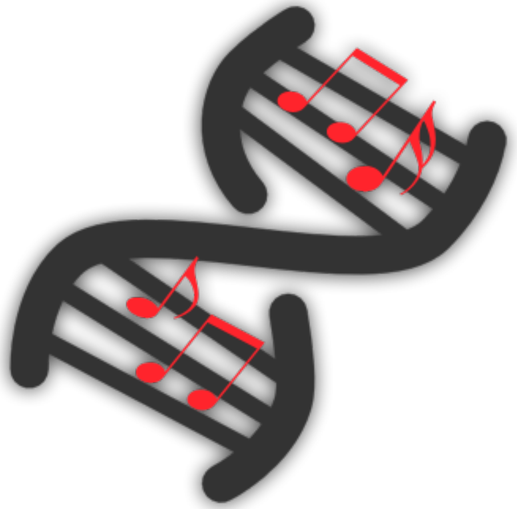


HITLAB DNA

HITLAB DNA PRODUCT PRESENTATION

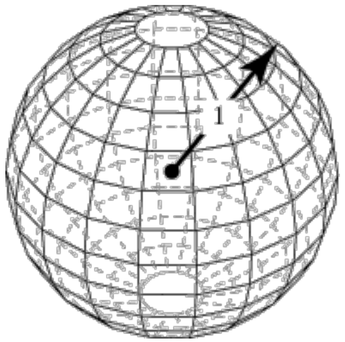
April 2017


HITLAB DNA
Digital Nuance Analysis
I

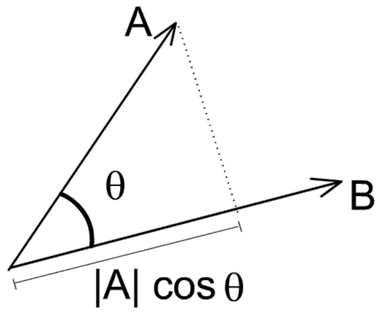
DIGITAL NUANCE ANALYSIS

Hitlab uses its patented proprietary technology to extract 84 attributes from a song. These attributes include tempo, cord progression, range, pitch, musical notes, and combinations of musical notes just to name a few. Isolating these attributes and transforming them into quantifiable mathematical equations allows us to create a unique signature for each song, essentially identifying the DNA of each song. Using data mining we can efficiently find songs that hold similar DNA.

DIGITAL NUANCE ANALYSIS



- Distance between songs are measured by a mathematical formula called proximity
- Songs are projected on unit sphere in Hilbert space



- Proximity may be seen roughly as the angle separating two songs in music space

AUDIO ATTRIBUTES

- Audio attributes are extracted using signal processing from digital files (MP3, WