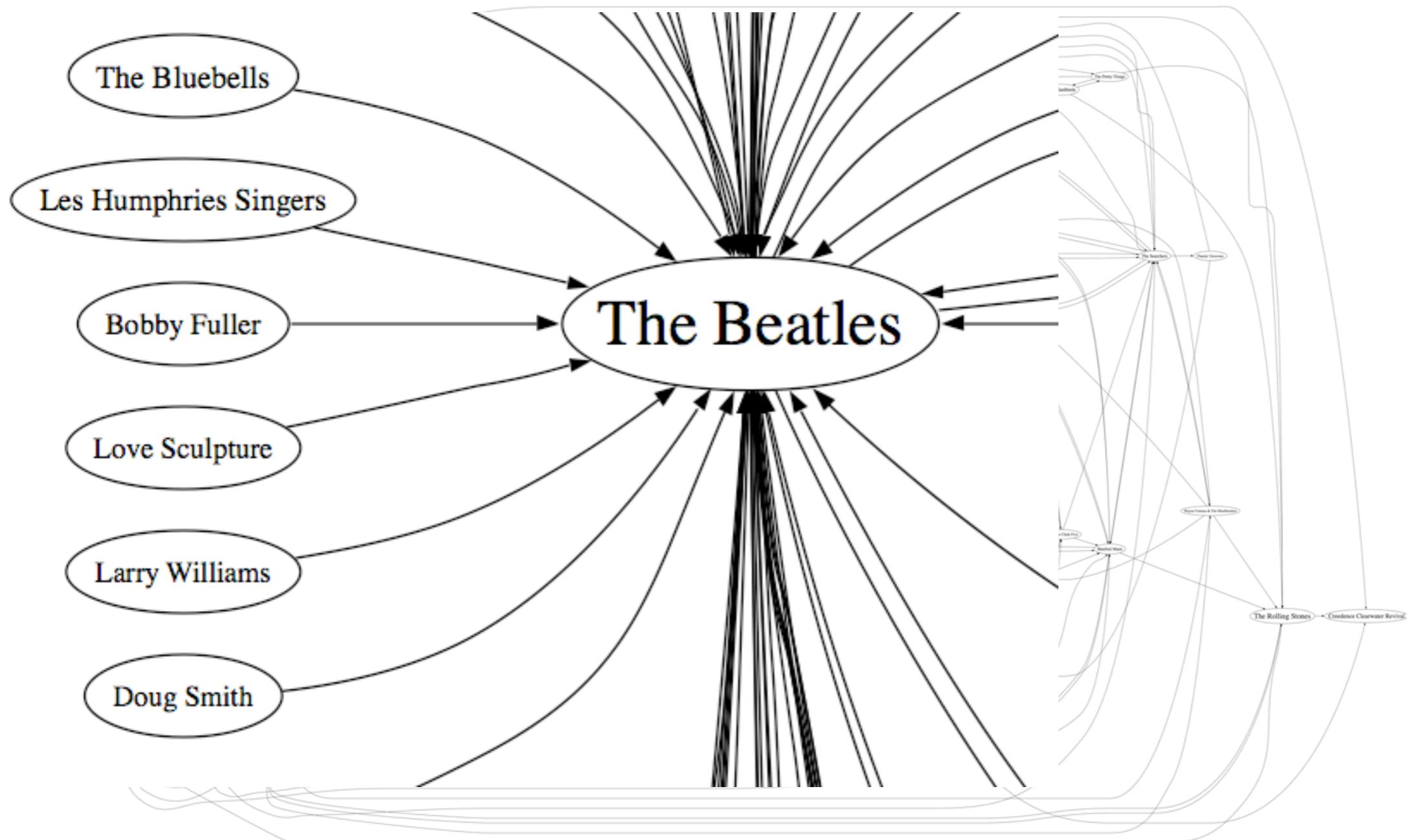


Already interconnections start to overwhelm

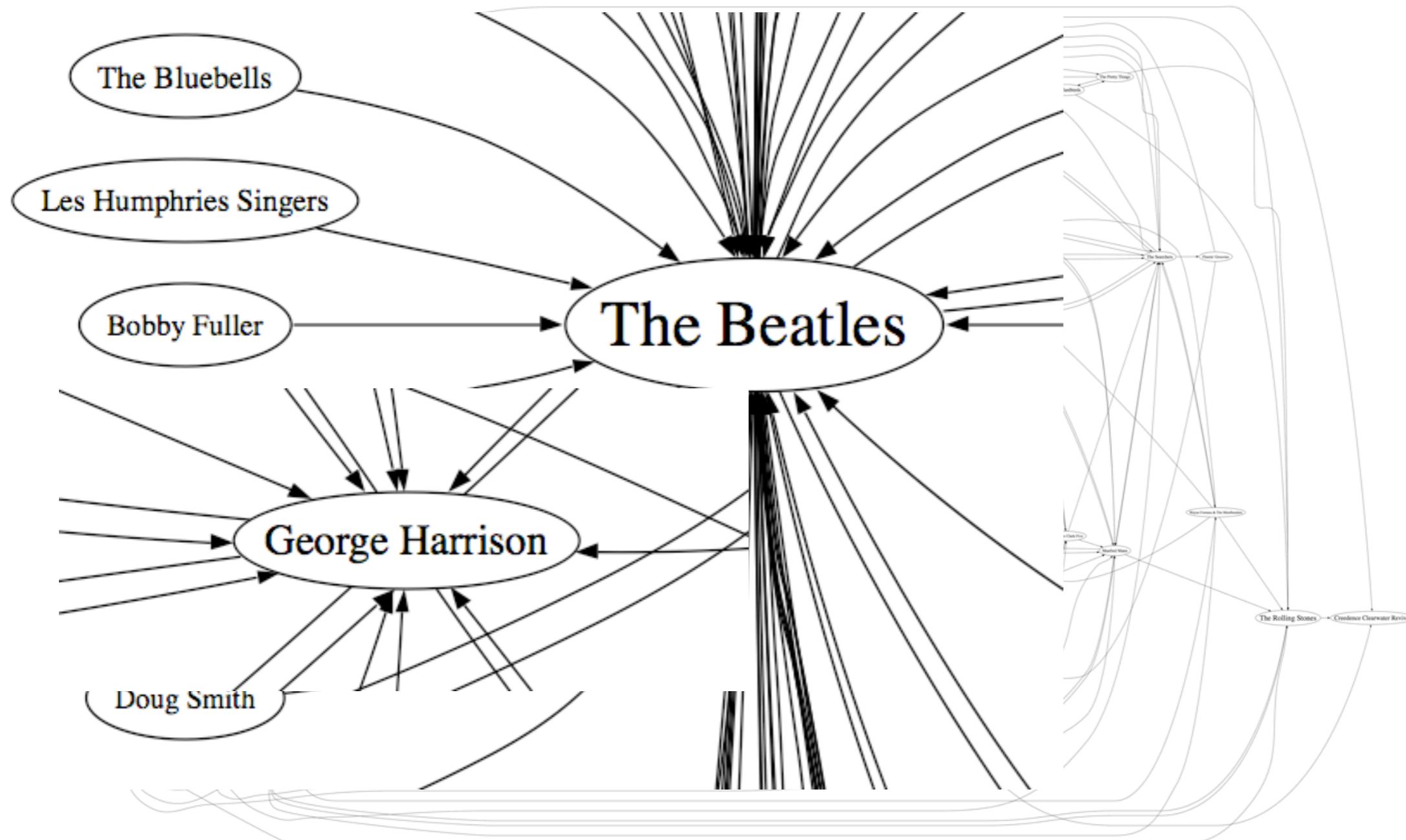
# Artist map - level I in/out



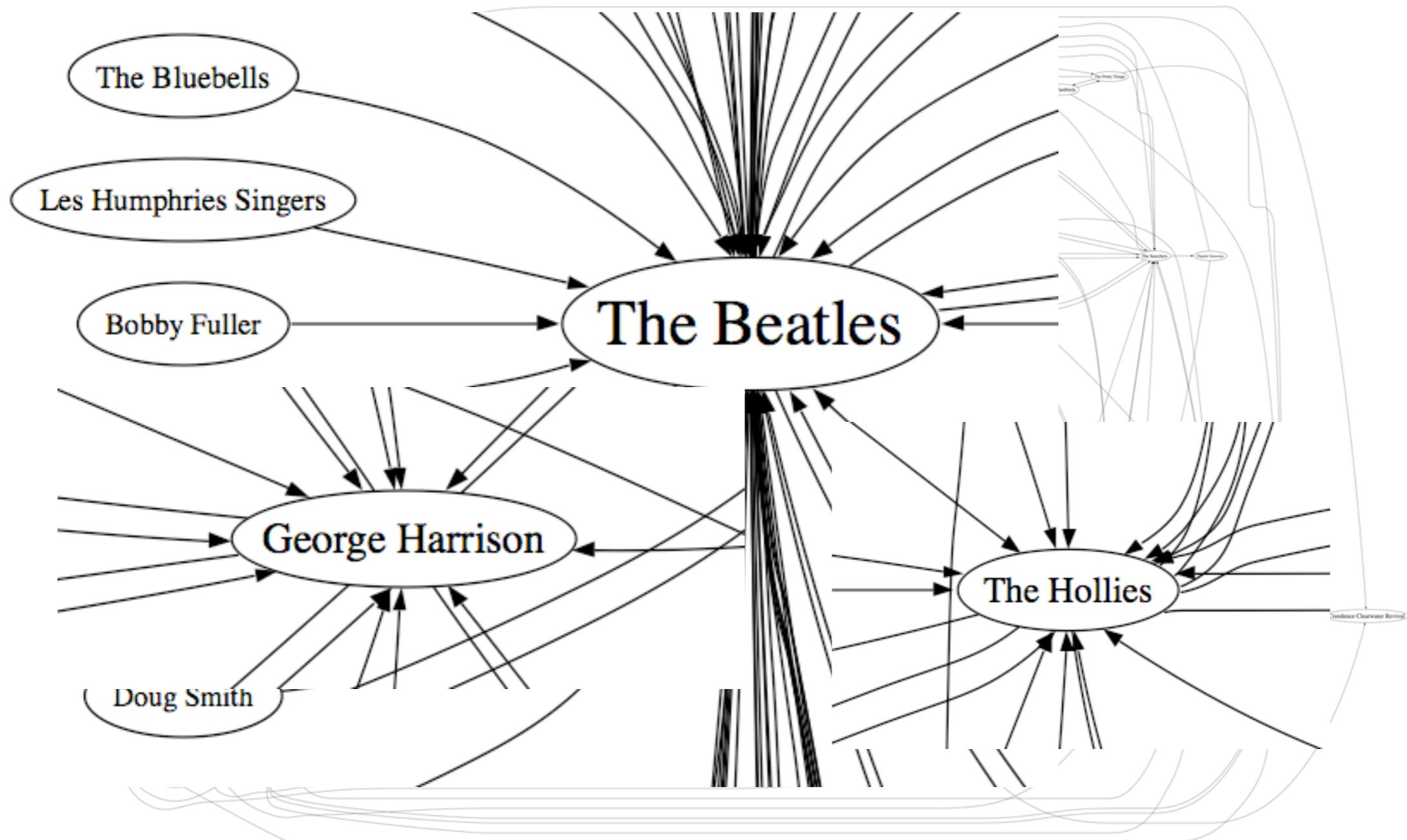
# Artist map - level I in/out



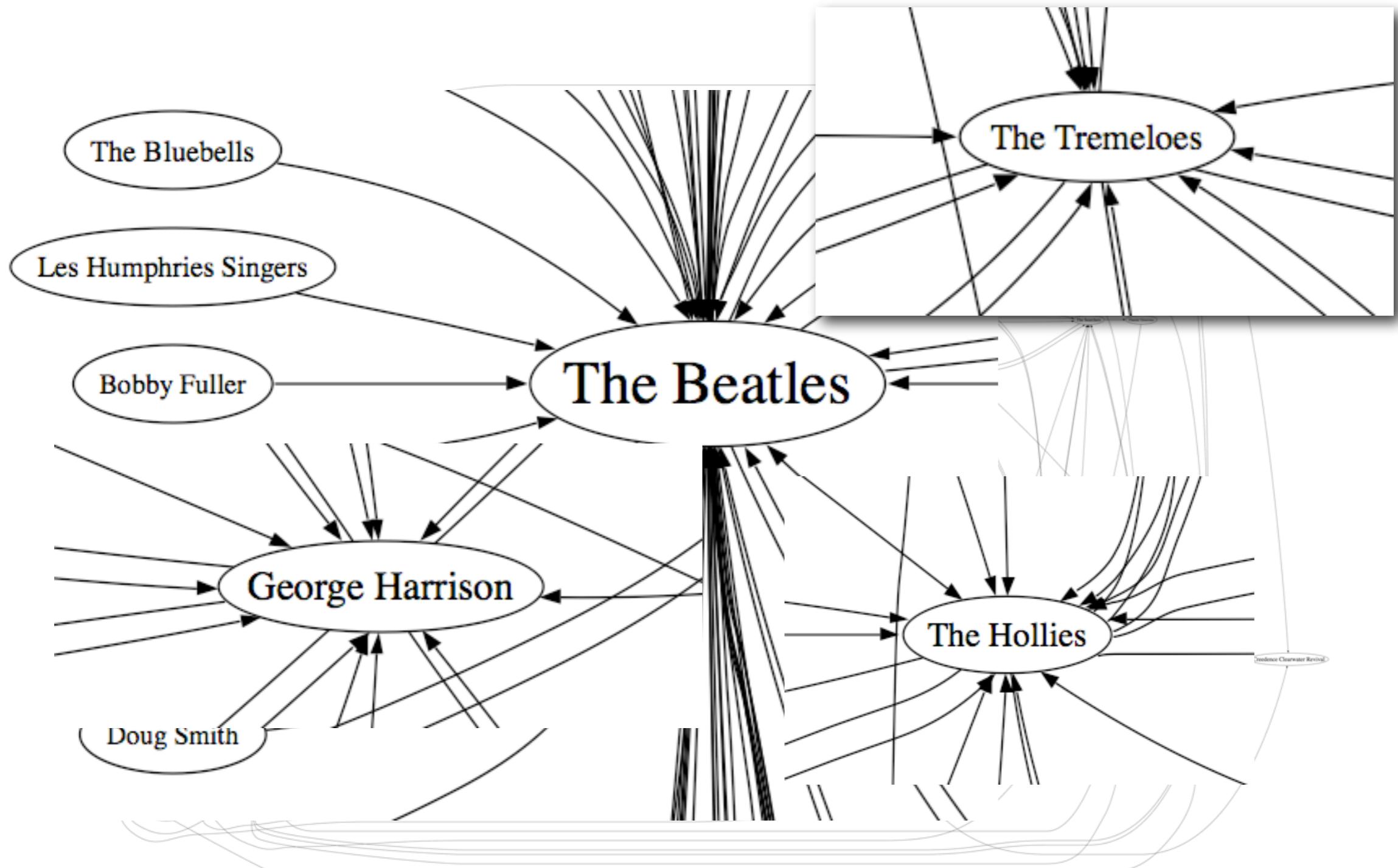
# Artist map - level I in/out



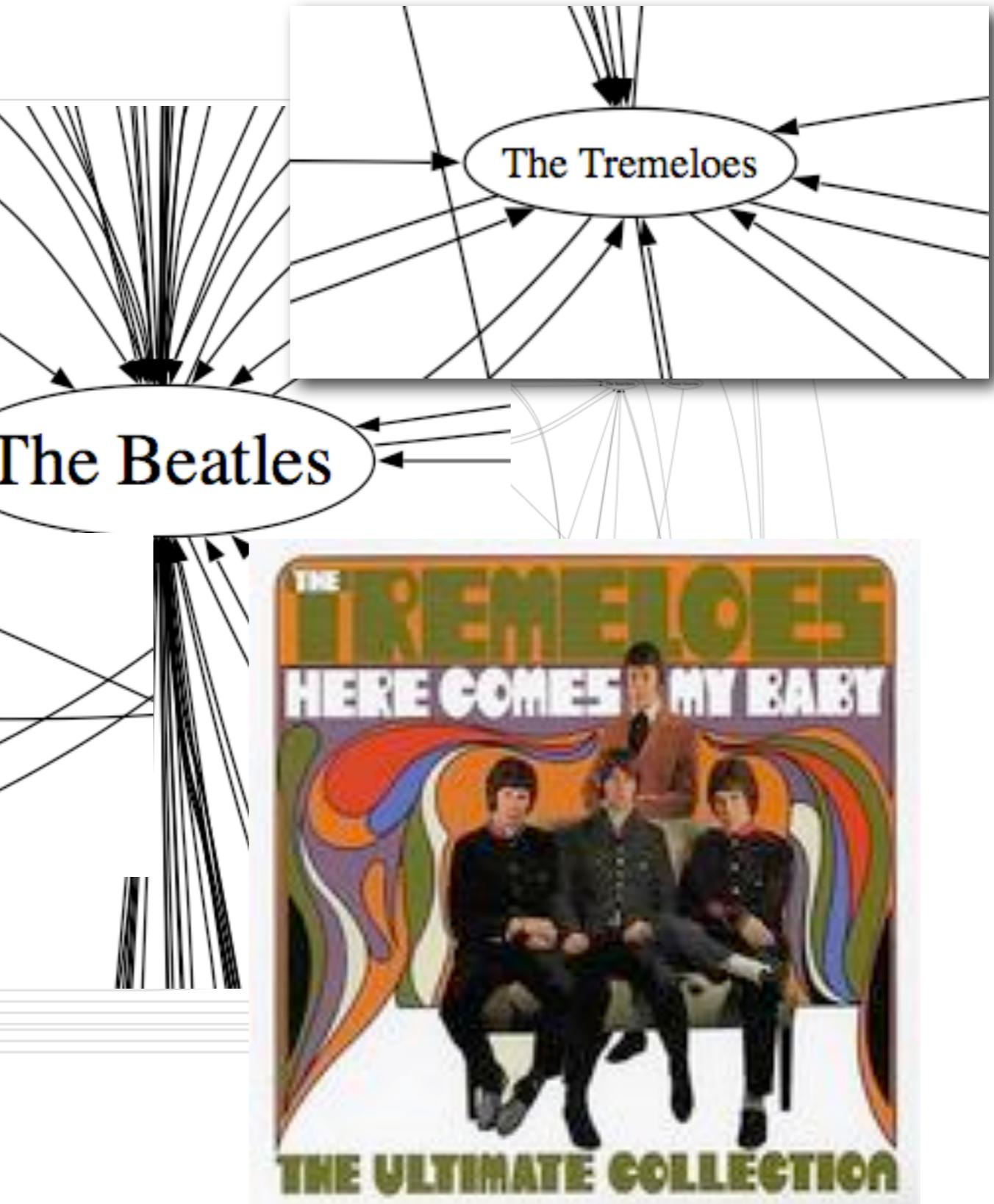
# Artist map - level I in/out



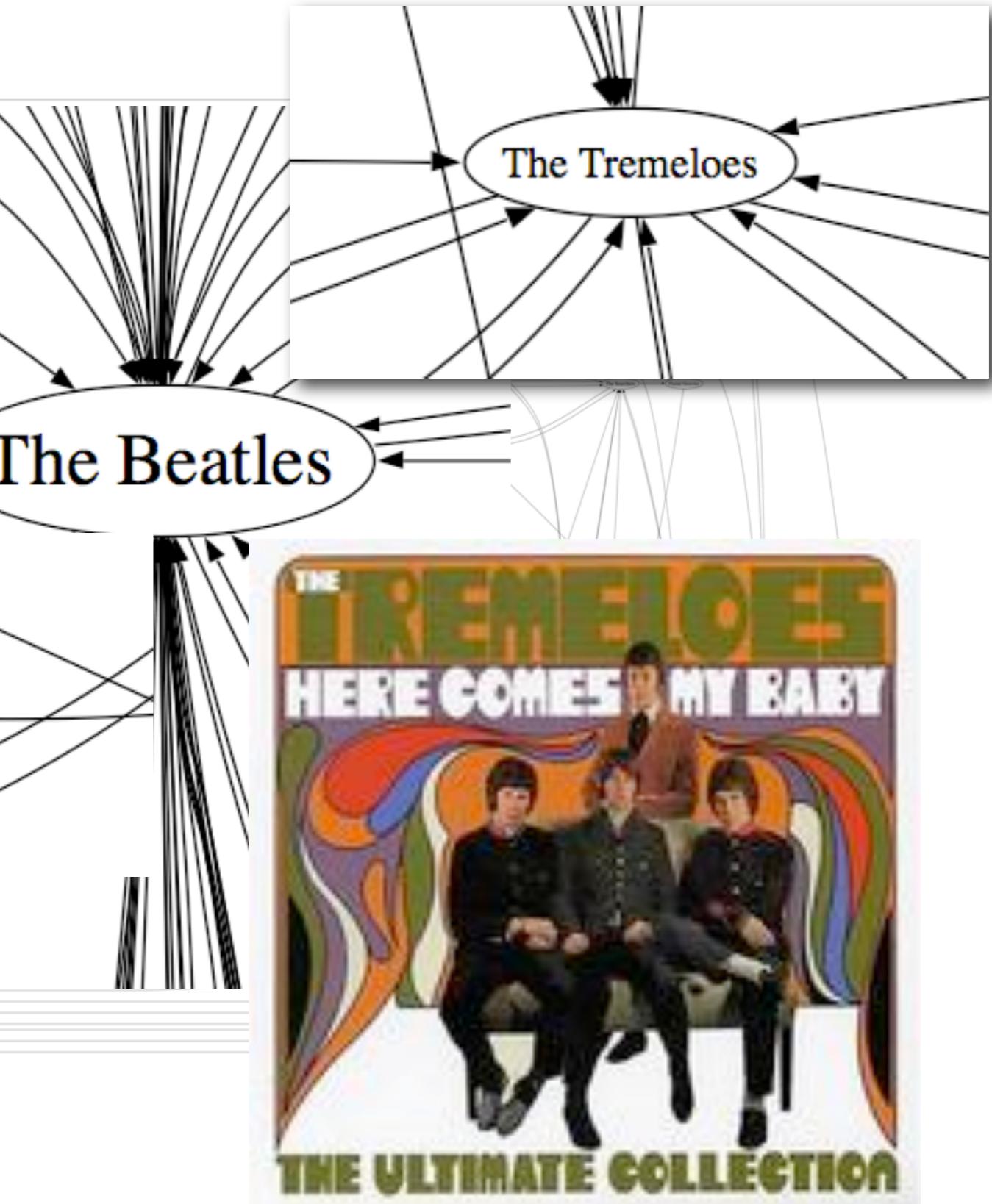
# Artist map - level I in/out



# Artist map - level I in/out



# Artist map - level I in/out

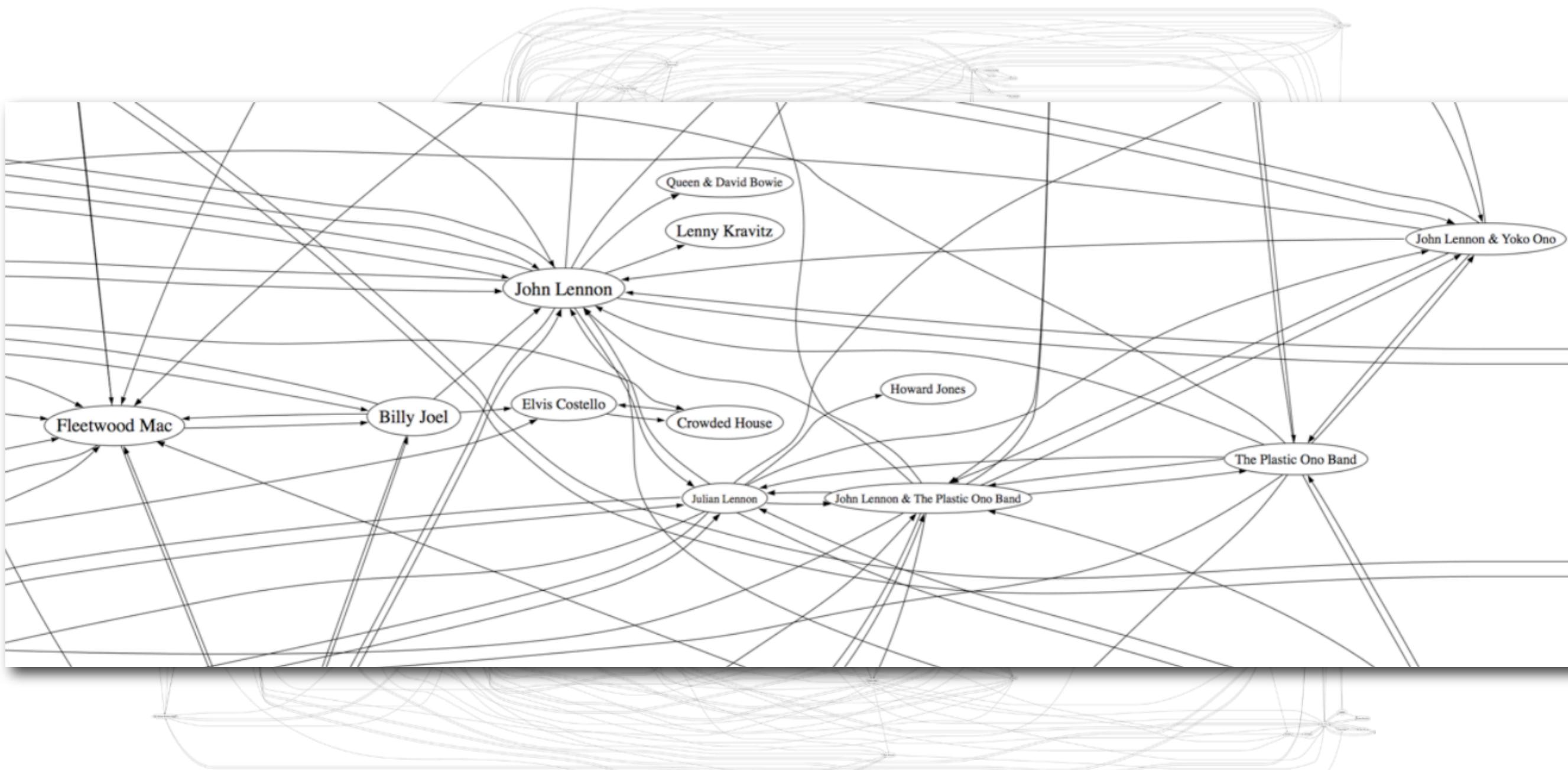


# Artist map - level 2



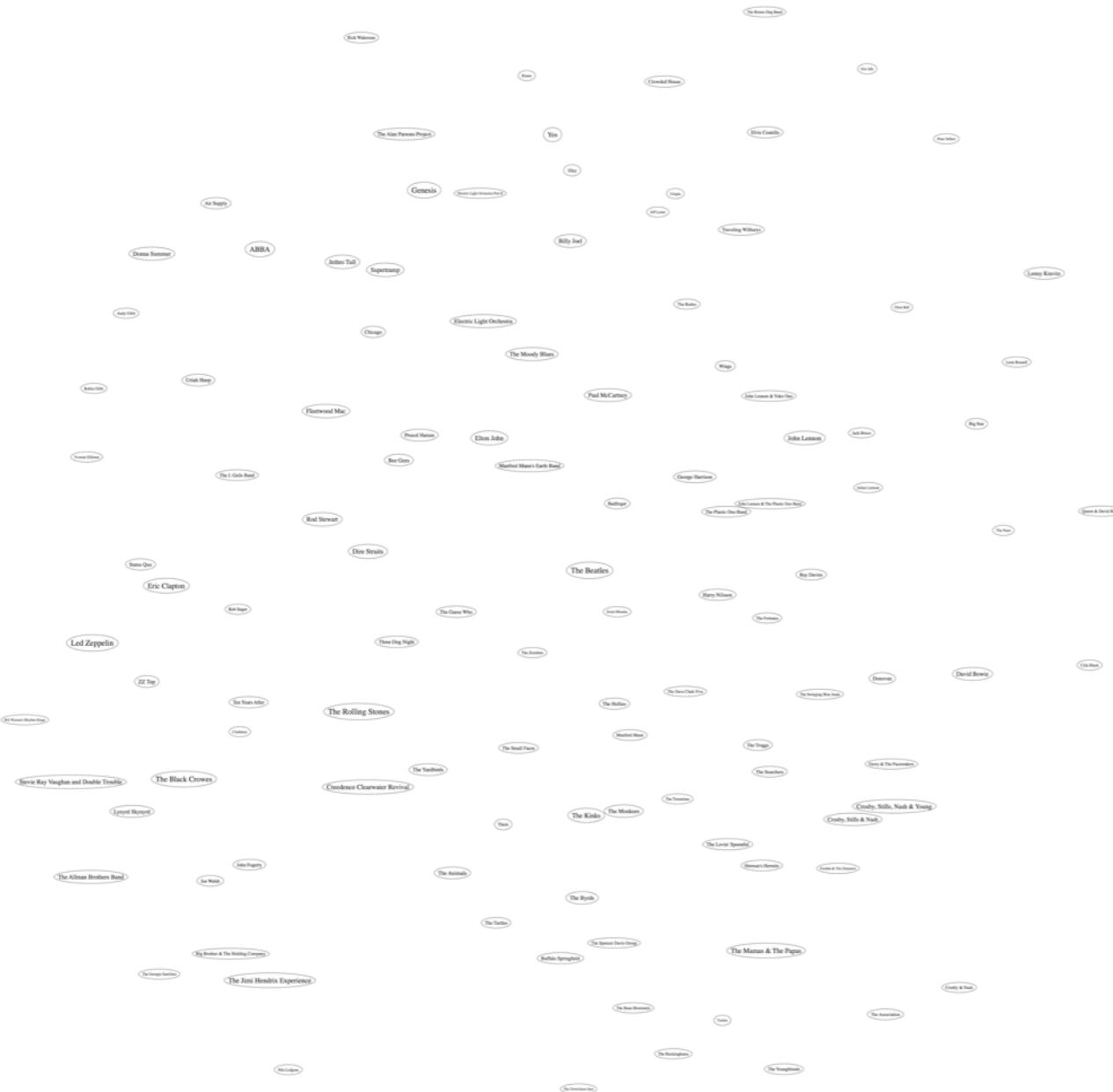
116 artists and 665 edges. We are totally overwhelmed.

# Artist map - level 2



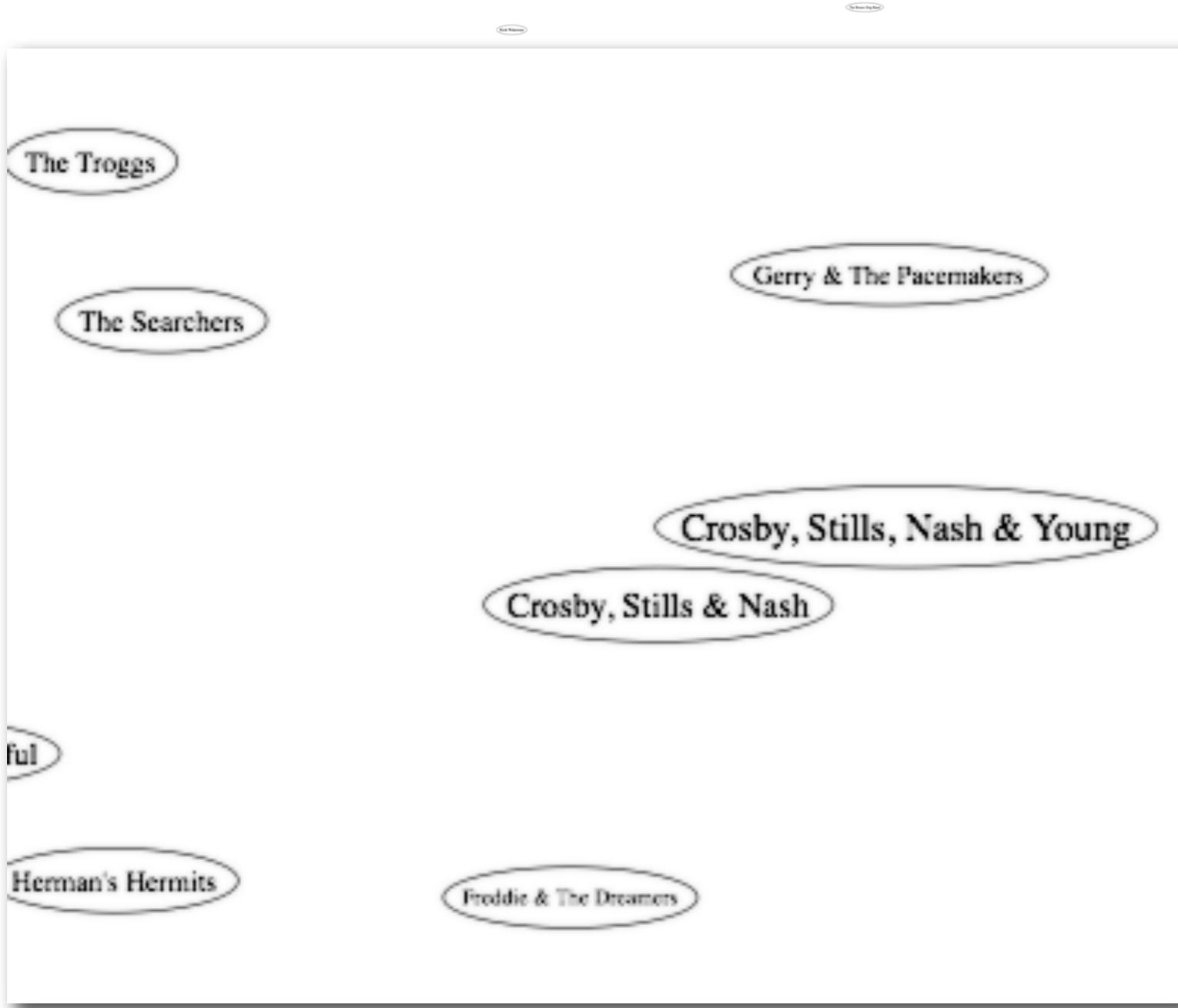
116 artists and 665 edges. We are totally overwhelmed.

# Simplifying the graph



Eliminate the edges and use spring force embedding to position the artists

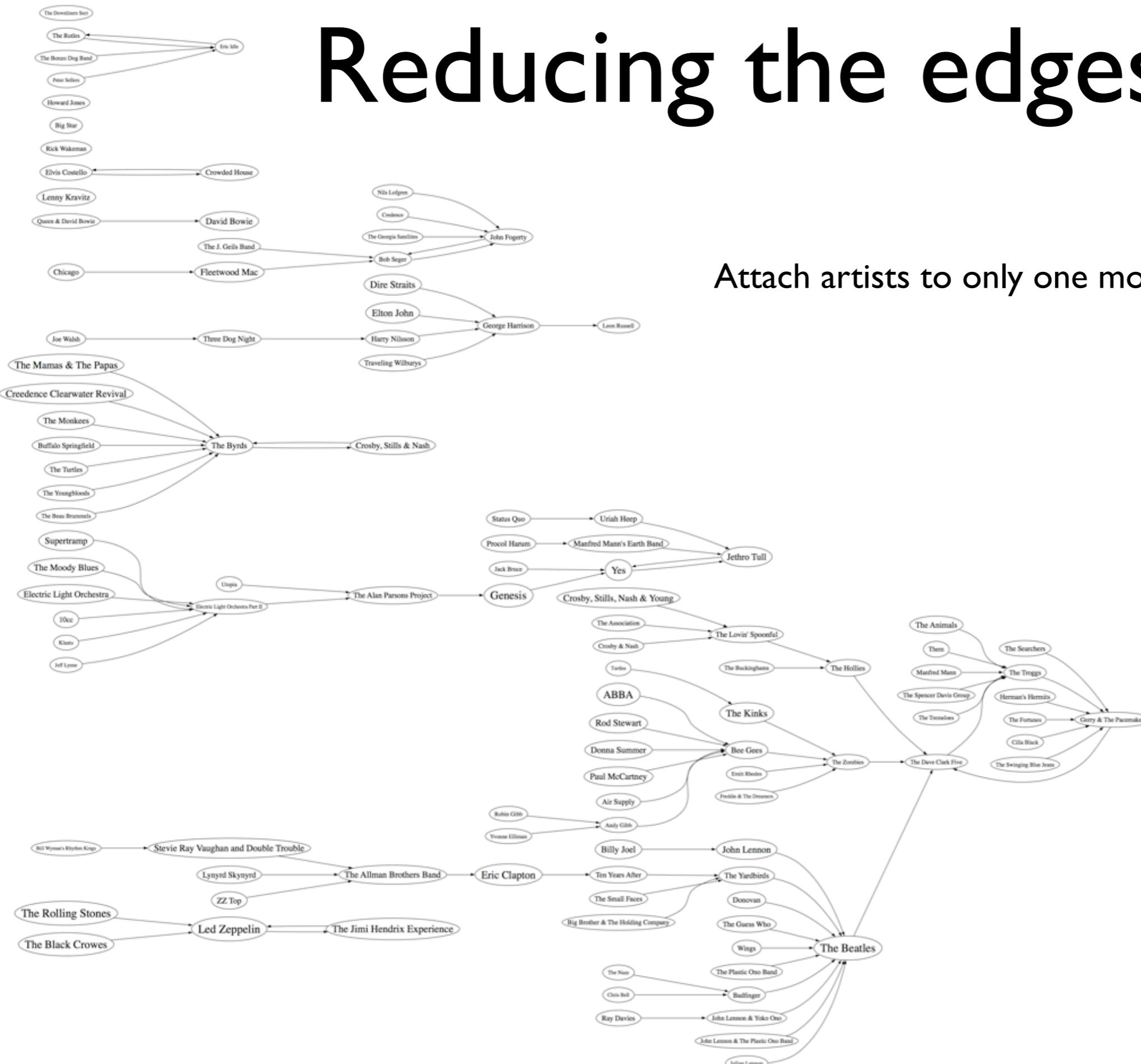
# Simplifying the graph



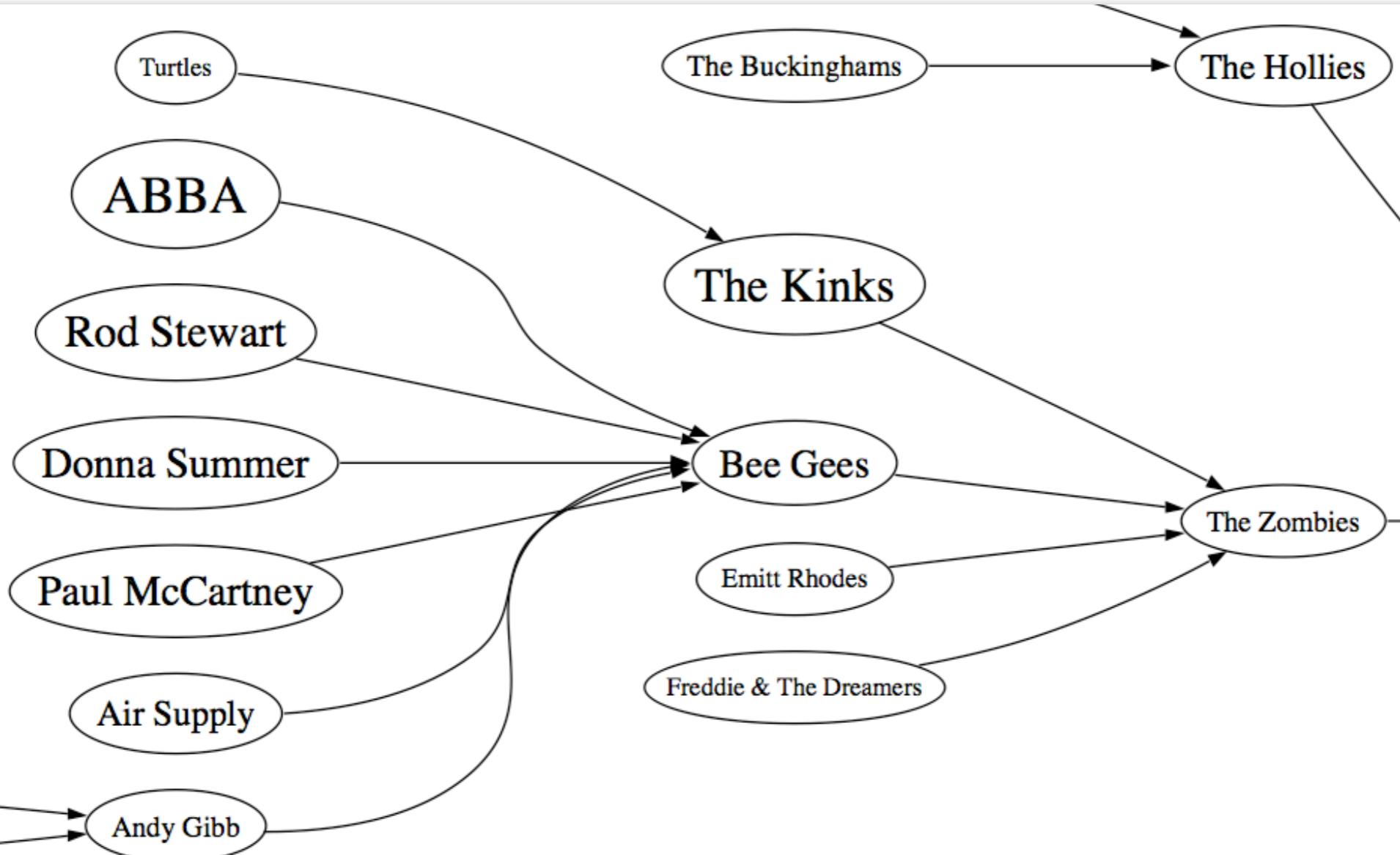
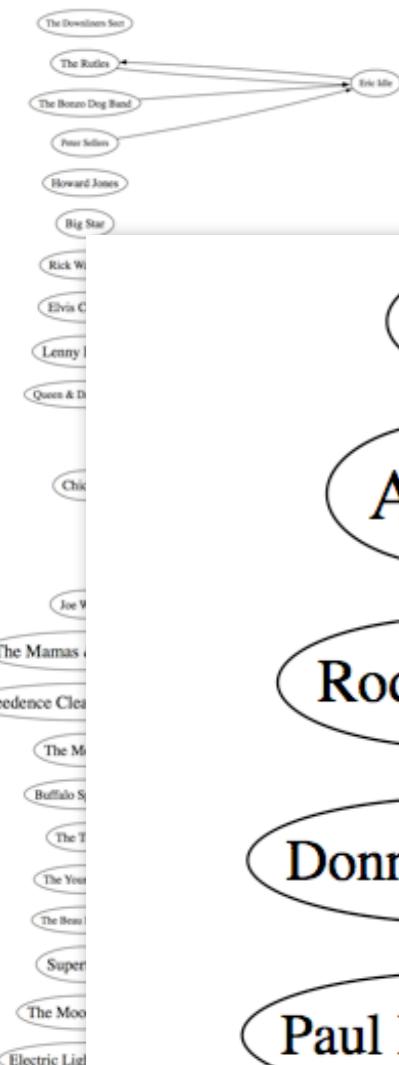
Eliminate the edges and use spring force embedding to position the artists

# Reducing the edges

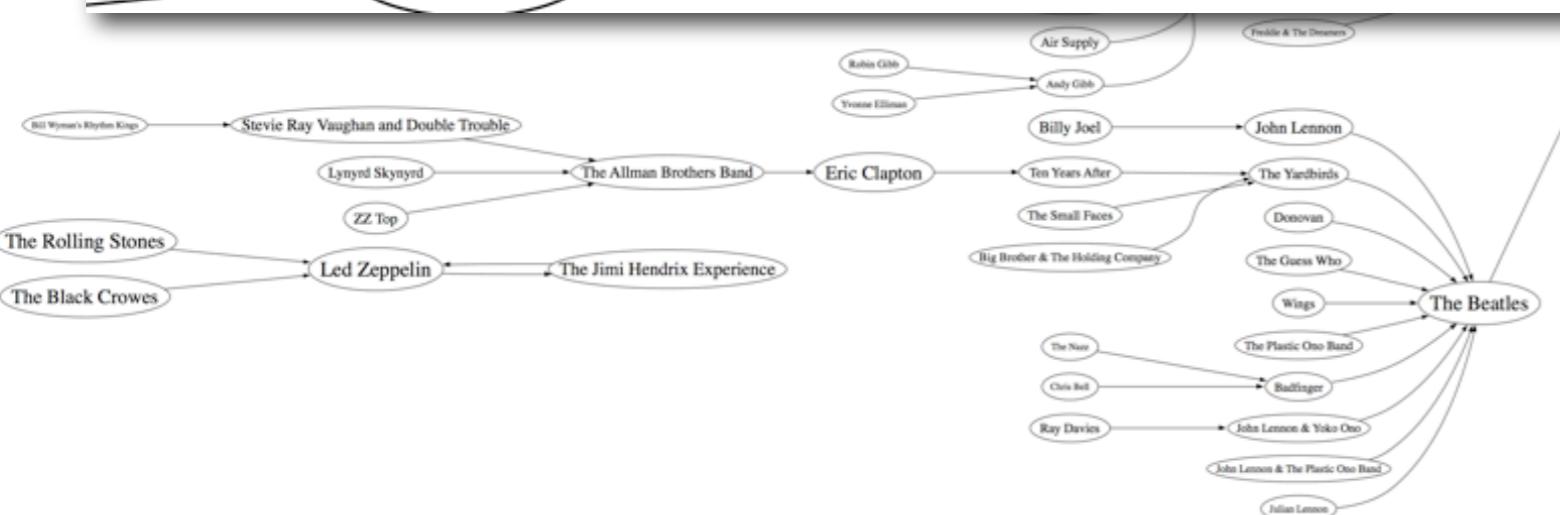
Attach artists to only one most similar artist



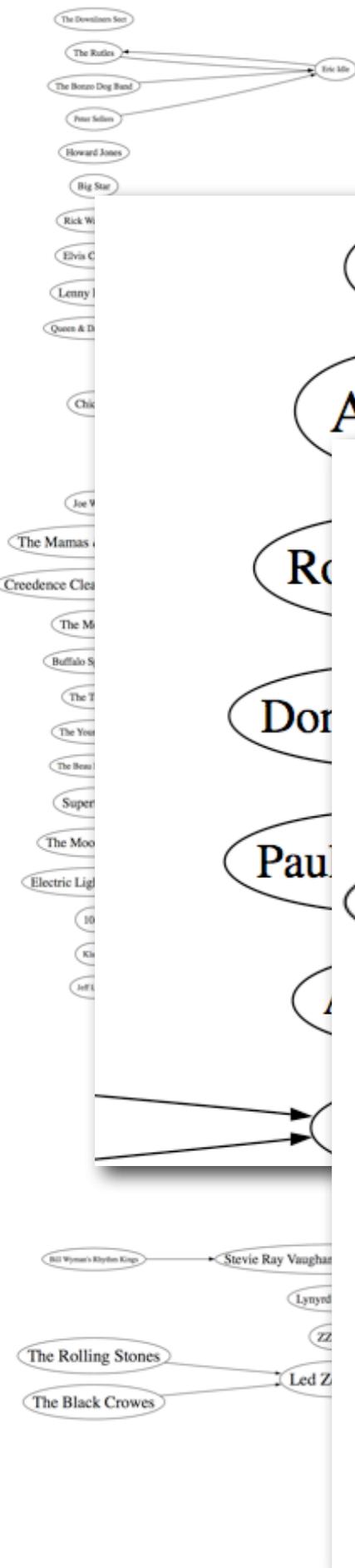
# Reducing the edges



similar artist

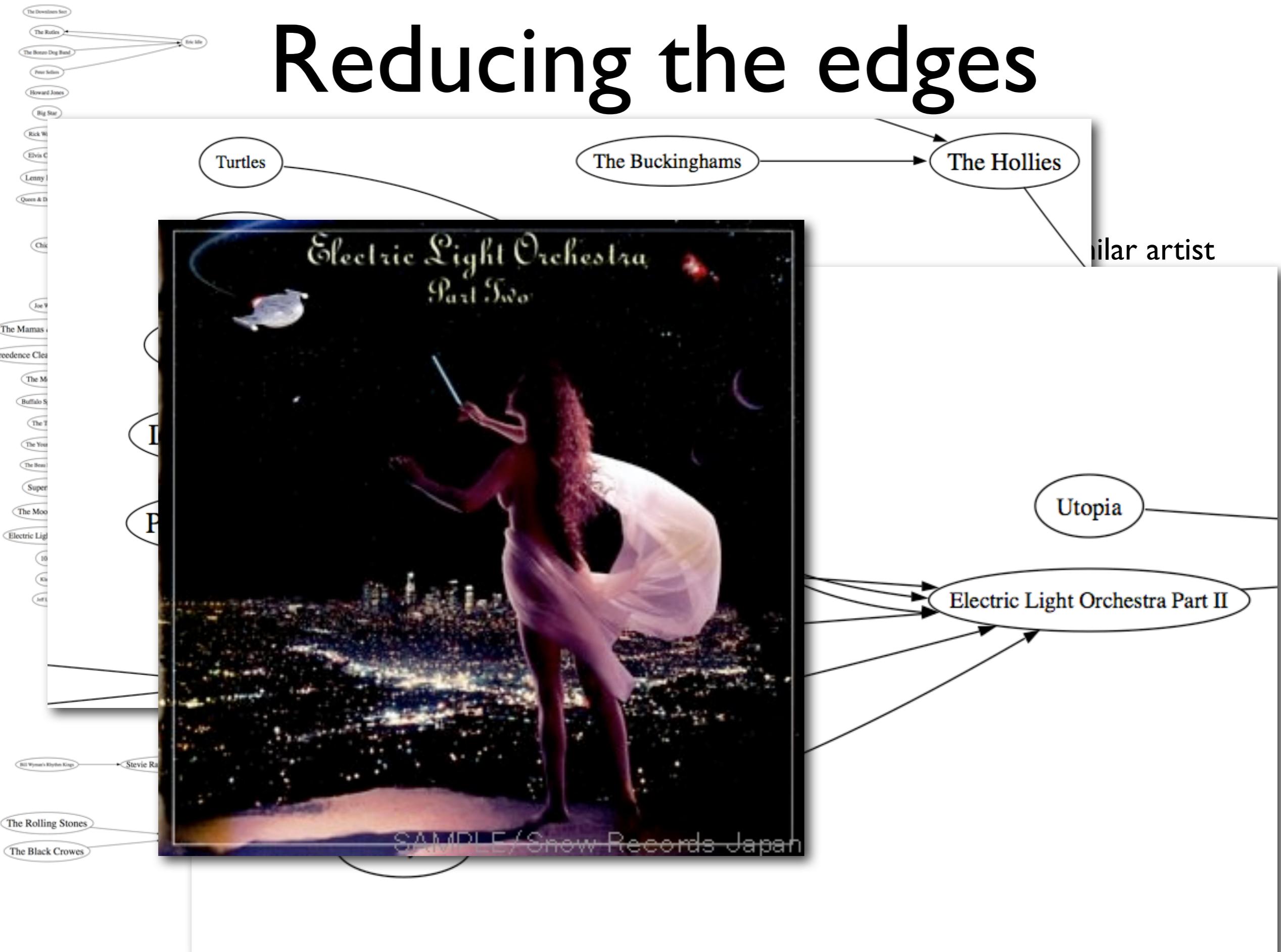


# Reducing the edges

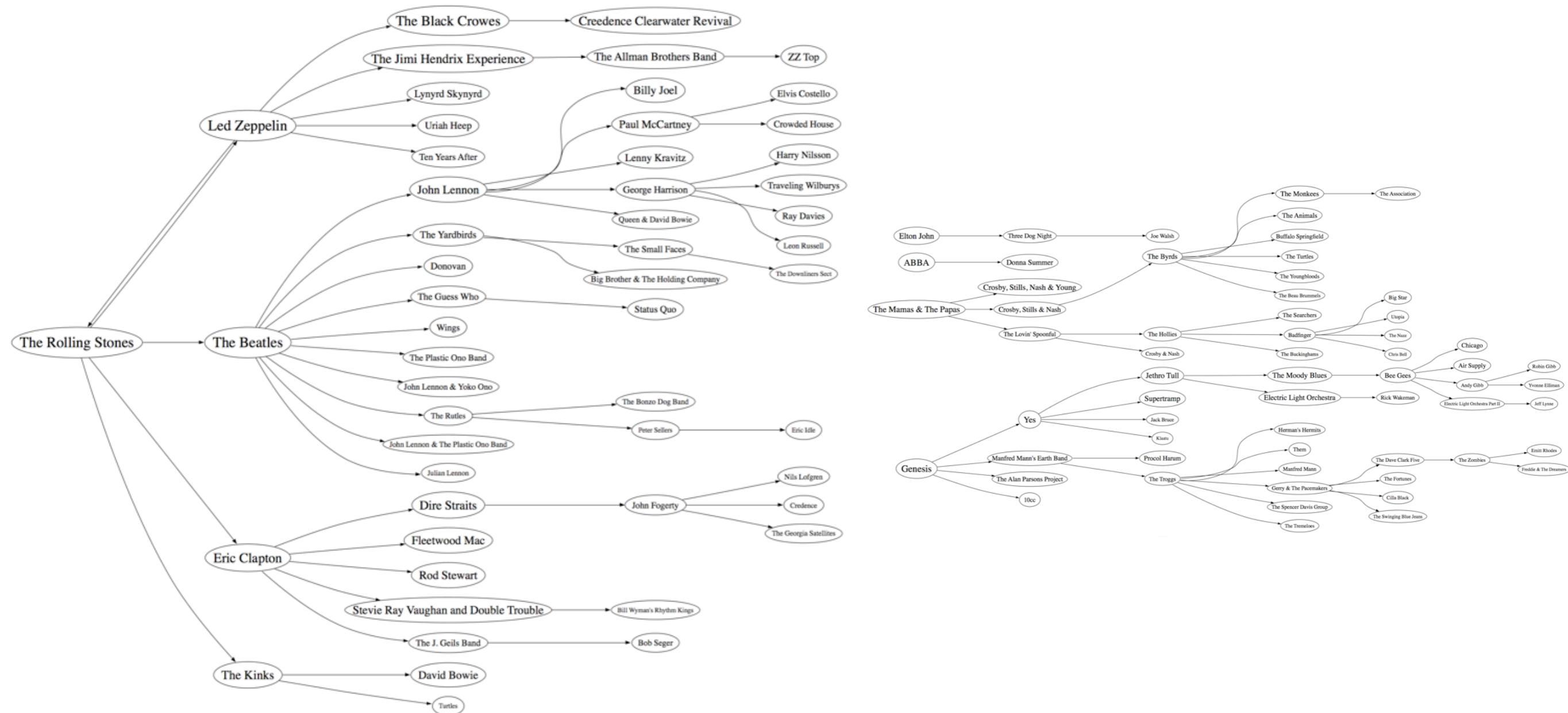


similar artist

# Reducing the edges

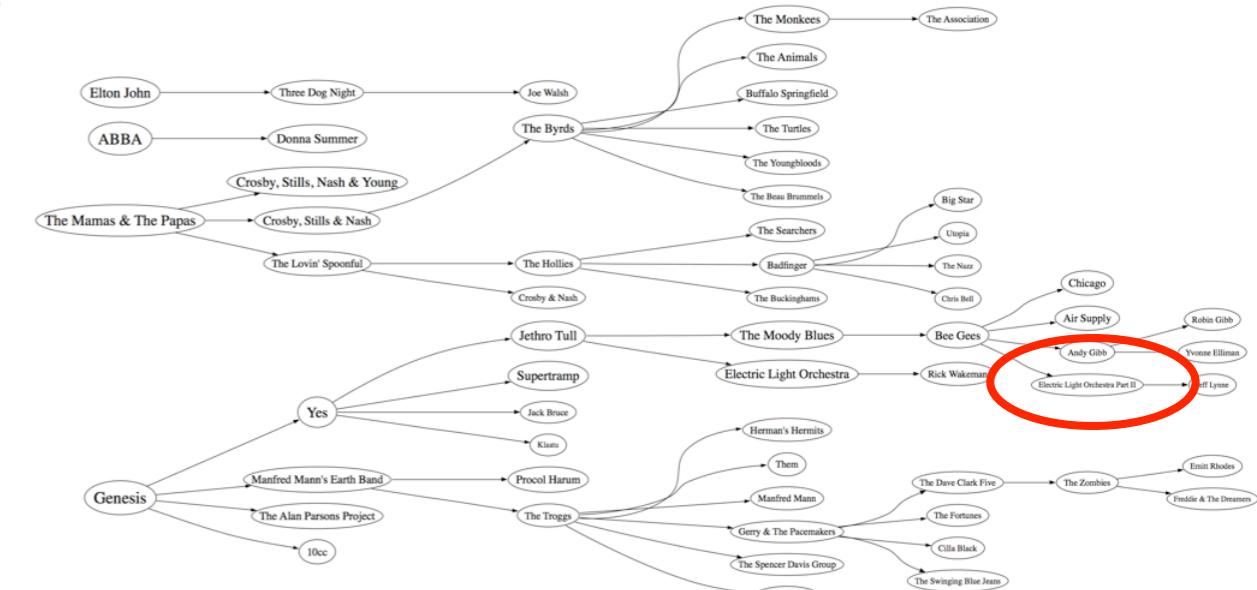
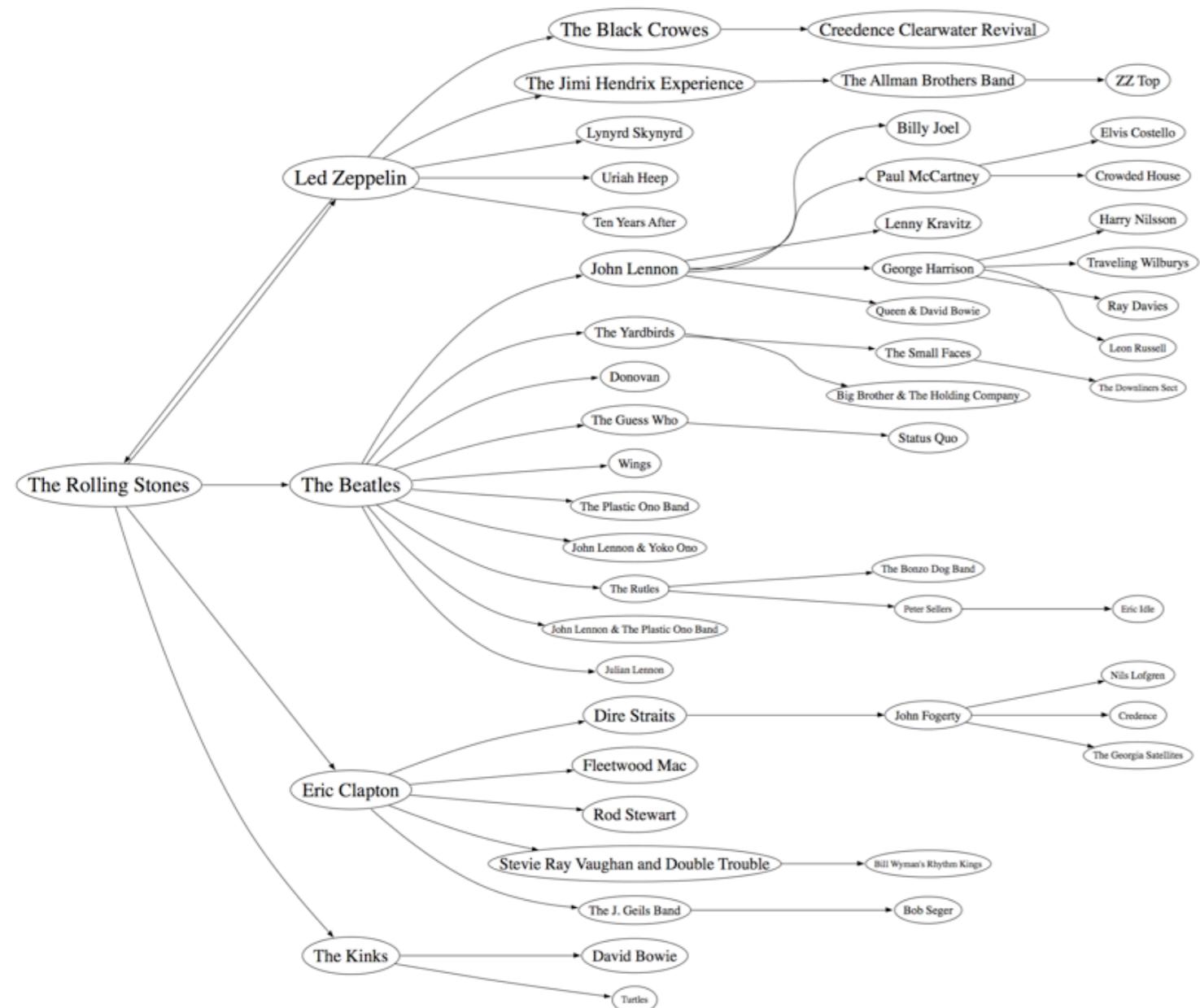


# Putting ELO II in its place



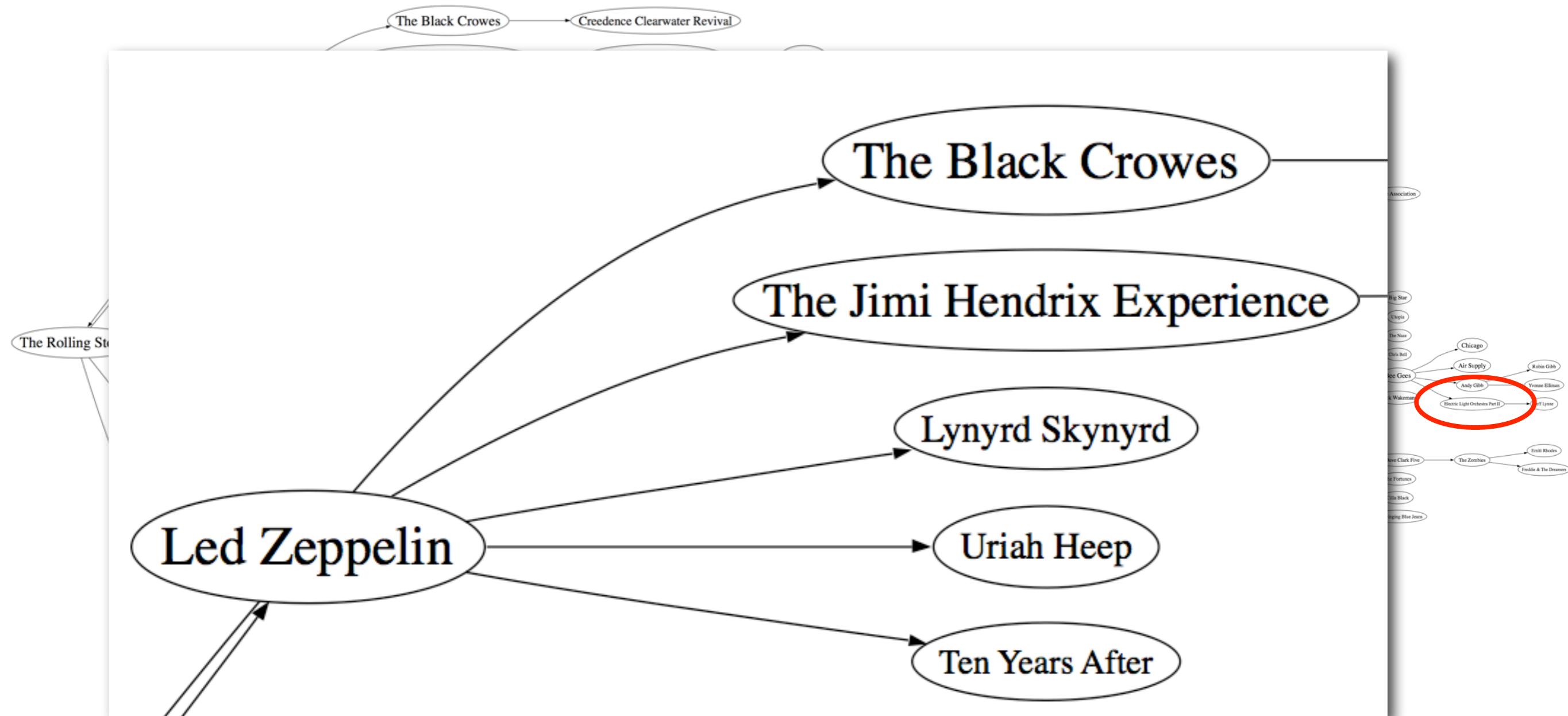
Attach artists to the most similar artist that has greater familiarity

# Putting ELO II in its place



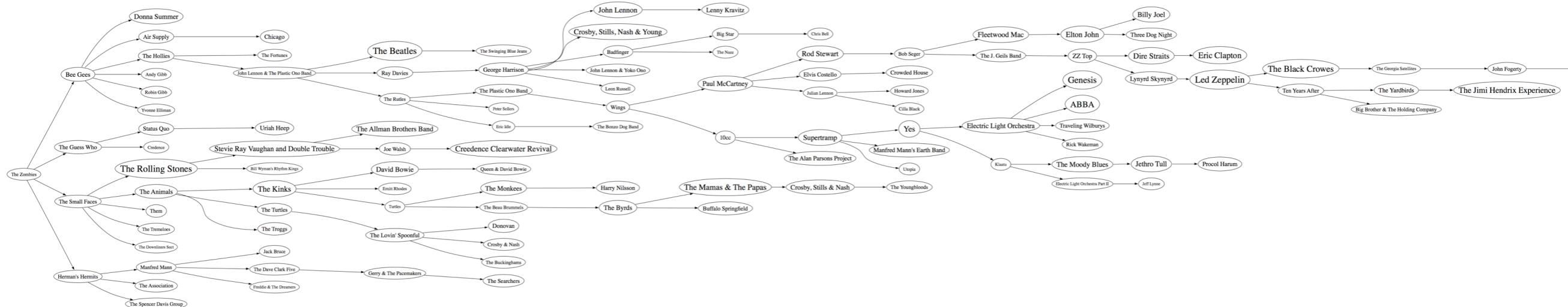
Attach artists to the most similar artist that has greater familiarity

# Putting ELO II in its place



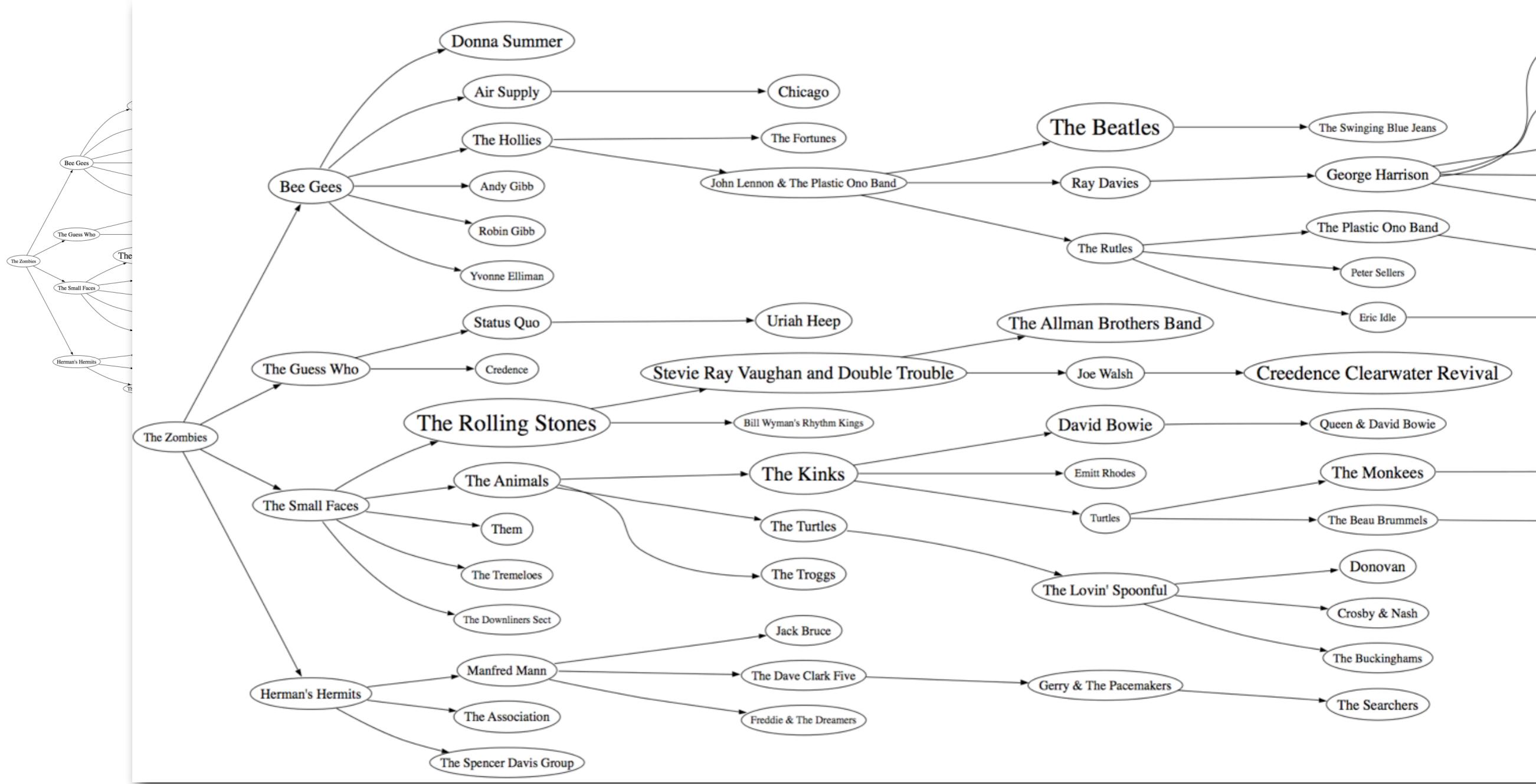
Attach artists to the most similar artist that has greater familiarity

# Making the graph connected



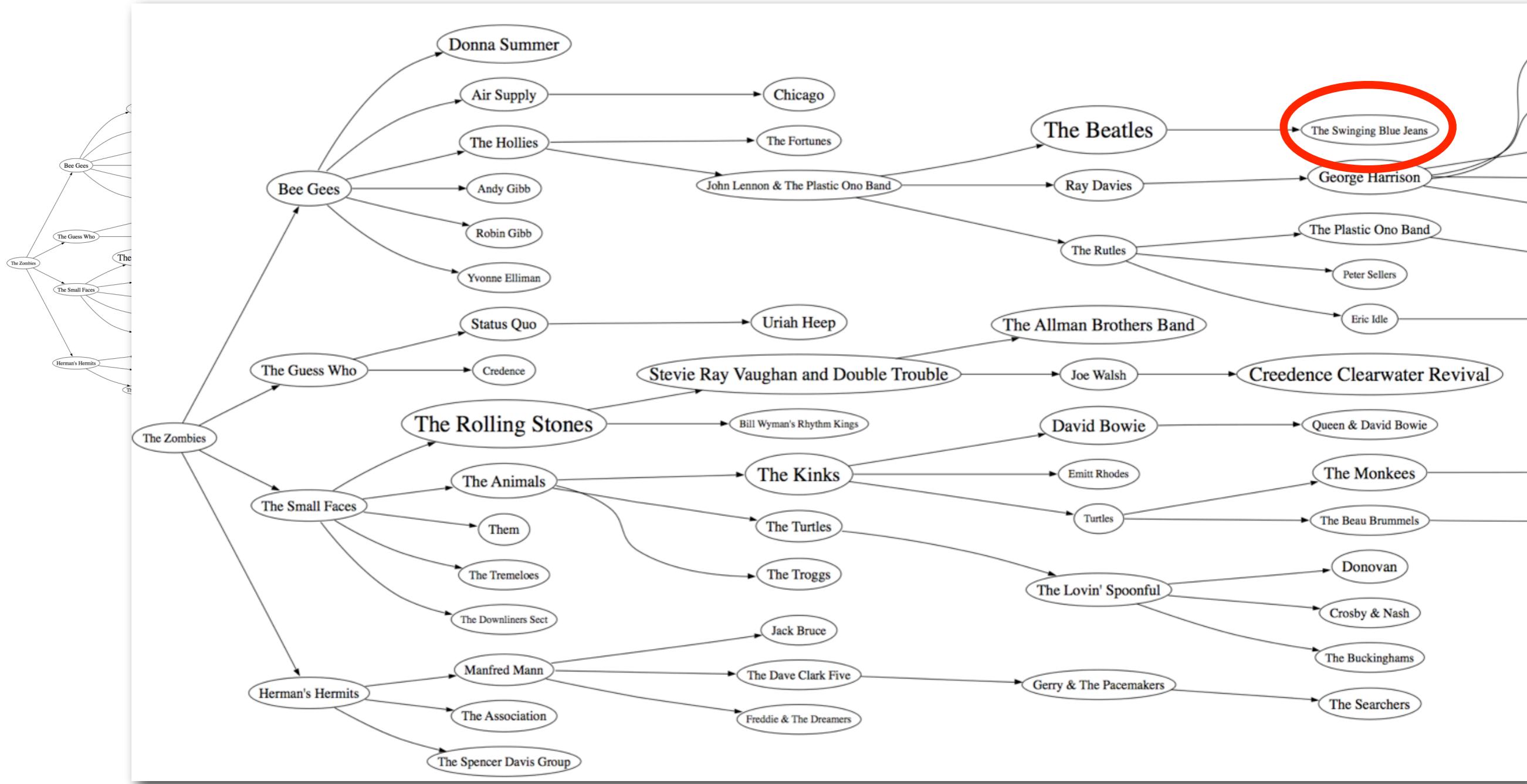
Build a minimum spanning tree from the graph

# Making the graph connected



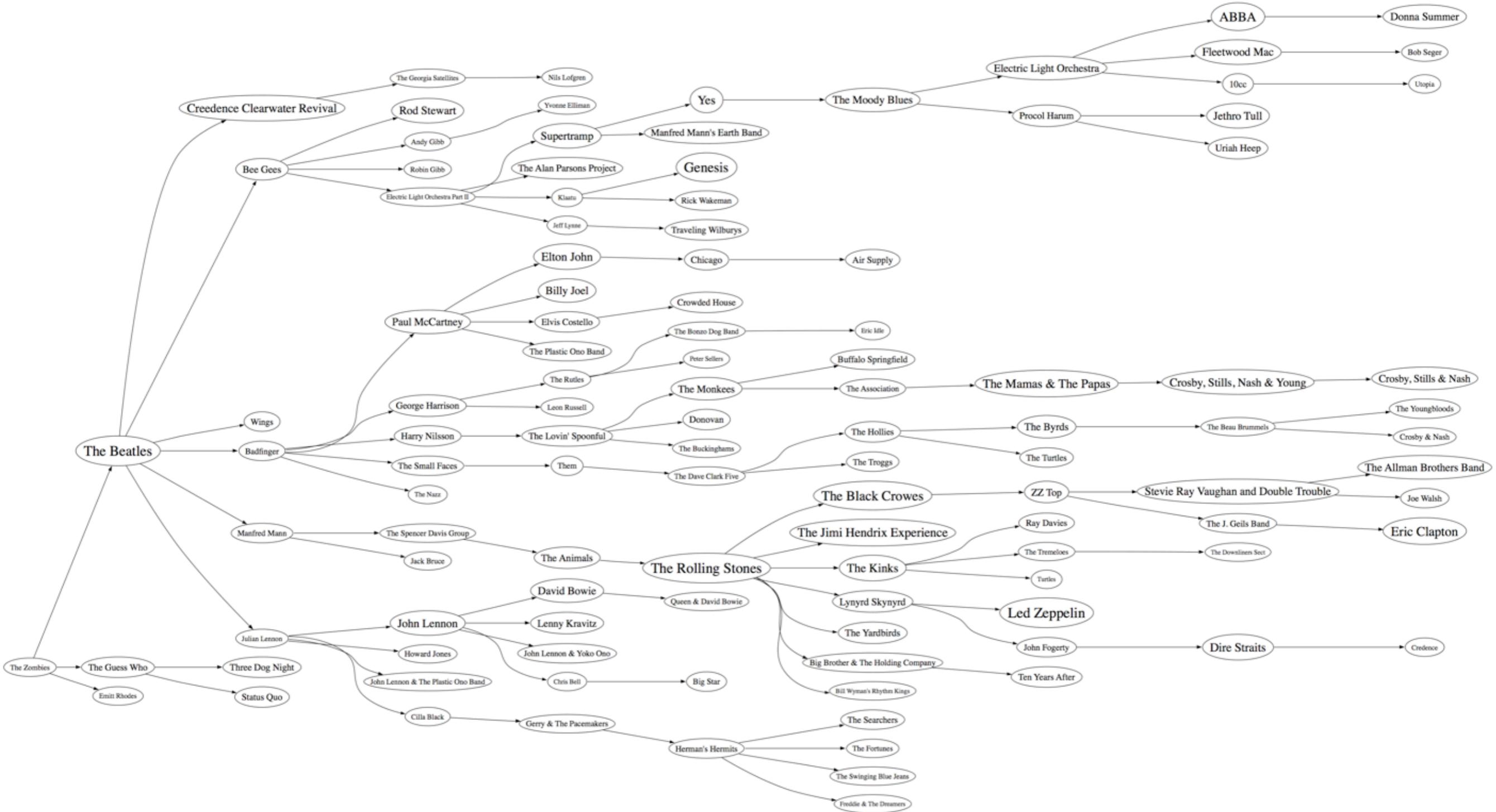
Build a minimum spanning tree from the graph

# Making the graph connected



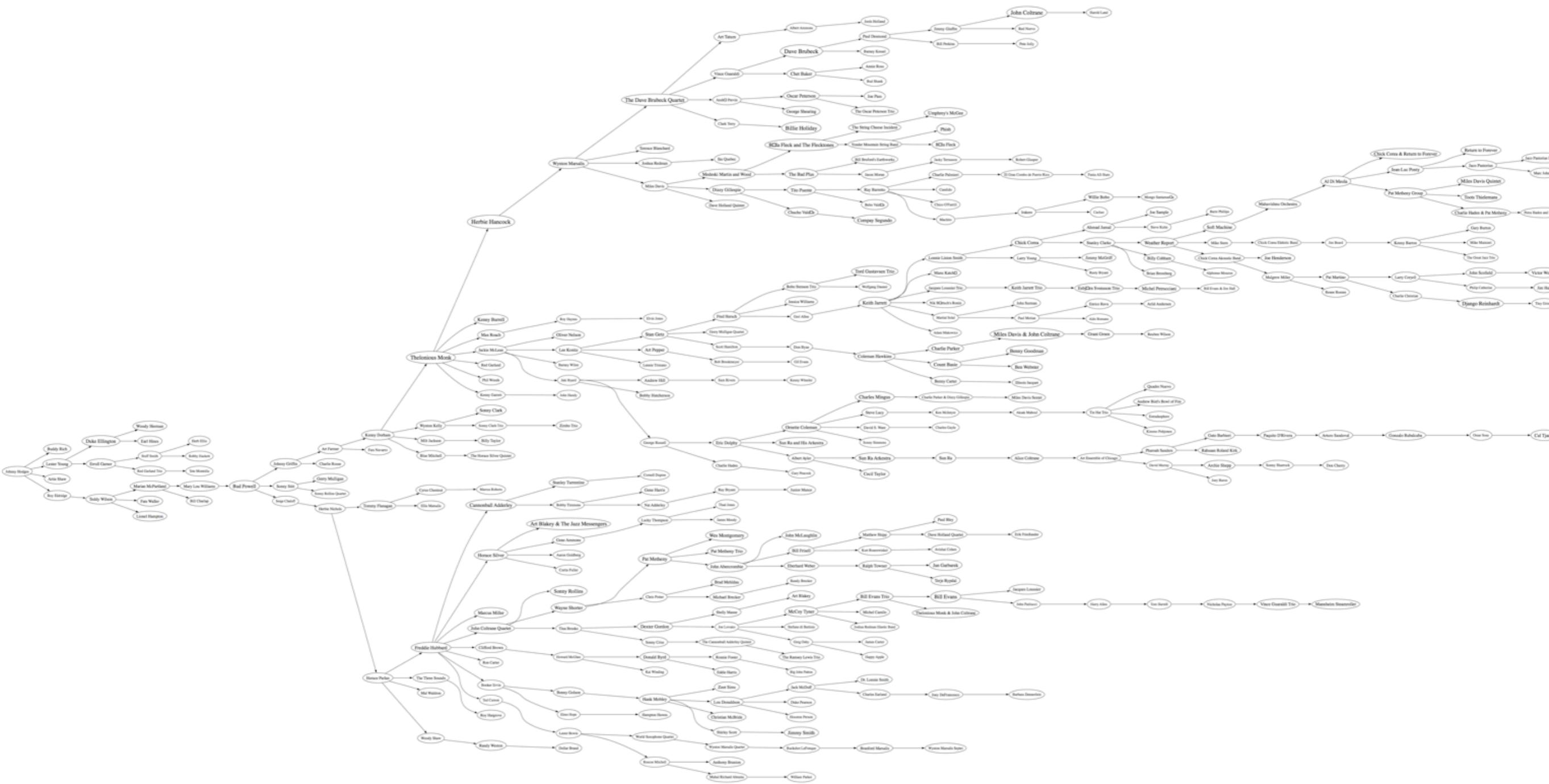
Build a minimum spanning tree from the graph

# Fixing the swinging blue jeans problem



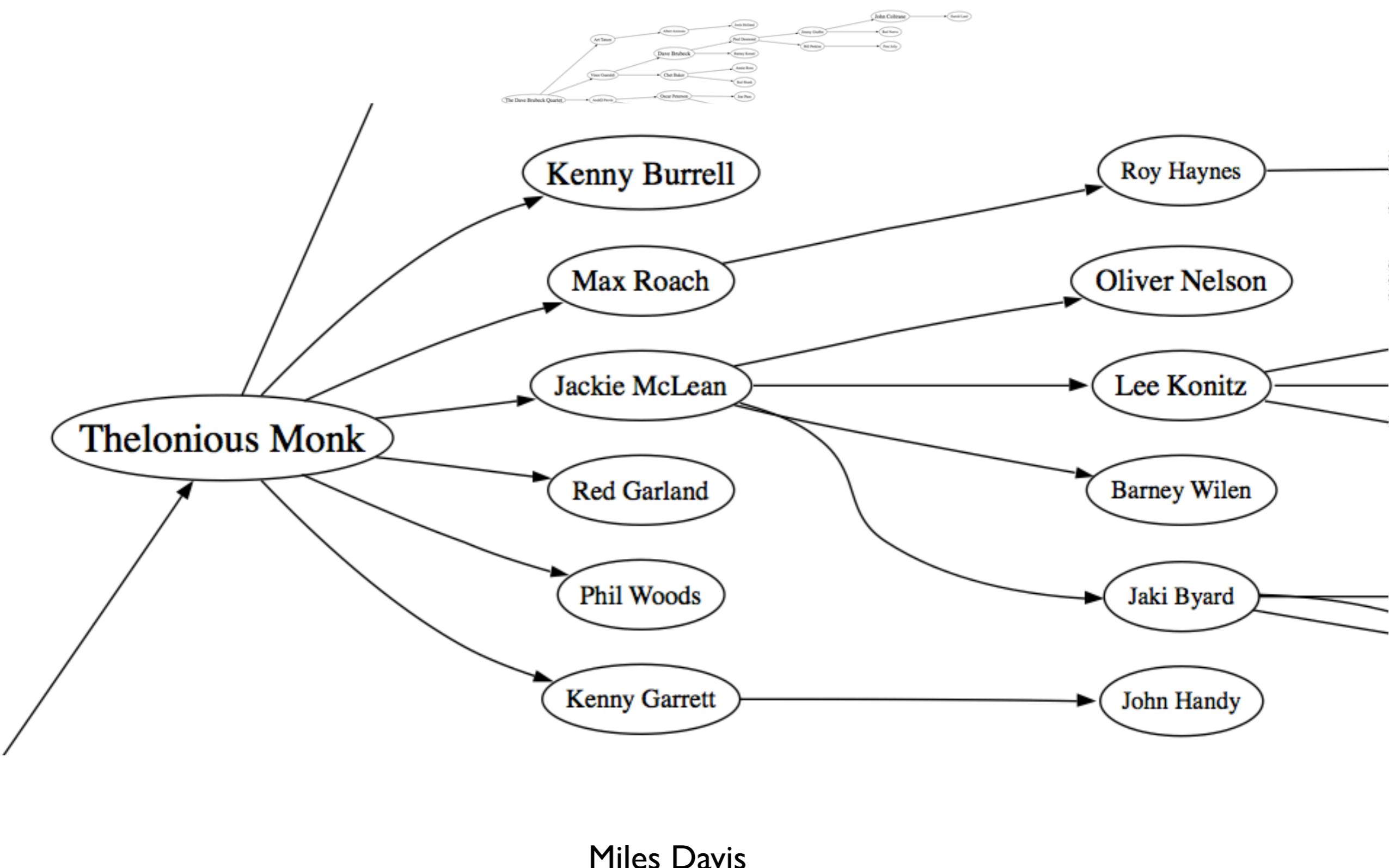
Prefer connections to bands of similar familiarity

# Other near-neighbor graphs

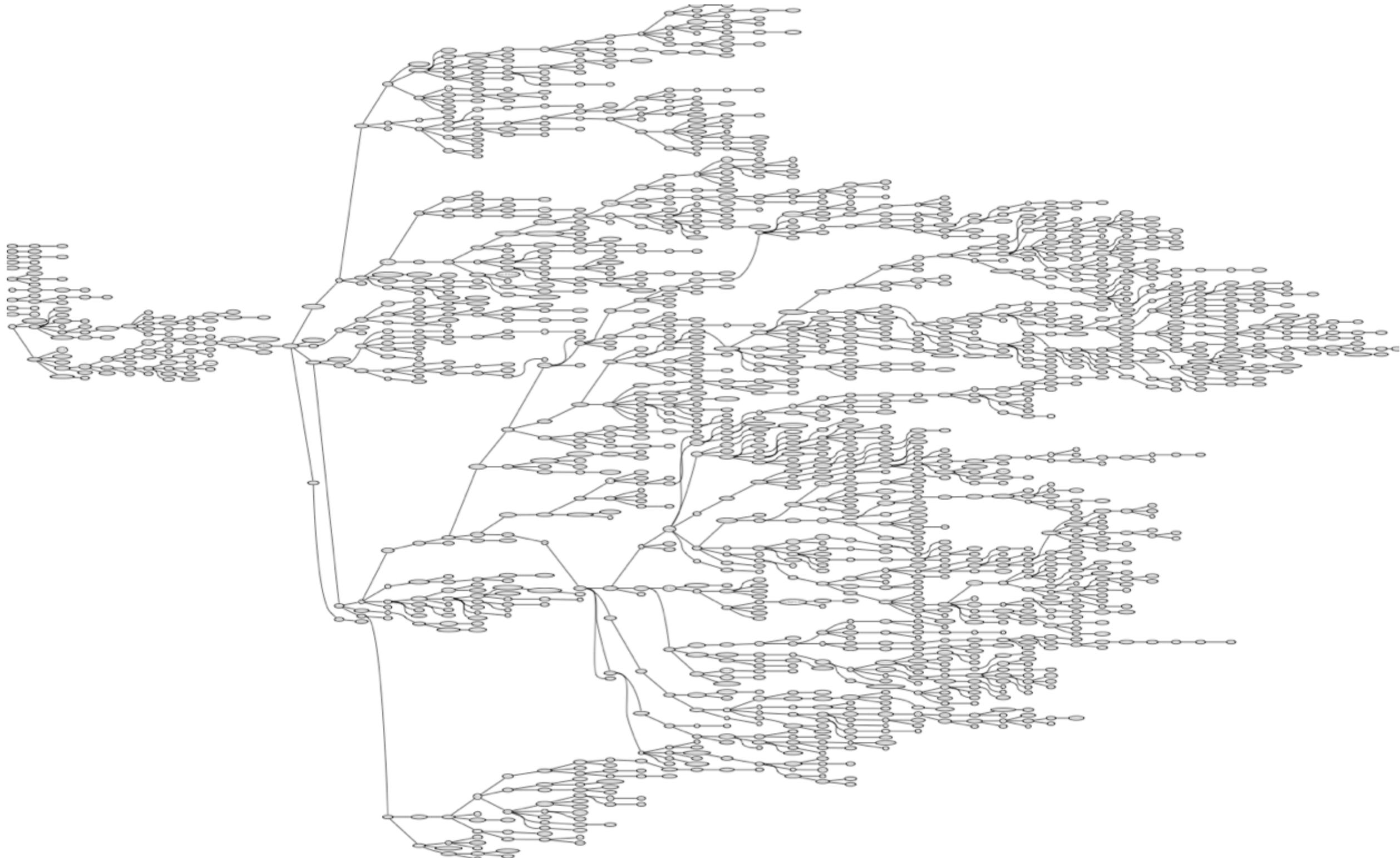


Miles Davis

# Other near-neighbor graphs

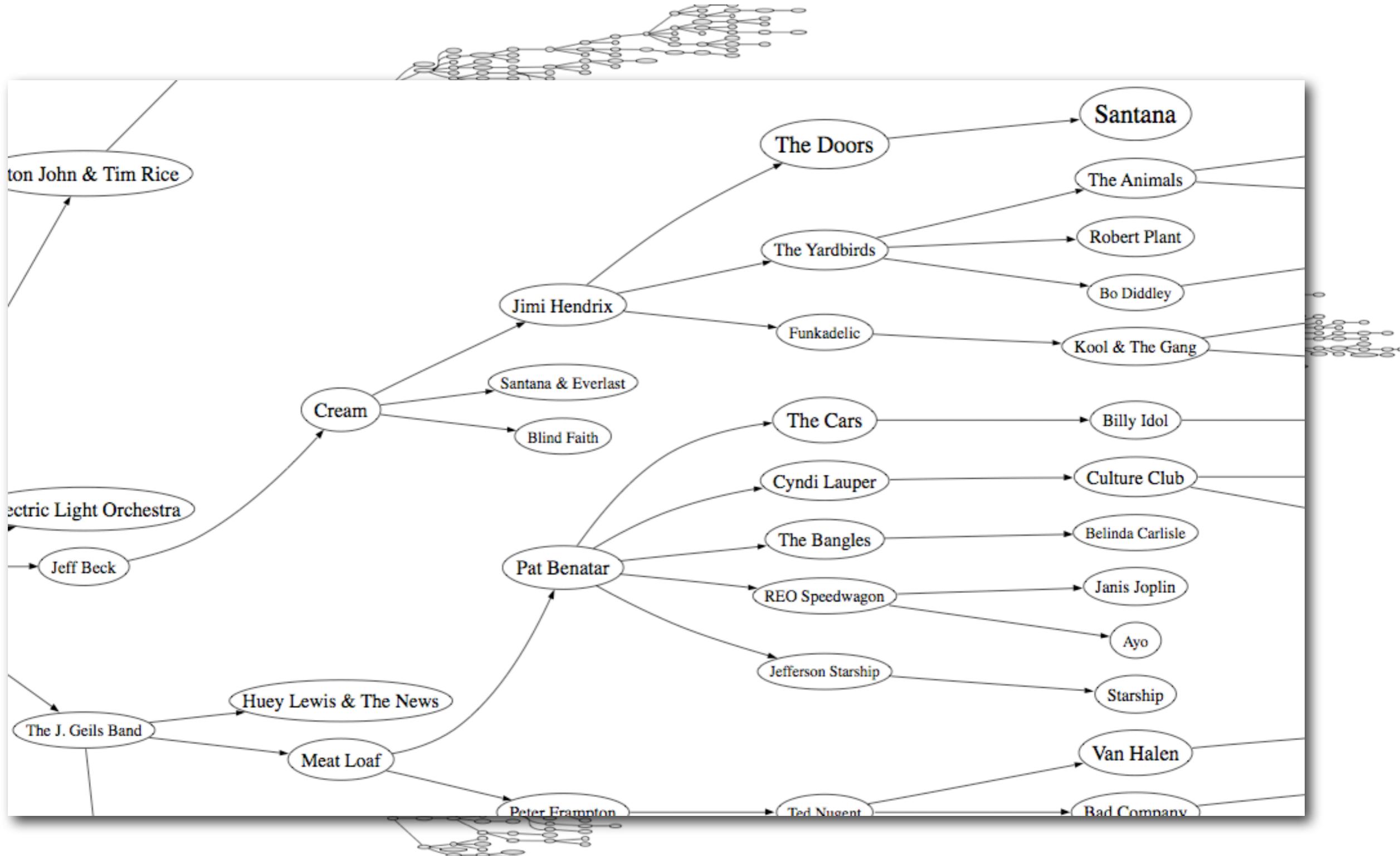


# 2K artists



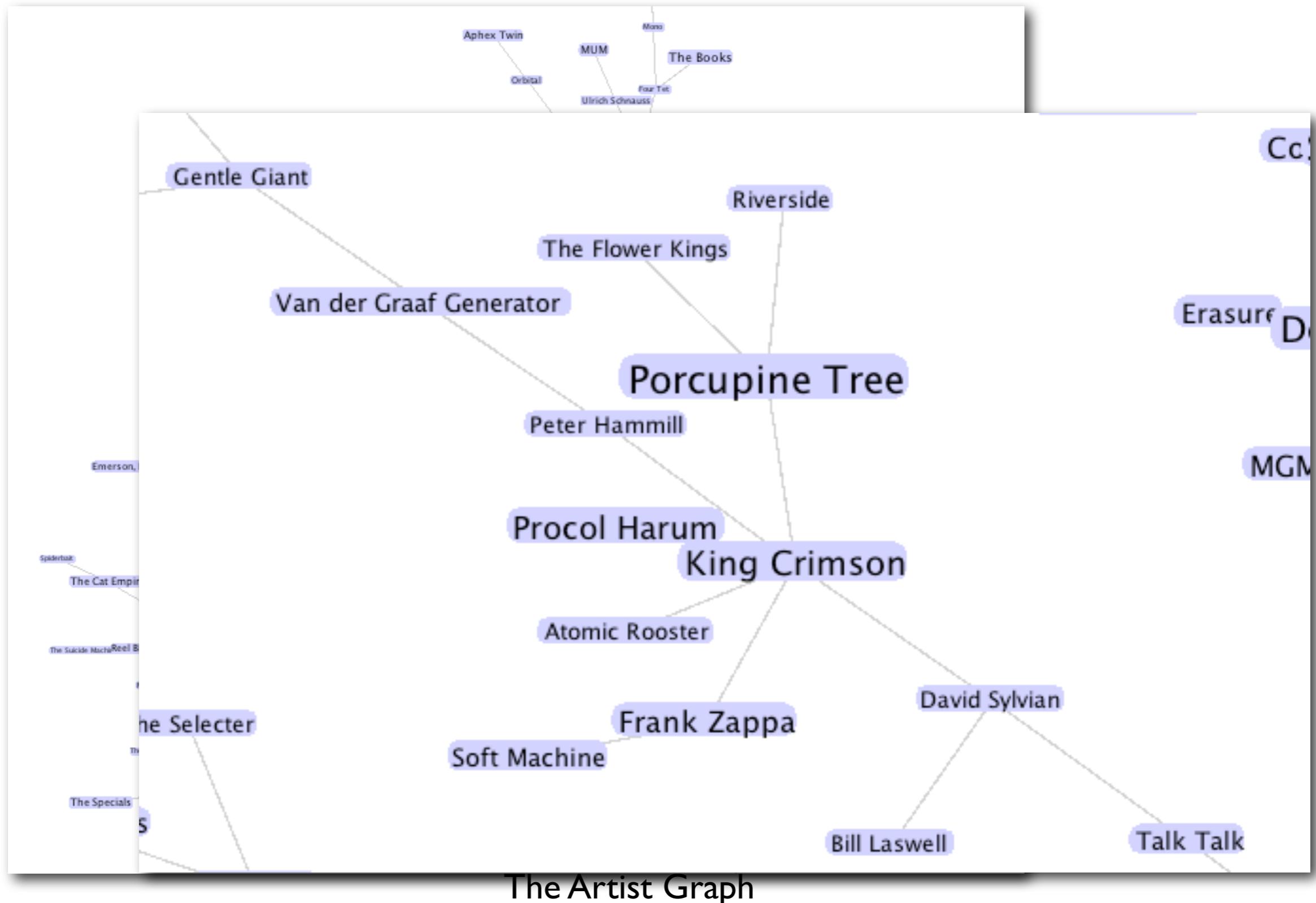
A browsing network for music discovery

# 2K artists

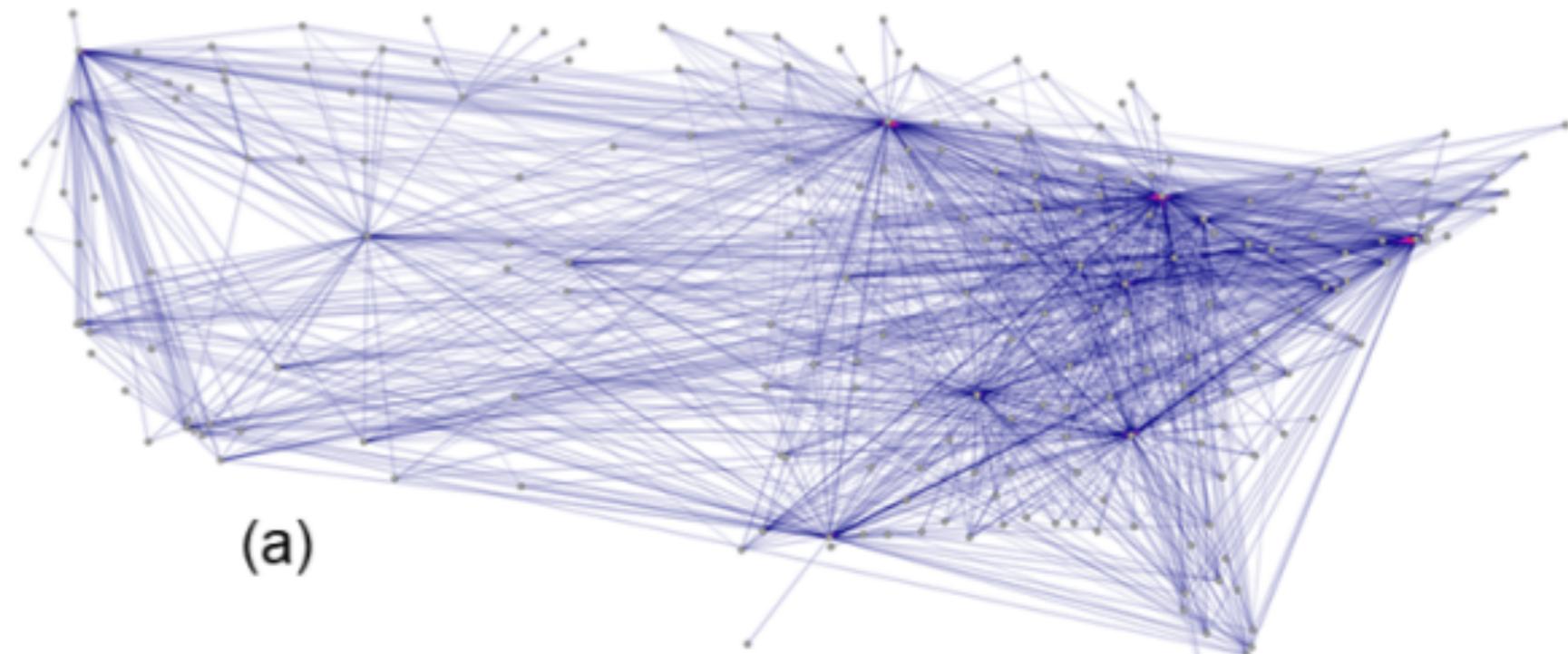


A browsing network for music discovery

# Making the graph interactive



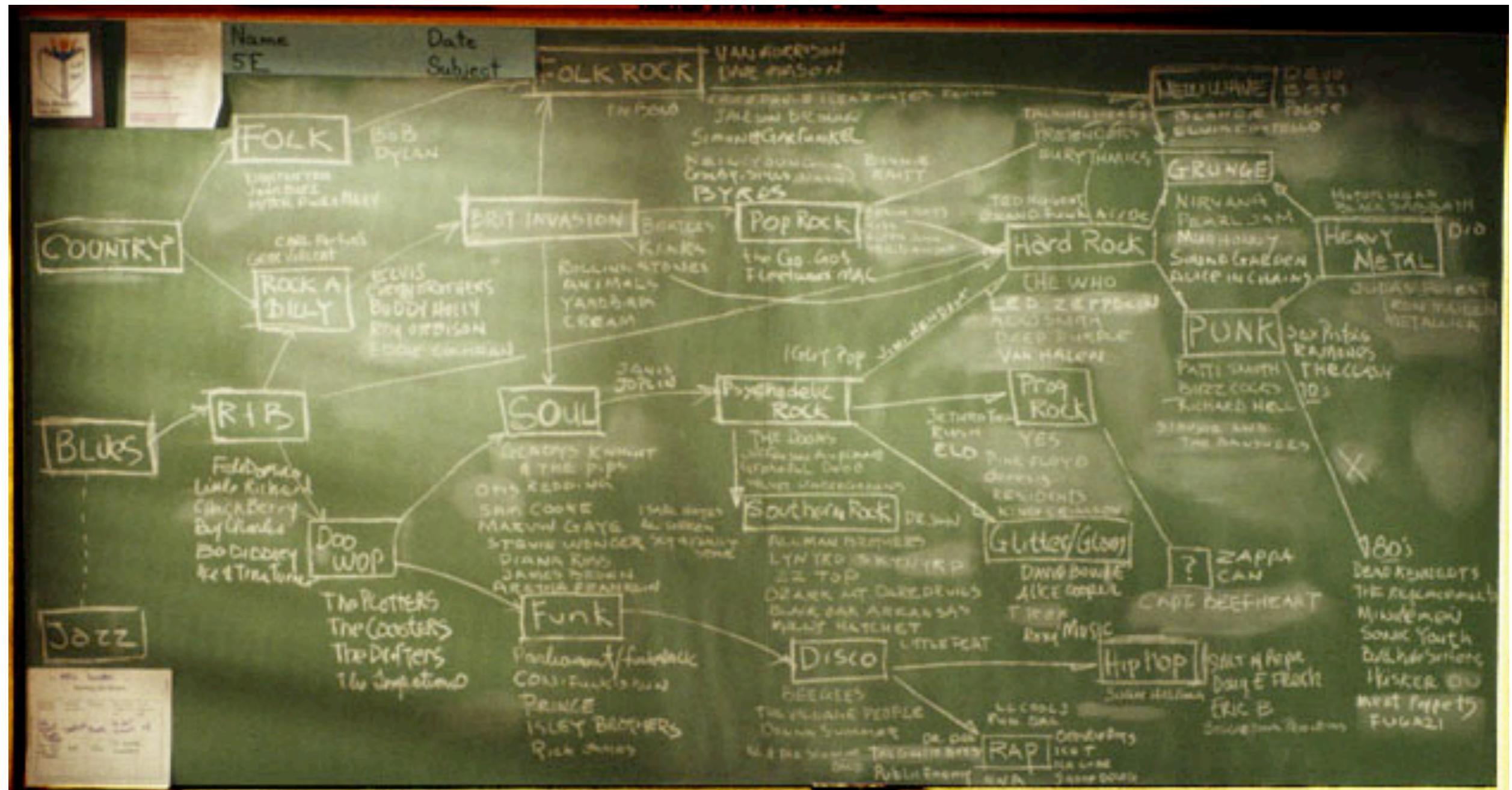
# Force-Directed Edge Bundling for Graph Visualization



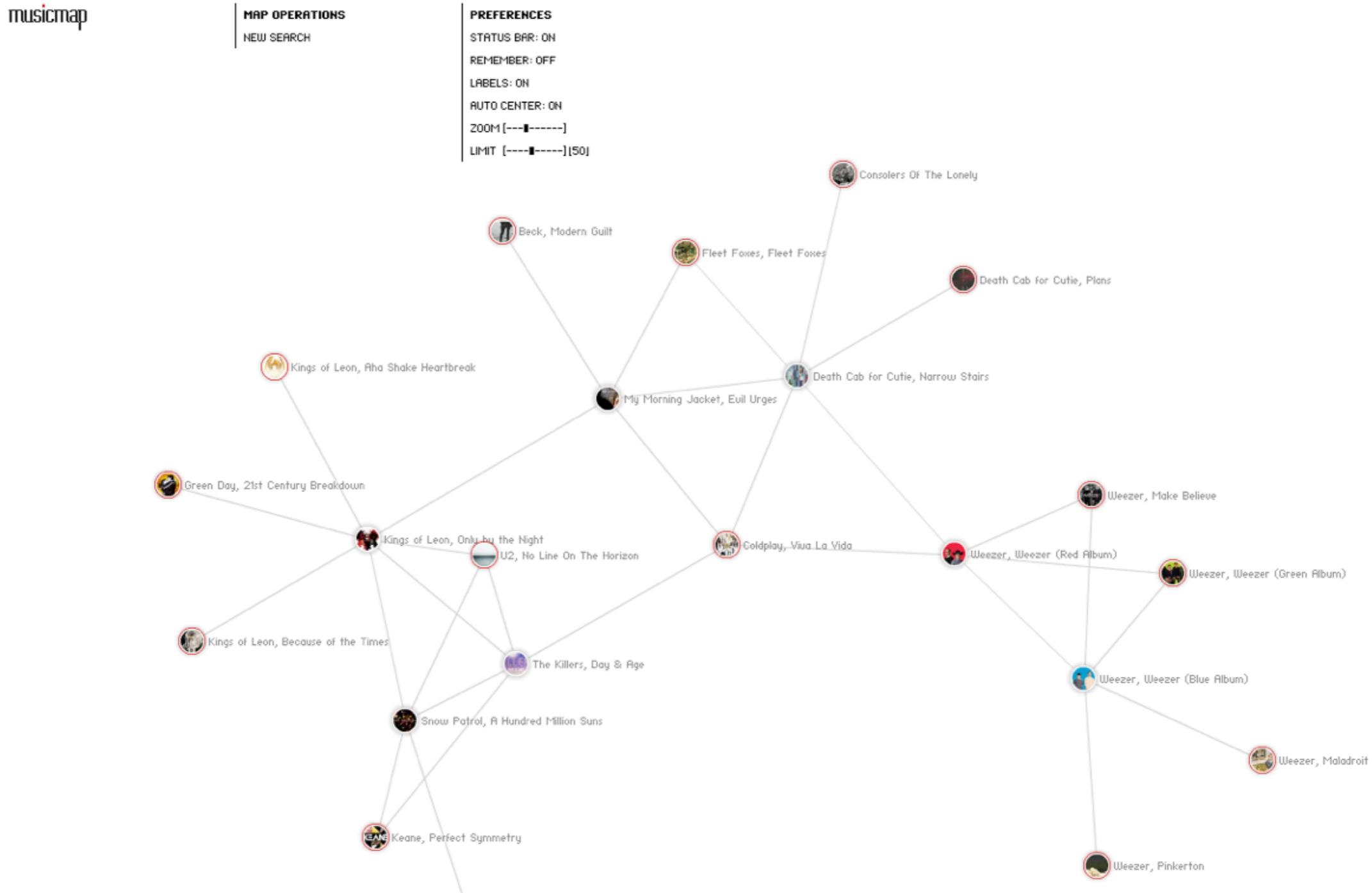
Danny Holten, Jarke J. van Wijk

# Survey of Music Visualizations

# Graphs

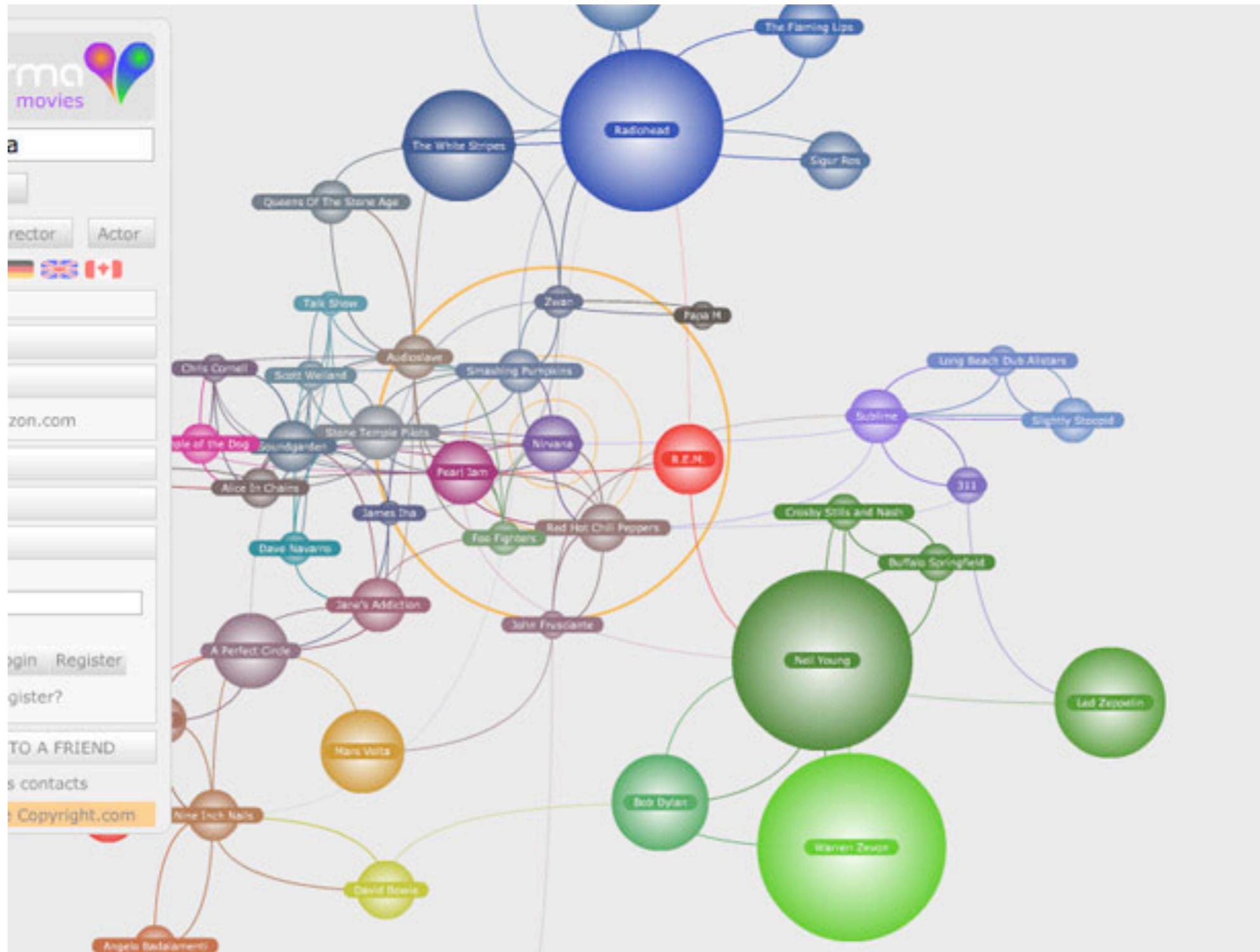


# musicmap



<http://www.dimvision.com/musicmap/>

# Music Plasma

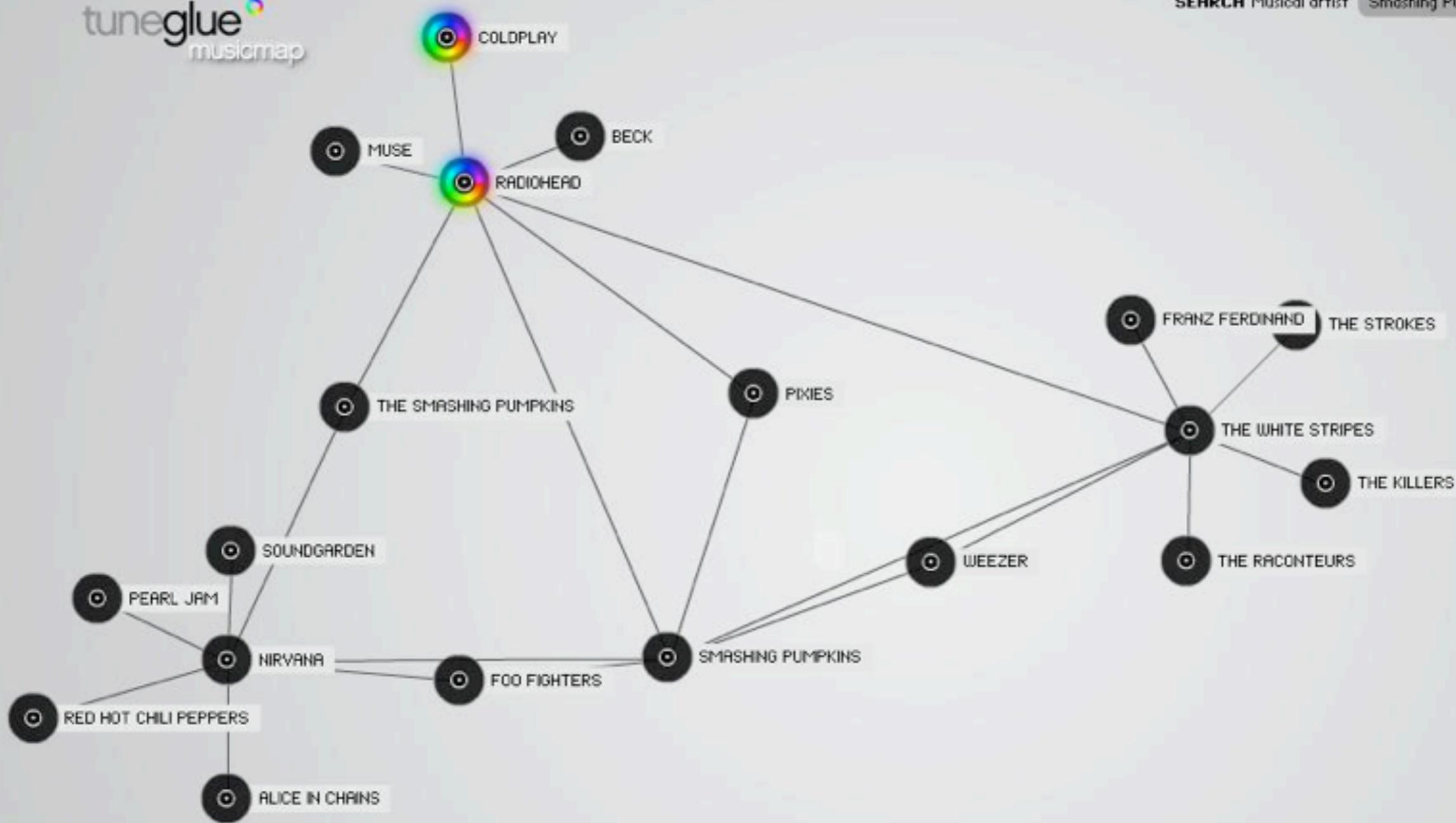


MusicPlasma.com

# tuneglue

tuneglue  
musicmap

SEARCH Musical artist Smashing Pumpkins



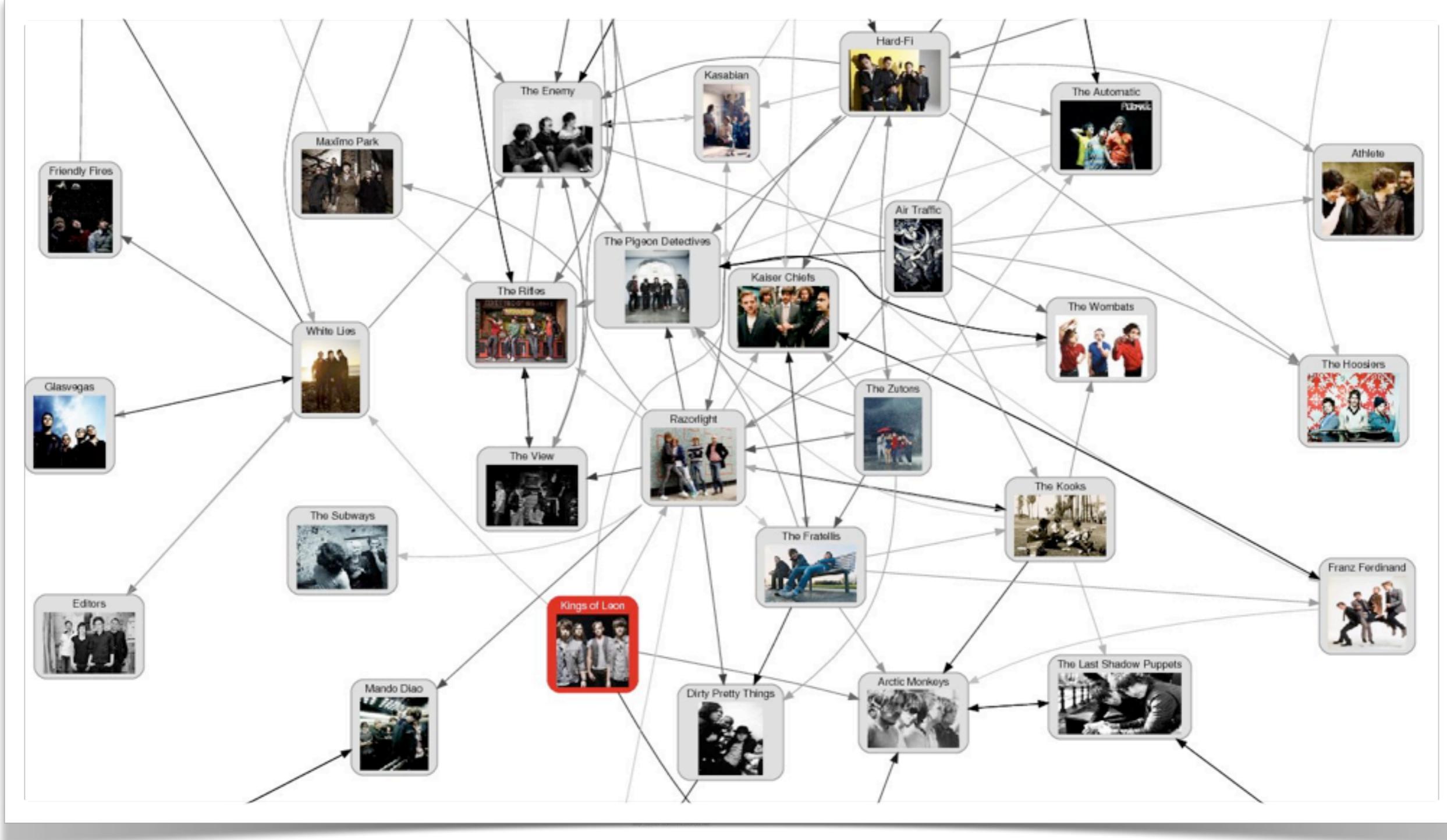
<http://audiomap.tuneglue.net/>

# Last.fm artist map



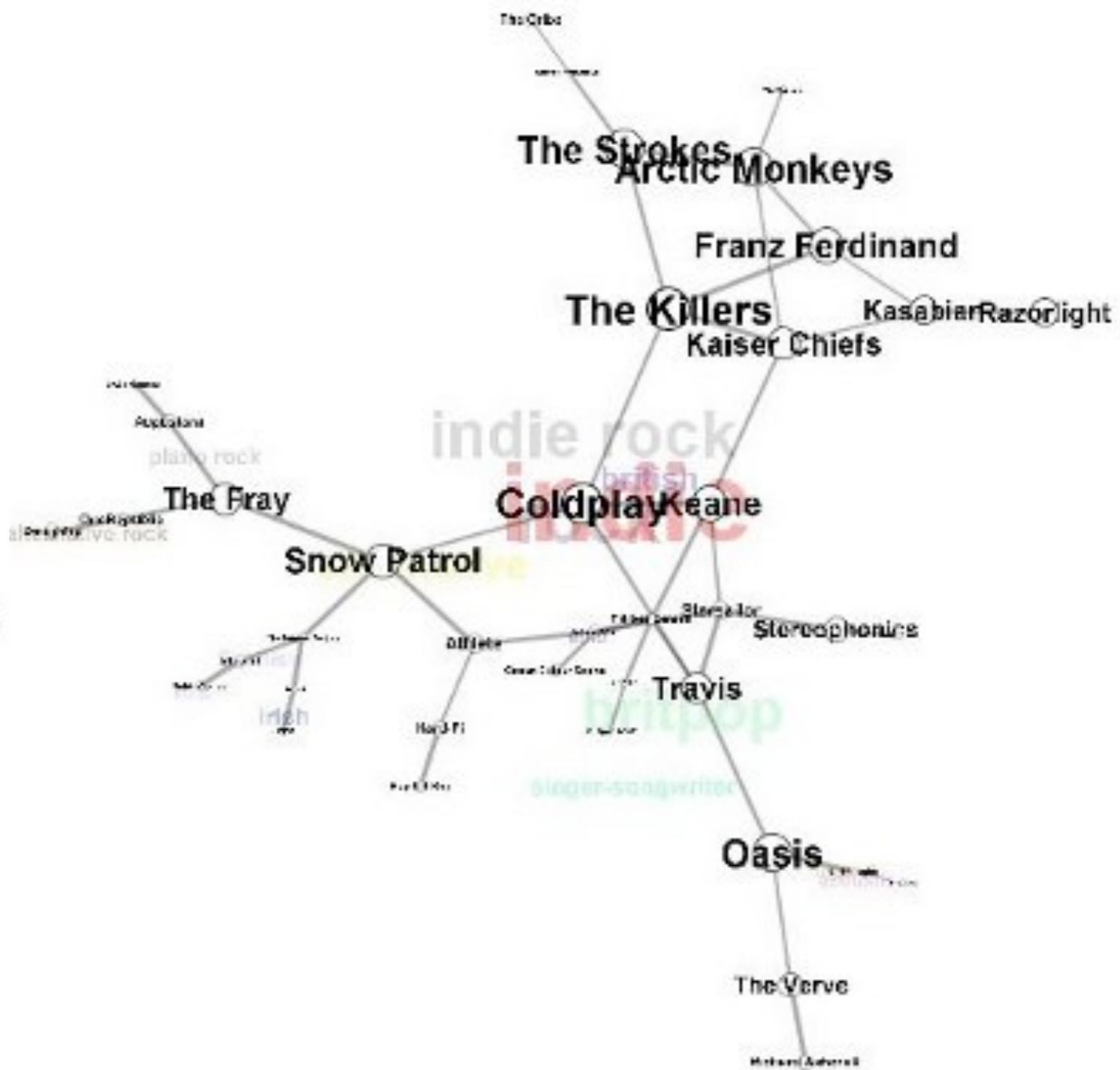
<http://lastfm.dontdrinkandroo.net/>

# Last.fm artist map



<http://lastfm.dontdrinkandroot.net/>

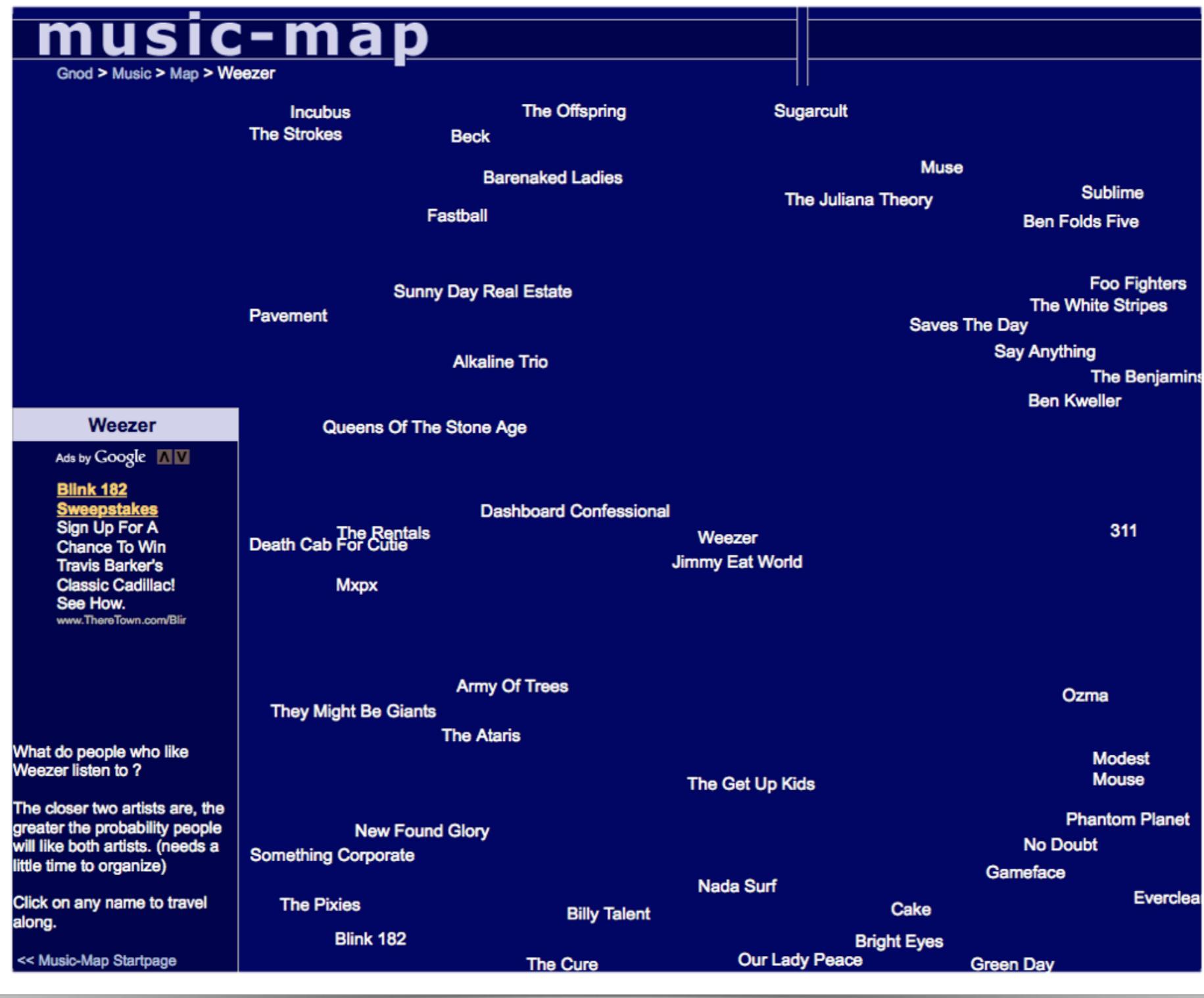
# RAMA - Relational Artist Maps



Late-Breaking Demo Session

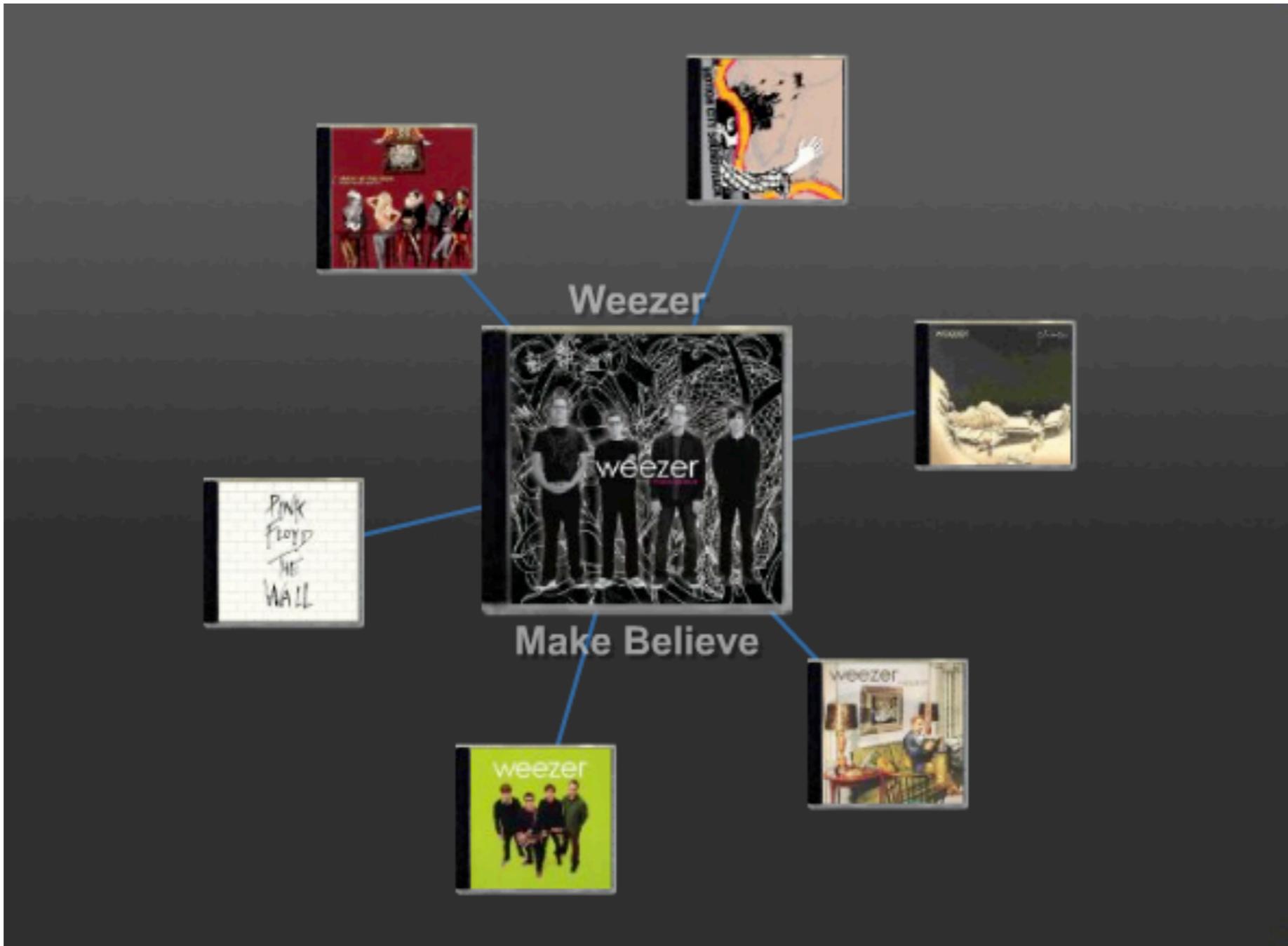
<http://rama.inescporto.pt/>

# gnod music-map



<http://www.music-map.com/>

# musicmesh



<http://www.musicmesh.net/>

# musicovery

musicovery

Mood: Energetic

Dark Positive

Calm

<< 50s 60s 70s 80s 90s 00s all

All Genres

- jazz
- gospel
- blues
- metal
- rock
- folk
- country
- vocal pop
- pop
- disco
- r & b
- rap
- electro
- latino
- classical
- soundtrack
- world
- reggae
- soul
- funk

Define your Musical Universe  
» more infos » register

Registered Member  
» Log in

Wii Musicovery  
on Wii

Musicovery on Mobile  
» more infos

The central network graph consists of nodes representing artists and songs, connected by lines of varying thicknesses. Nodes include:

- Linkin Park: Crawling
- Coldplay: Talk
- Lenny Kravitz: It's your life
- Ben Folds: Annie waits
- Muse: Bliss
- Linkin Park: Faint
- Guns N'Roses: Welcome to the jungle
- David Guetta: Love Is Gone (Radio Edit)
- David Guetta: Love Is Gone (Original Mix)
- The Strokes: Reptilia
- Kasabian: Club foot
- Dax Riders: I was made for loving you
- Finch: Post Script
- Linkin Park: Bleed It Out
- Travis: Sing
- Placebo: Pure morning
- Green Day: Boulevard Of Broken Dreams
- The Beastie Boys: Ch-check in out
- Blink 182: Story Of A Lonely Guy
- Blink 182: What's My Age Again
- The Killers: Smile like you mean it
- Red Hot Chili Peppers: The Other Side
- Keane: Put It Behind You
- Britney Spears: Overprotected
- Breaking Benjamin: Saturate
- Finch: Post Script
- Linkin Park: Bleed It Out
- Travis: Sing
- Placebo: Pure morning
- Green Day: Boulevard Of Broken Dreams
- The Beastie Boys: Ch-check in out

Below the graph, several player interfaces are shown, each displaying a song and control buttons (play, skip, volume, etc.).

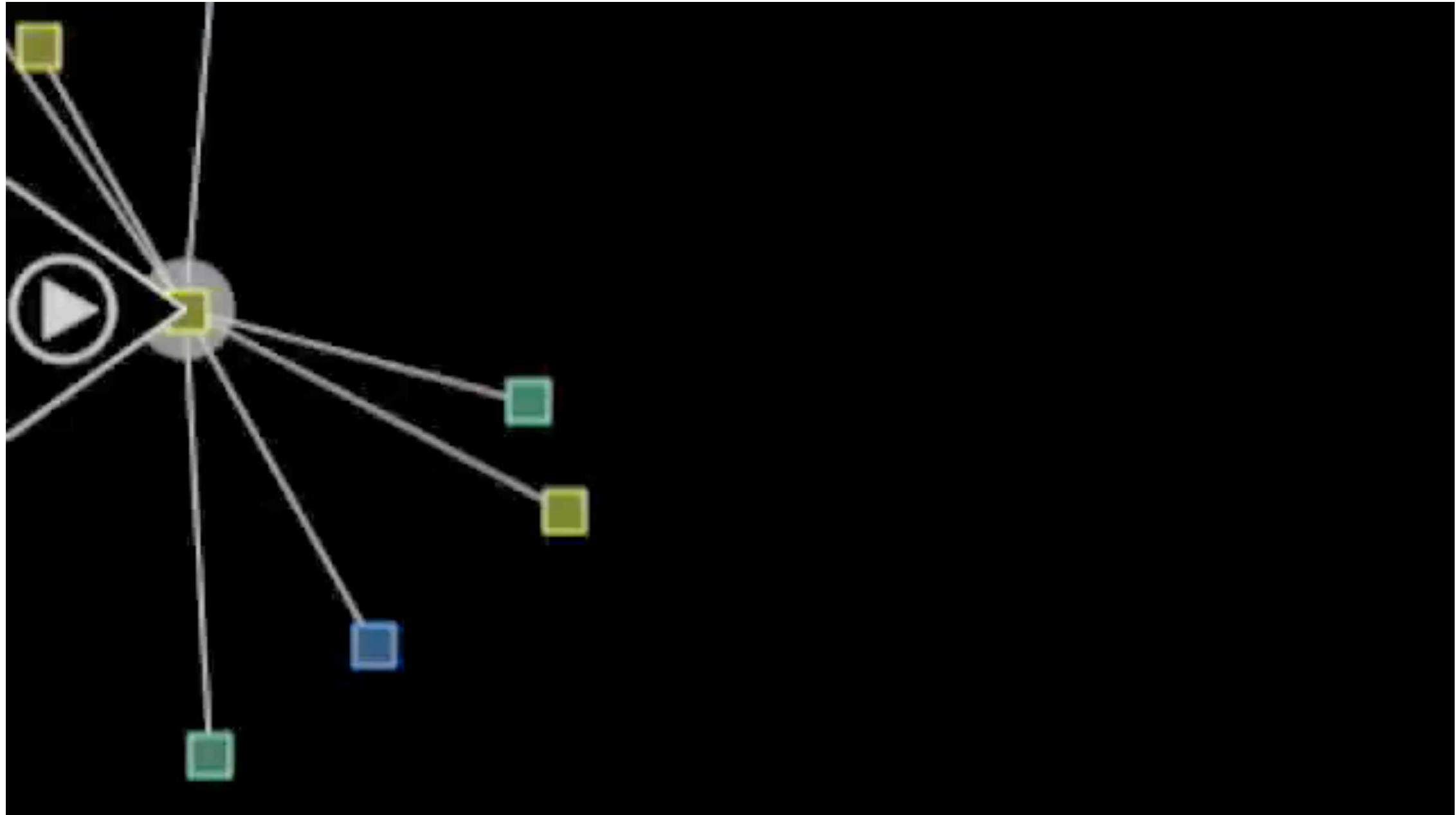
<http://musicovery.com/>

104

# SoundBite for SongBird

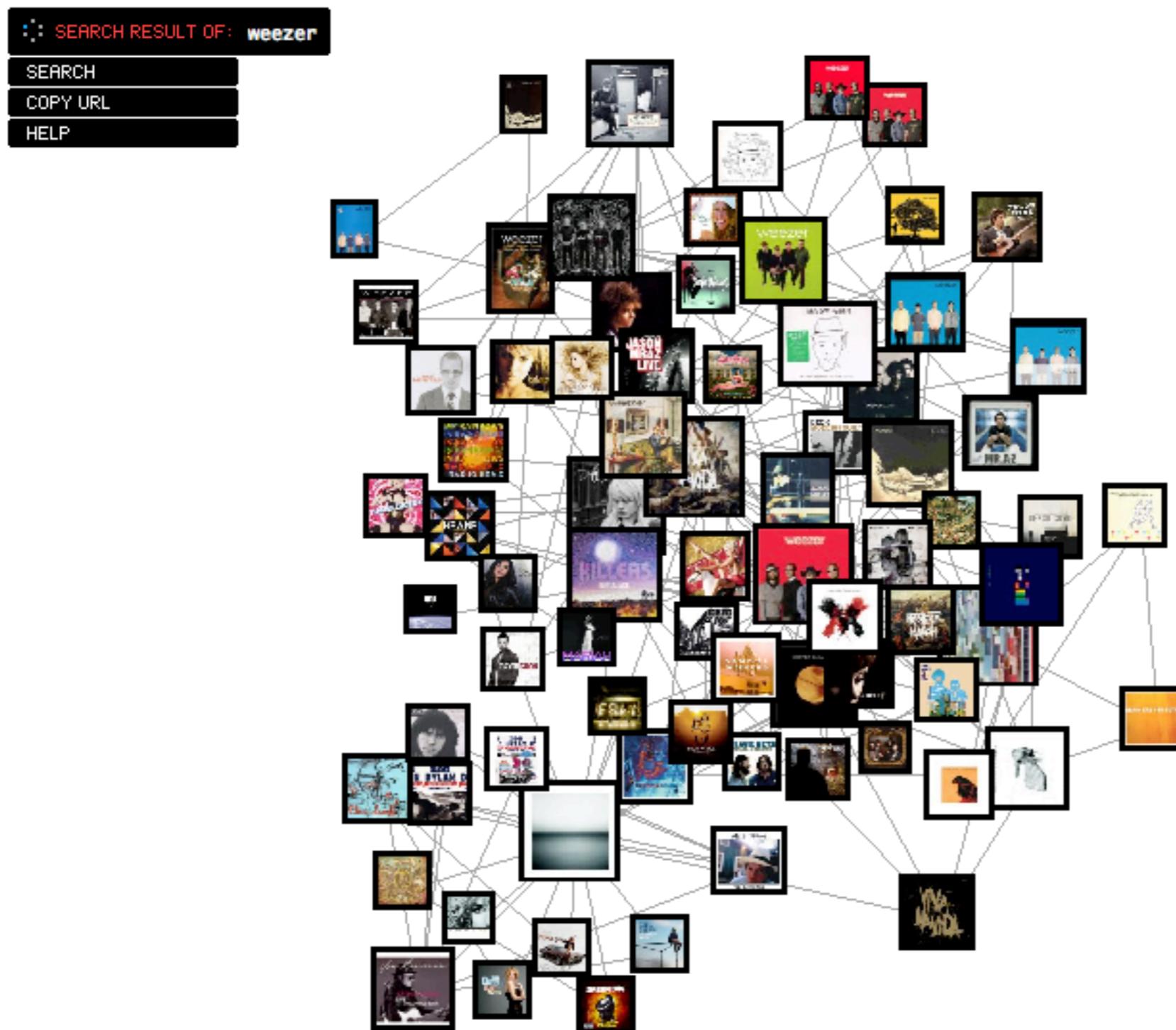
<http://www.repeatingbeats.com/thesis.php> - Steve Lloyd - QMUL

# SoundBite for SongBird



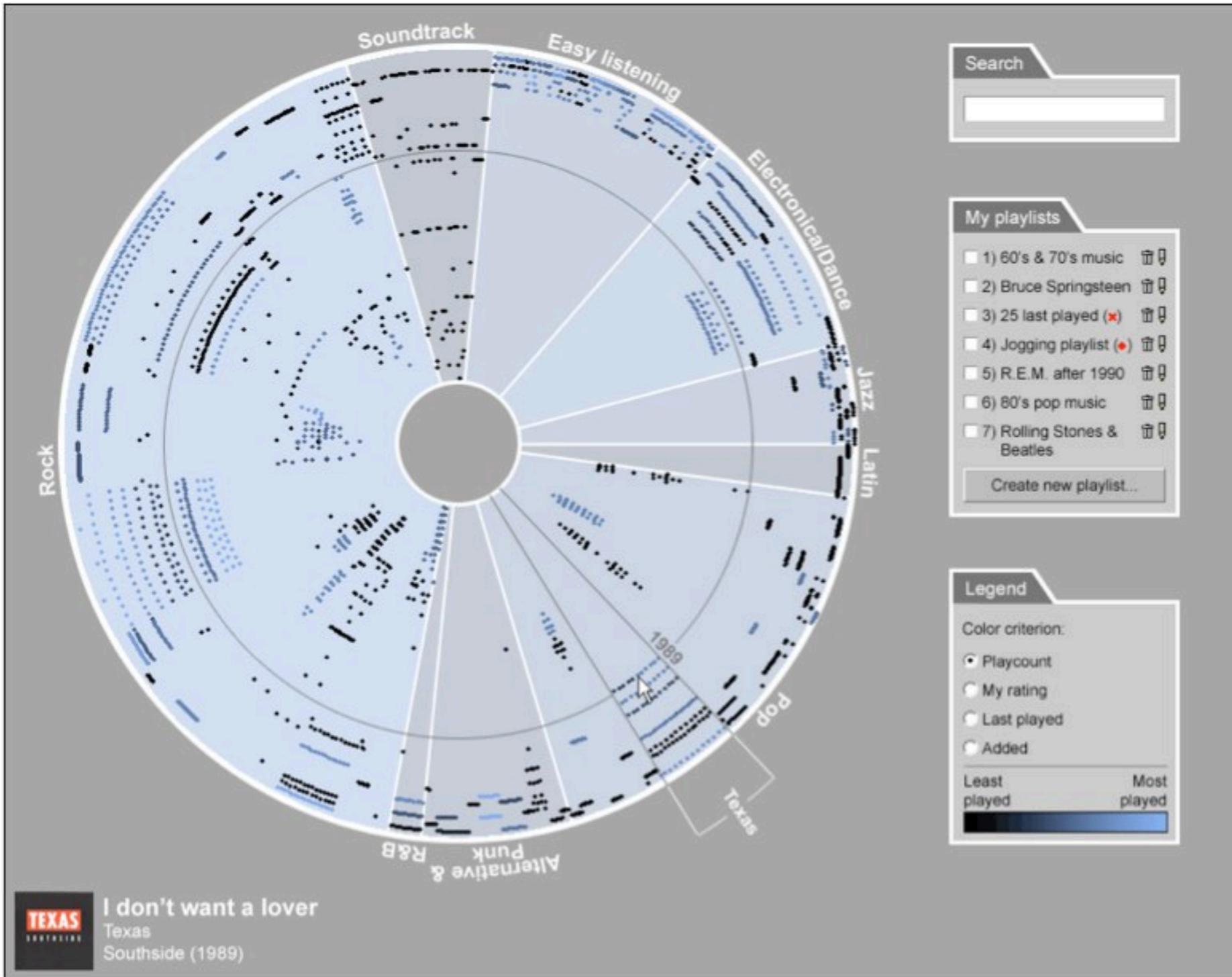
<http://www.repeatingbeats.com/thesis.php> - Steve Lloyd - QMUL

# Amaznode



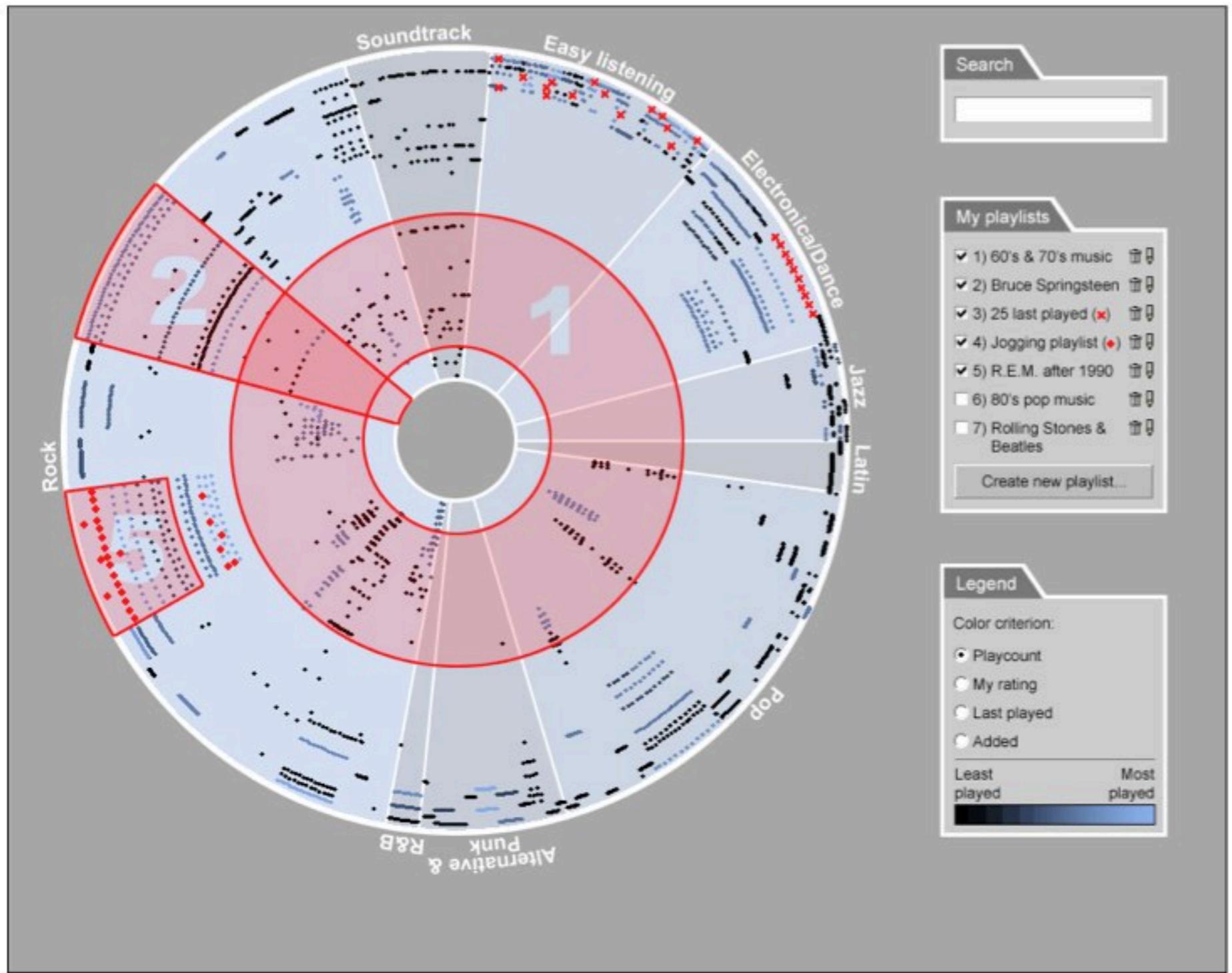
<http://amaznode.fladdict.net/>

# Visualizing and Exploring Personal Libraries



<http://torrens.files.wordpress.com/2009/06/ismir.pdf>  
Torrens, Patrick Hertzog, Josep-Lluís Arcos

# Visualizing and Exploring Personal Libraries



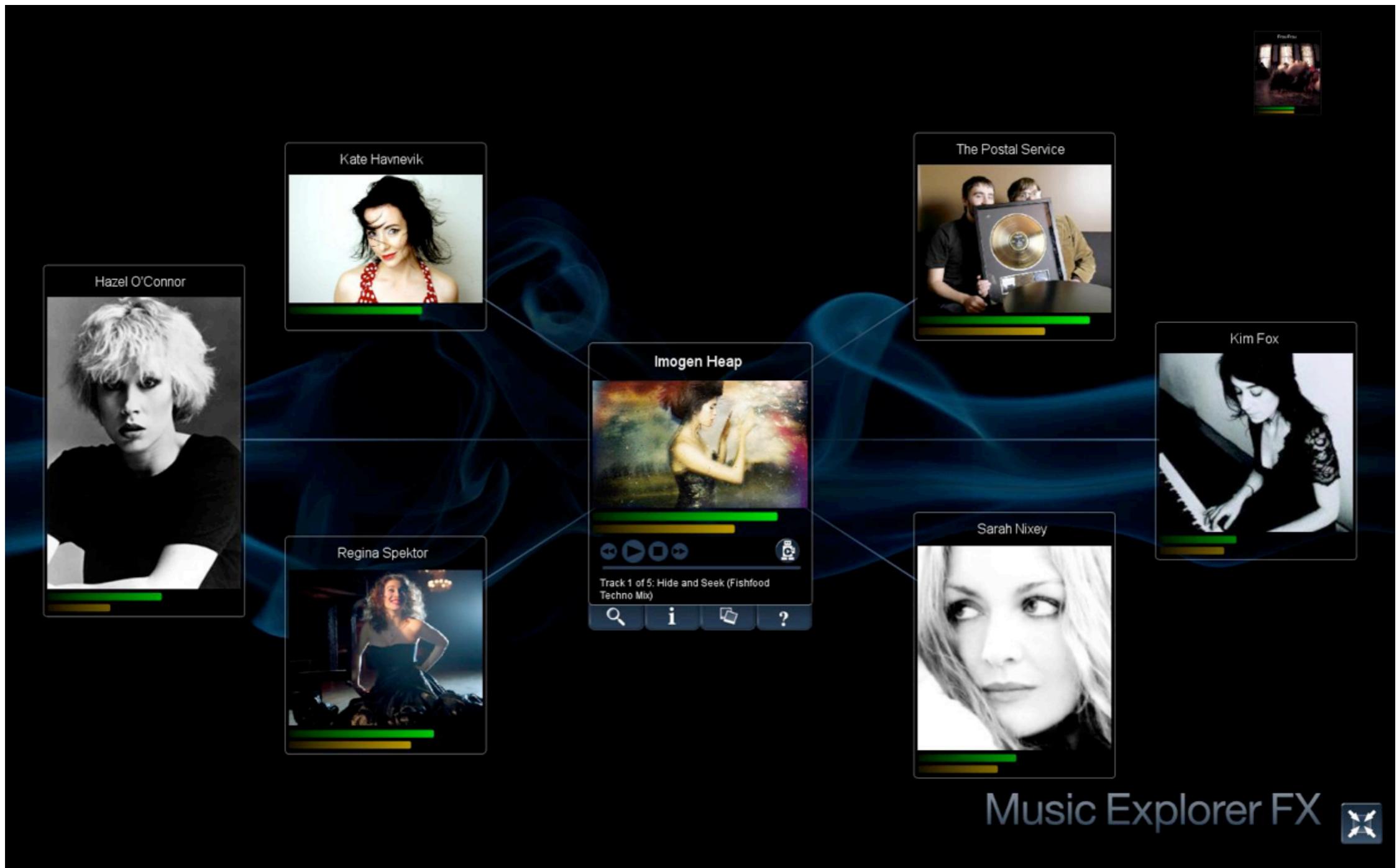
<http://torrents.files.wordpress.com/2009/06/ismir.pdf>  
Torrens, Patrick Hertzog, Josep-Lluís Arcos

# Visualizing and Exploring Personal Libraries



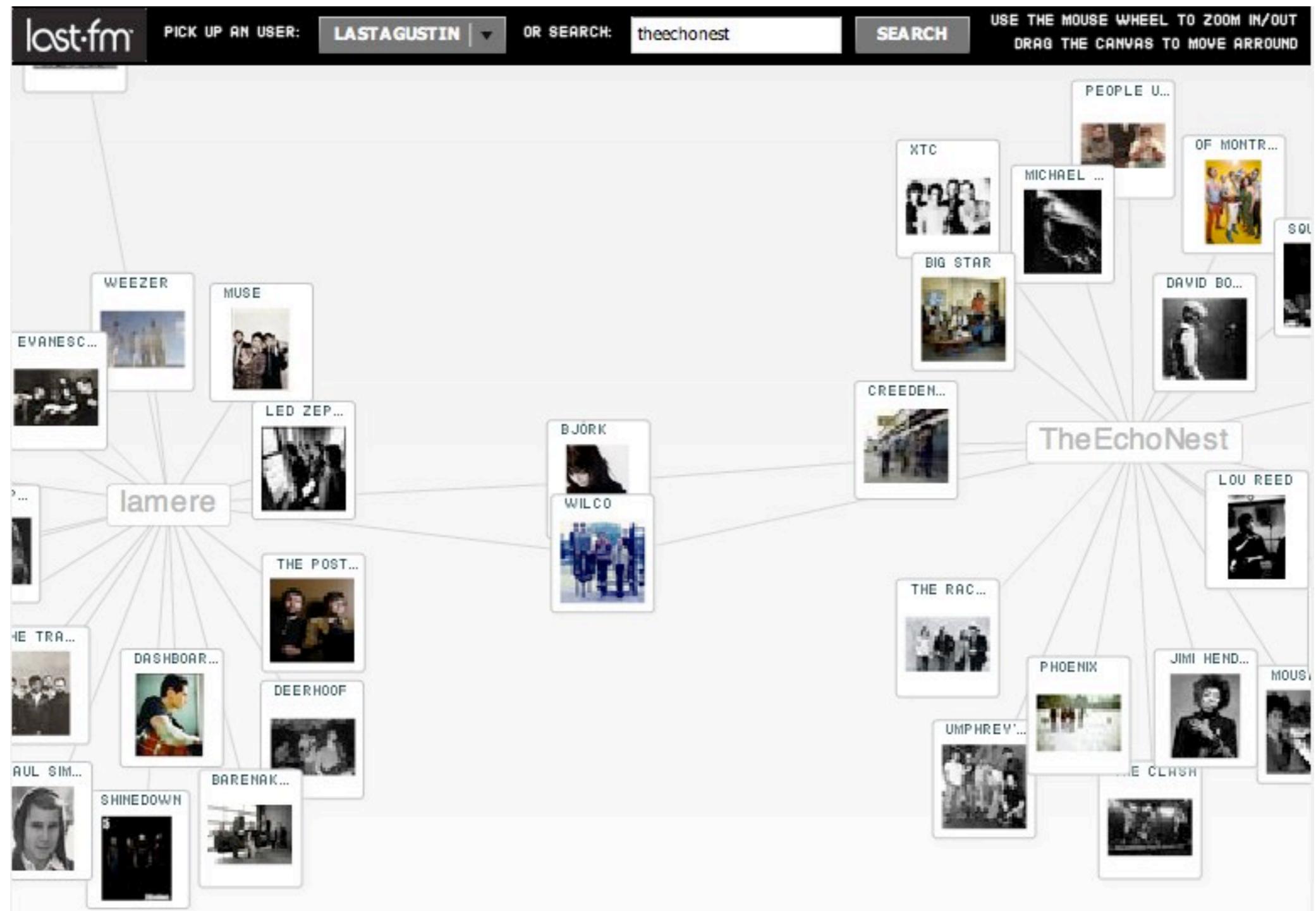
<http://torrents.files.wordpress.com/2009/06/ismir.pdf>  
Torrens, Patrick Hertzog, Josep-Lluís Arcos

# Music Explorer FX



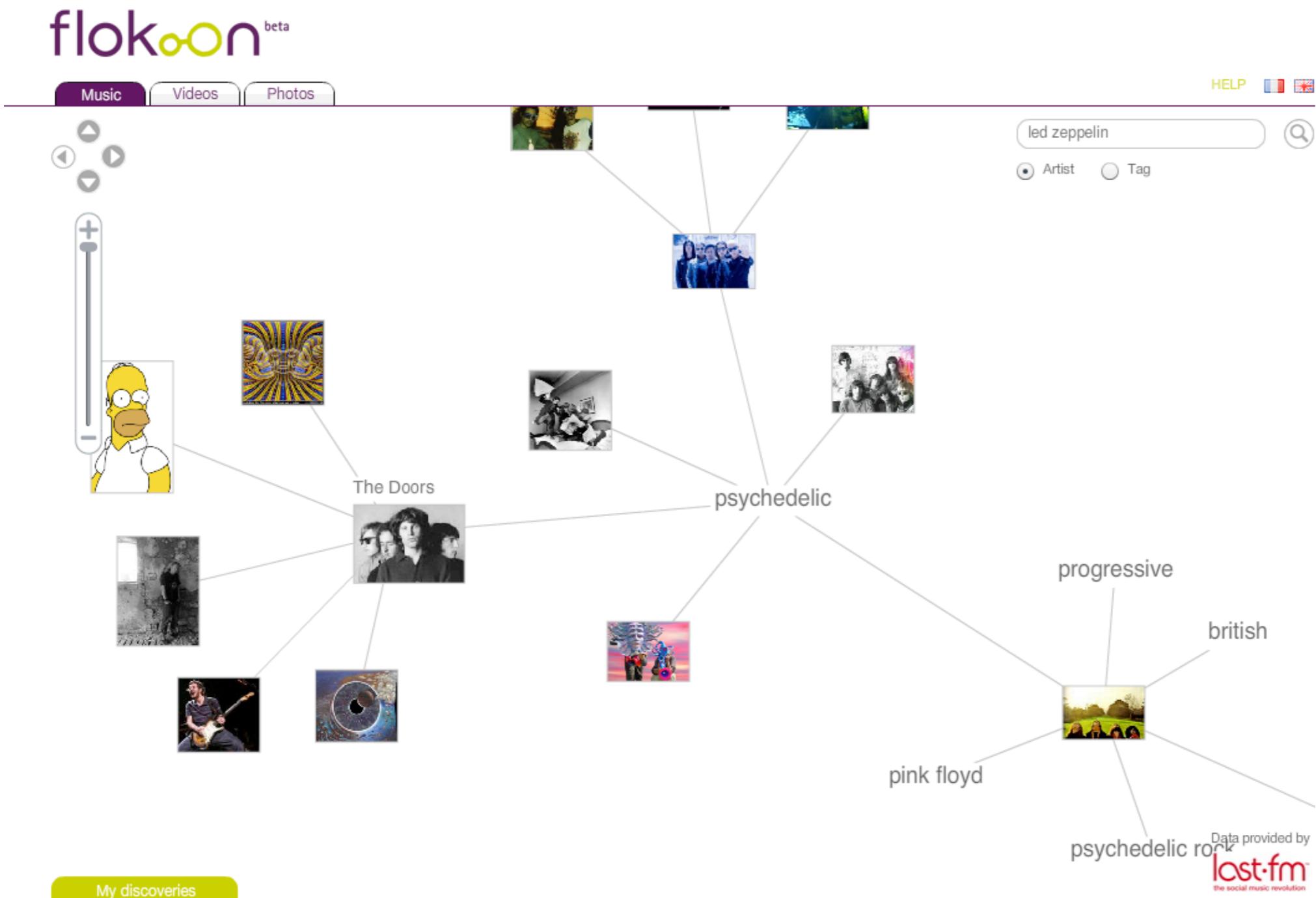
<http://musicexplorervfx.citytechinc.com/>

# Social Music Discovery



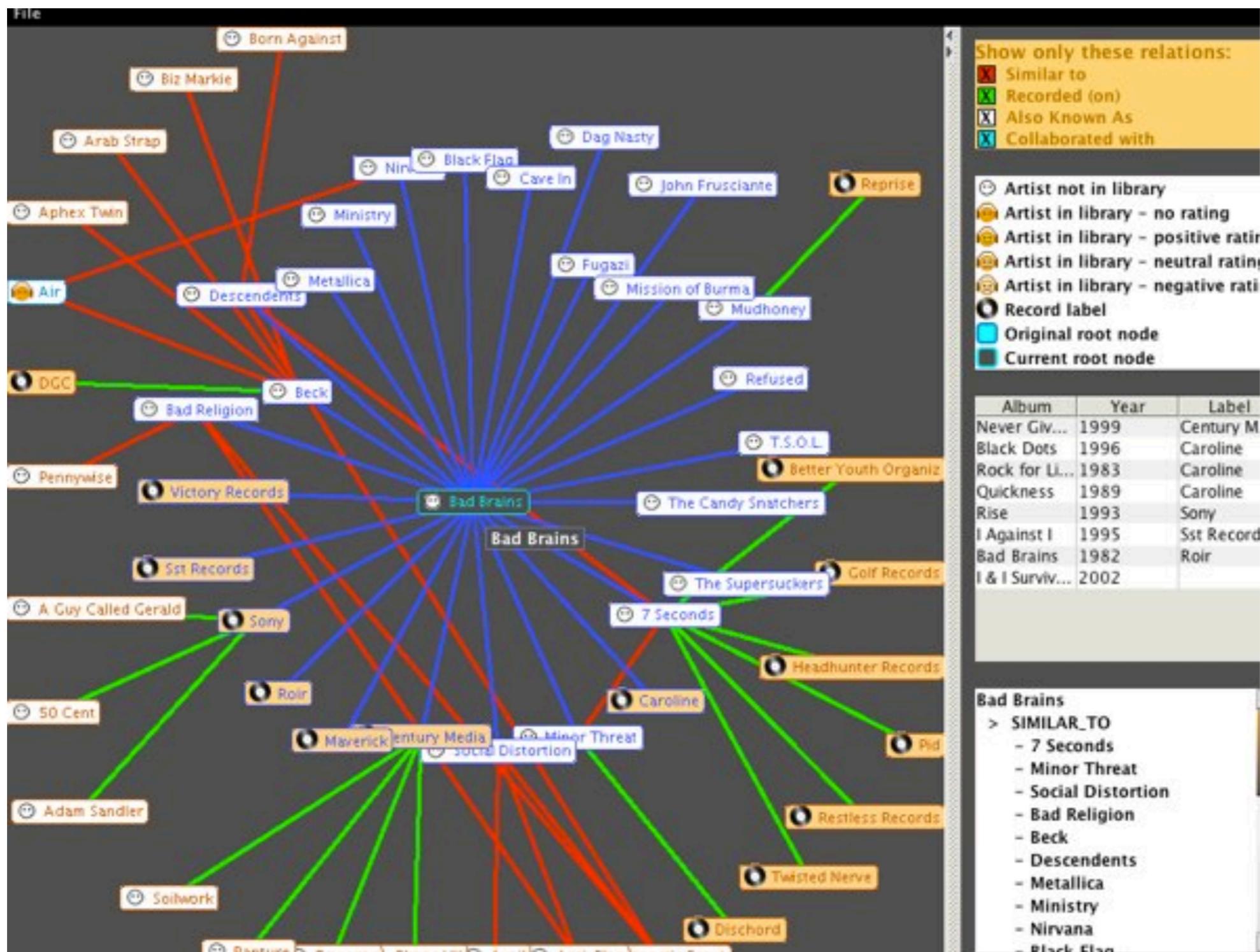
Last FM tasteOgraph  
<http://geniol.publishpath.com/last-fm-tasteograph>

# Floko-On



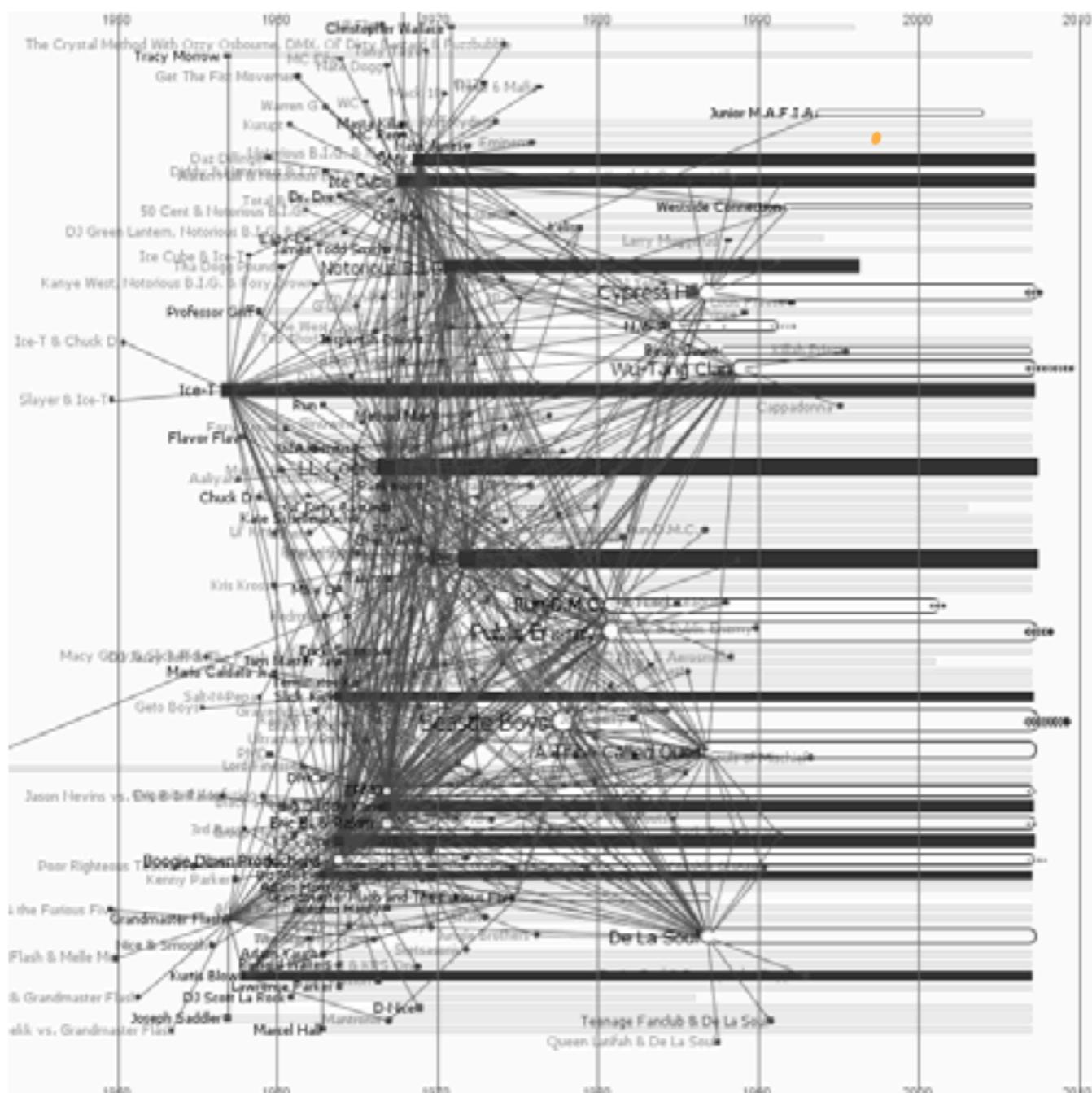
<http://www.flokoon.com/#lastfm>

# Project Orpheus



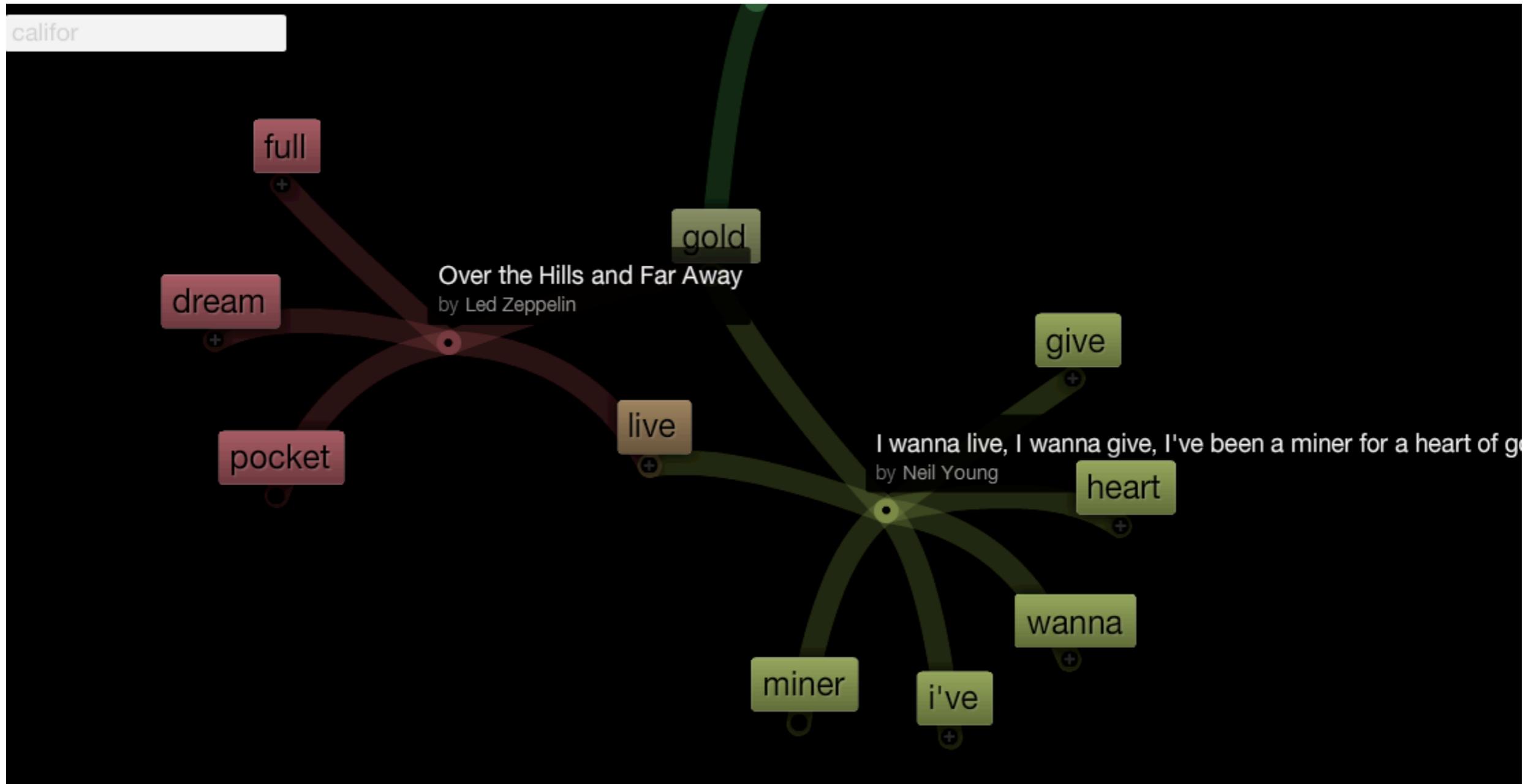
<http://arcus-associates.com/orpheus/>

# Musician Map: visualizing music collaborations over time



<http://www.sfu.ca/~jdyim/musicianMap/>  
Ji-Dong Yim Chris Shaw Lyn Bartram

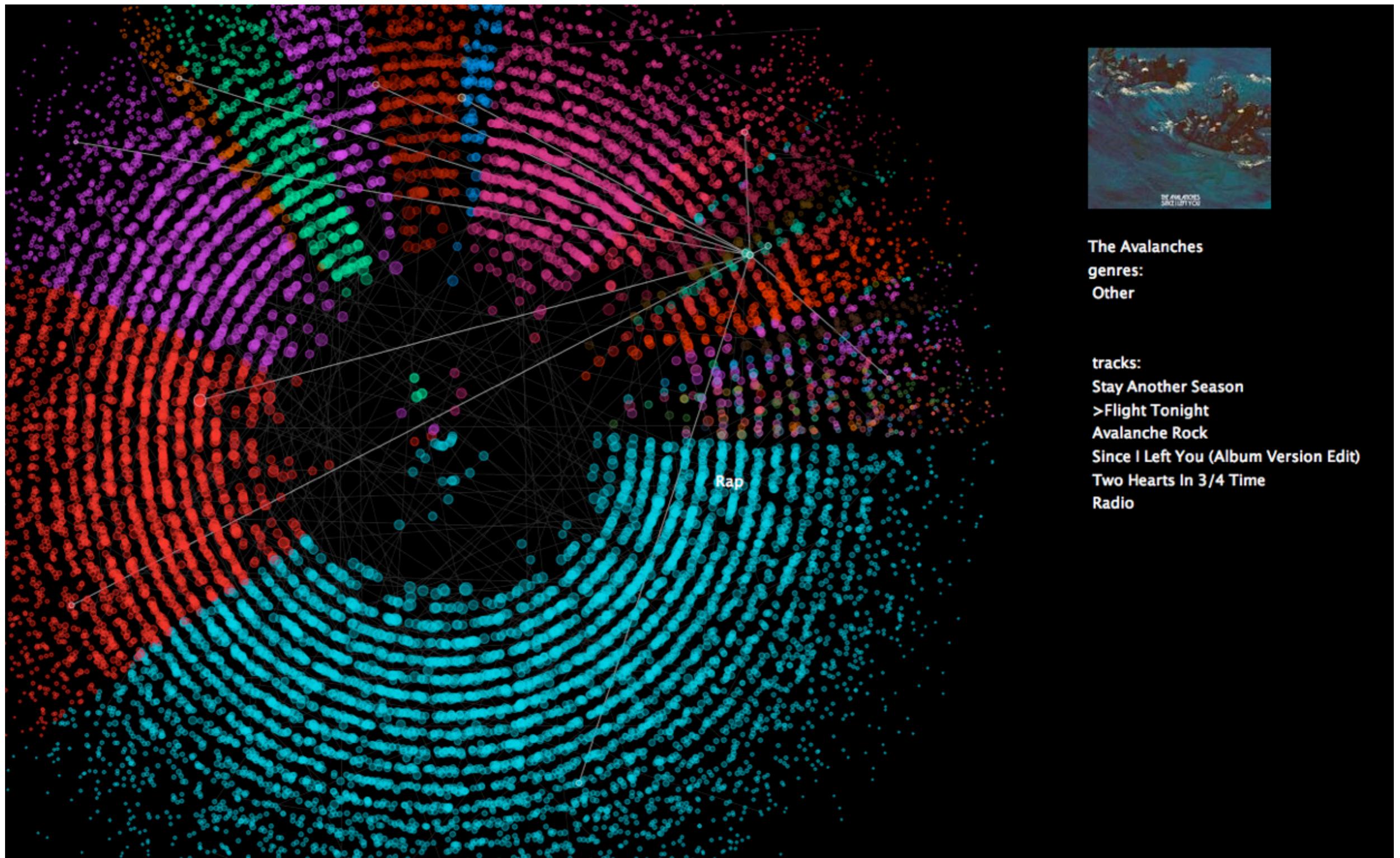
# lyric connections



<http://www.identitee.com/visualizer.php>

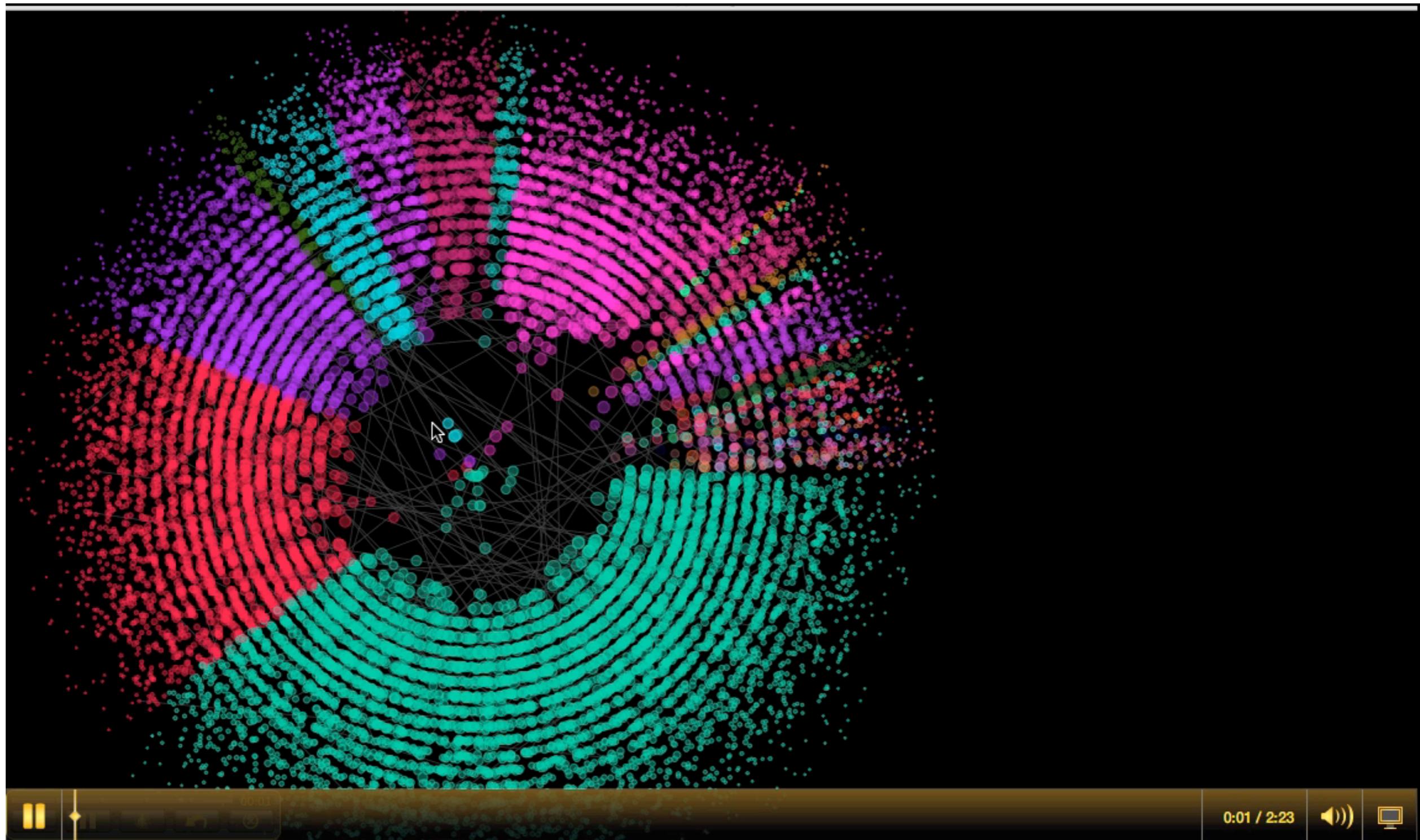
[music tees and tee shirts on i/denti/tee](#)

# Interacting with linked data about music



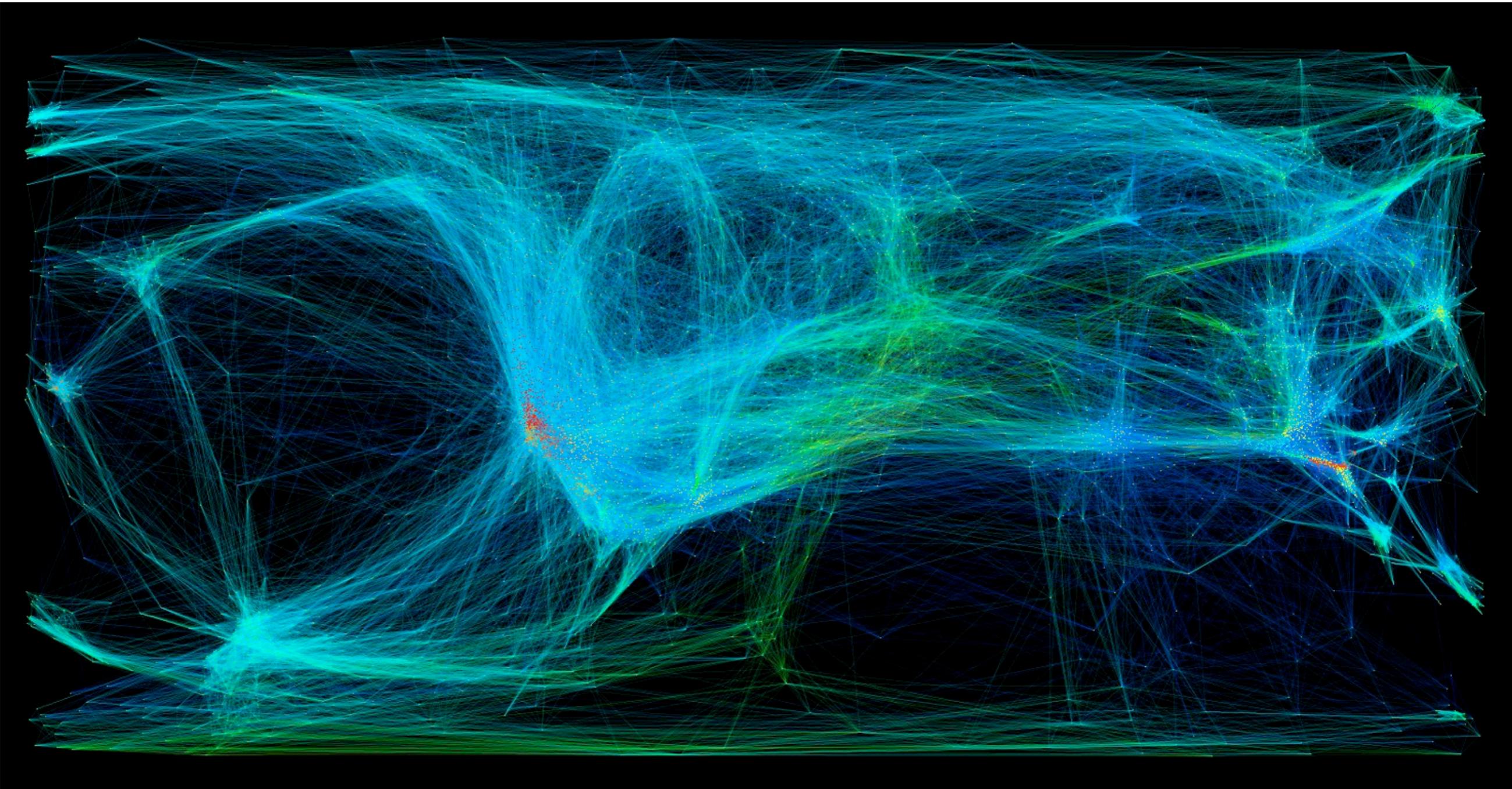
<http://journal.webscience.org/110/>

# Interacting with linked data about music



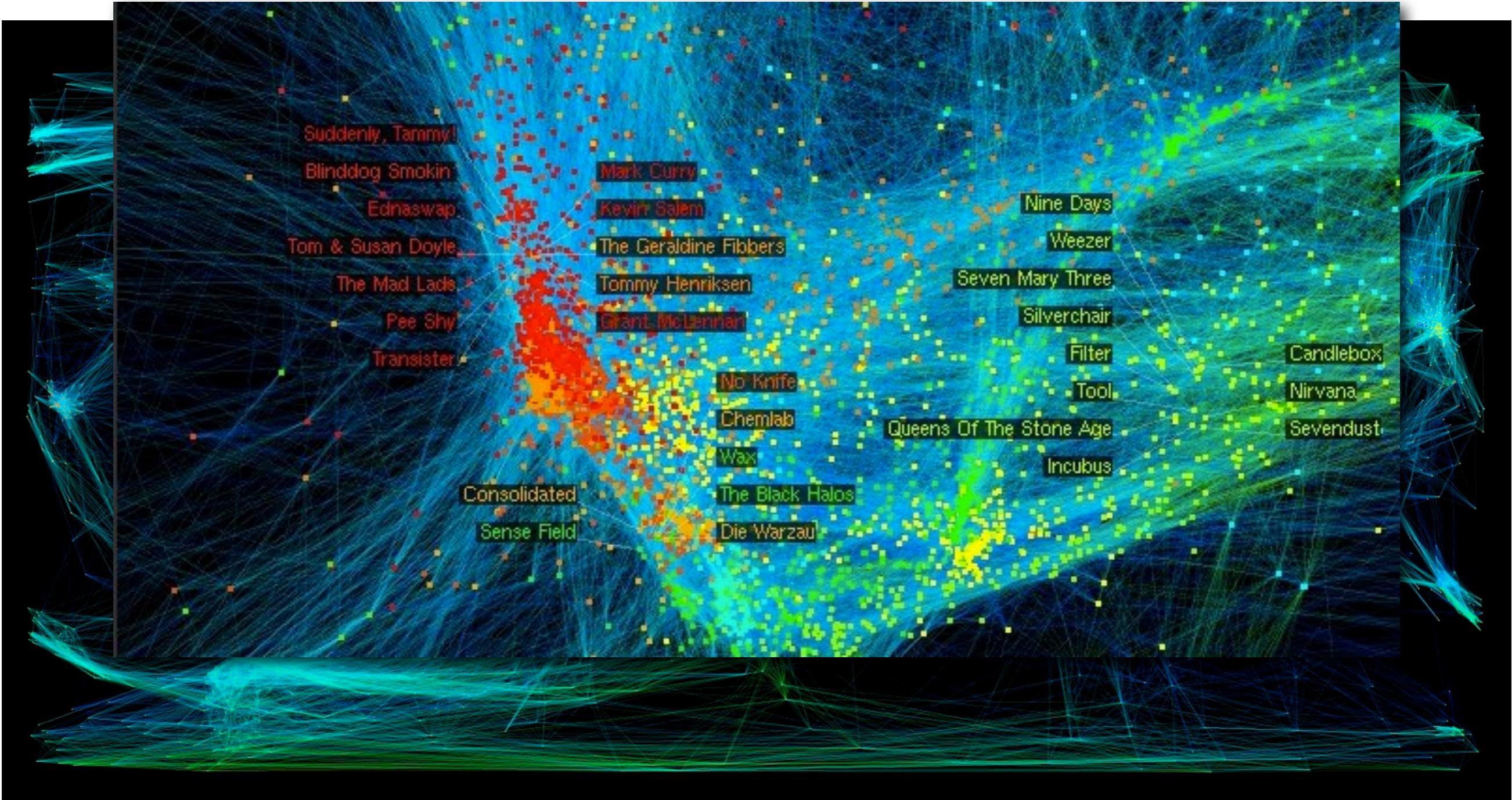
<http://journal.webscience.org/110/>

# The World Of Music



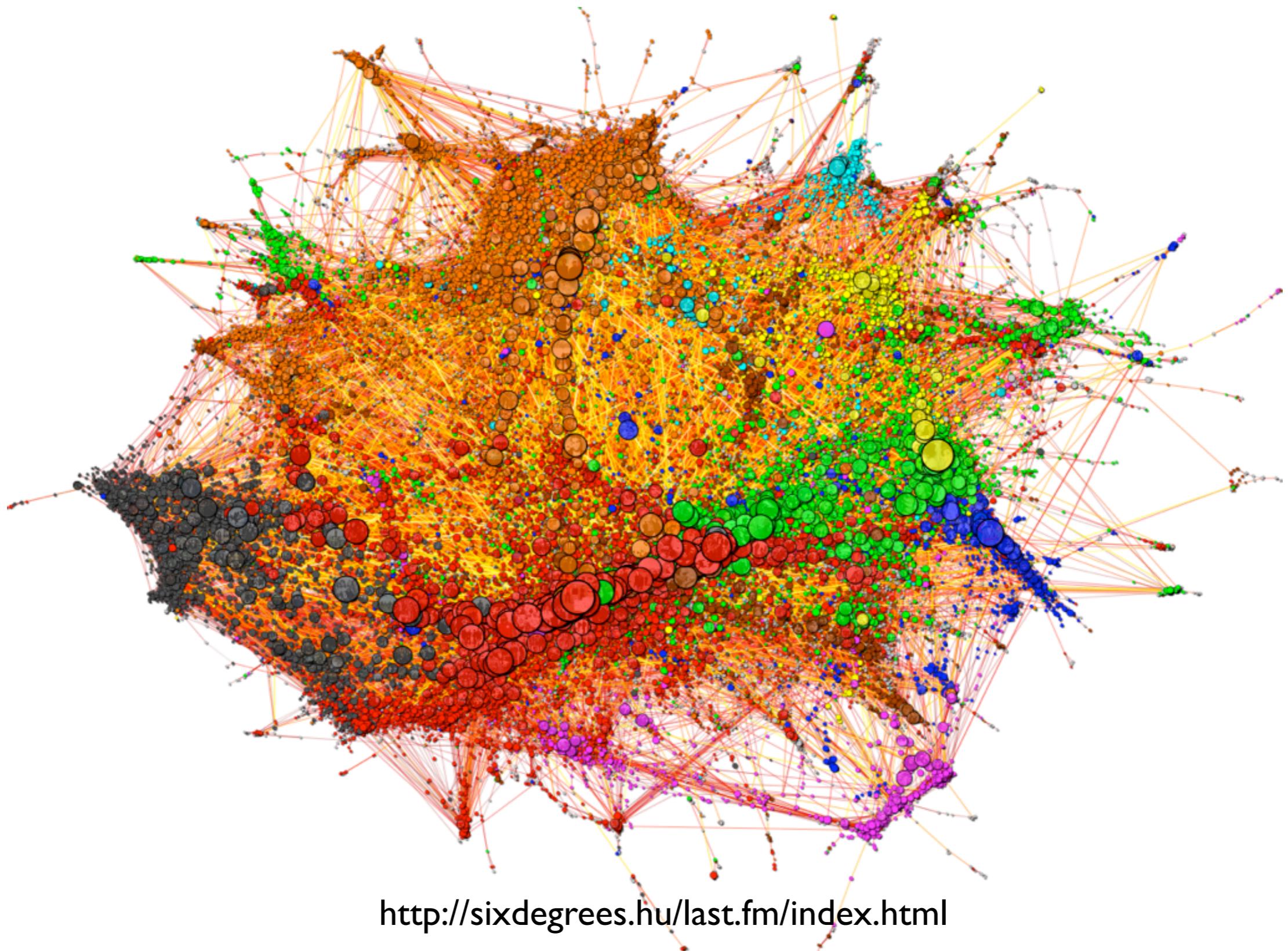
<http://www.stanford.edu/~dgleich/demos/worldofmusic/WorldOfMusic.html>  
David Gleich, Matt Rasmussen, Leonid Zhukov, and Kevin Lang

# The World Of Music



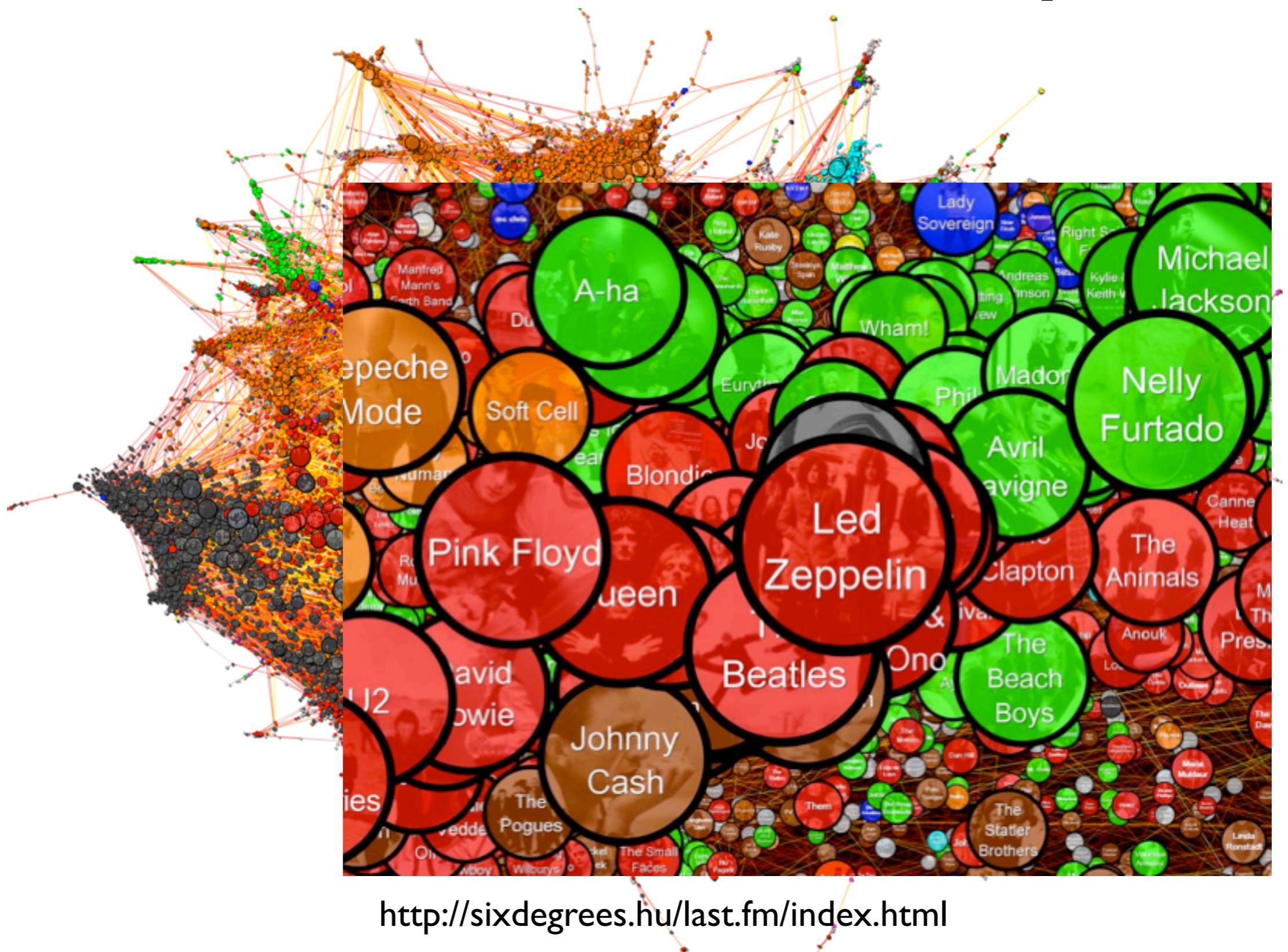
<http://www.stanford.edu/~dgleich/demos/worldofmusic/WorldOfMusic.html>  
David Gleich, Matt Rasmussen, Leonid Zhukov, and Kevin Lang

# Last.fm Artist Map

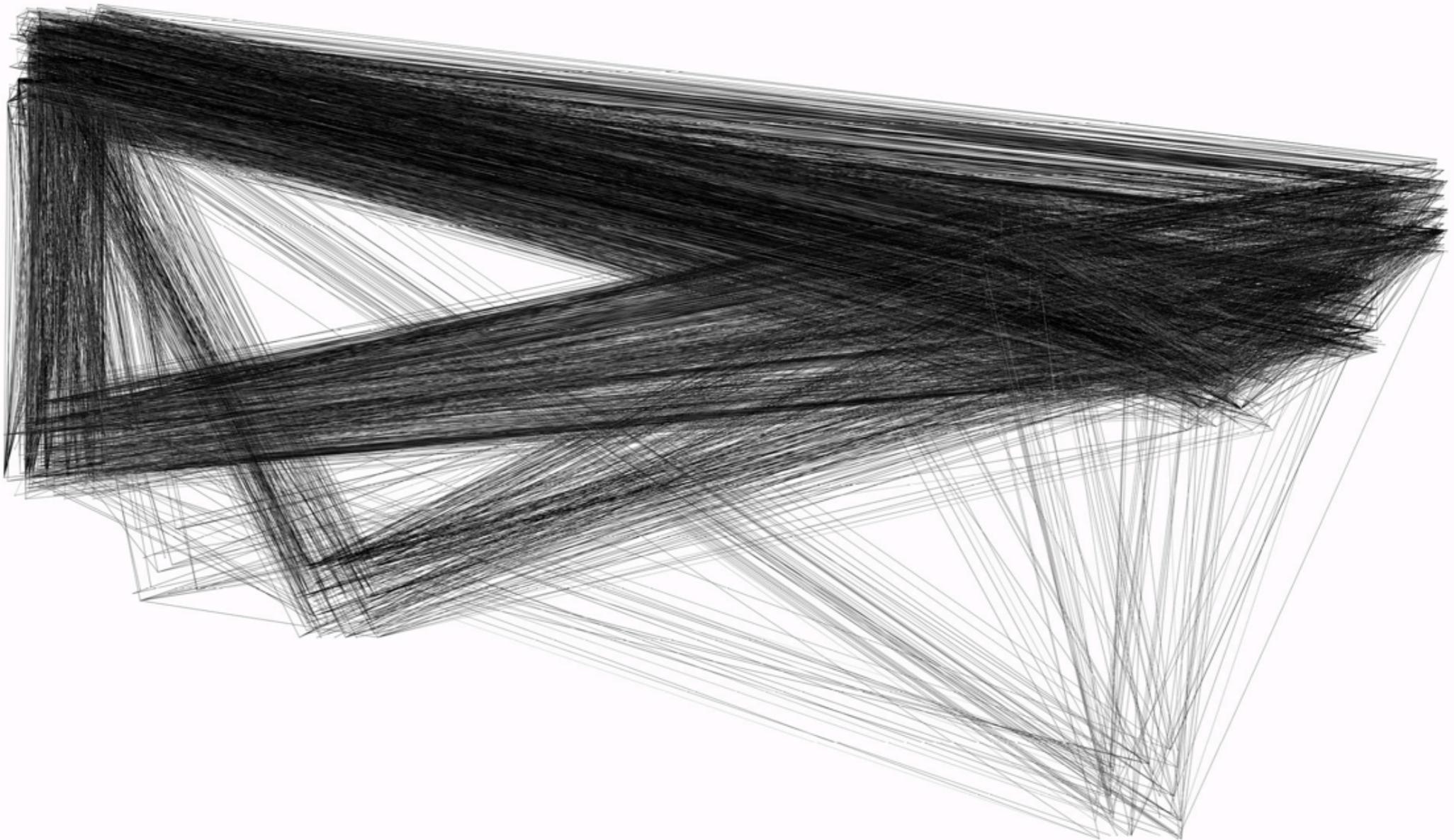


<http://sixdegrees.hu/last.fm/index.html>

# Last.fm Artist Map



# Visualizations of the connections amongst geographically located iTunes libraries



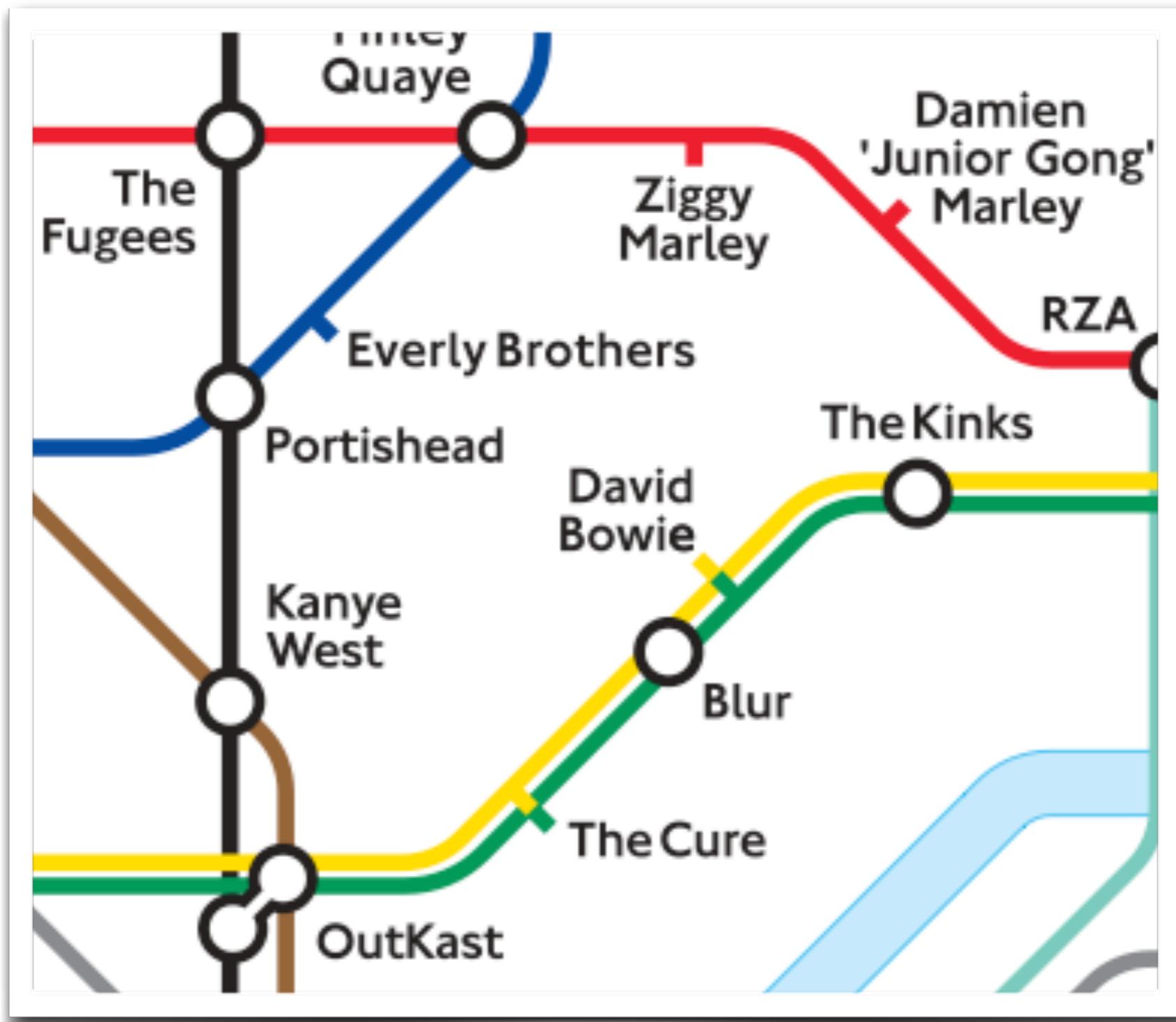
<http://caleblarsen.com/projects/visualization-of-the-inherent-connections-/#0>

# Visualizations of the connections amongst geographically located iTunes libraries

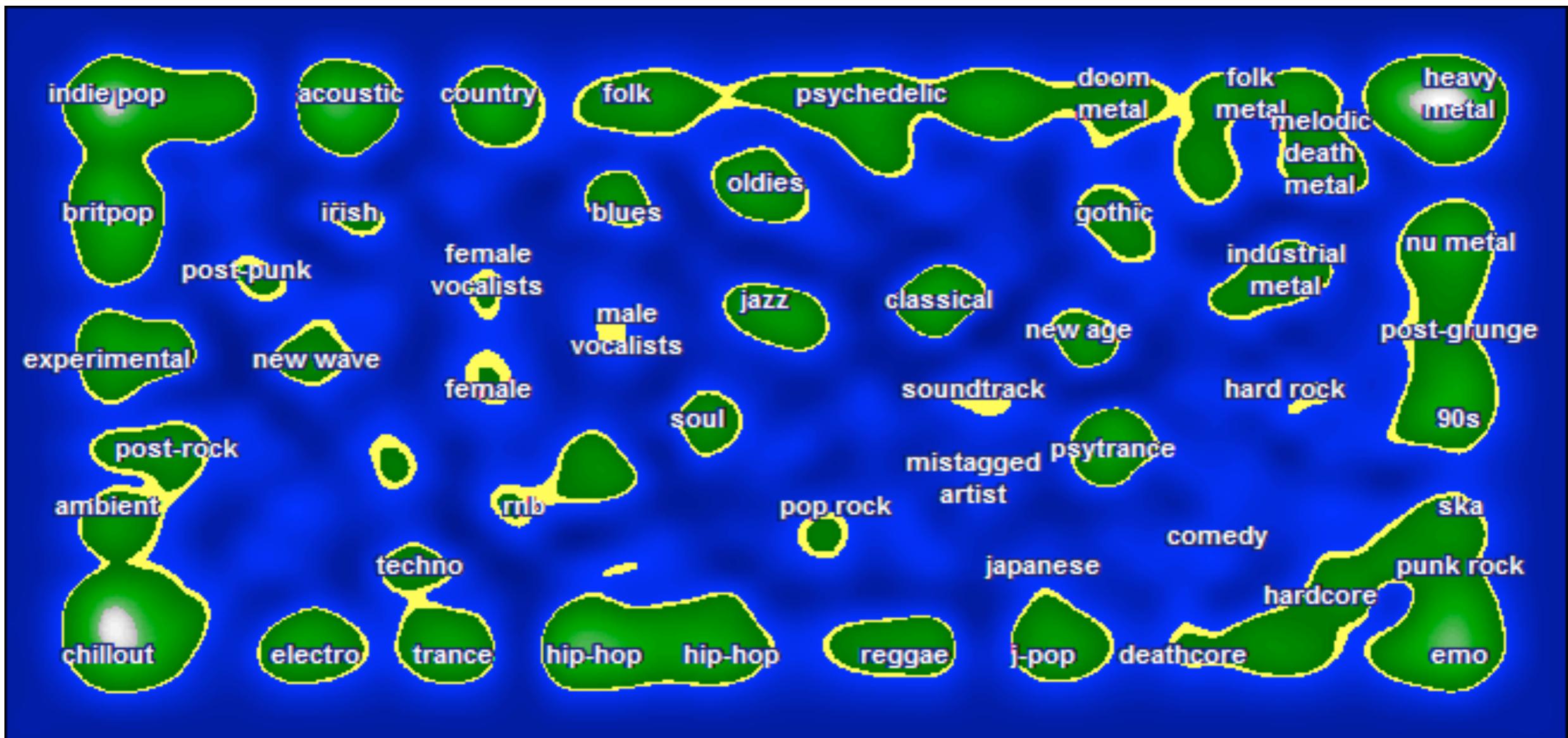


<http://caleblarsen.com/projects/visualization-of-the-inherent-connections-/#0>

# Maps



# Maps



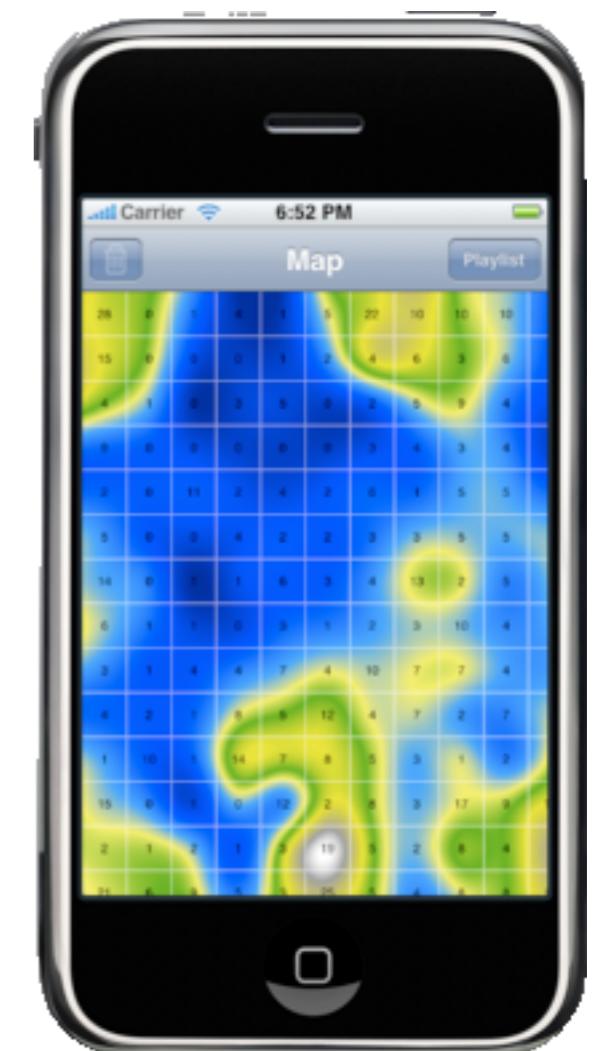
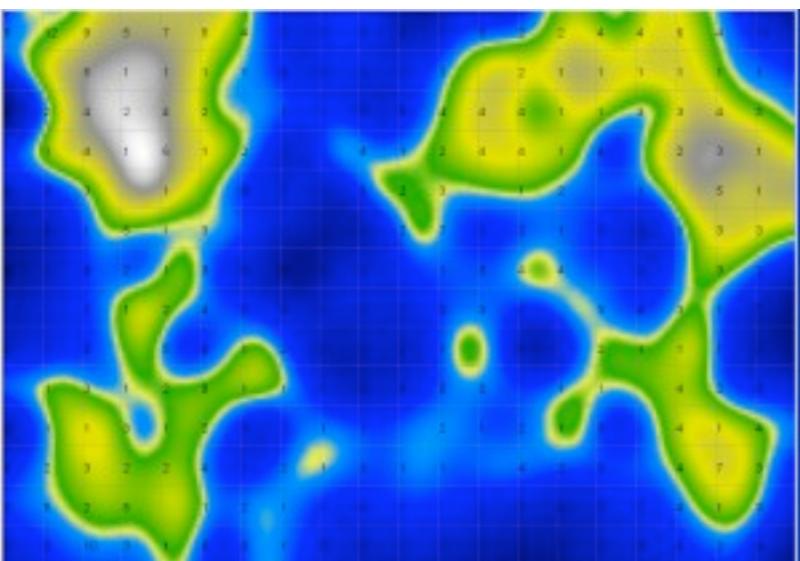
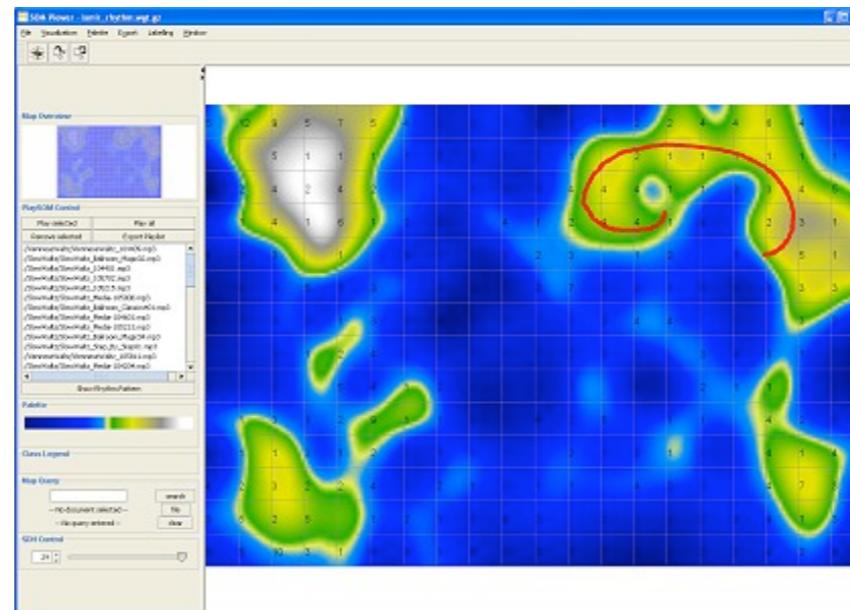
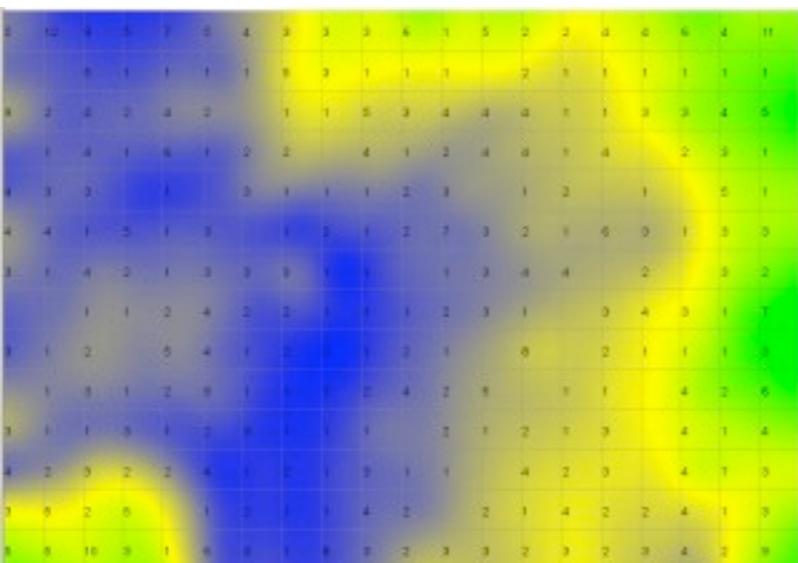
<http://playground.last.fm/iom> - Islands of Music - Elias Pampalk

# marGrid



<http://margrid.sness.net/>

# PlaySOM - Intuitive access to Music Archives



<http://www.ifs.tuwien.ac.at/mir/playsom.html>  
Vienna University of Technology

# FM4 Soundpark

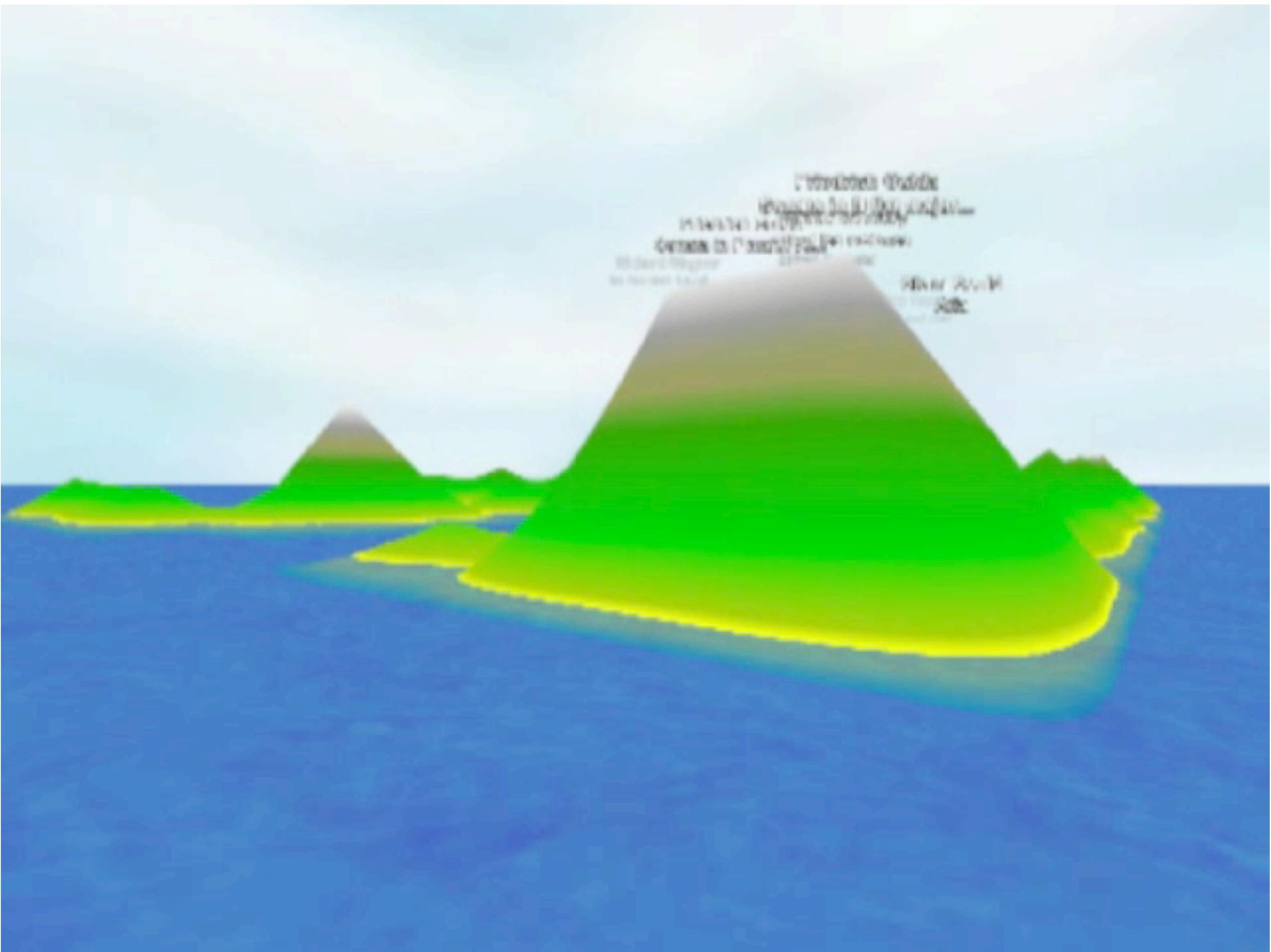


<http://fm4.orf.at/soundpark> Martin Gasser, Arthur Flexer

# nepTune

<http://www.cp.jku.at/projects/nepTune/>

# nepTune



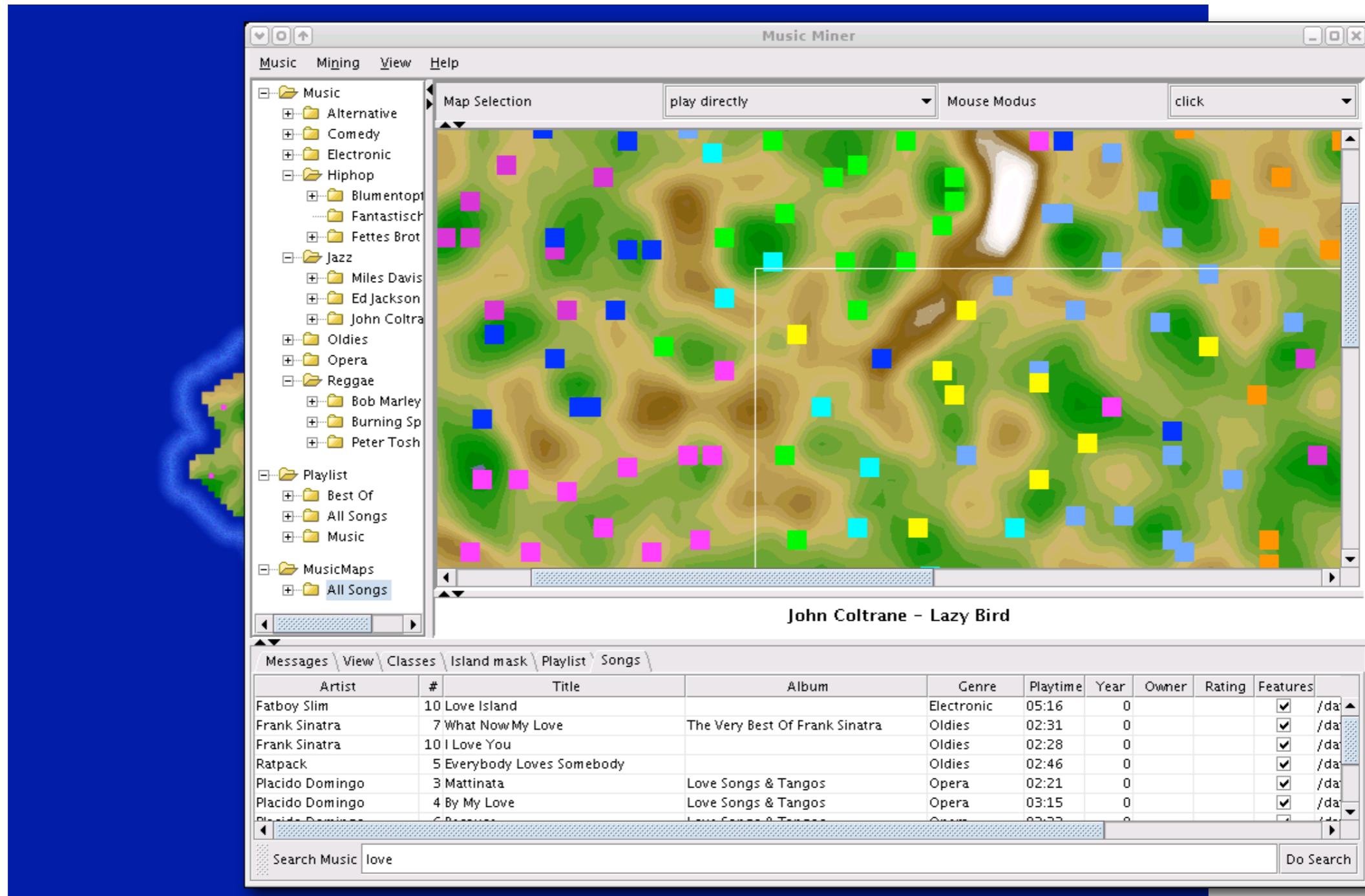
<http://www.cp.jku.at/projects/nepTune/>

# Databionic Music Miner



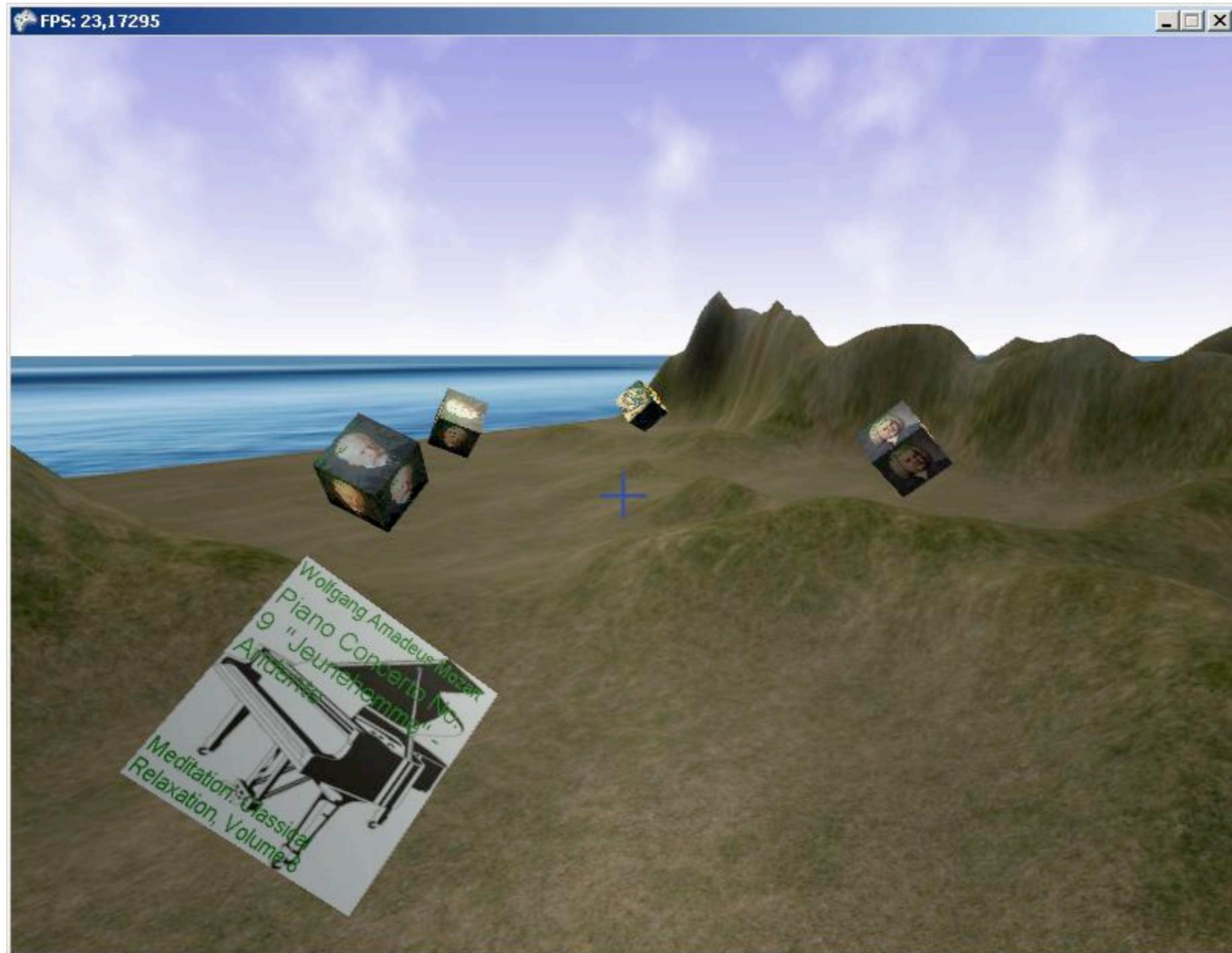
<http://musicminer.sourceforge.net/>

# Databionic Music Miner



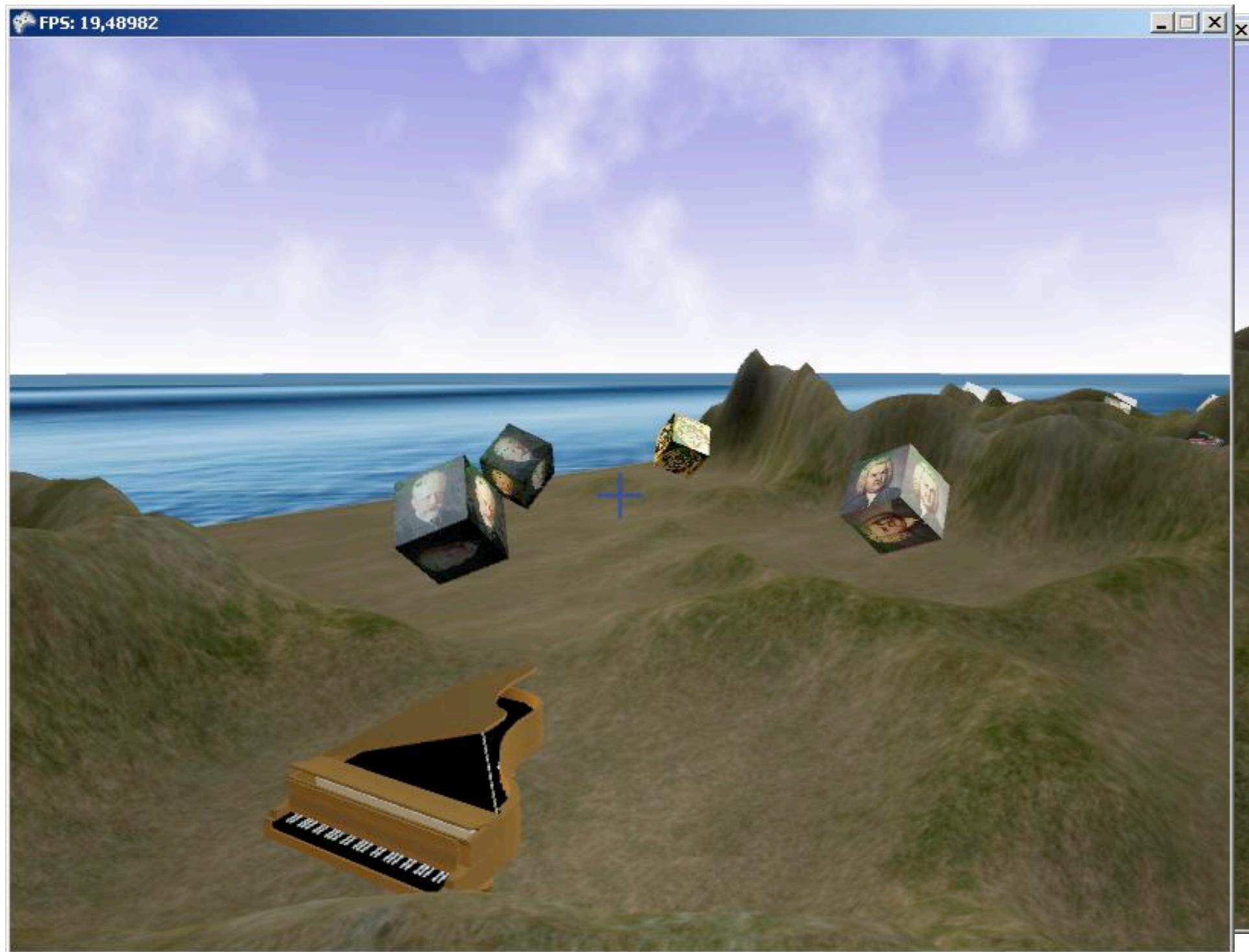
<http://musicminer.sourceforge.net/>

# soniXplorer



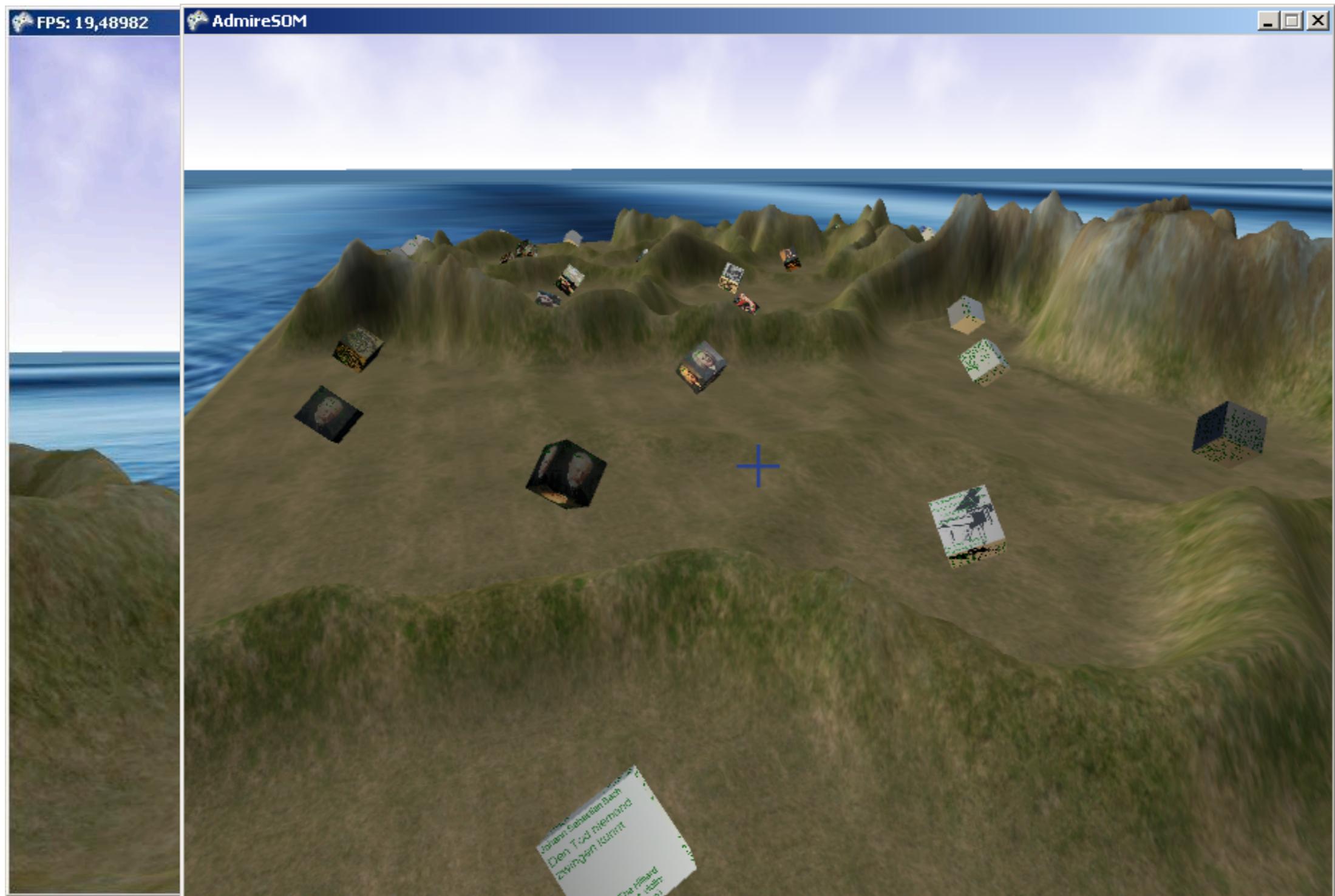
Presented at ISMIR 2009 by Dominik Lübers

# soniXplorer



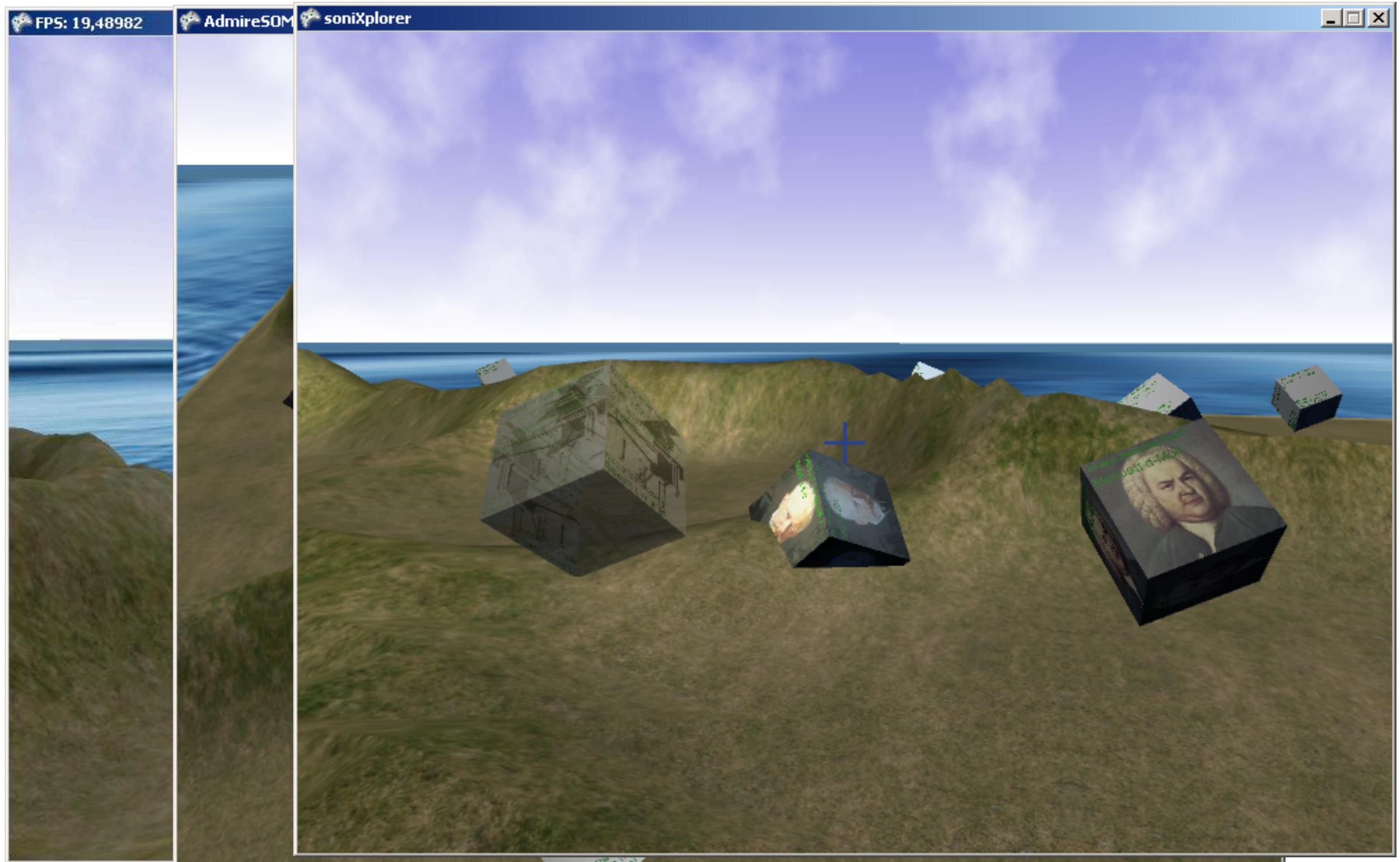
Presented at ISMIR 2009 by Dominik Lübers

# soniXplorer



Presented at ISMIR 2009 by Dominik Lübers

# soniXplorer



Presented at ISMIR 2009 by Dominik Lübers

# mHashup

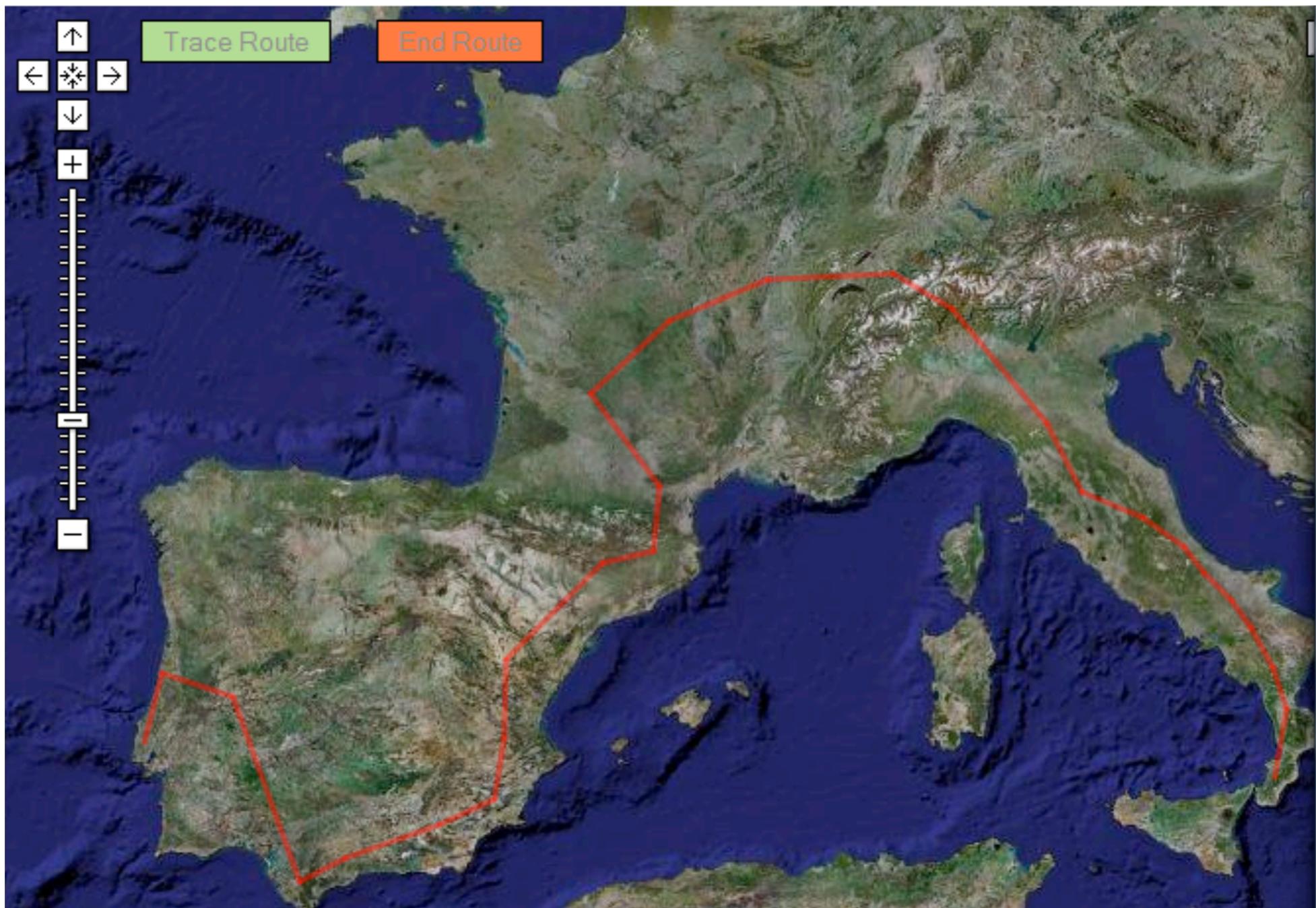
<http://www.mhashup.com/>

# mHashup



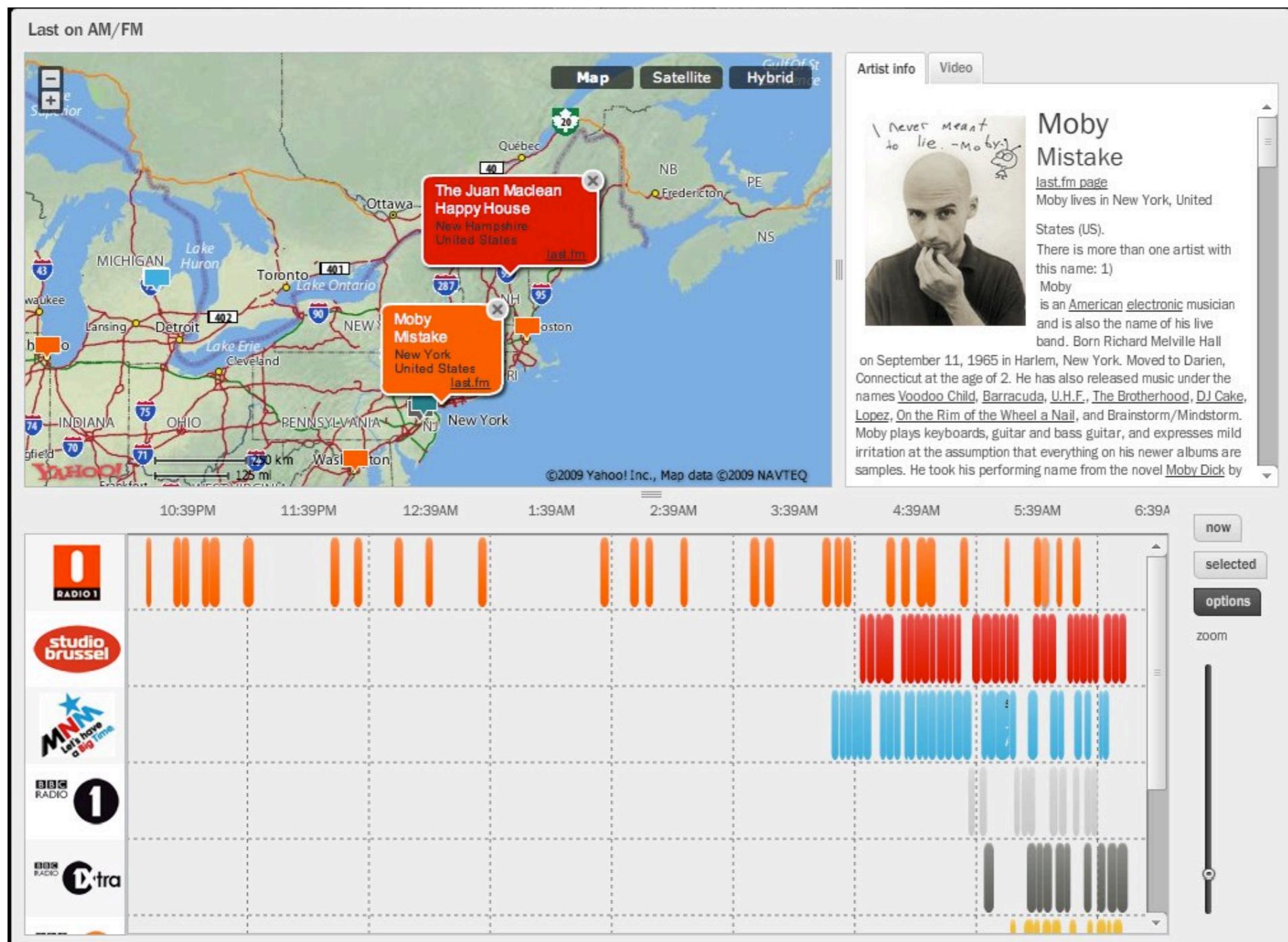
<http://www.mhashup.com/>

# GeoMuzik



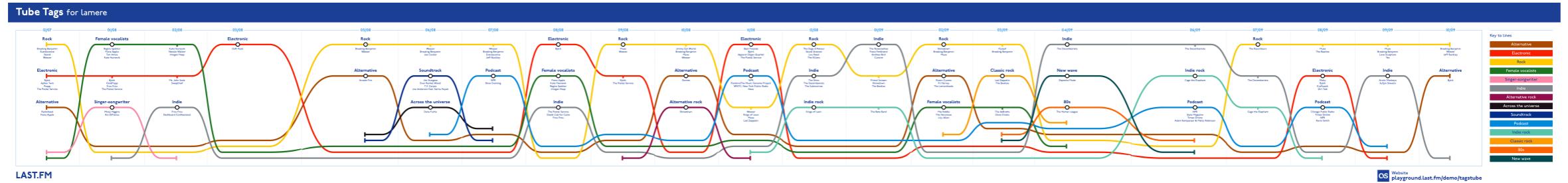
ISMIR 2008 - Oscar Celma

# Last on AM/FM



<http://www.cs.kuleuven.be/~sten/lastonamfm>

# Last.fm tube tags



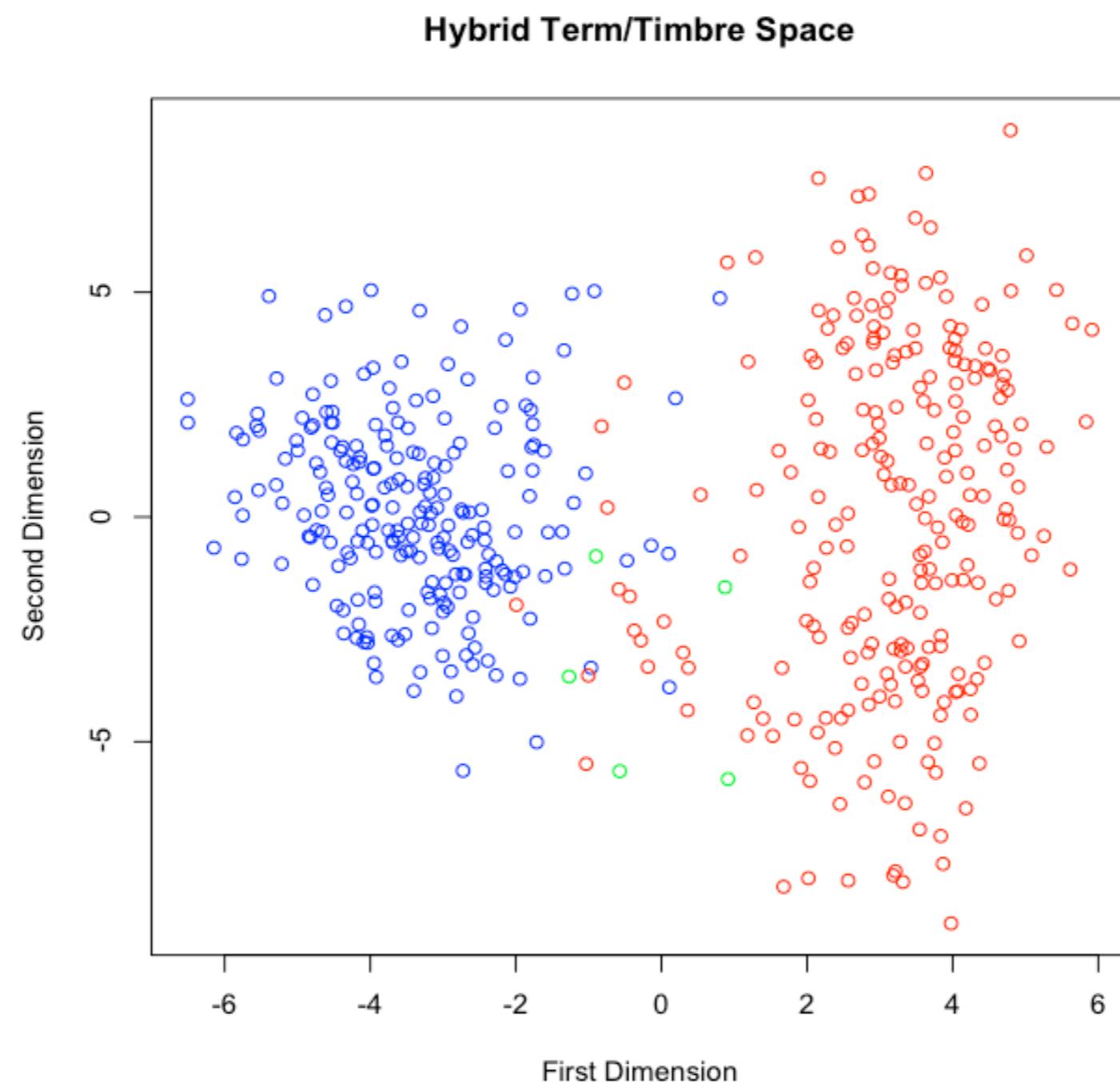
<http://playground.last.fm/demo/tagstube>

# Last.fm tube tags

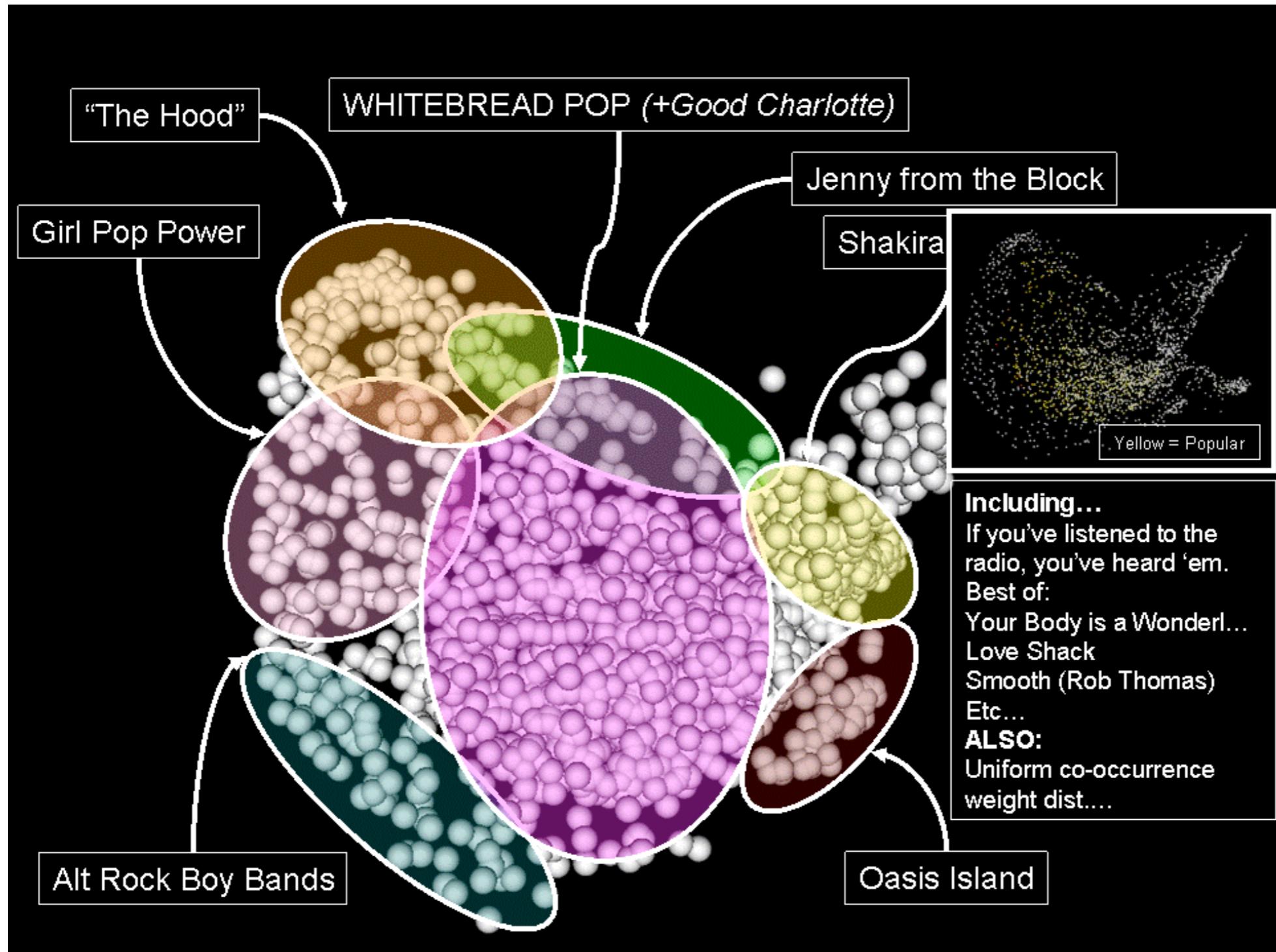


<http://playground.last.fm/demo/tagstube>

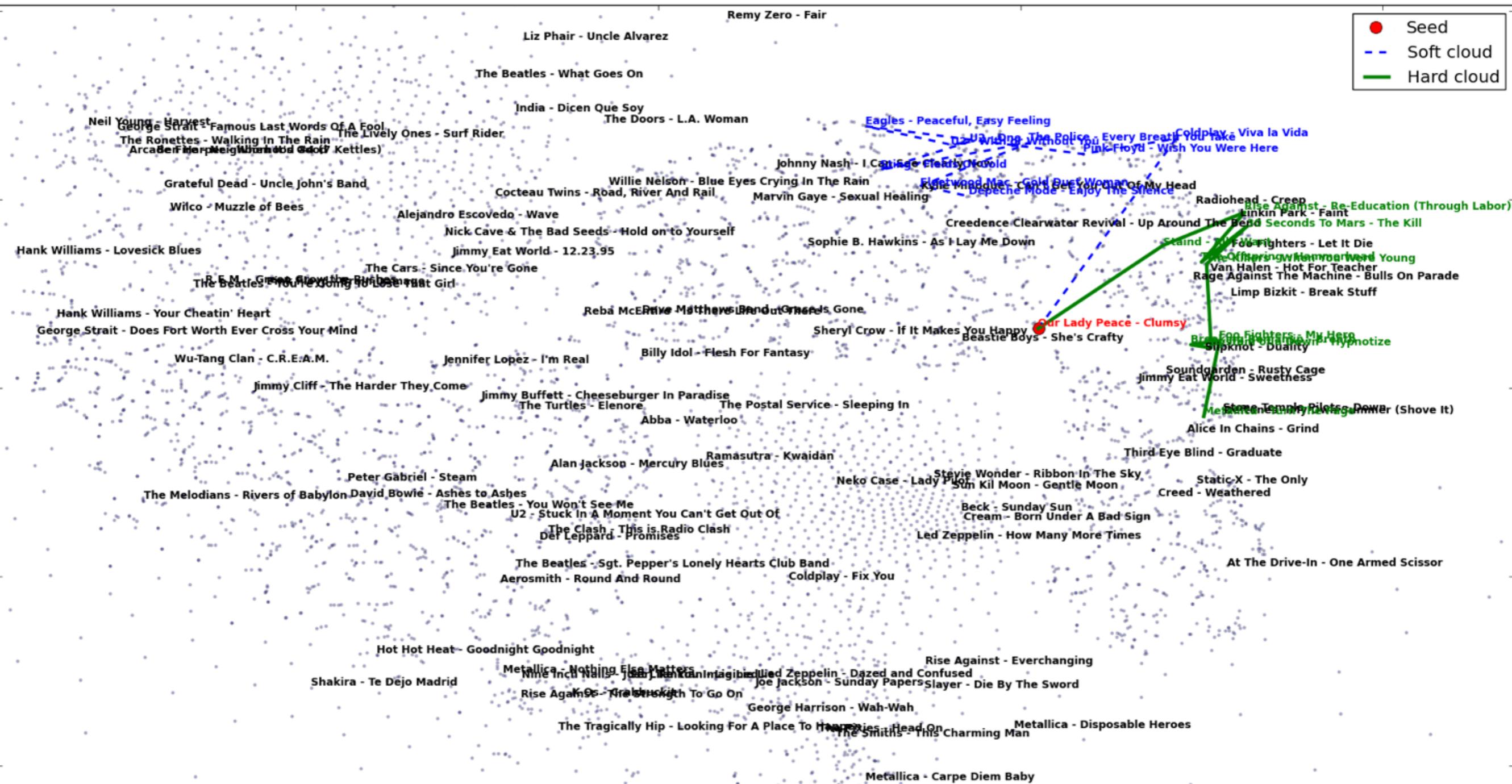
# Scatter plots



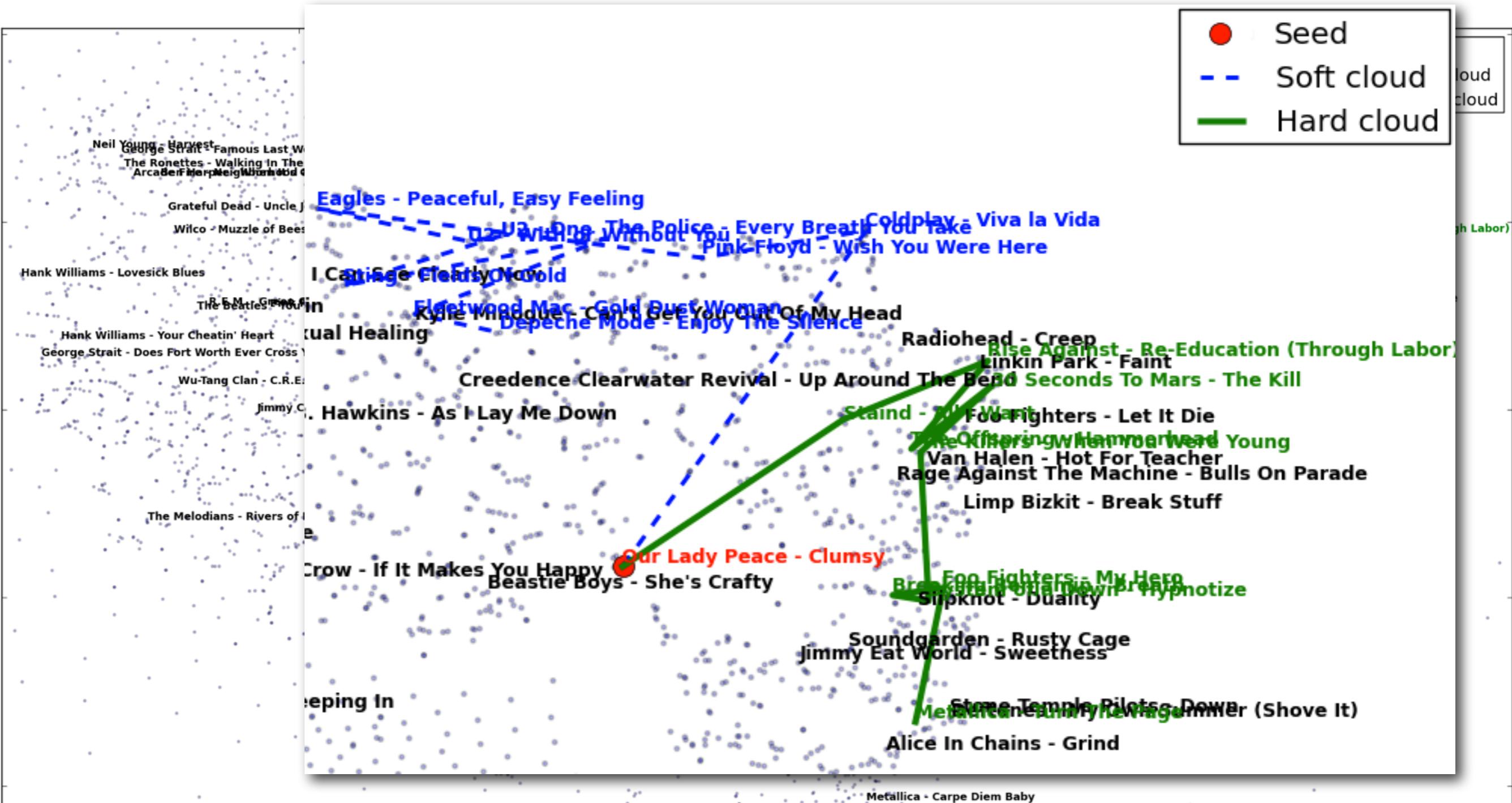
# ZMDS Visualization



Justin Donaldson

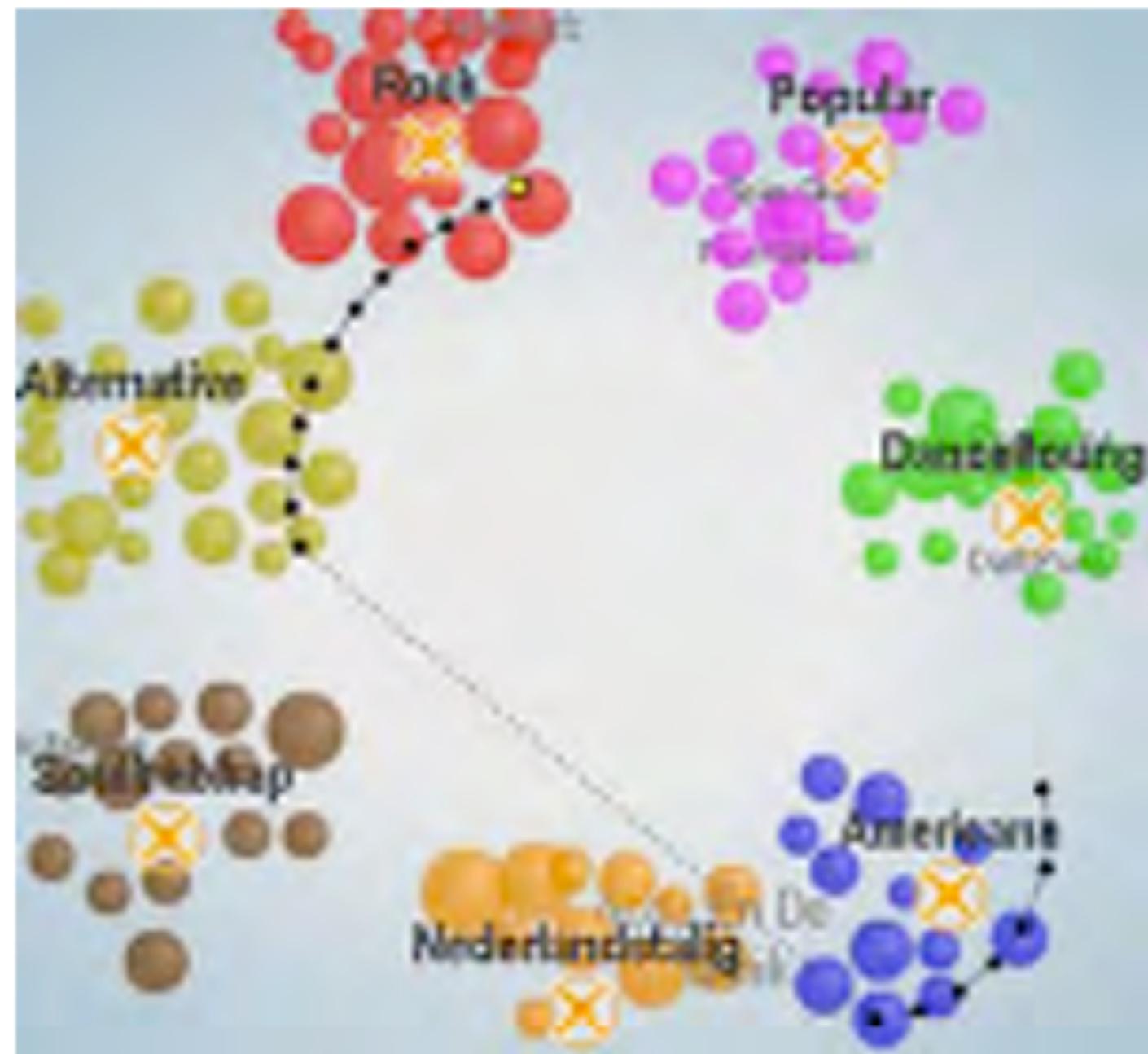
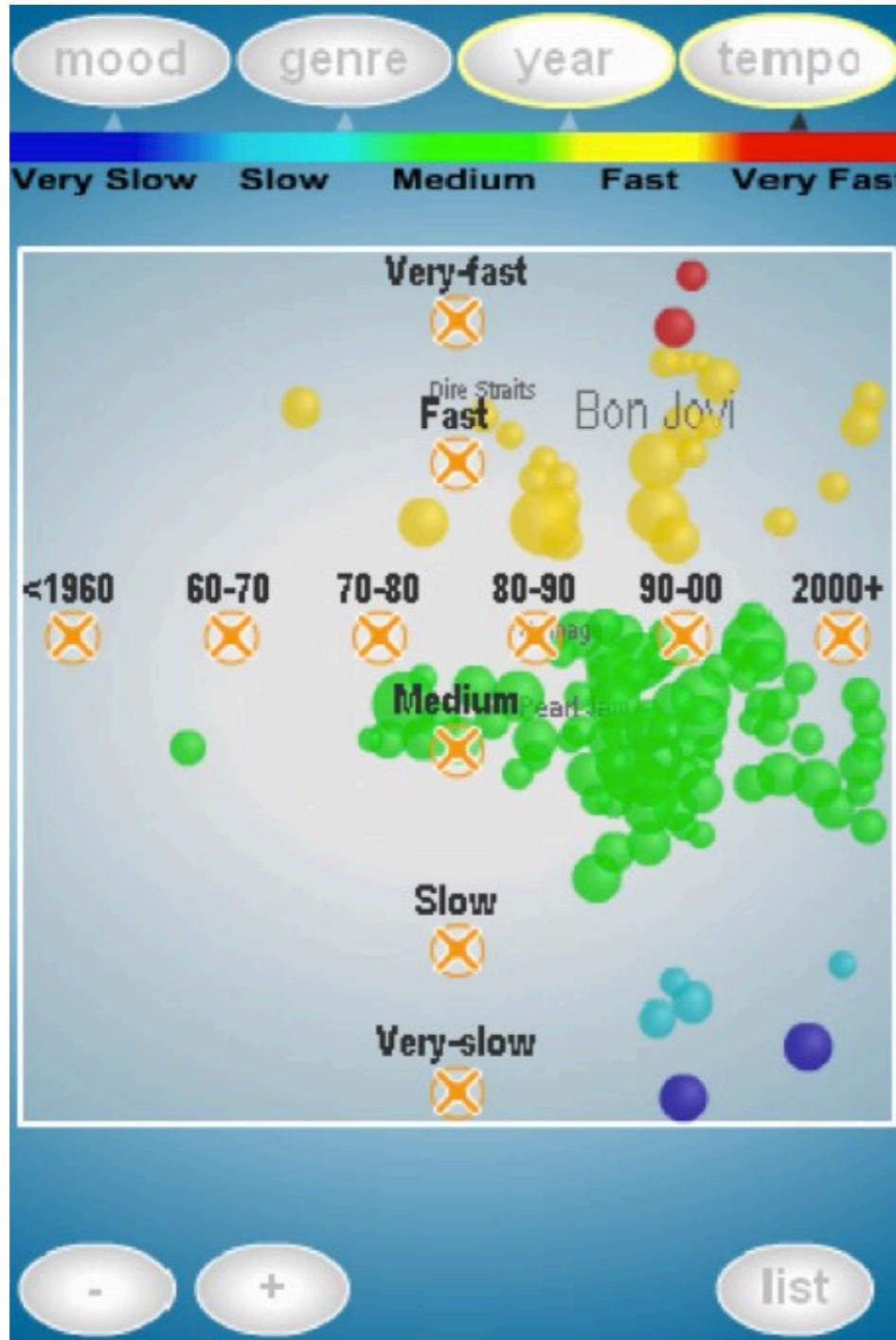


## Visualization Name



Visualization Name

# Using map for playlist navigation



Visual Playlist Generation on the Artist Map - Van Gulick, Vignoli

# Mr. Emo: Music Retrieval in the Emotional Plane

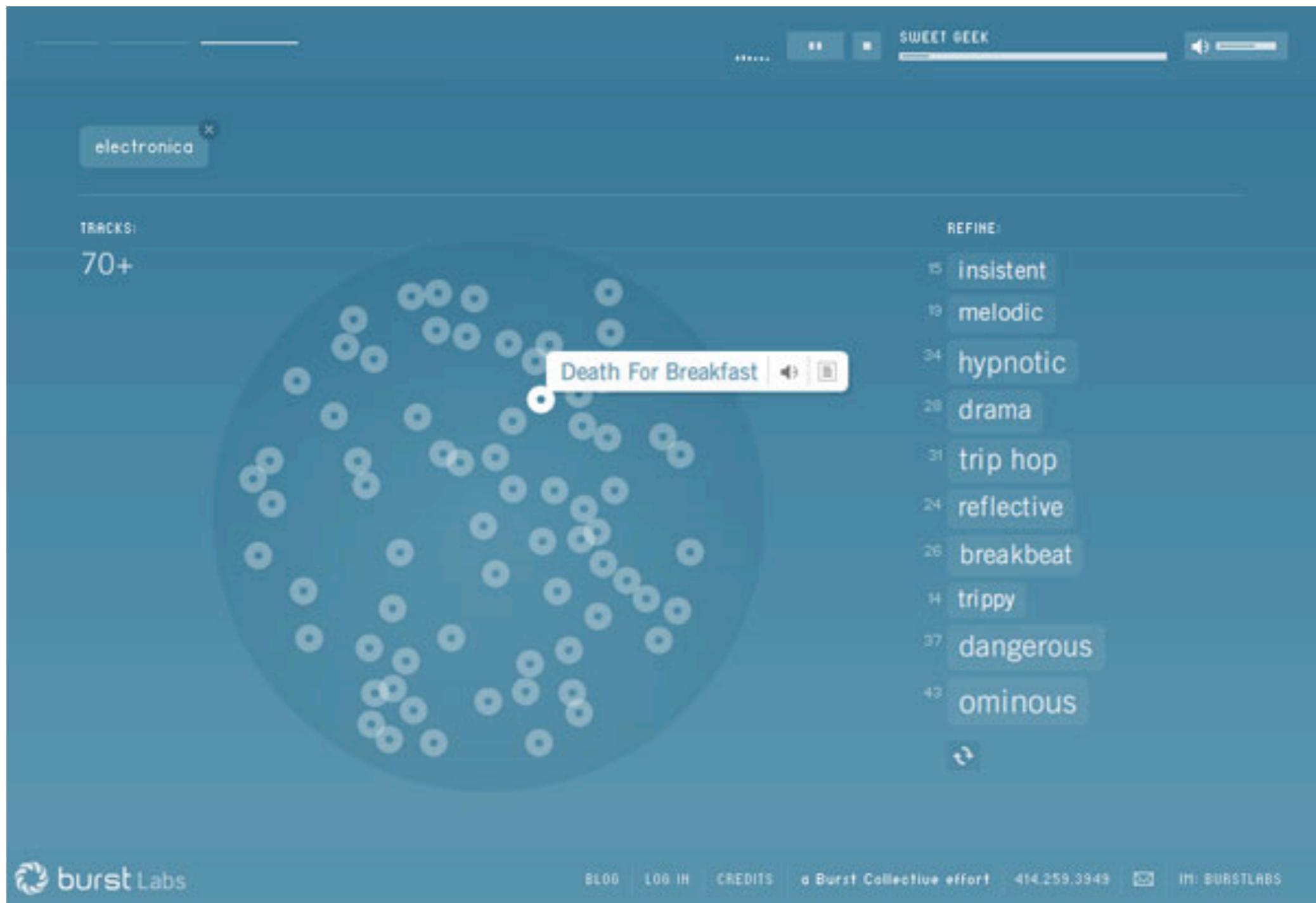
[http://mpac.ee.ntu.edu.tw/~yihuan/pub/MM08\\_MrEmo.pdf](http://mpac.ee.ntu.edu.tw/~yihuan/pub/MM08_MrEmo.pdf)

# Mr. Emo: Music Retrieval in the Emotional Plane



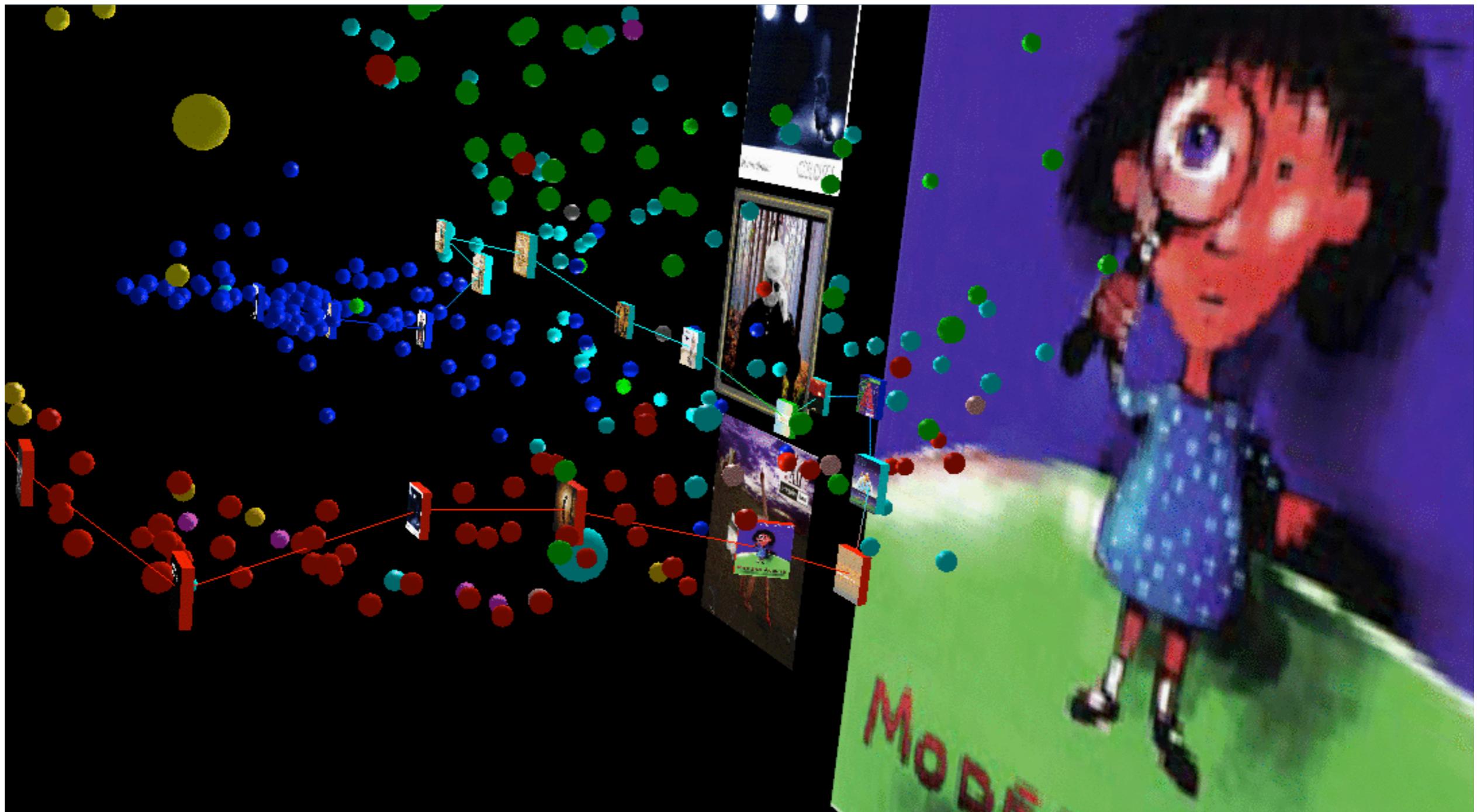
[http://mpac.ee.ntu.edu.tw/~yihsuan/pub/MM08\\_MrEmo.pdf](http://mpac.ee.ntu.edu.tw/~yihsuan/pub/MM08_MrEmo.pdf)

# Burst Labs



<http://www.burstlabs.com/>

# Search Inside the Music



[http://mediacast.sun.com/share/plamere/sitm\\_final.pdf](http://mediacast.sun.com/share/plamere/sitm_final.pdf) - Lamere, Eck

# 3D Track similarity

The Mufin Player

# 3D Track similarity

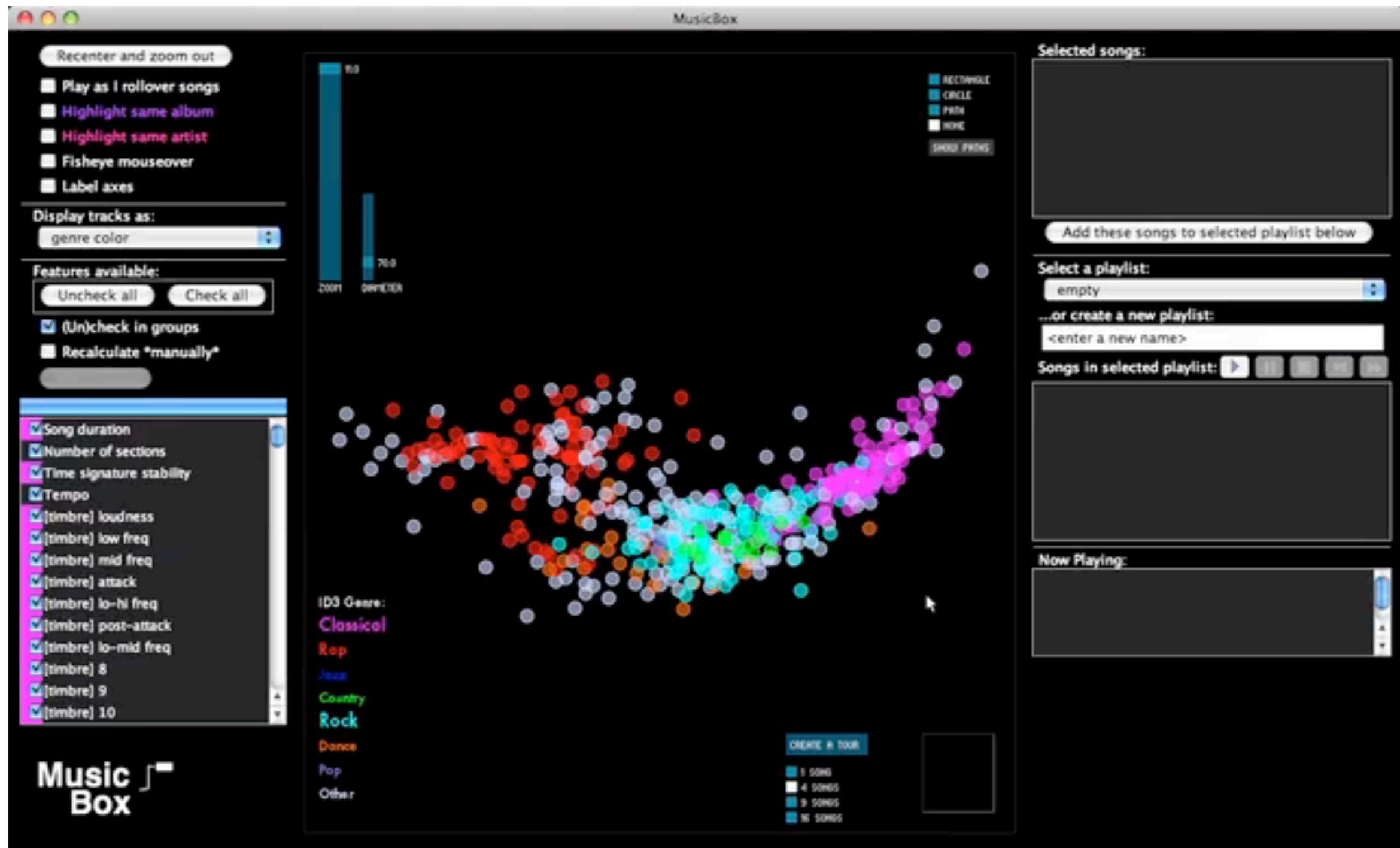


The Mufin Player

# Music Box

<http://thesis.flyingpudding.com/> - Anita Lillie

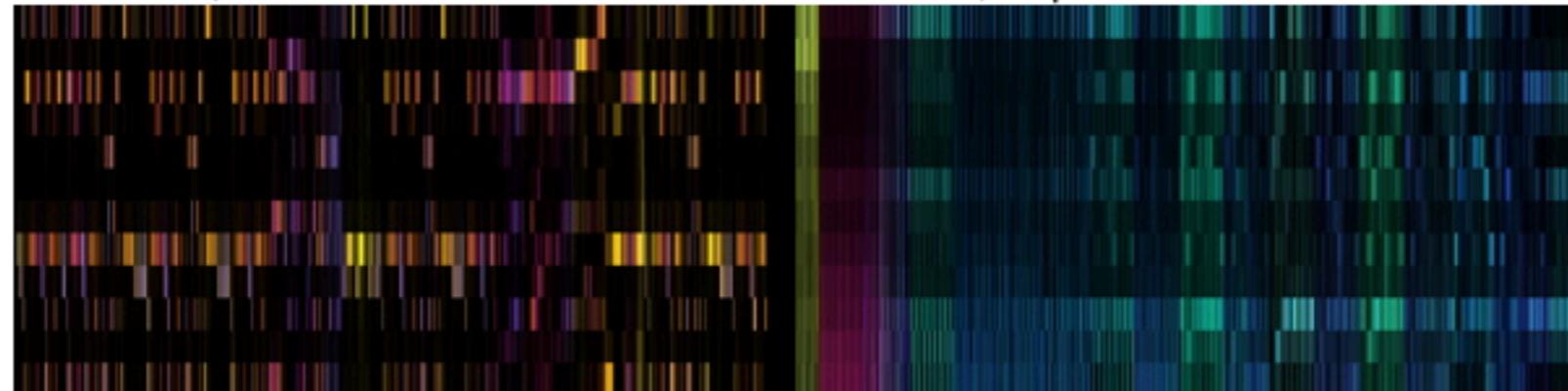
# Music Box



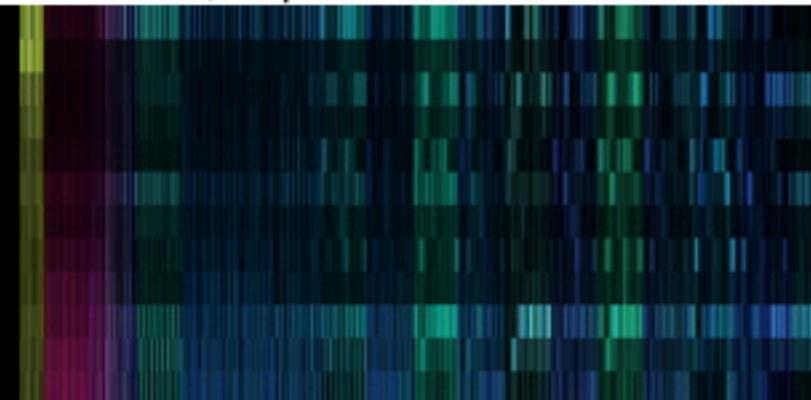
<http://thesis.flyingpudding.com/> - Anita Lillie

# Pictures of Songs

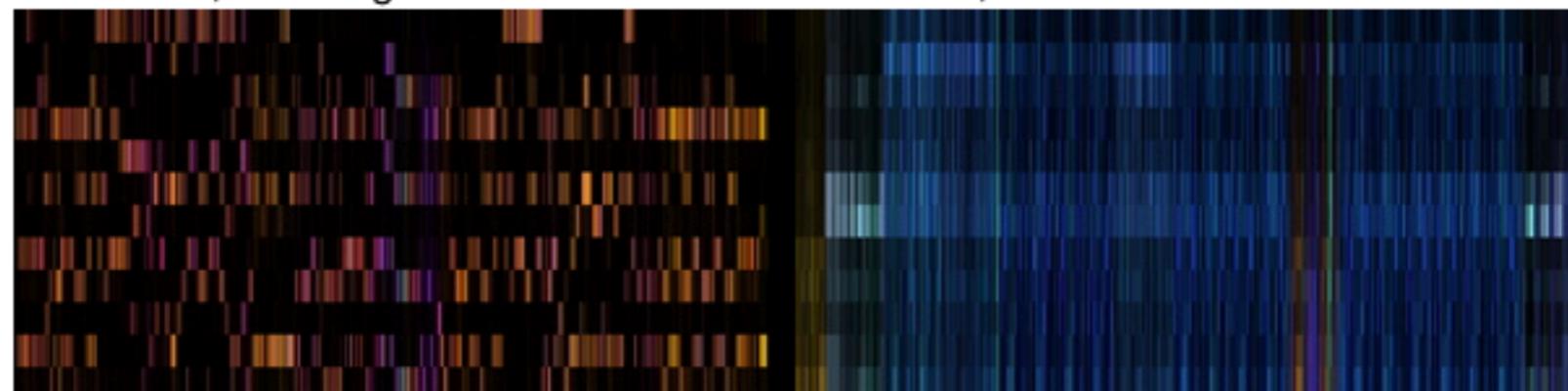
Beethoven, Fur Elise:



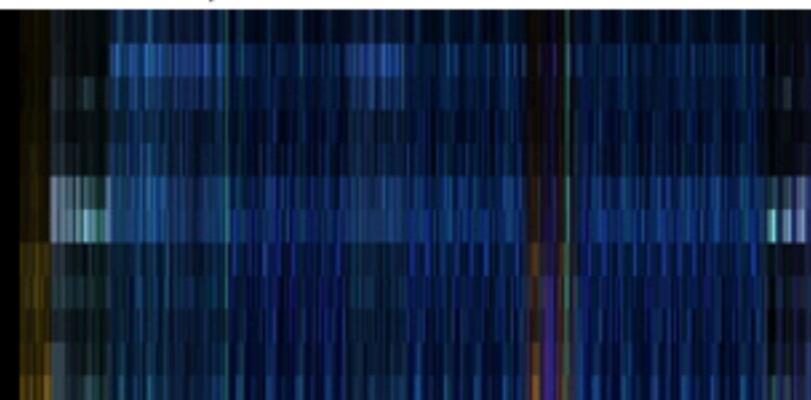
Daft Punk, Superheroes:



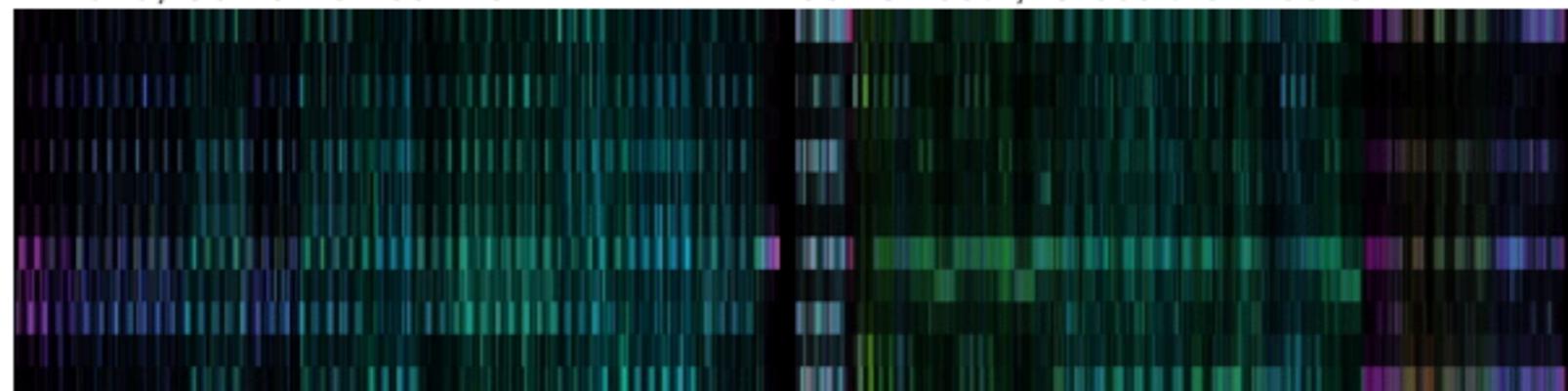
Beethoven, "Moonlight" Sonata:



Daft Punk, Crescendolls:



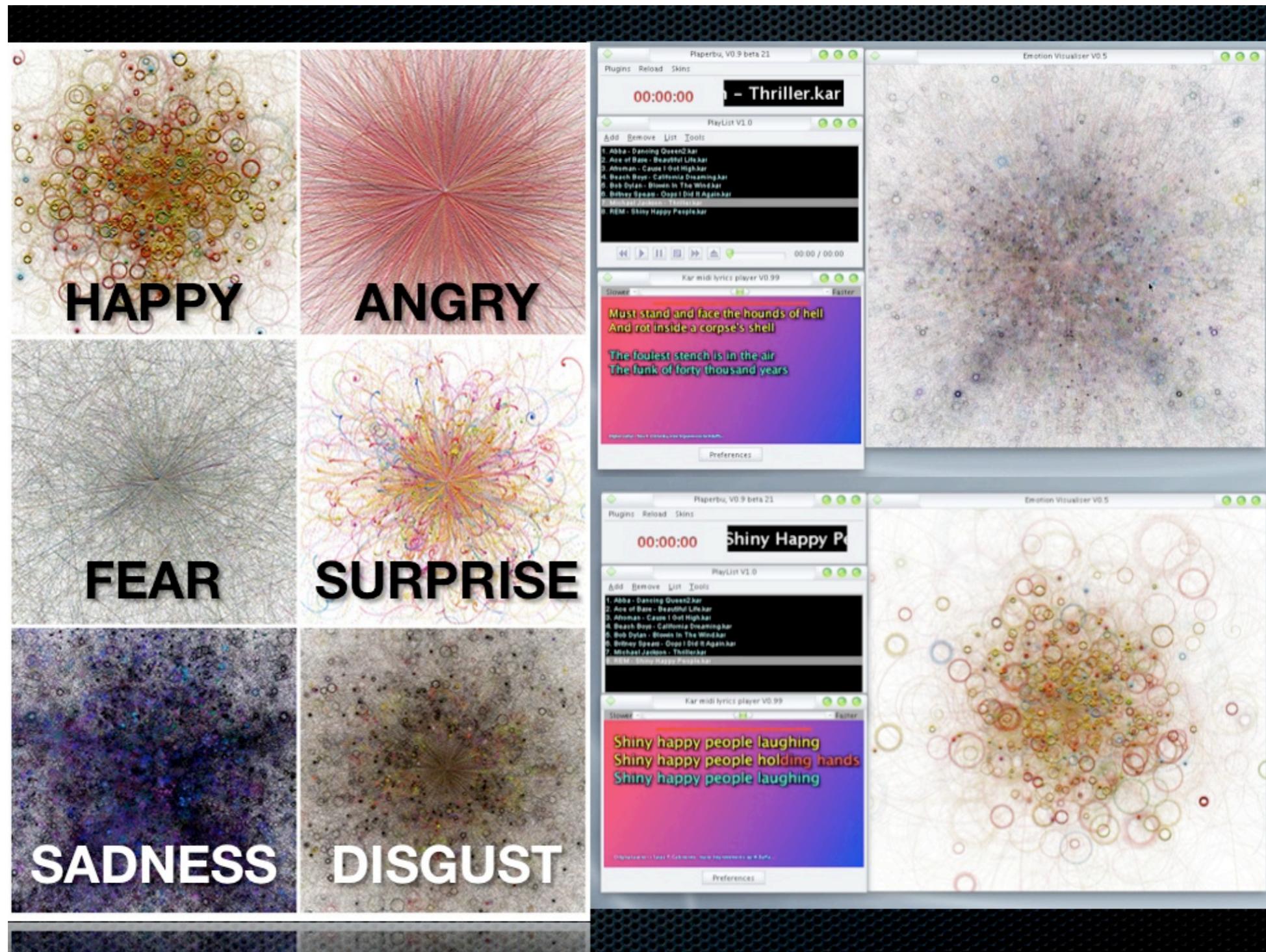
Nirvana, Come As You Are:



Sonic Youth, 'Cross the Breeze:

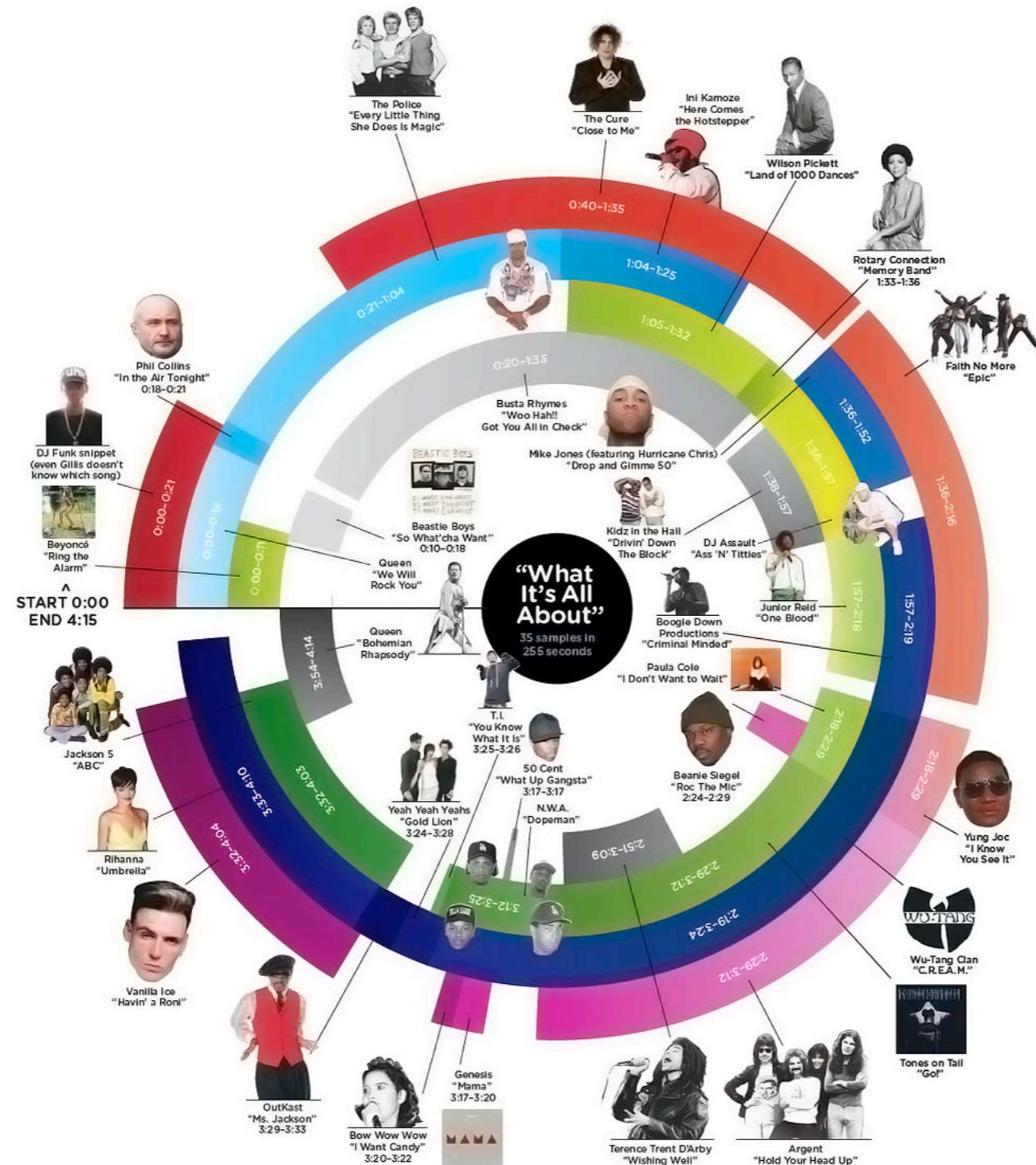
[http://www.flyingpudding.com/projects/viz\\_music/](http://www.flyingpudding.com/projects/viz_music/)

# Visualizing Emotion in Lyrics

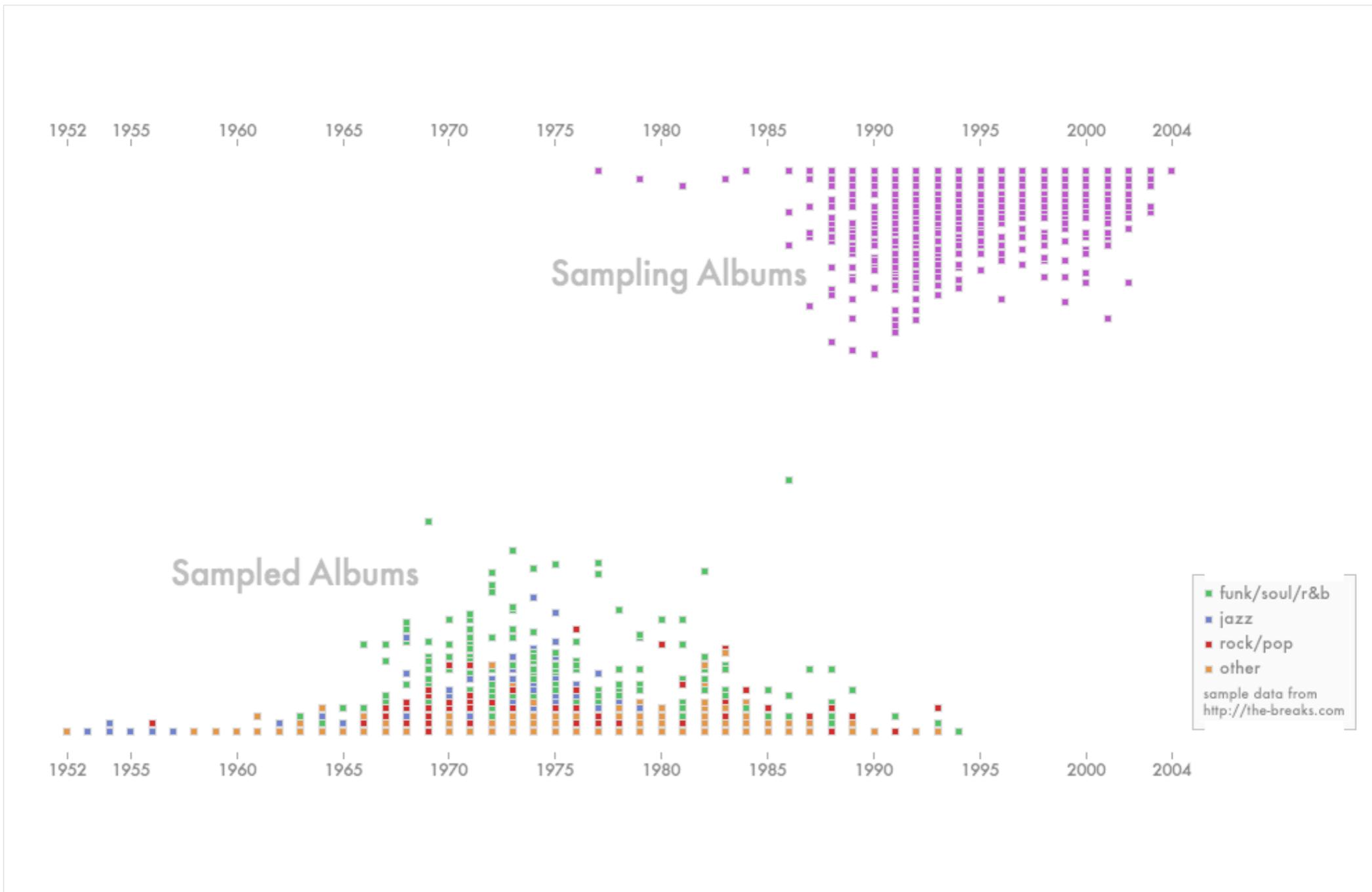


<http://www.cs.kuleuven.be/~jorisk/thrillerMovie.mov>

# Sampling Connections

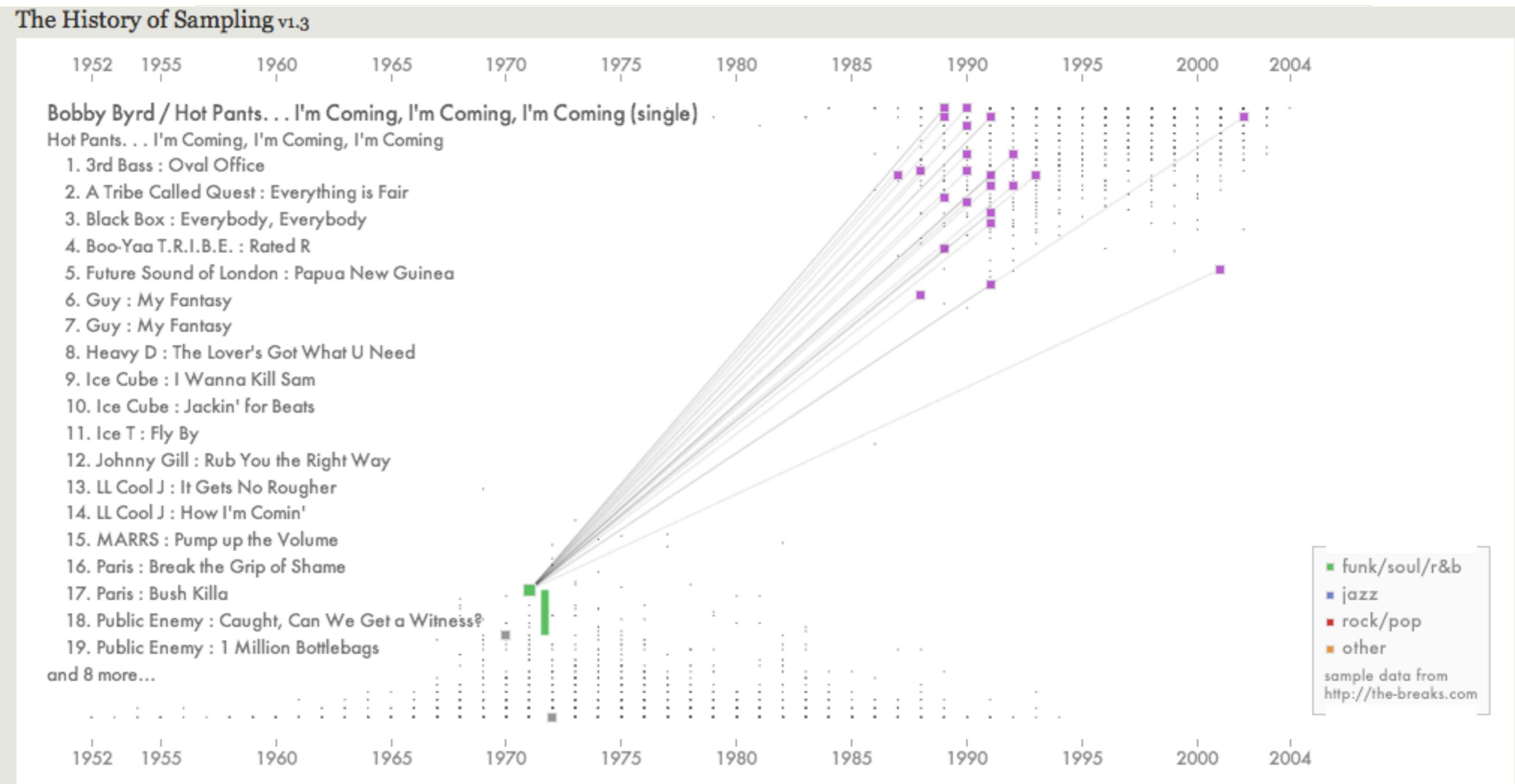


# The History of Sampling



<http://jessekriess.com/projects/samplinghistory/>

# The History of Sampling



<http://jessekriess.com/projects/samplinghistory/>

# Mused: Navigating the personal sample library

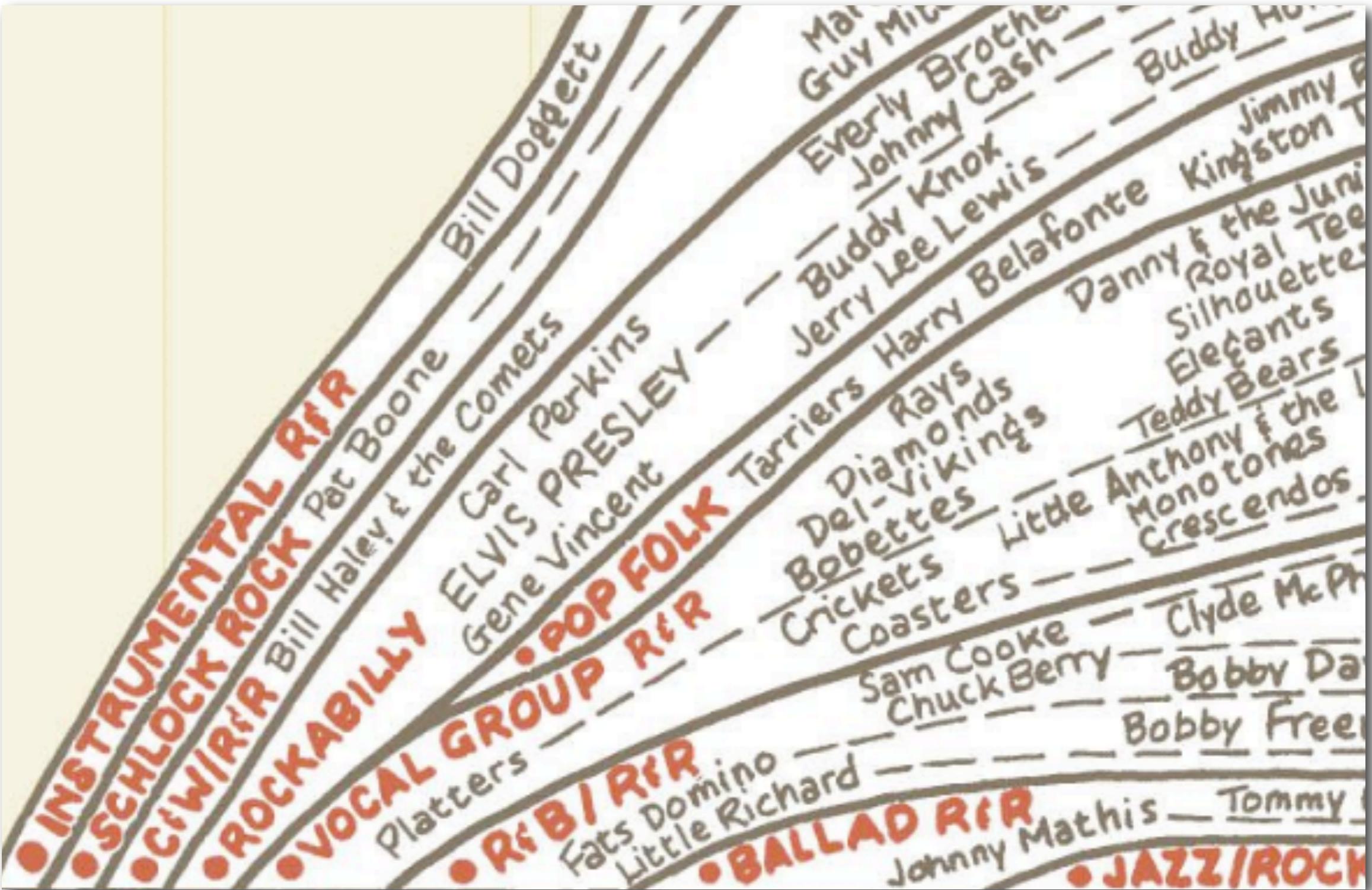
Graham Coleman - <http://www.iua.upf.edu/~gcoleman/pubs/mused07.pdf>

# Mused: Navigating the personal sample library

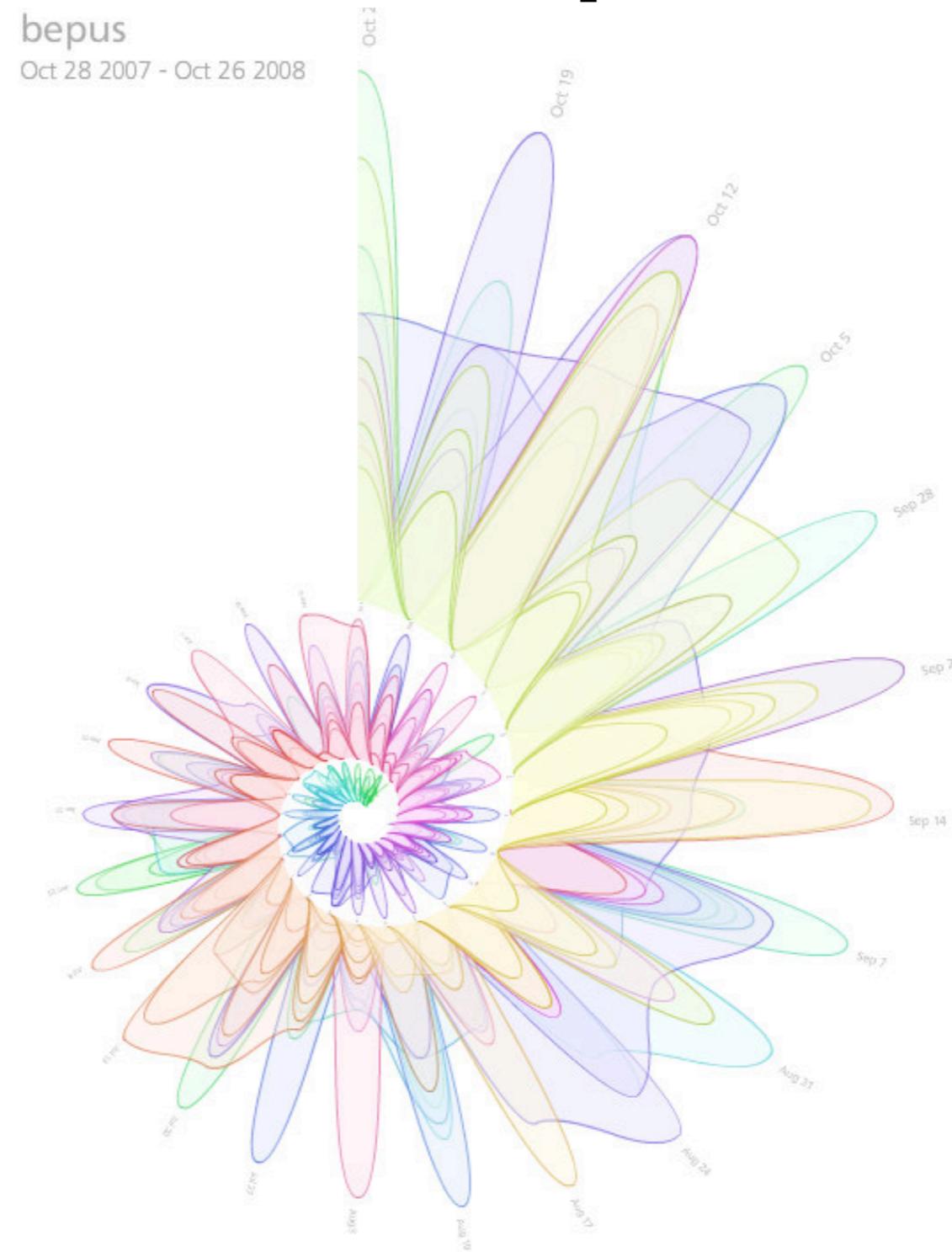


Graham Coleman - <http://www.iua.upf.edu/~gcoleman/pubs/mused07.pdf>

# Time Series

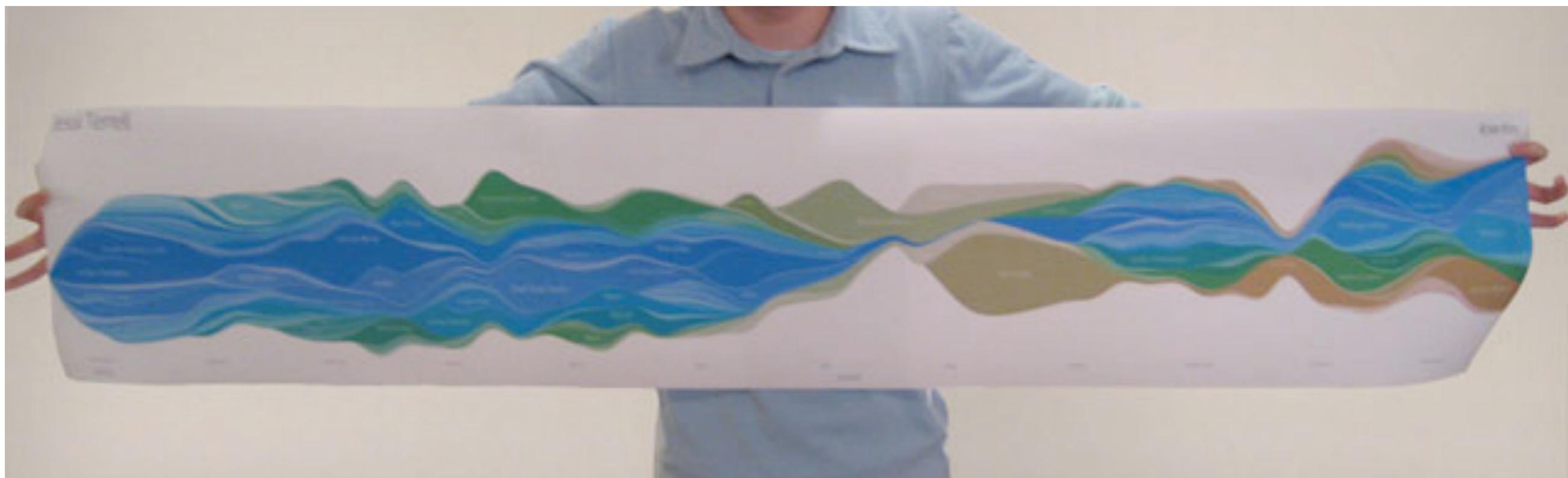


# last.fm spiral



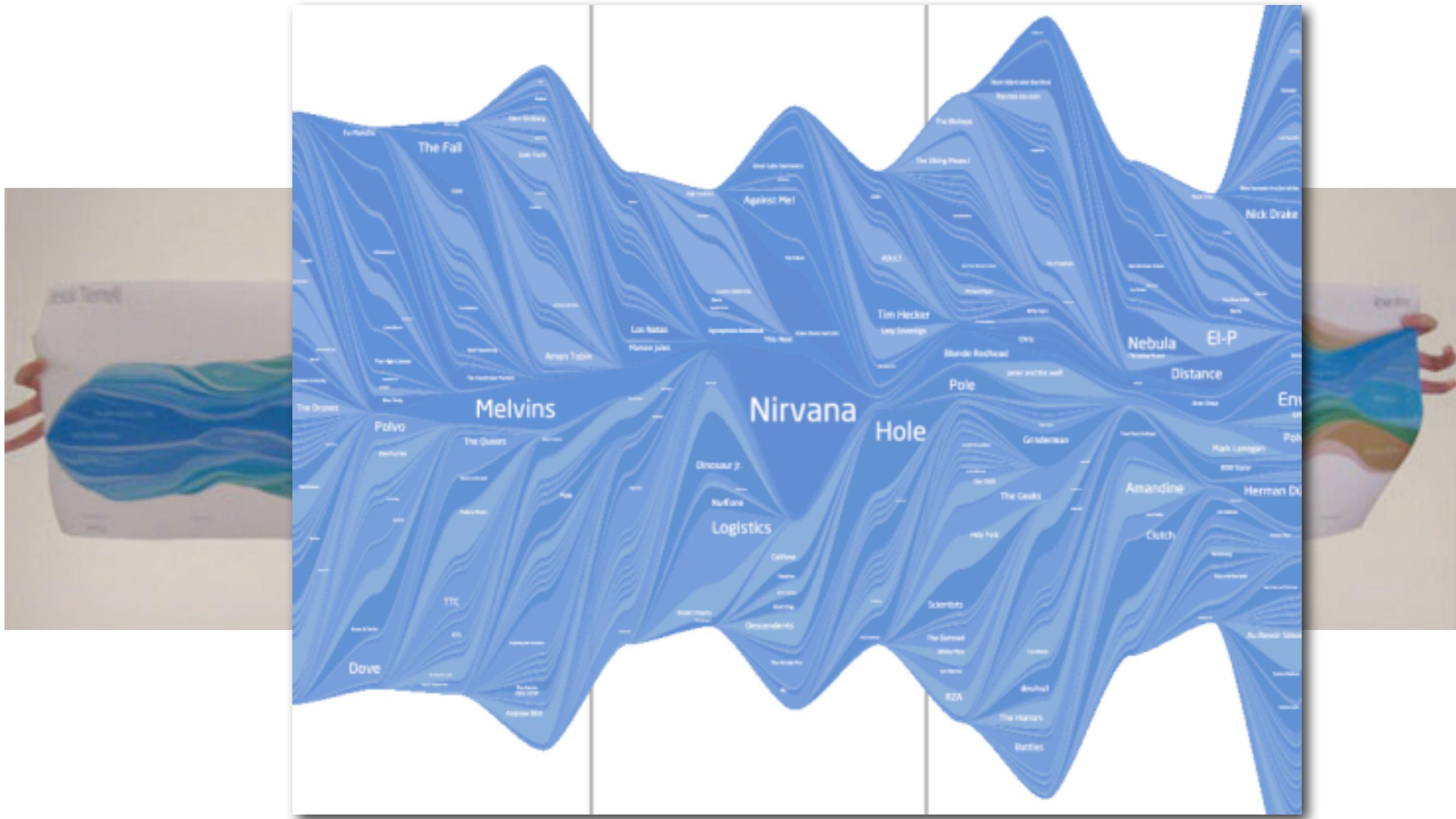
<http://www.diametunim.com/muse/>

# Visualizing Listening History



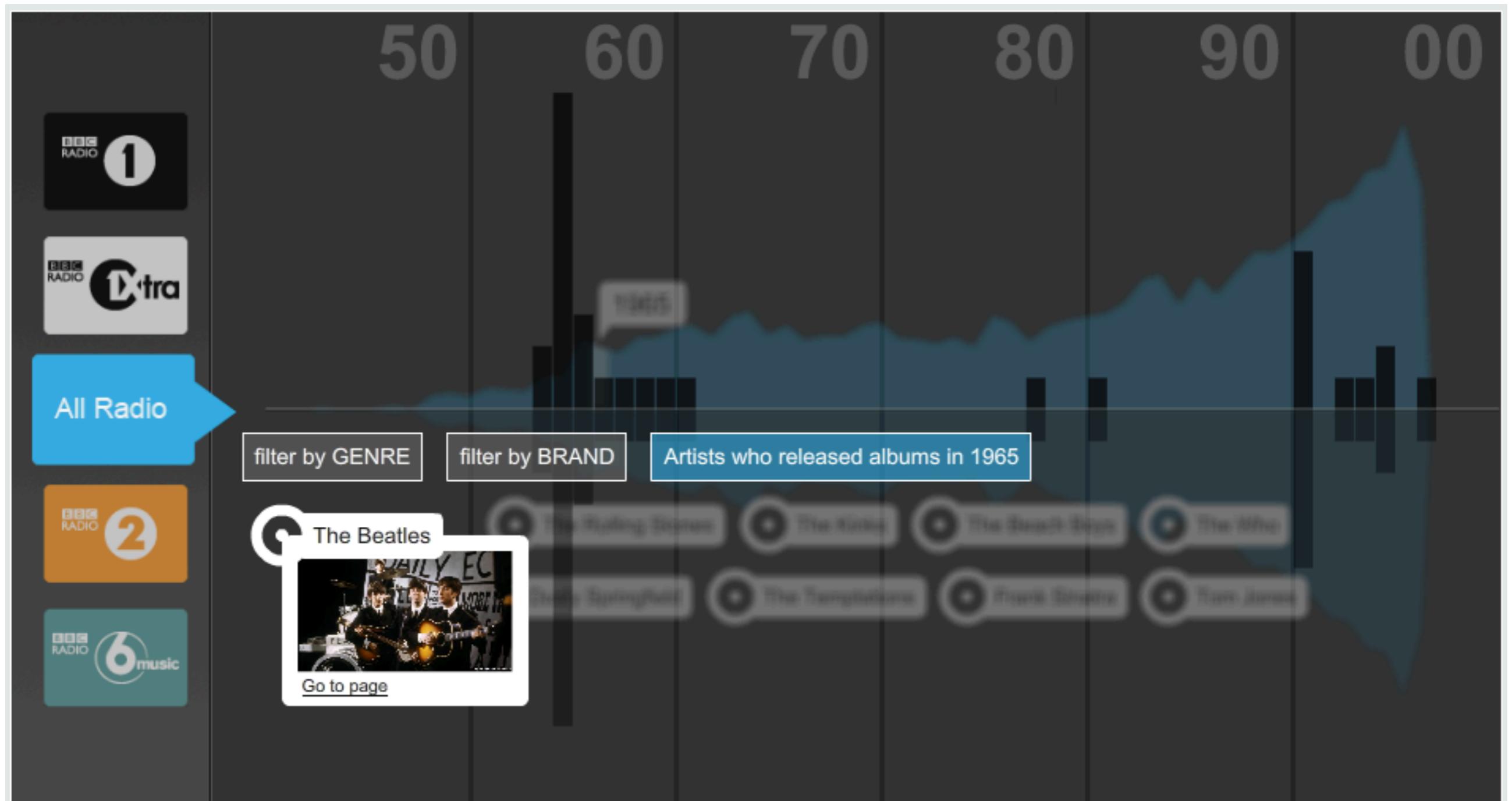
<http://www.leebyron.com/what/lastfm/> - Lee Byron

# Visualizing Listening History



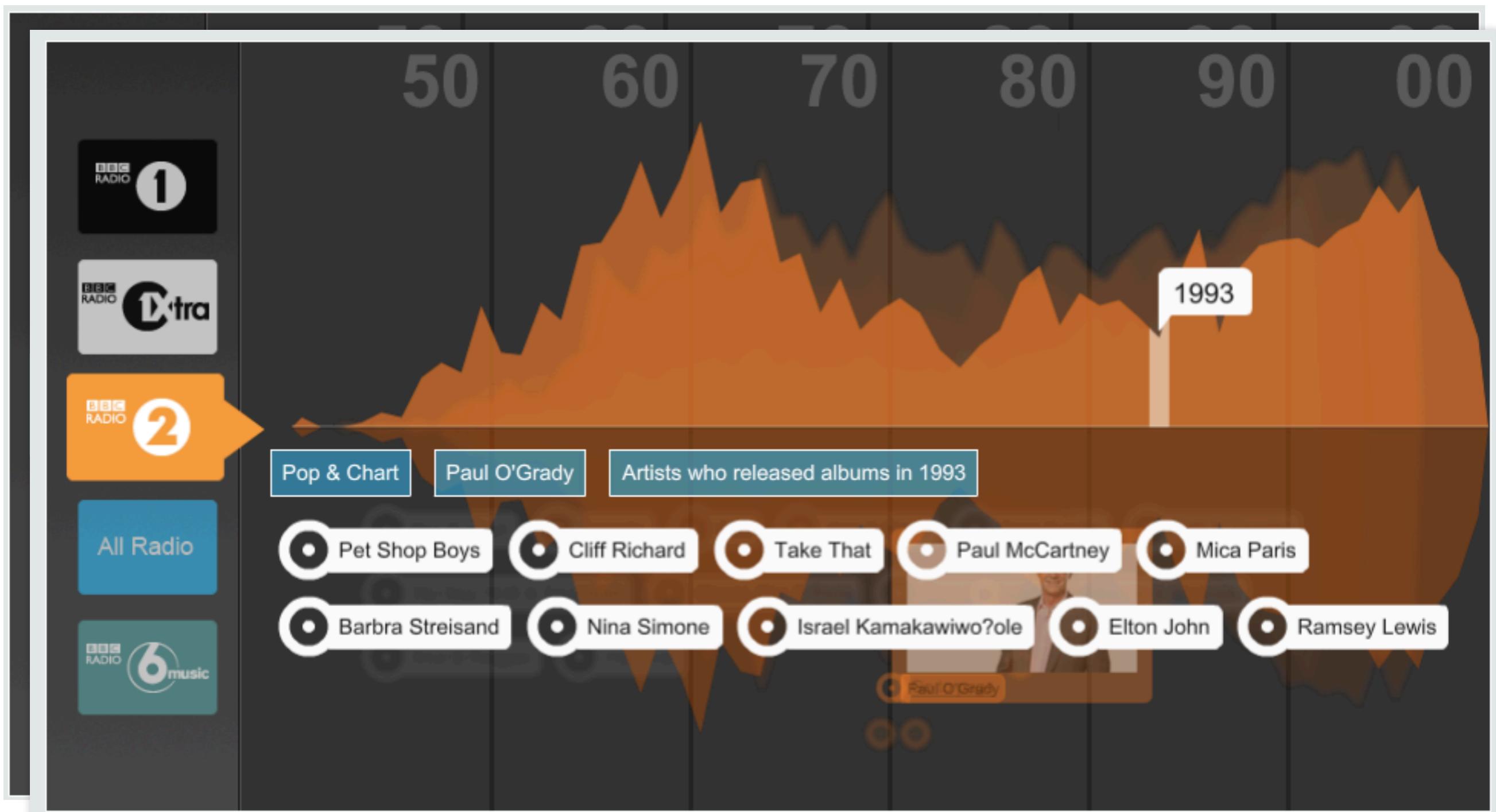
<http://www.leebyron.com/what/lastfm/> - Lee Byron

# Radio Waves



<http://www.bbc.co.uk/radio/labs/radiowaves/>

# Radio Waves



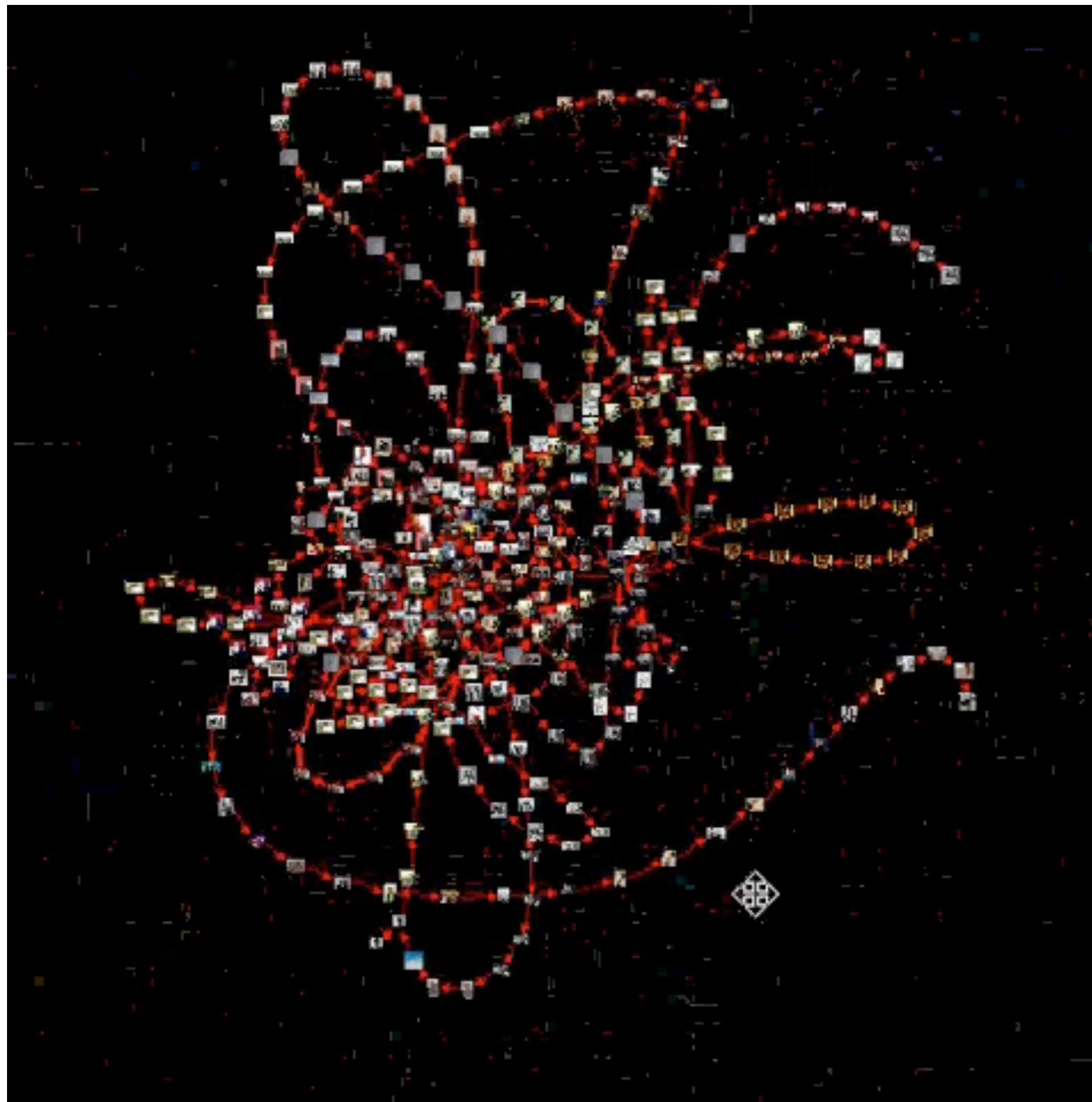
<http://www.bbc.co.uk/radio/labs/radiowaves/>

# Pulling strings from a tangle

<http://bowr.de/blog/?p=49>

Dominikus Baur University of Munich

# Pulling strings from a tangle



<http://bowr.de/blog/?p=49>

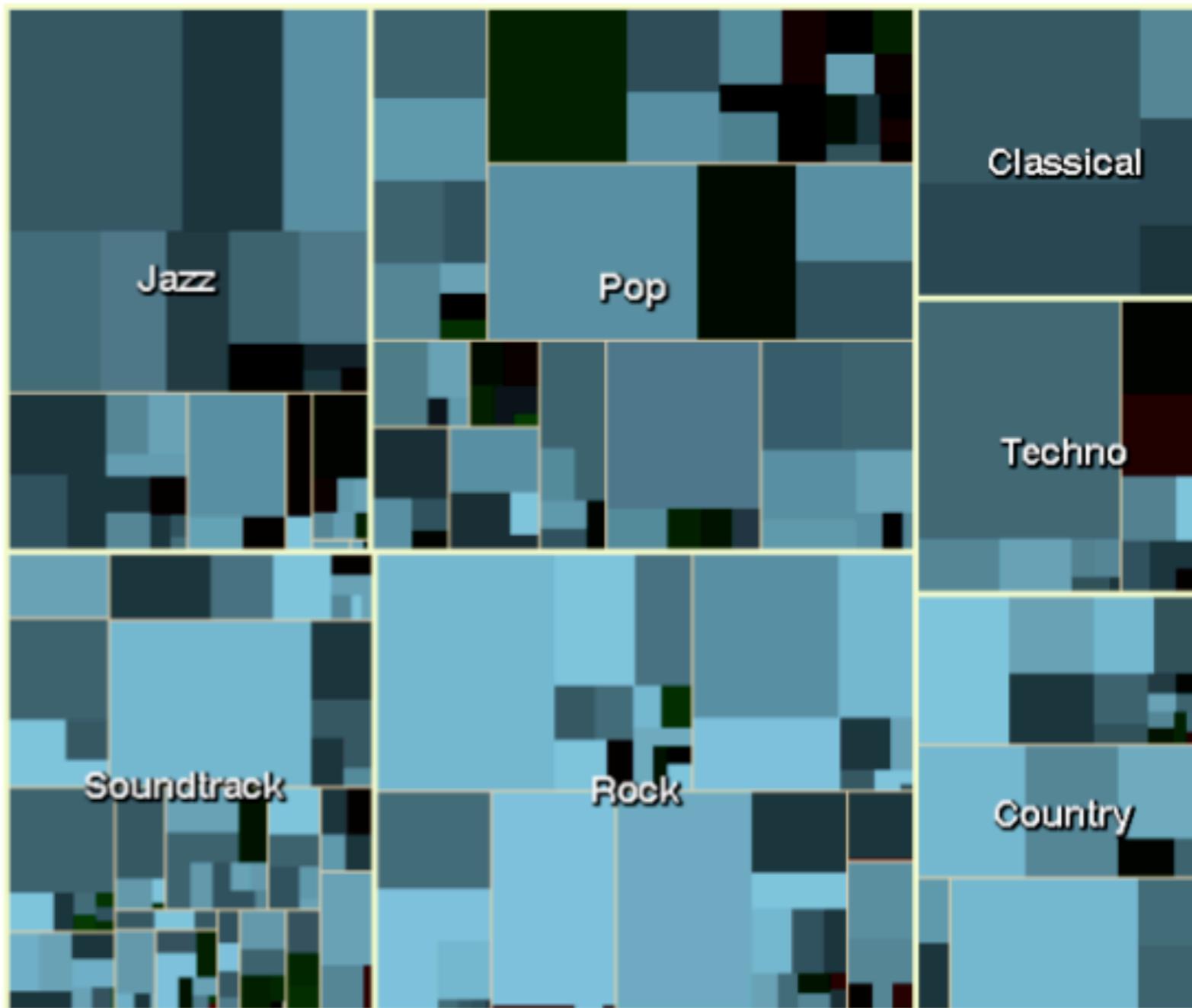
Dominikus Baur University of Munich

# Trees



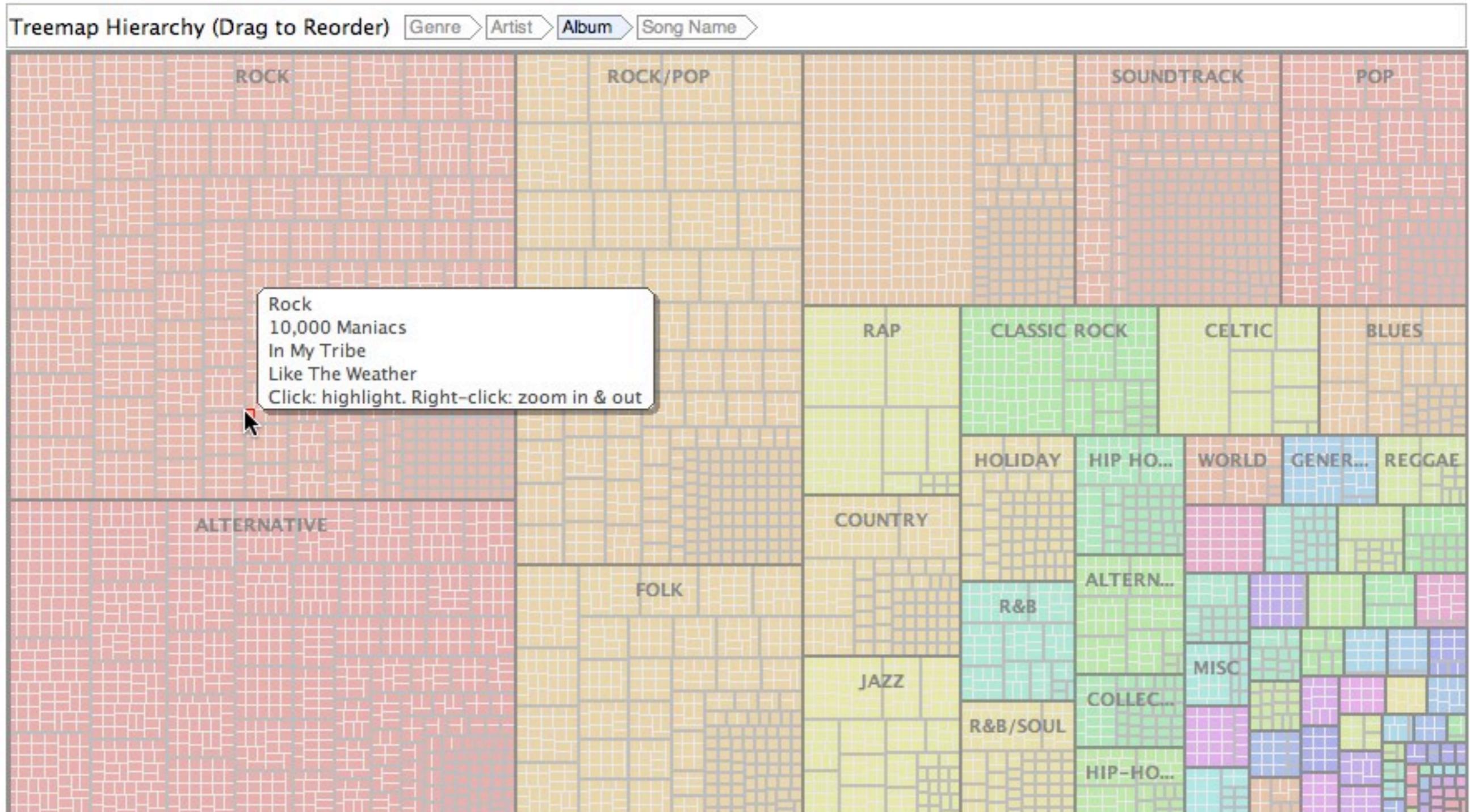
Genre Map derived from Last.fm tags  
Lamere

# Trees



Visualizing and exploring personal music libraries  
Torrens, Hertzog, Arcos

# Treemap of a personal music collection



Visualizations : Dave's Music Library Contents

# Interactive

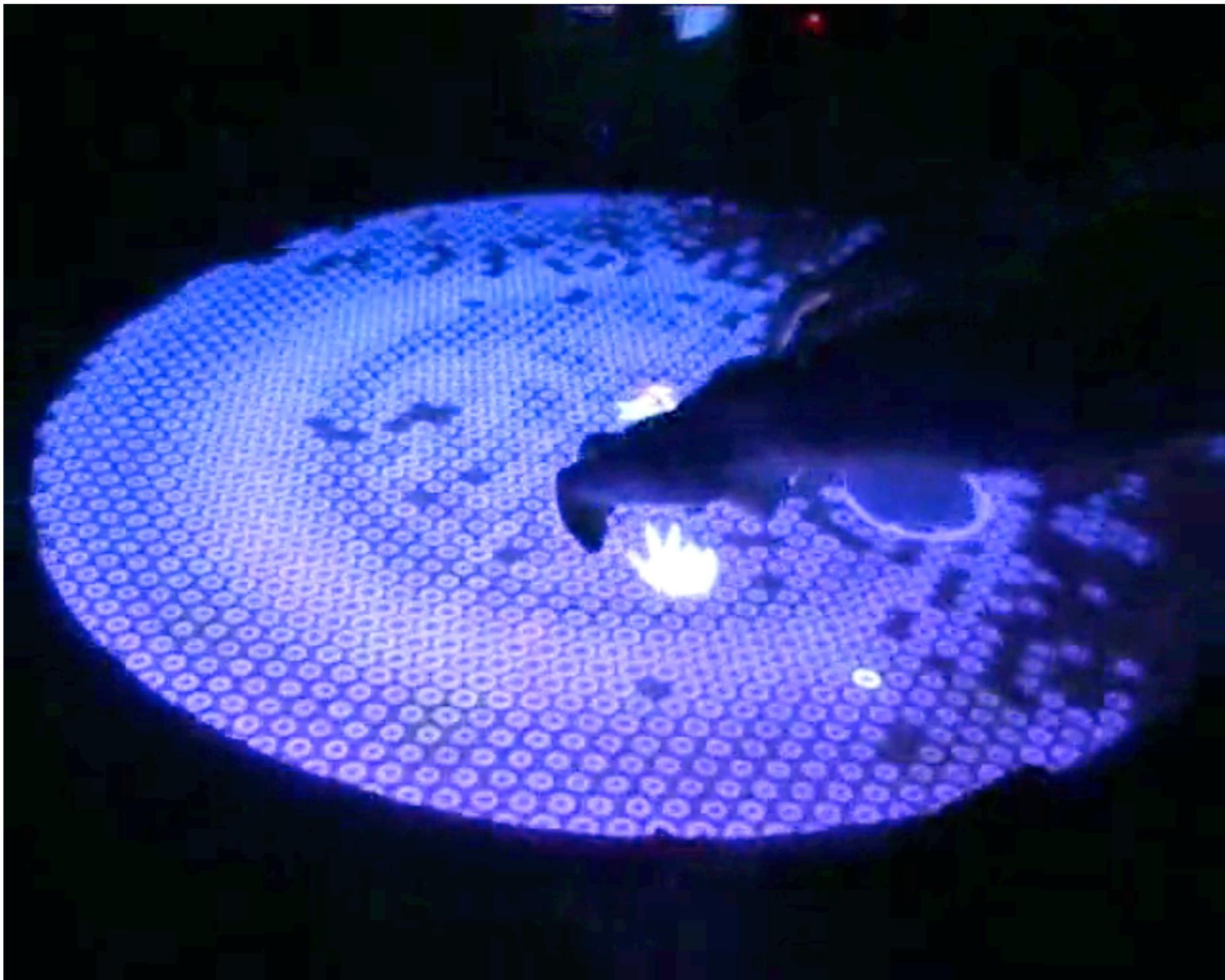


Mirrored Radio dial - by thomwatson

# SongExplorer

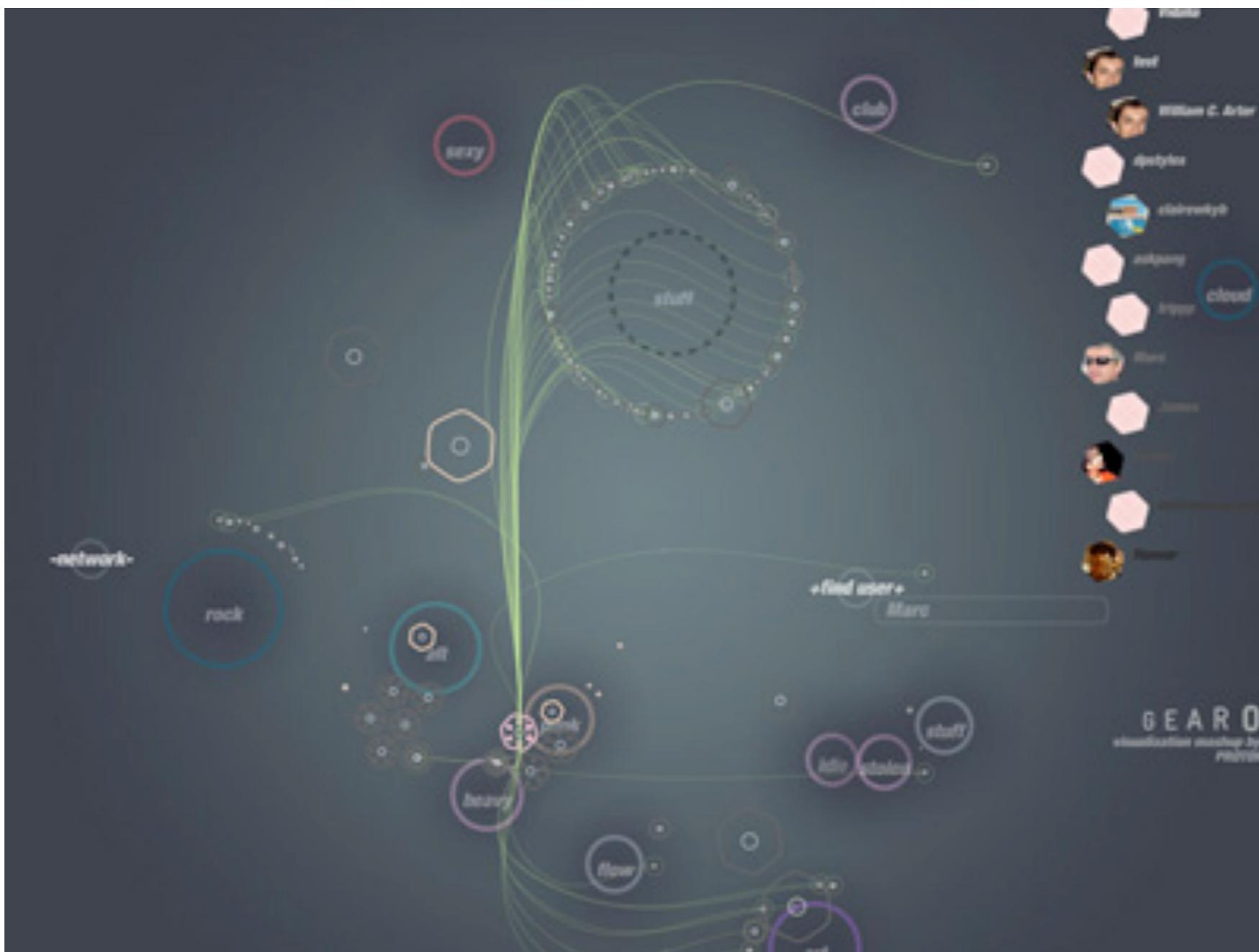
**SongExplorer: Exploring Large Musical Databases Using a Tabletop Interface**  
**Carles F. Julià - Music Technology Group - Universitat Pompeu Fabra**

# SongExplorer



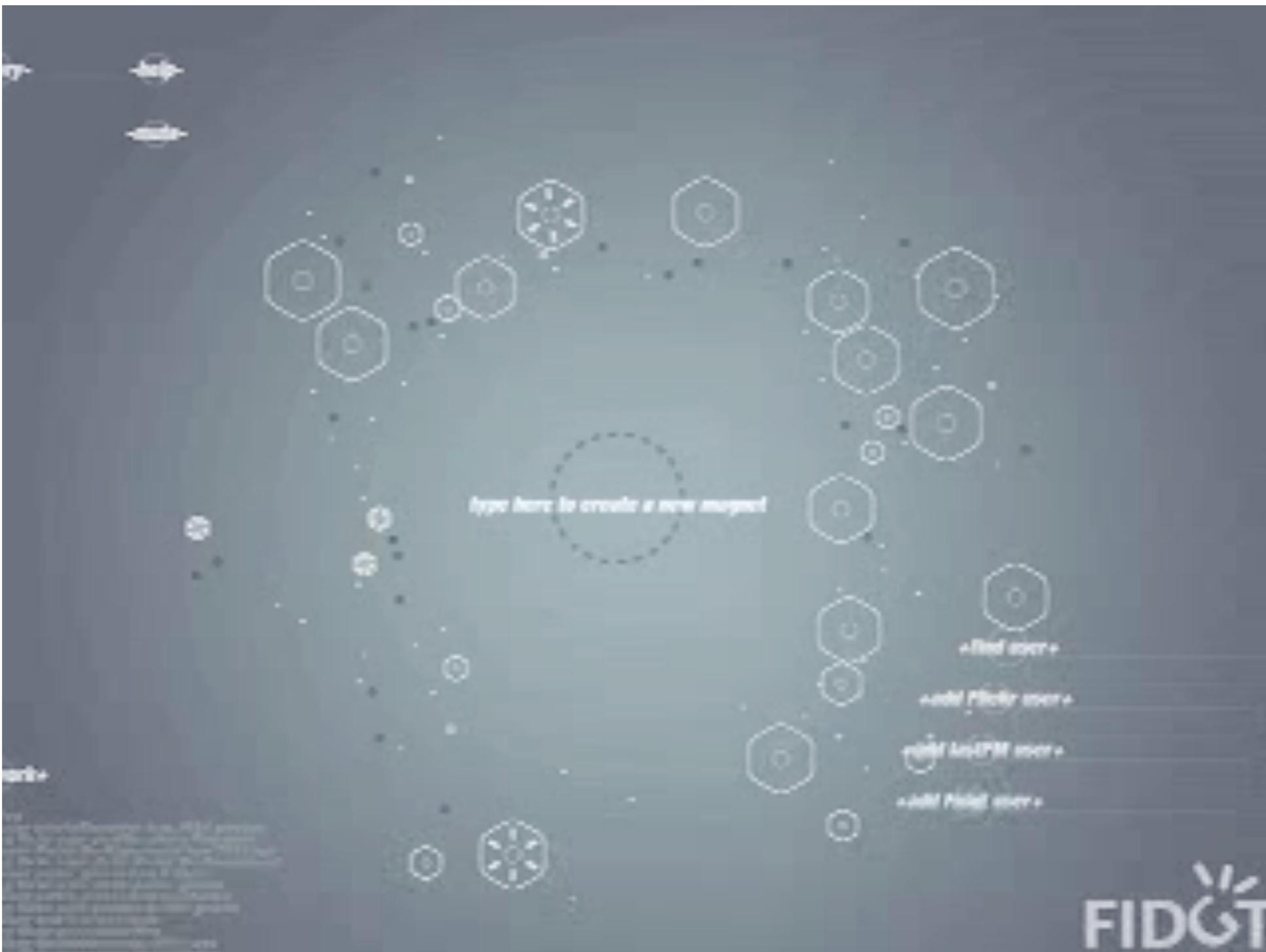
SongExplorer: Exploring Large Musical Databases Using a Tabletop Interface  
Carles F. Julià - Music Technology Group - Universitat Pompeu Fabra

# Fidgt:Visualize



<http://fidgt.com/visualize>

# Fidgt:Visualize



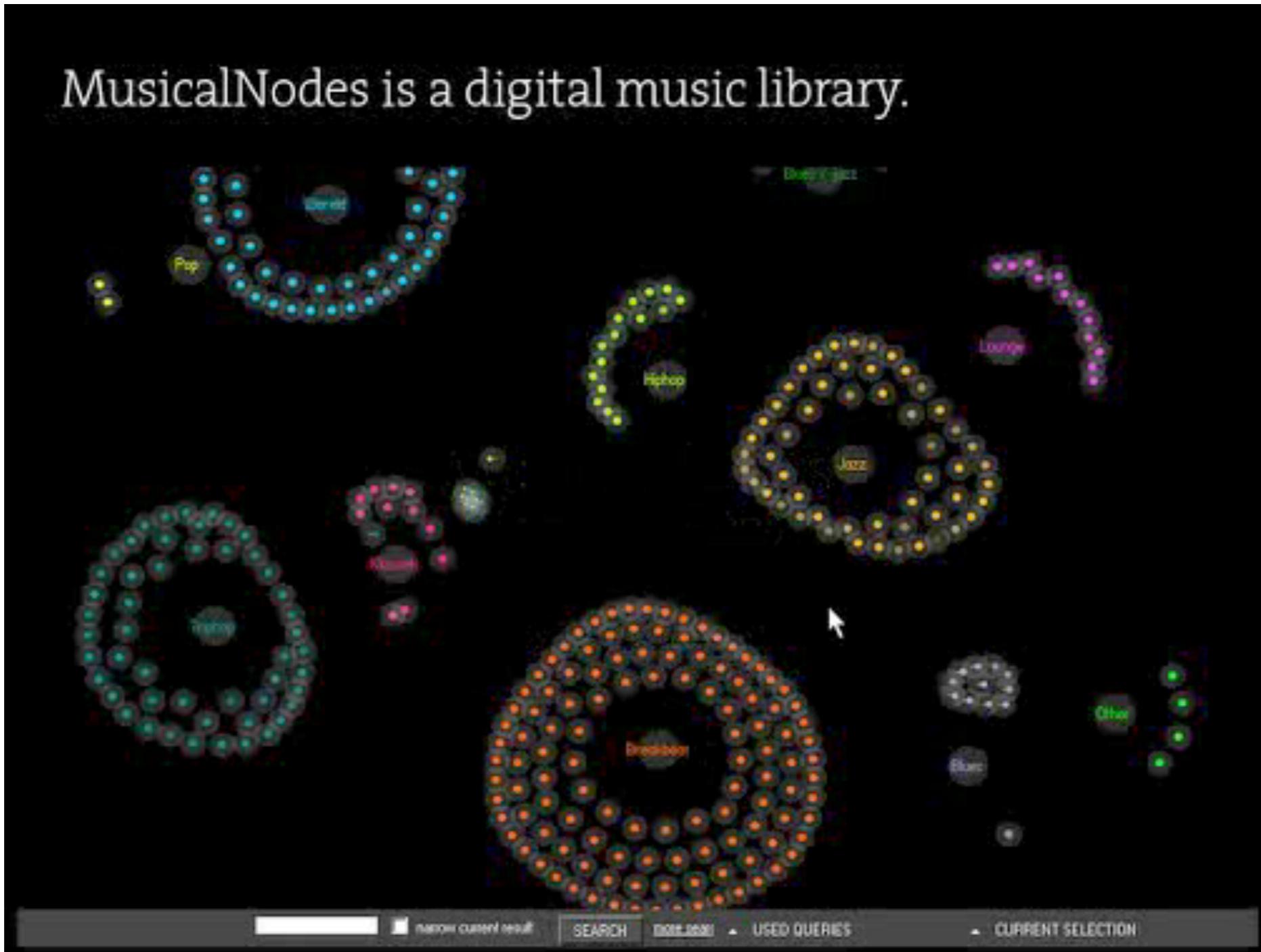
<http://fidgt.com/visualize>

# MusicNodes

<http://waks.nl/nl/musicalnodes>

Lisa Dalhuijsen, Lieven van Velthoven -LIACS, Leiden University

# MusicNodes



<http://waks.nl/nl/musicalnodes>

Lisa Dalhuijsen, Lieven van Velthoven -LIACS, Leiden University

# Zune MixView

[social.zune.net](http://social.zune.net)

# Zune MixView

The screenshot displays the Zune MixView application interface. At the top, there's a navigation bar with a back arrow, a search bar, and links for 'Settings' and 'Help'. Below the navigation is a color-coded navigation bar with tabs for 'collection', 'marketplace', 'social', 'device', 'music', 'videos', 'pictures', 'podcasts', and 'channels'. On the right side, there's a user profile for 'MossyRoc' with 5,433 plays, accompanied by a colorful geometric icon.

Below the navigation bar, there are four main sections:

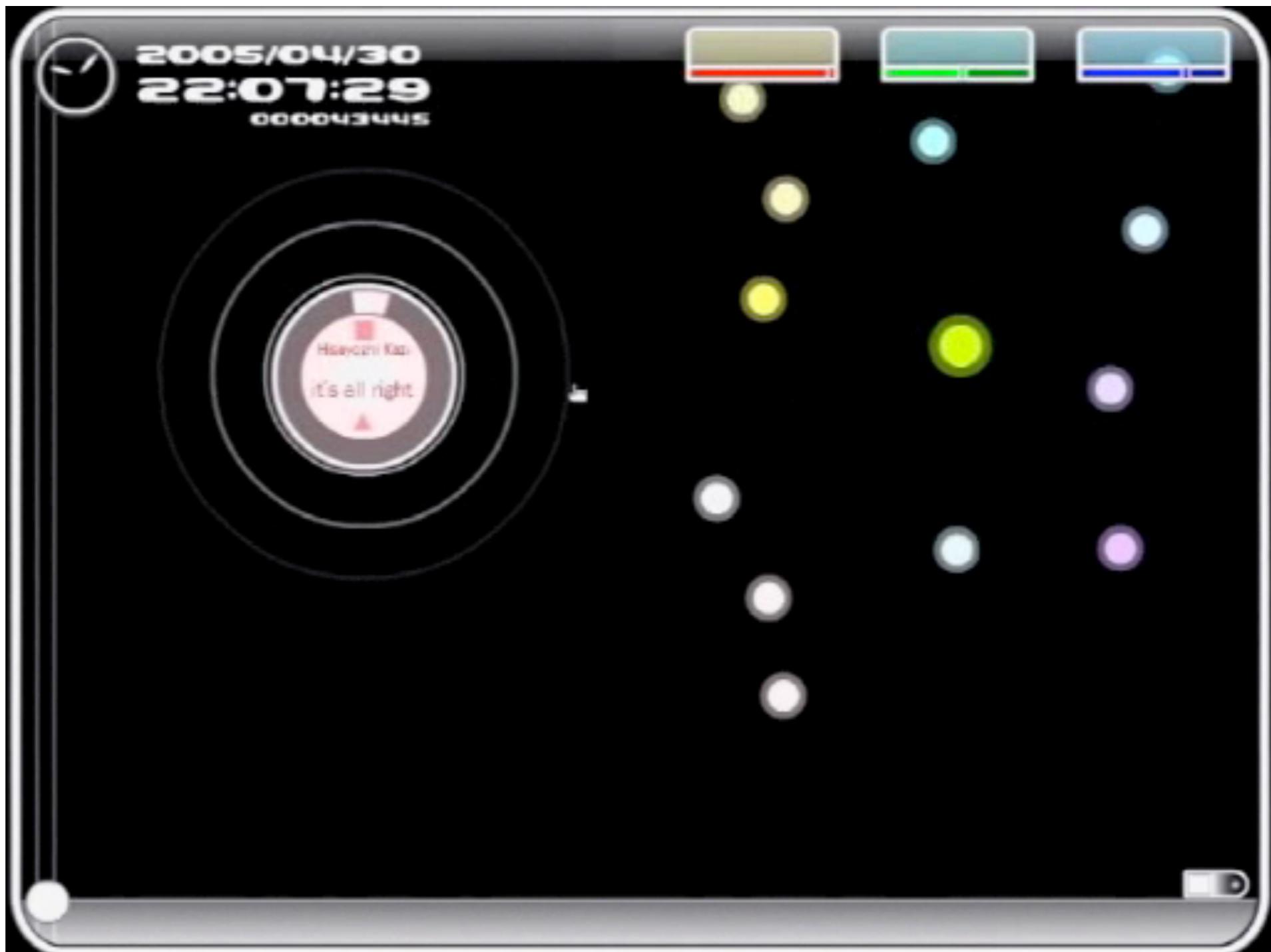
- artists:** A list of 20 artists from A-Z, including Amanda Palmer, Bayside, Dierks Bentley, Does It Offend You Yeah, Dragonforce, Dresden Dolls, Estelle, Hawthorne Heights, Janelle Monae, Katy Perry, Saving Abel, Slipknot, The Dandy Warhols, and The Hold Steady.
- albums:** A list of 21 albums from A-Z, including All Hope Is Gone by Slipknot, Earth To The Dan by The Dandy Warhols, Fragile Future by Hawthorne Heights, Greatest Hits by Dierks Bentley, Llora Lloviendo by Toby Love, Lost In The Sound by Underoath, Love is Back by Toby Love, Mediocre by Ximena Sariñana, Metropolis: The Janelle Monae by Janelle Monae, Morning Tide by The Little Ones, No, Virginia... by Dresden Dolls, and One Of The Boys by Katy Perry.
- songs:** A list of 12 songs by album, numbered 04 to 12, including Thinking Of You, Mannequin, Ur So Gay, Hot N Cold, If You Can Afford Me, Lost, Self Inflicted, I'm Still Breathing, and Fingerprints.
- player controls:** At the bottom, there are various player controls: a volume slider set at 50%, a play/pause button, a gender switch, and navigation arrows.

[social.zune.net](http://social.zune.net)

# Musicream

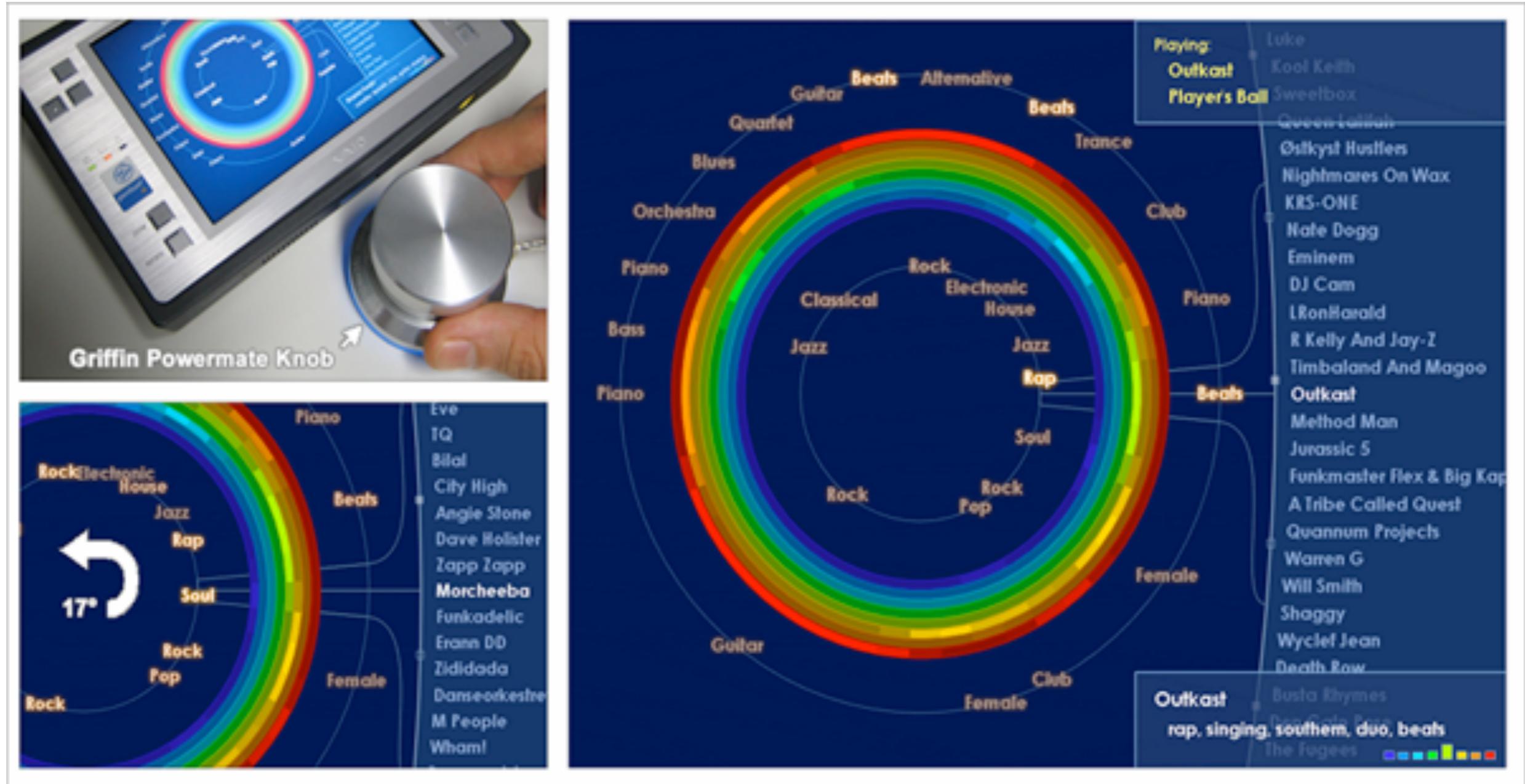
<http://staff.aist.go.jp/m.goto/Musicream/> Goto and Masataka Goto.

# Musicream



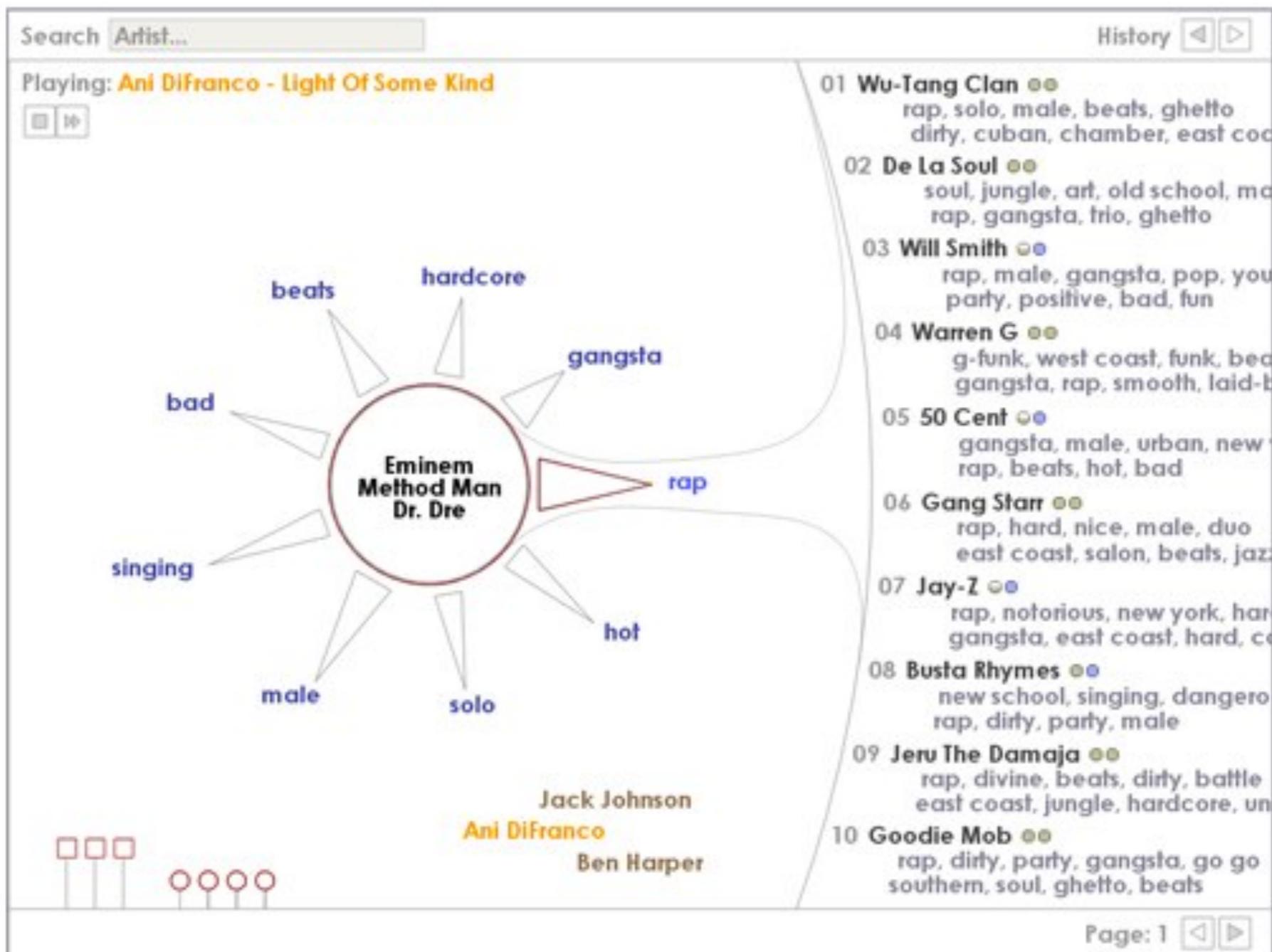
<http://staff.aist.go.jp/m.goto/Musicream/> Goto and Masataka Goto.

# MusicRainbow



Elias Pampalk & Masataka Goto, "MusicRainbow: A New User Interface to Discover Artists Using Audio-based Similarity and Web-based Labeling

# MusicSun



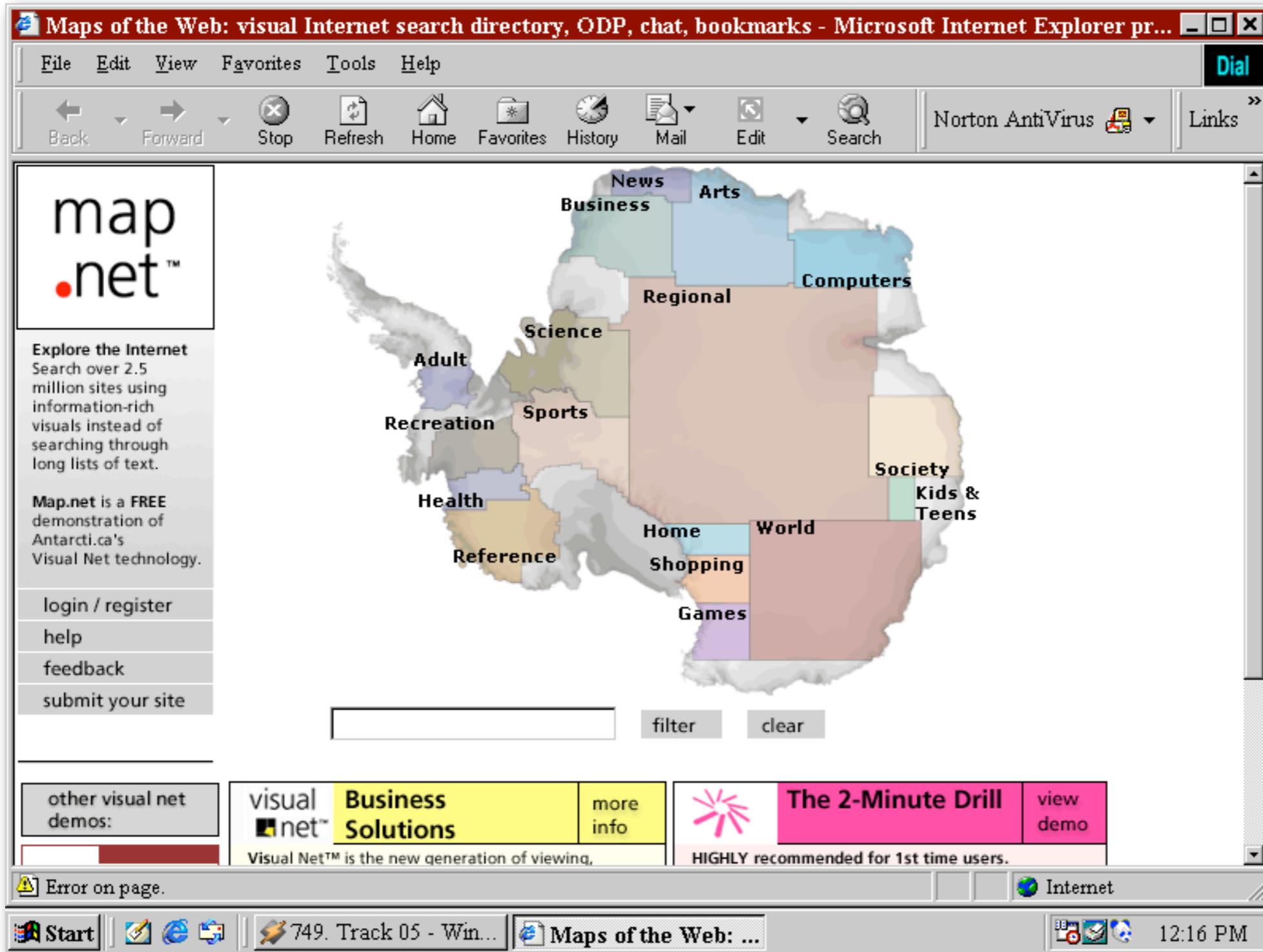
Elias Pampalk & Masataka Goto,  
"MusicSun: A New Approach to Artist Recommendation"

# EN Music Explorer

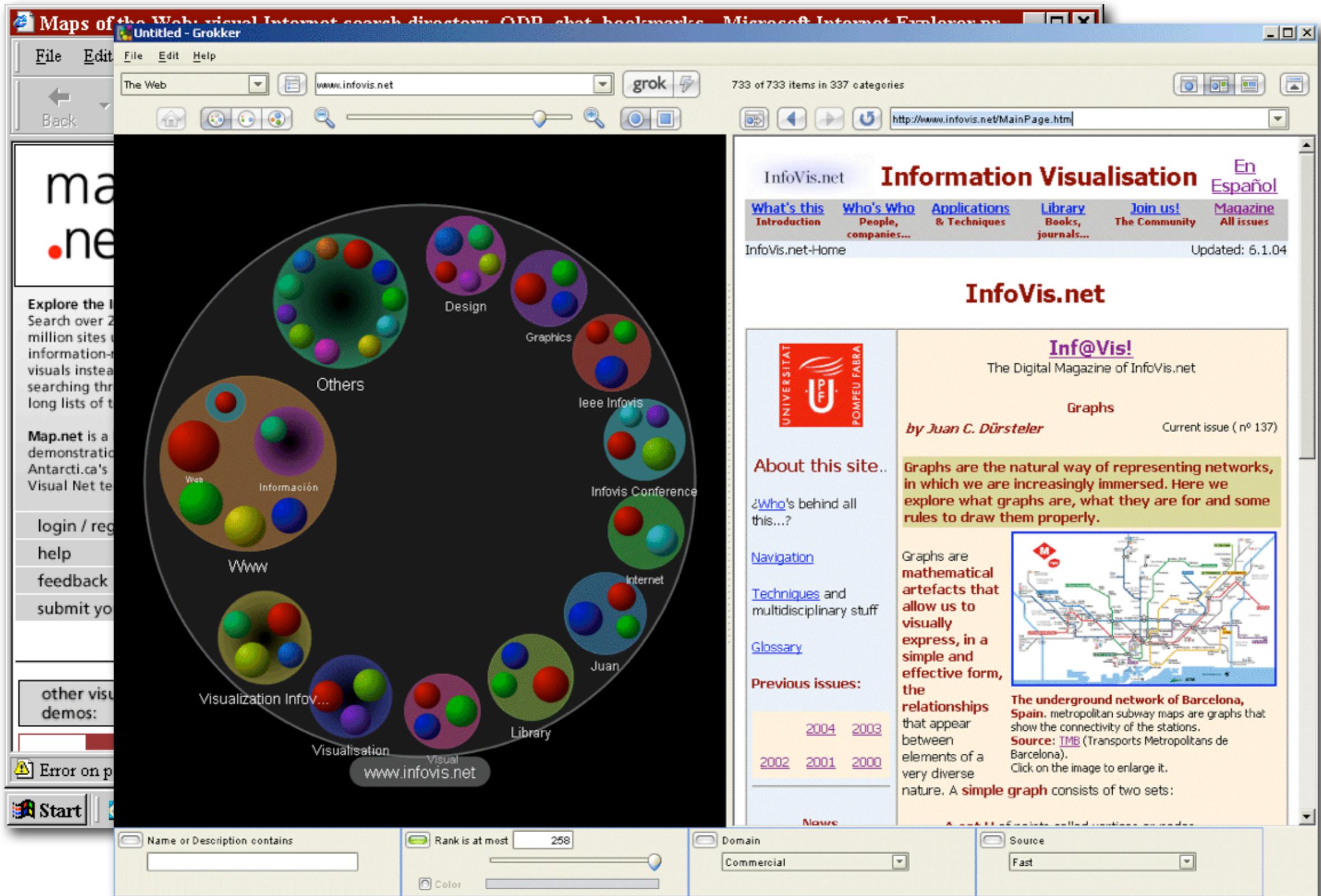
# EN Music Explorer



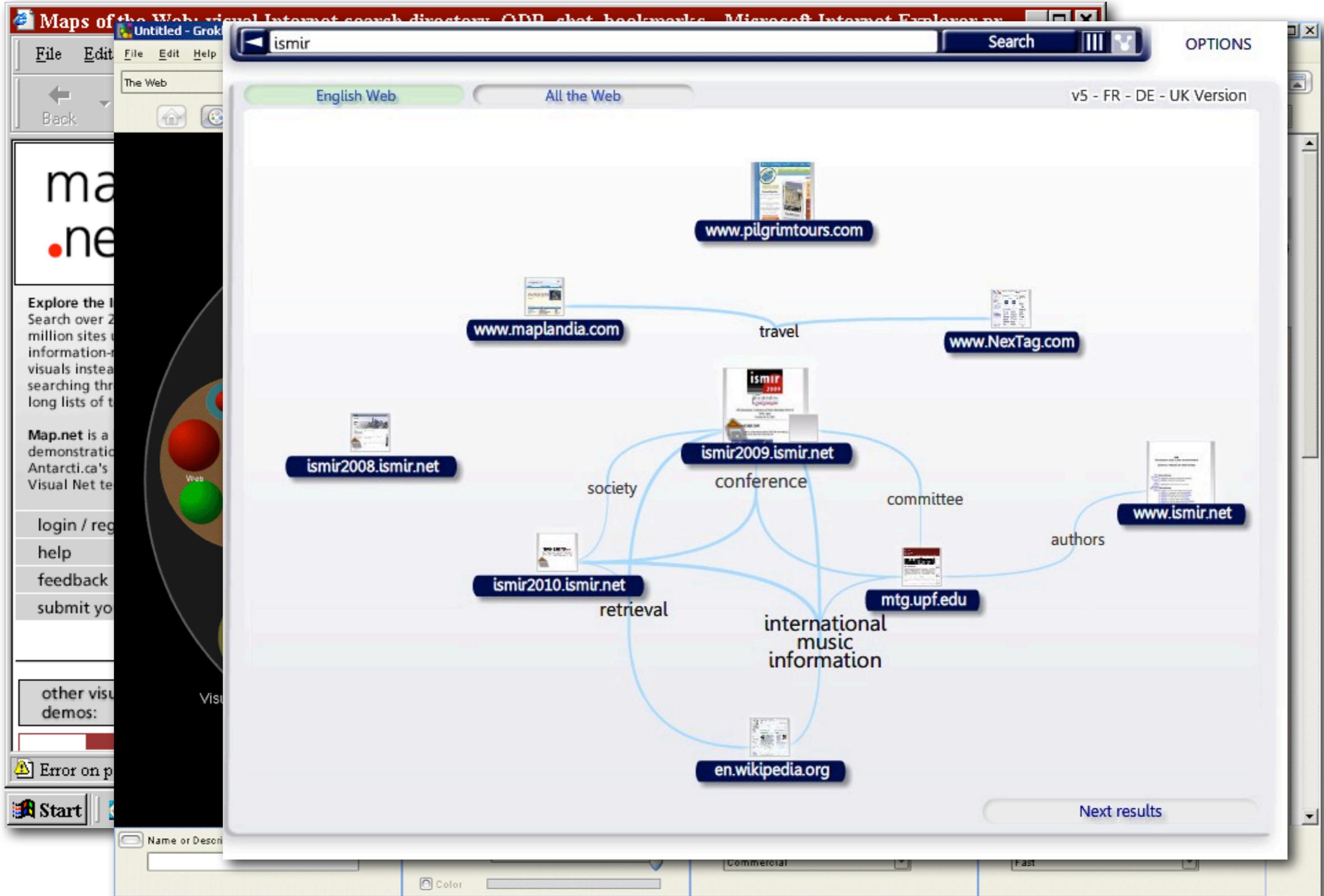
# Here be Dragons



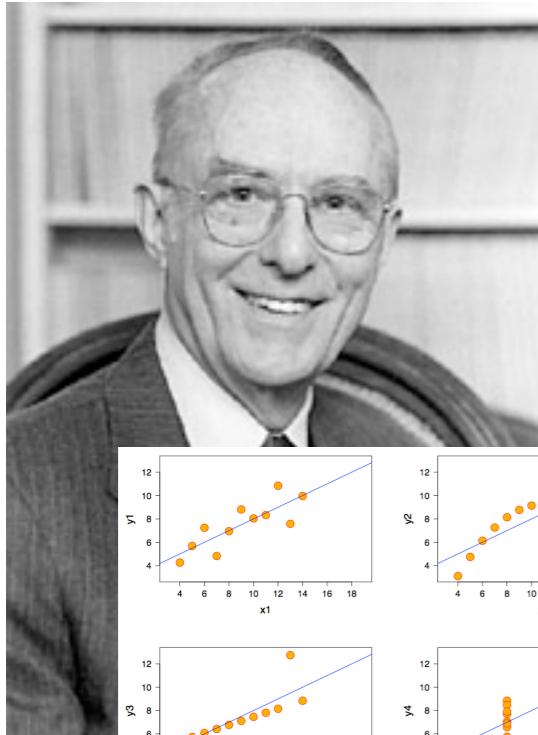
# Here be Dragons



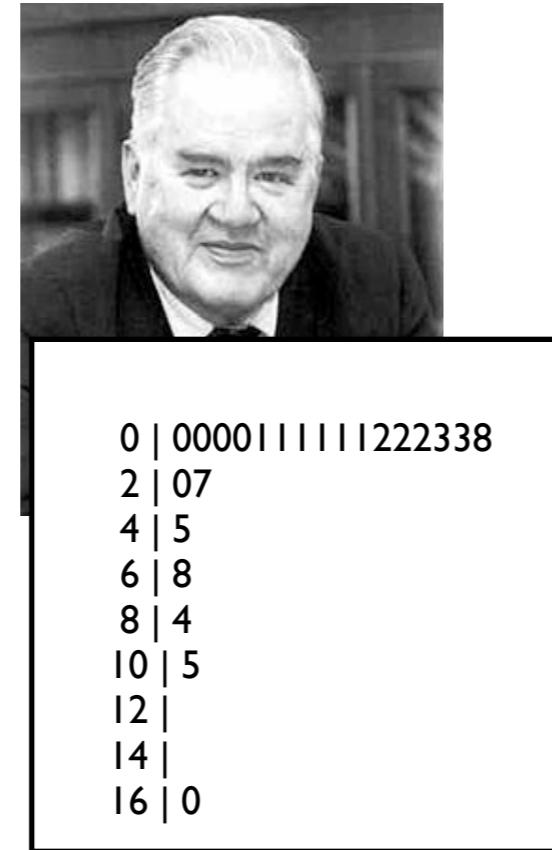
# Here be Dragons



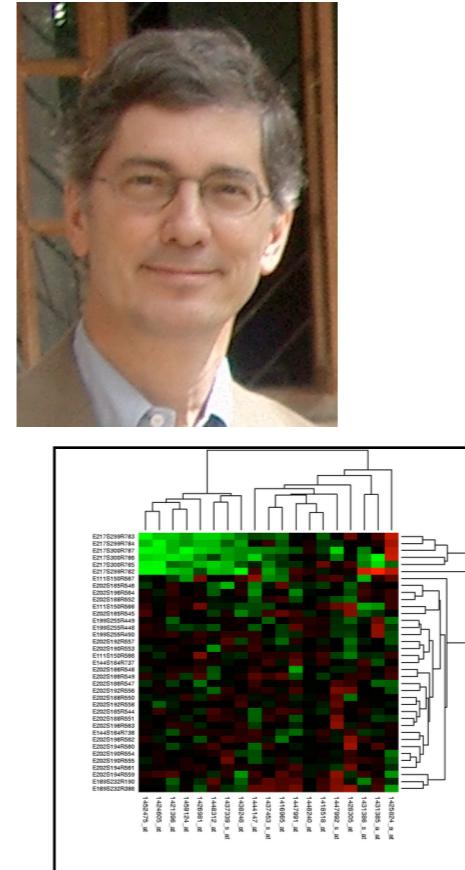
# Visualization Proponents (The Yale Club)



F.J. Anscombe  
(Anscombe's Quartet)



John Tukey  
(stem/leaf plots)

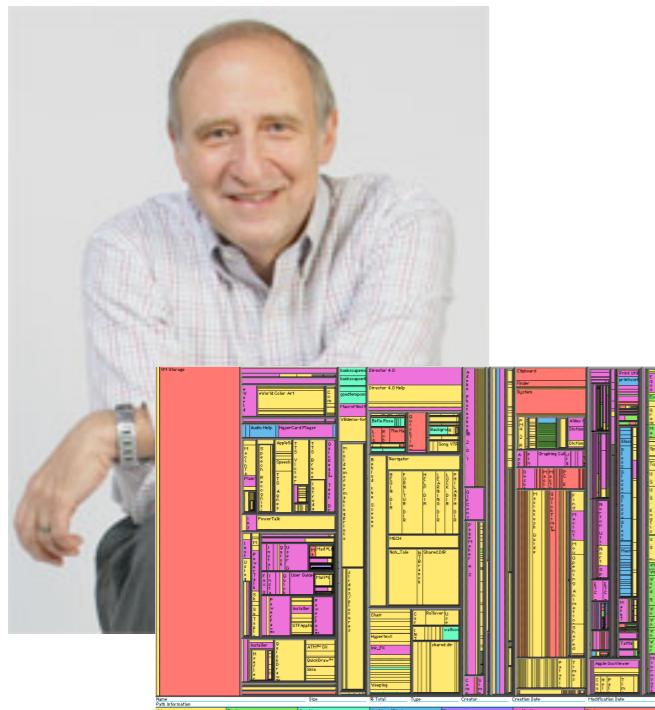


Leland Wilkinson  
(Cluster heat maps)



Edward Tufte  
(Sparklines)

# Interactive Visualization Proponents



Ben Shneiderman  
(Treemaps, NSD  
diagrams)



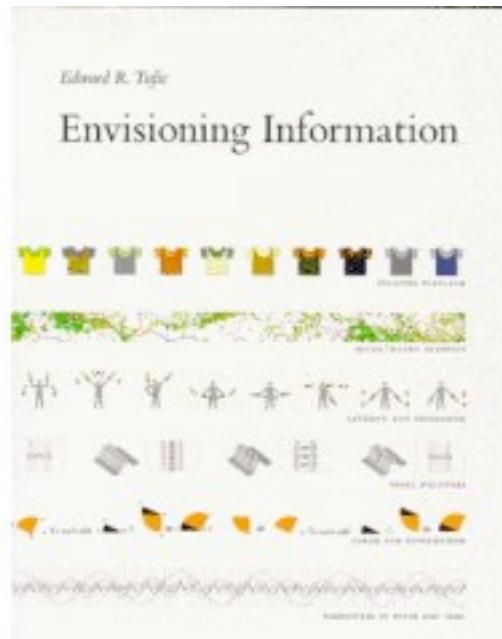
Steve Deunes  
(& entire NYT  
Graphics  
Department)



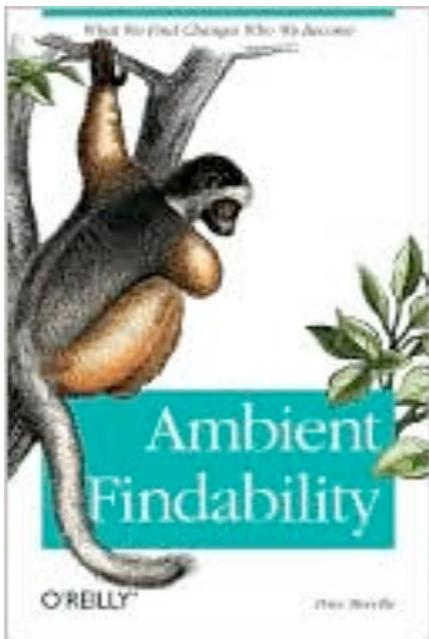
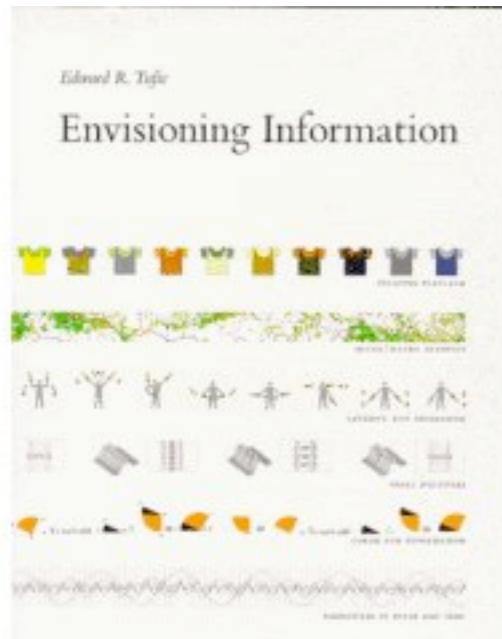
Ben Fry & Casey  
Reas  
(Processing)

# Resources

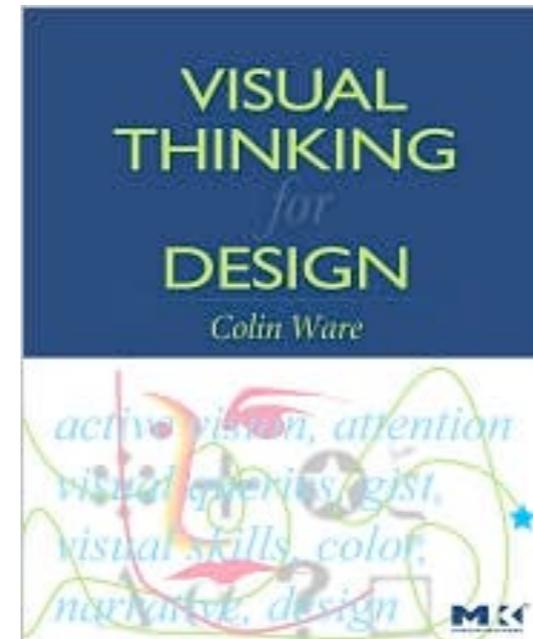
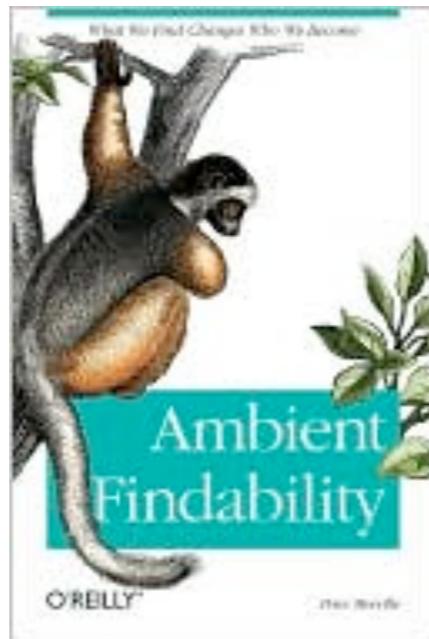
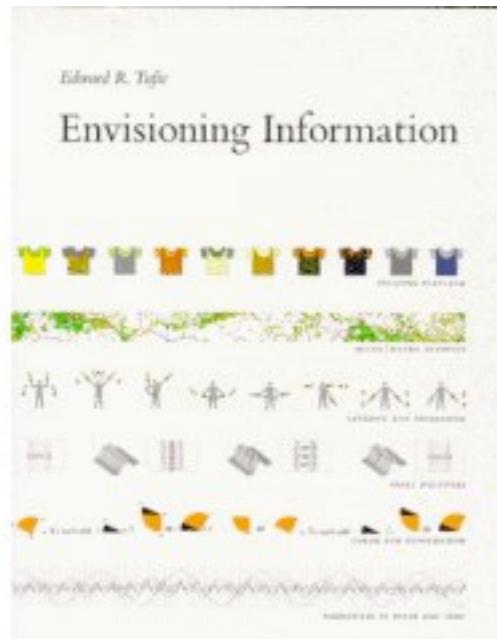
# Resources



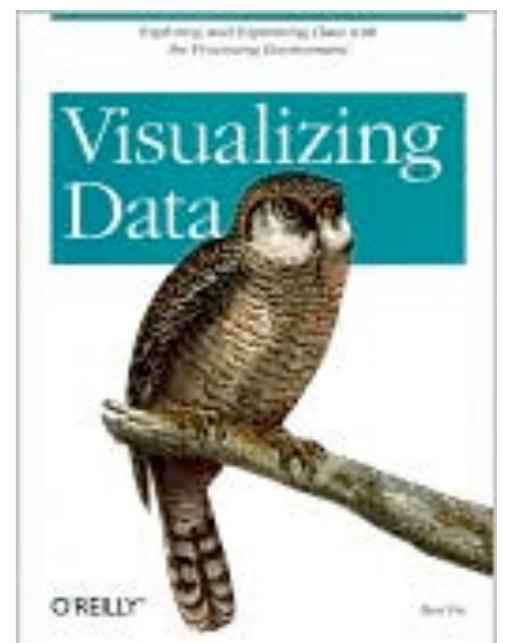
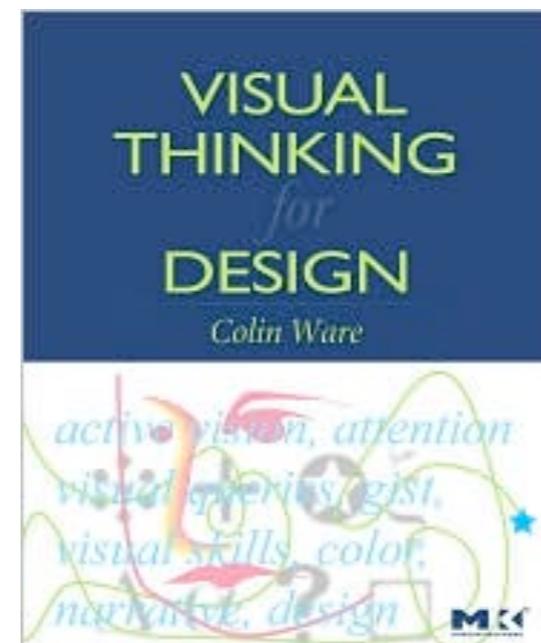
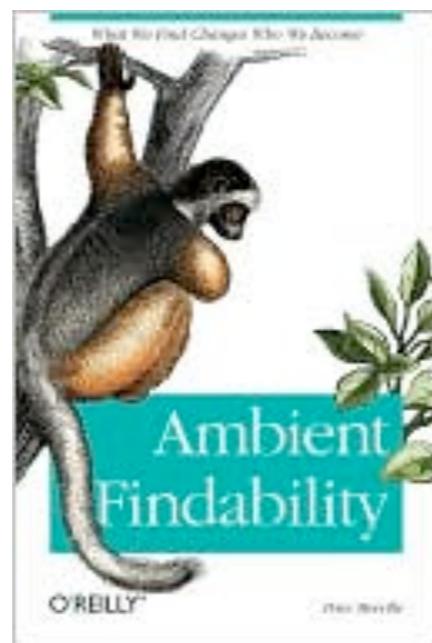
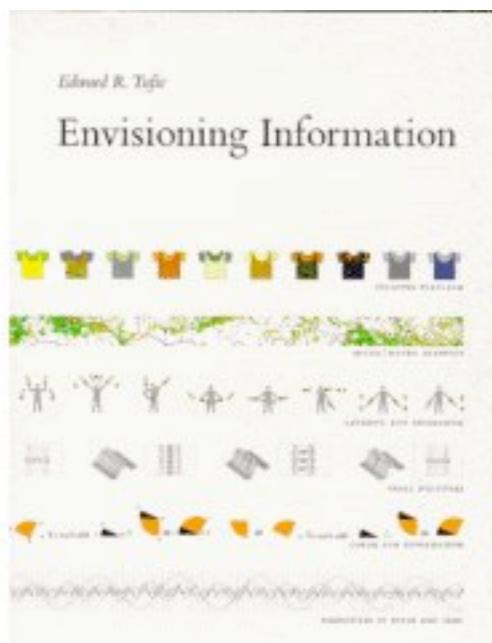
# Resources



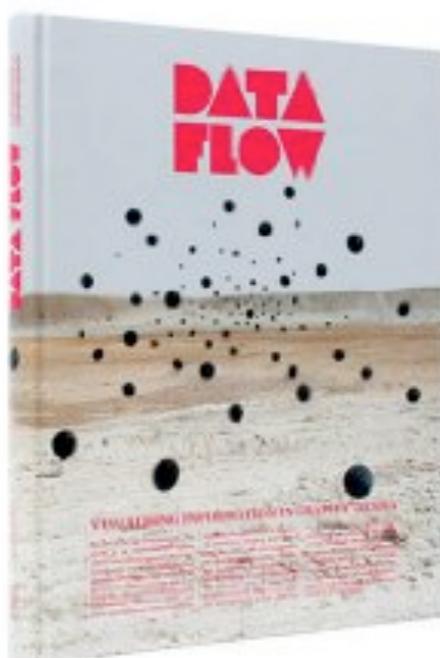
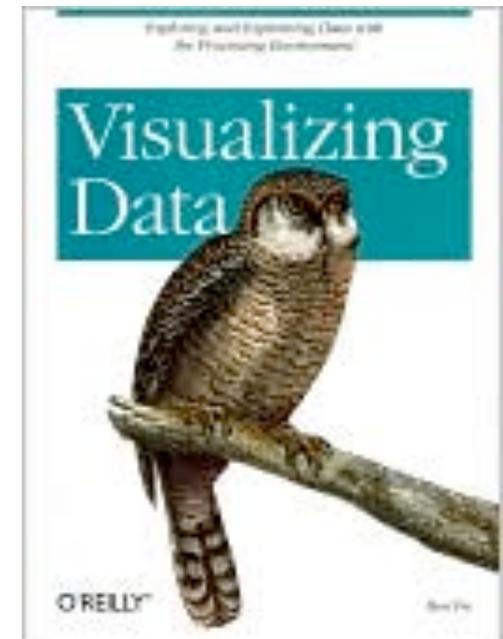
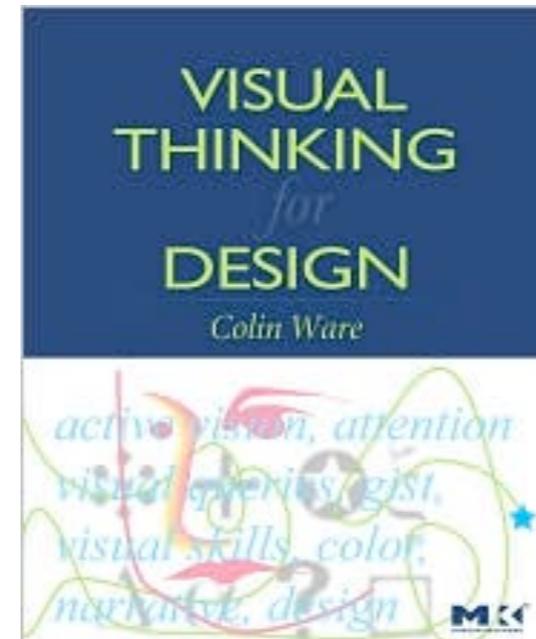
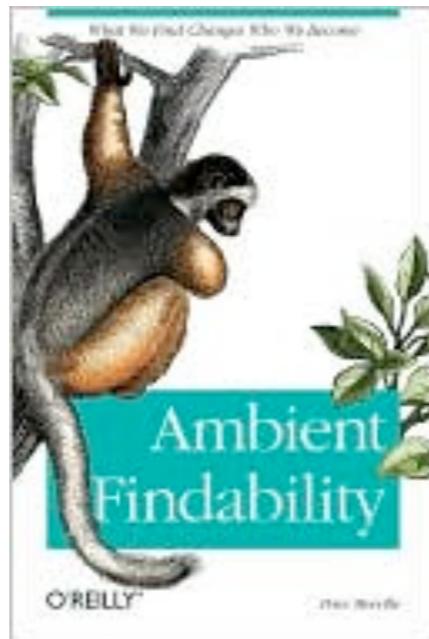
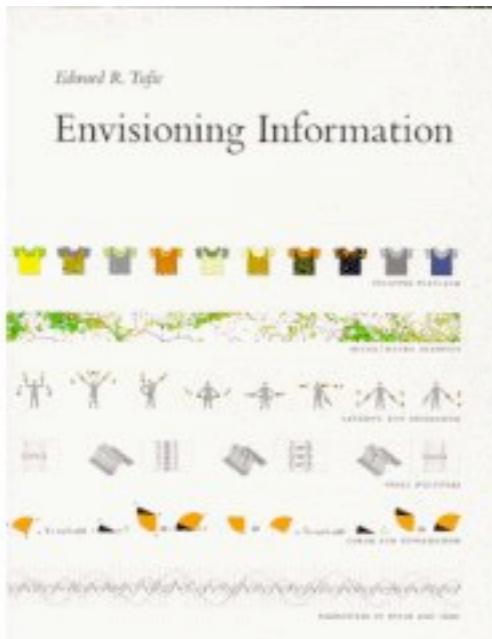
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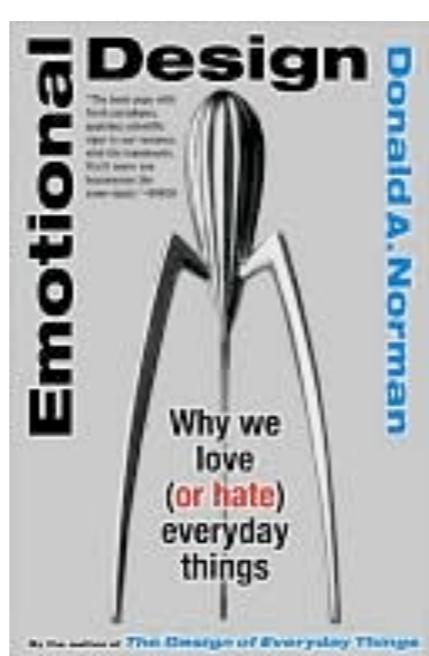
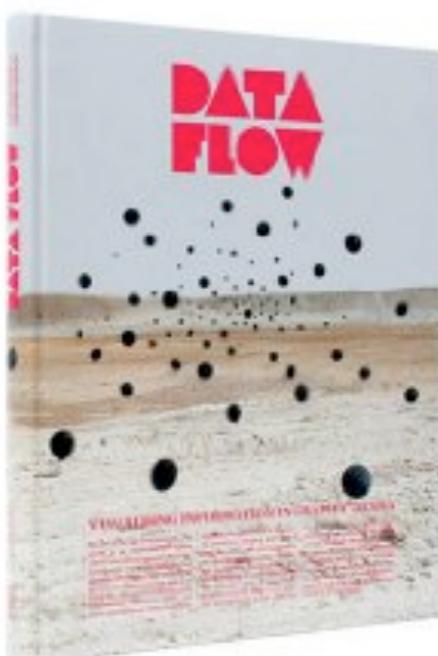
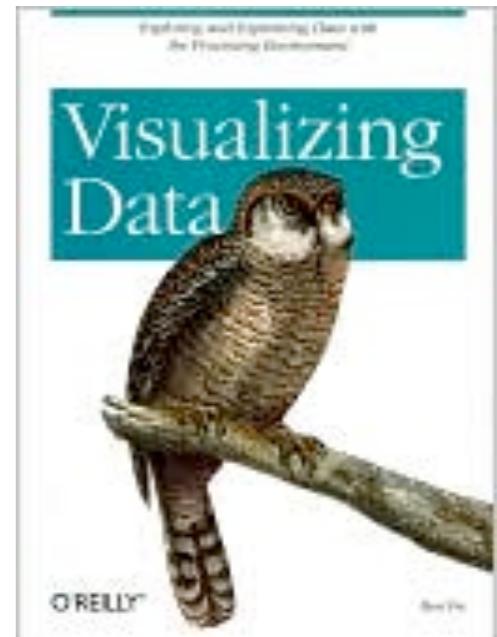
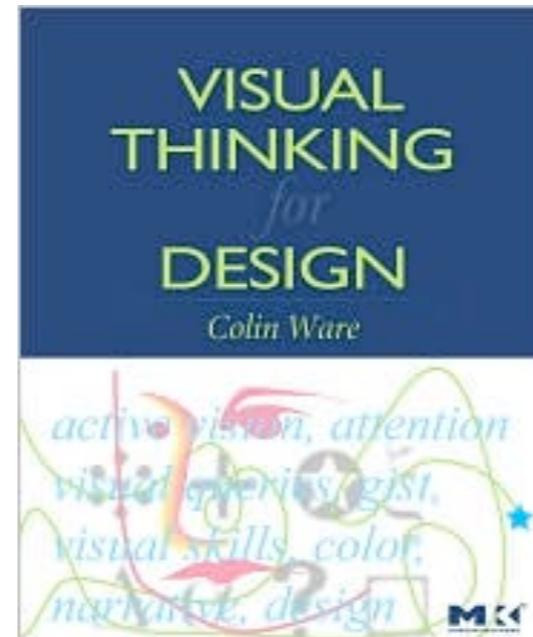
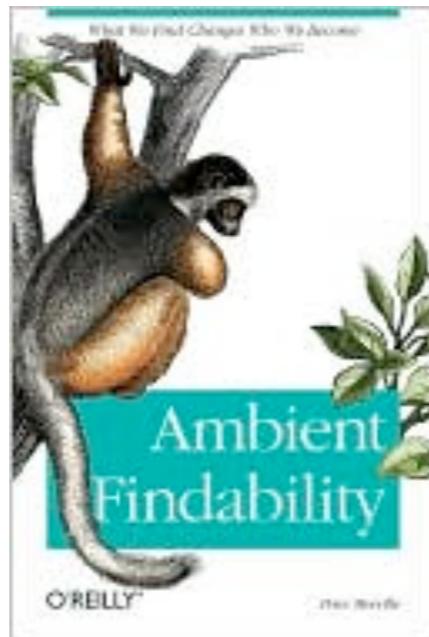
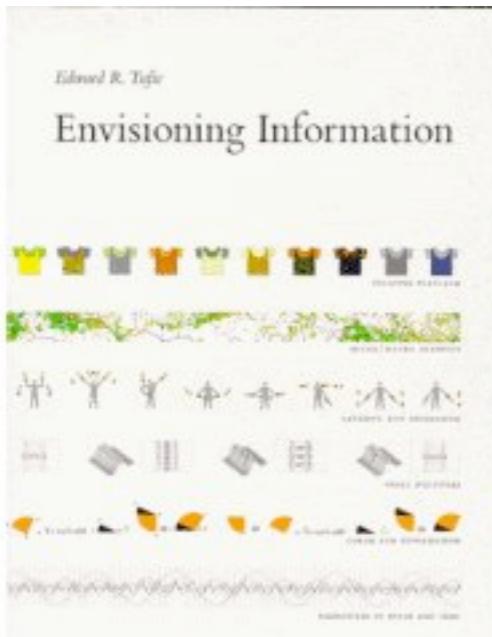
# Resources



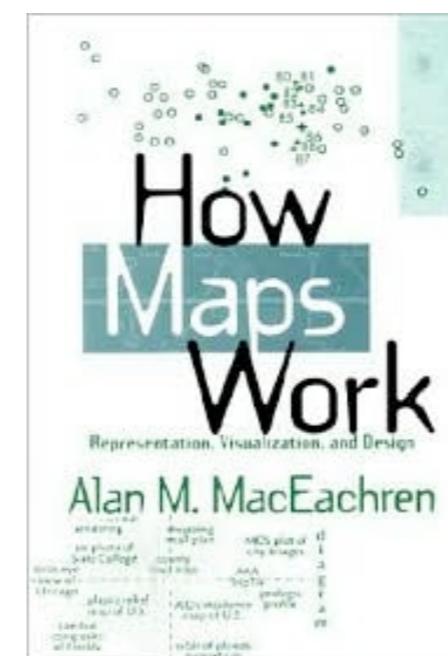
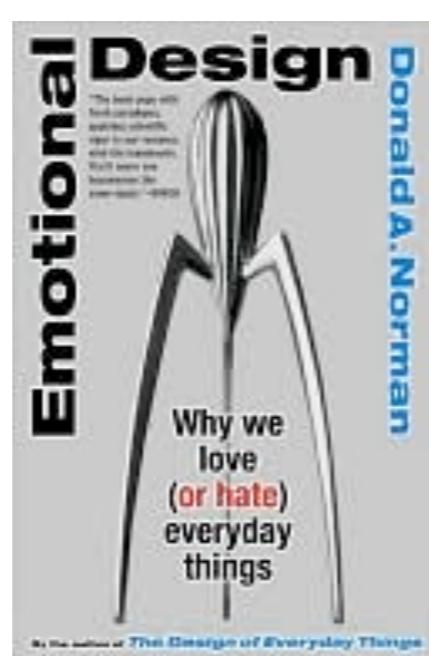
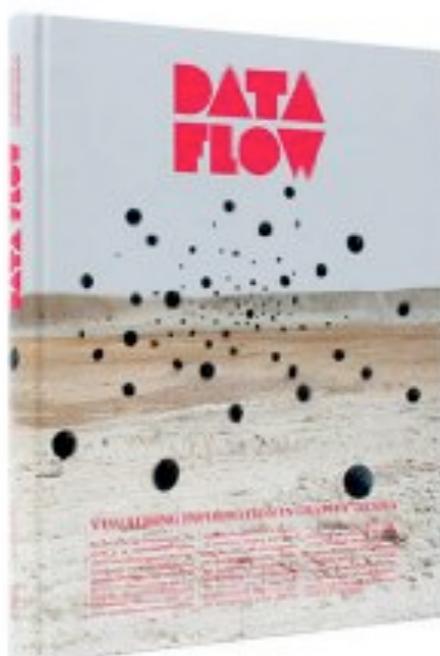
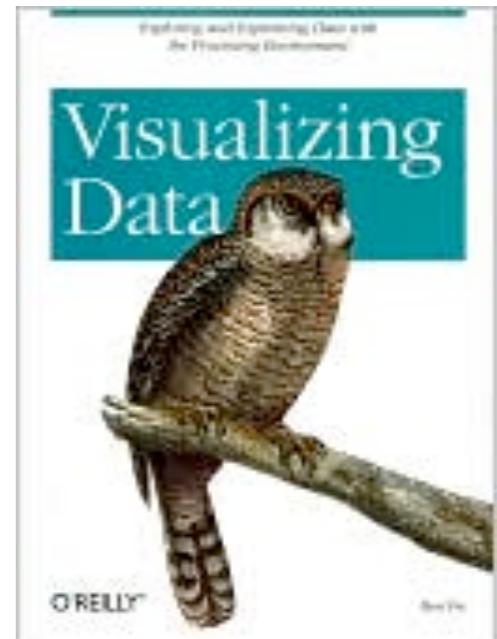
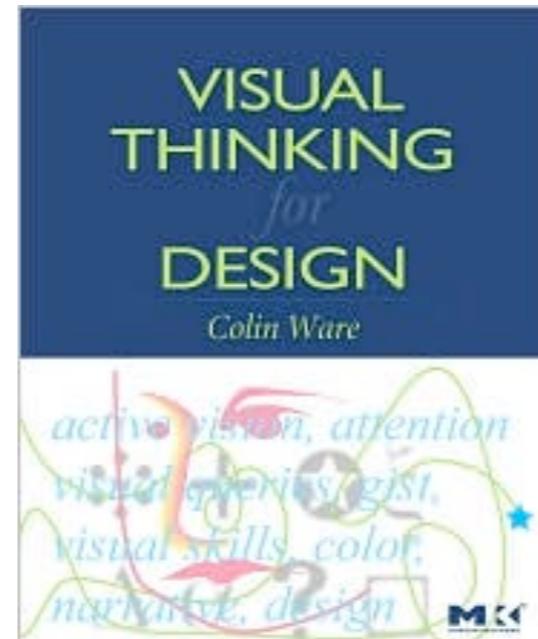
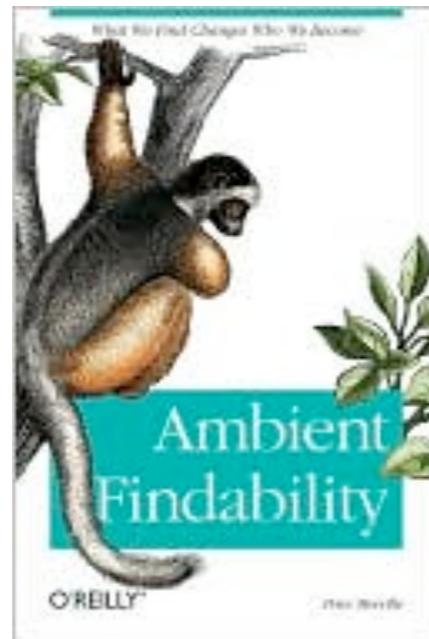
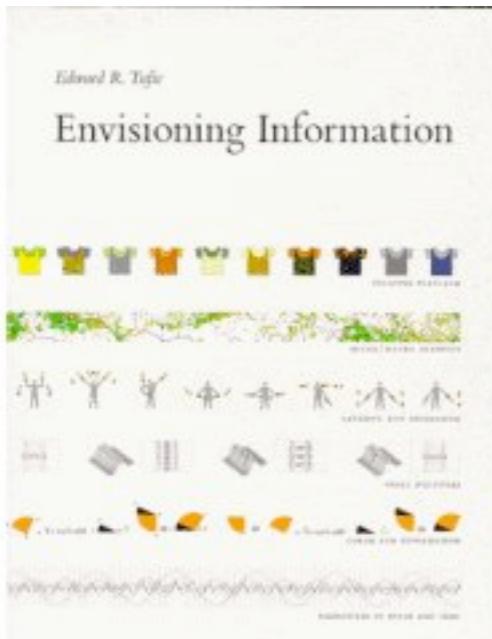
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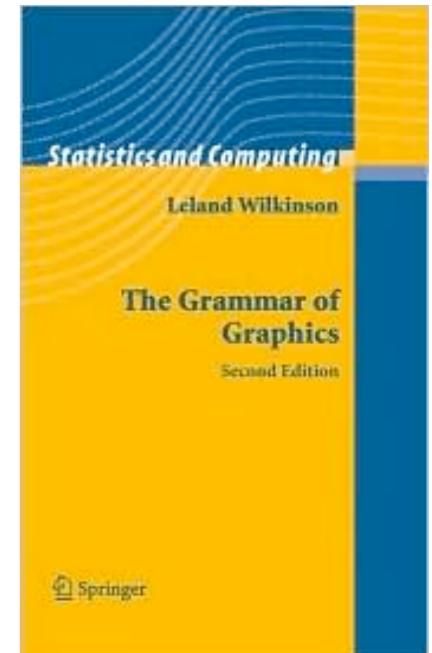
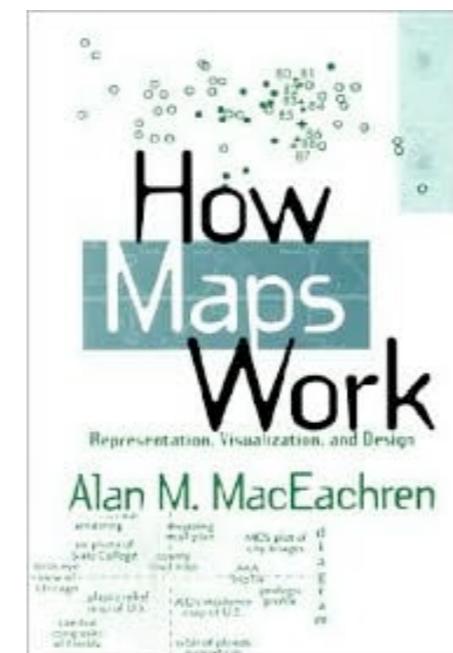
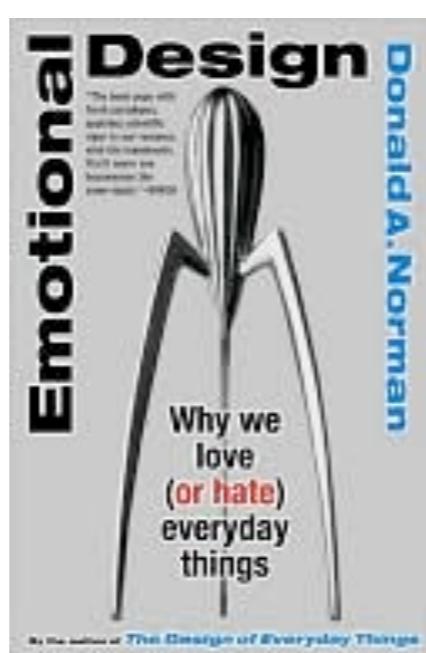
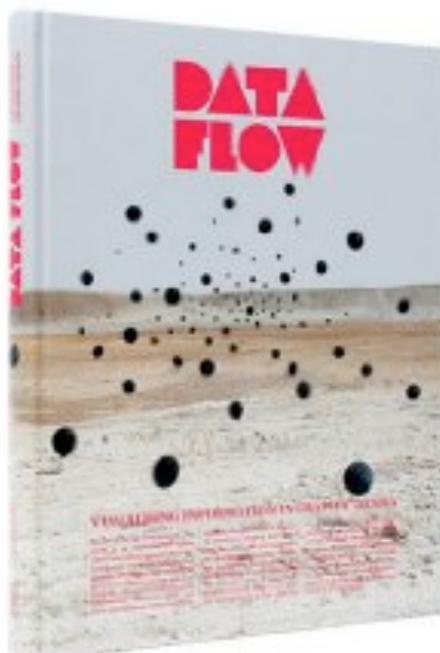
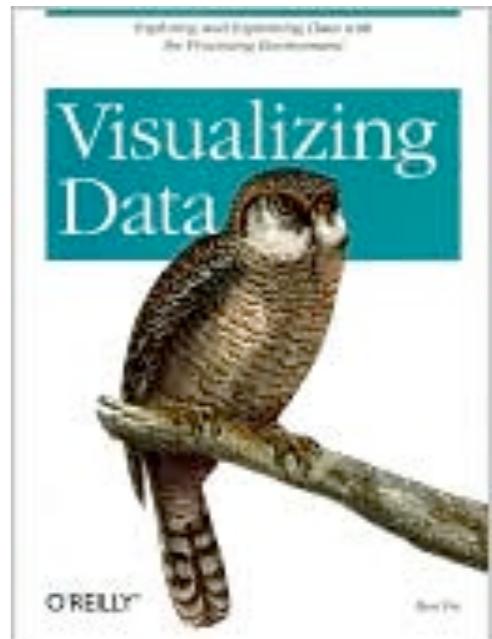
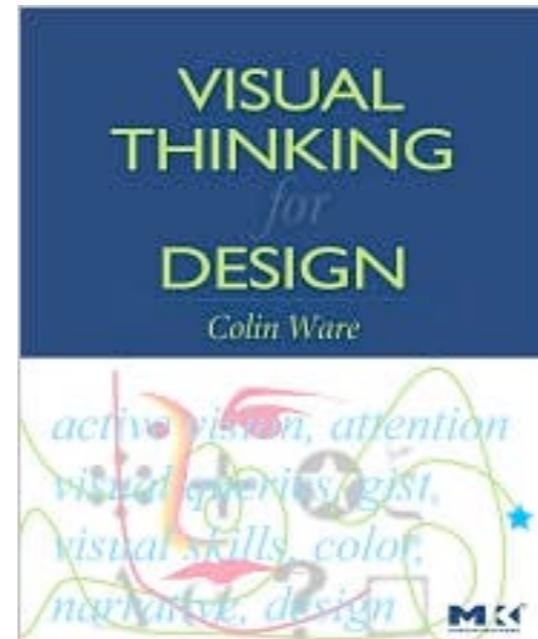
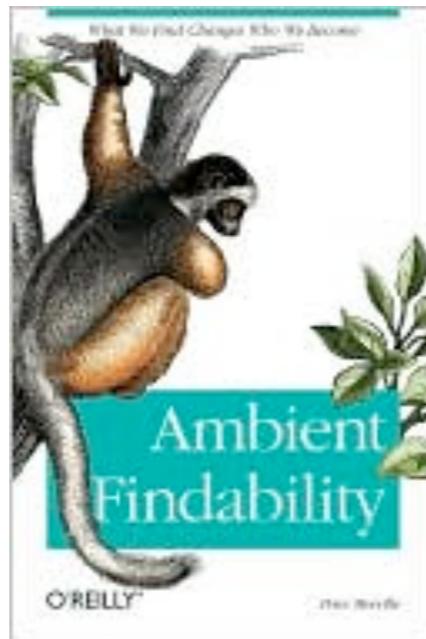
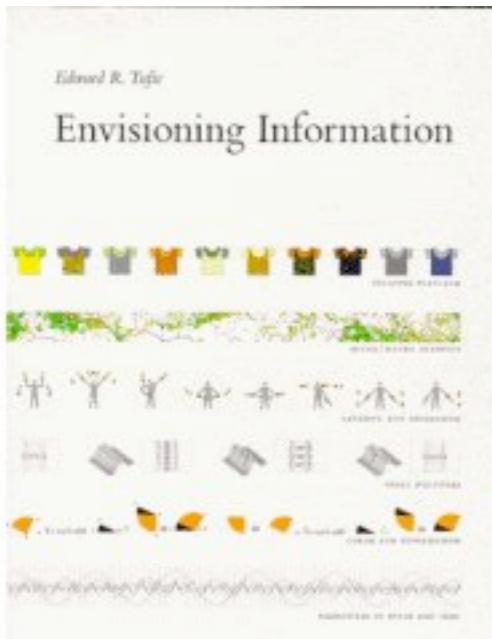
# Resources



# Resources



# Resources



# Visualizing Music

**Visualizing Music**  
Finding music with pictures



» Visualizing emotion in lyrics  
September 11, 2009



**Info**  
What's this?  
Suggest a link

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search archives

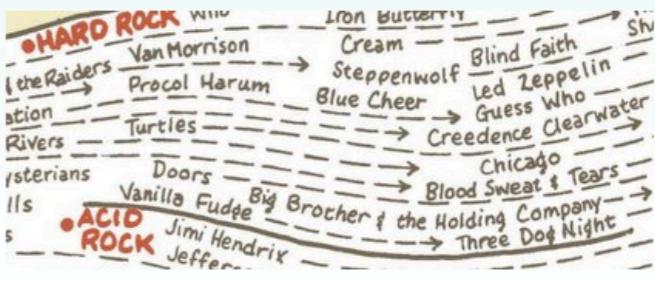
**Categories**  
» 3d  
» commercial  
» discovery  
» emotion  
» flow  
» landscape  
» live  
» lyrics  
» map  
» mood  
» news  
» open source  
» playlists  
» research  
» timeline  
» Uncategorized  
» video  
» visualization

**Bloaroll**

Joris Klerkx has built a visualizer of the emotions in lyrics. Joris has integrated a karaoke player and Synesketch, a framework for visualizing 6 basic emotions, defined by Ekman (happiness, anger, fear, surprise, sadness, disgust). The player takes a song, plays it, and with each line of text that plays in the lyrics, the strongest emotion of that line is visualized. In the image above, on the left hand side, you'll see the 6 emotions and their visualization. On the right hand side, 2 screenshots of demo's of the prototype.  
Some video of the player in action:

**Using Visualizations for Music Discovery**  
The companion website to the ISMIR 2009 Tutorial

ISMIR Tutorial  
[MusicVizismir2009@Delicious](#)  
Bibliography  
Datasets  
Code  
Slides



**Abstract:** As the world of online music grows, tools for helping people find new and interesting music in these extremely large collections become increasingly important. In this tutorial we look at one such tool that can be used to help people explore large music collections: information visualization. We survey the state-of-the-art in visualization for music discovery in commercial and research systems. Using numerous examples, we explore different algorithms and techniques that can be used to visualize large and complex music spaces, focusing on the advantages and the disadvantages of the various techniques. We investigate user factors that affect the usefulness of a visualization and we suggest possible areas of exploration for future research.

This tutorial will be filled with examples (both of code and of commercial and research oriented visualizations).

**Outline**

- Why is data visualization important for music discovery?

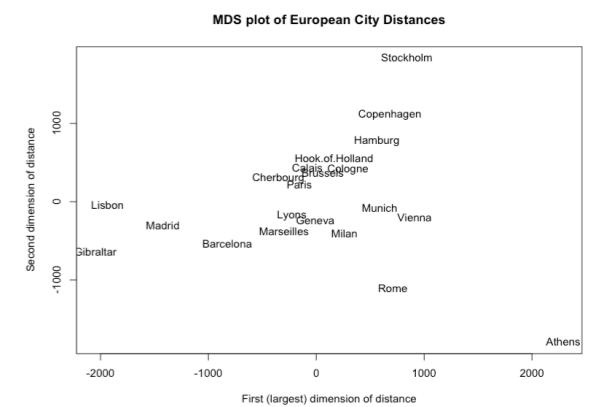
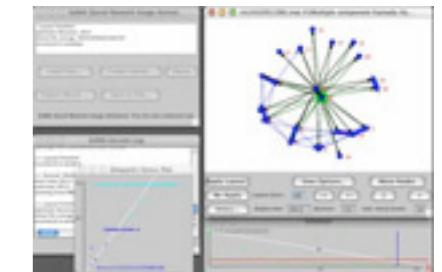
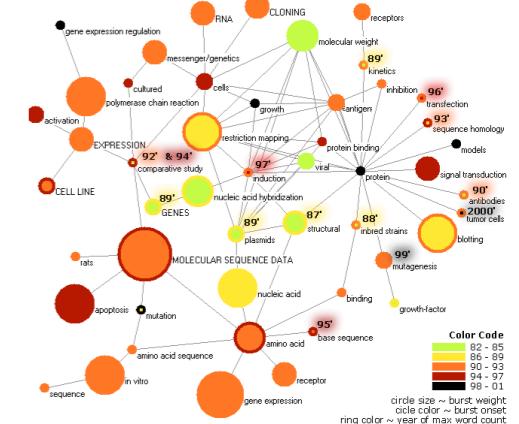
VisualizingMusic.com

[musicviz.googlepages.com/home](http://musicviz.googlepages.com/home)

# Other Tools

# Other Analytic\* Tools

- Matlab
  - Dimensionality Reduction Toolbox
  - (missing good network viz/analysis option)
  - Extensive Interactive Pub-quality plotting environment
- Pajek (standalone Network Visualization/Analysis Platform)
- IVC Software Framework (research platform for analysis and viz).
- R
  - Excellent network viz/analysis package “network”
  - PCA/MDS (base library), ISOMap {vegan} (no LLE, T-SNE yet)
  - Pub quality plotting environments (default, ggplot2, iplots)



[http://ict.ewi.tudelft.nl/~lvandermaaten/Matlab\\_Toolbox\\_for\\_Dimensionality\\_Reduction.html](http://ict.ewi.tudelft.nl/~lvandermaaten/Matlab_Toolbox_for_Dimensionality_Reduction.html)

<http://cran.r-project.org/web/packages/network/index.html>

<http://cran.r-project.org/web/packages/vegan/index.html>

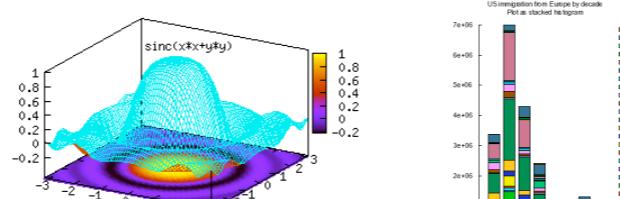
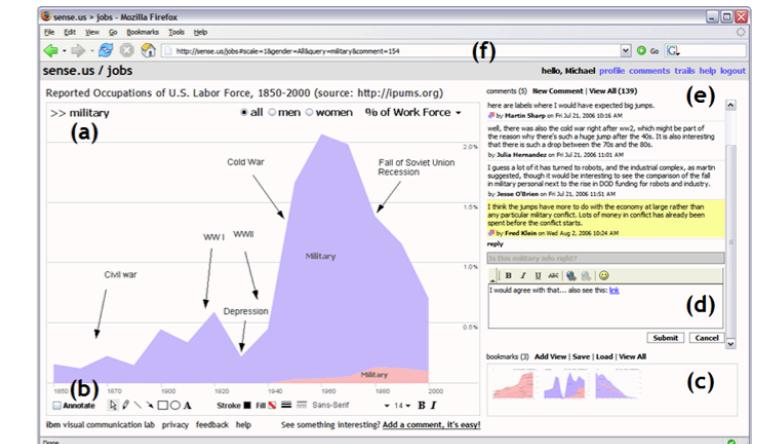
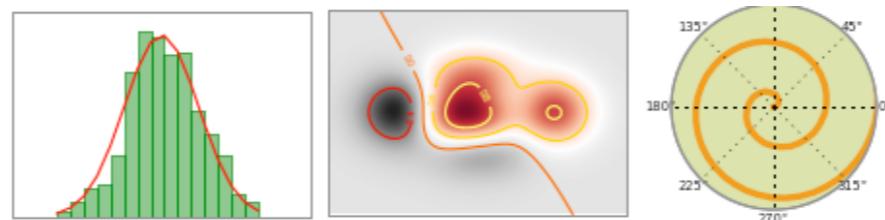
<http://vlado.fmf.uni-lj.si/pub/networks/pajek/>

<http://iv.slis.indiana.edu/sw/index.html>

\*for publications

# Other “Generic” Viz Tools

- Prefuse (java/as3)
- Processing\*
- Gephi
- TouchGraph
- Gnuplot
- matplotlib (python)



**Processing**

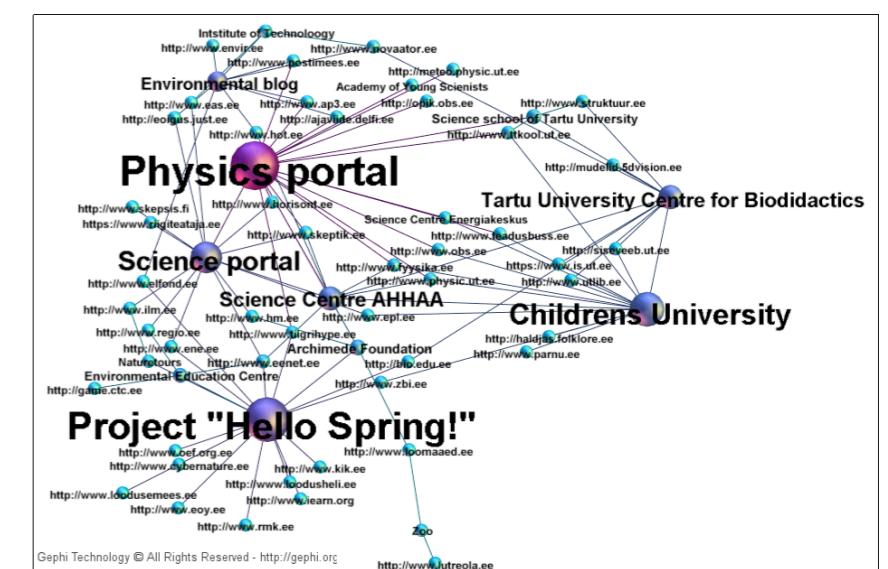
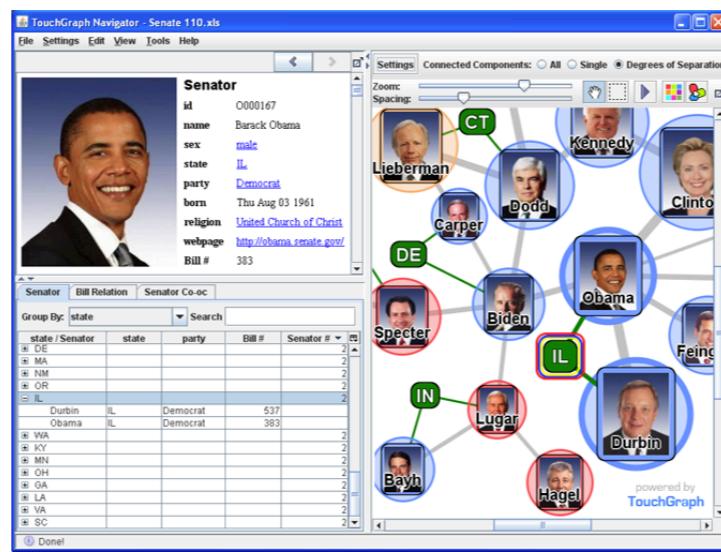
Cover | Exhibition | Reference | Learning | Download | Discourse | Contribute | About | FAQ

**Exhibition**

**Wayfarer**

**» Download Processing**

Processing is an open source programming language and environment for people who want to program images, animation, and interactions. It is used by students, artists, designers, researchers, and hobbyists for learning, prototyping, and production. It is created to teach fundamentals of computer programming within a visual context and to serve as a software sketchbook and professional production tool. Processing is an alternative to proprietary software tools in the same domain.



<http://www.prefuse.org/>

<http://processing.org/>

<http://gephi.org/>

<http://www.touchgraph.com/navigator.html>

<http://www.gnuplot.info/>

<http://matplotlib.sourceforge.net/>

# Conclusions

- Music visualizations reflect ways of *understanding music*.
- Music understanding draws from many different types of information (musicological, acoustic, social, bibliographic, etc.)
- Music visualizations can help to express this understanding in a way that can help aid navigation and discovery.



# Questions?

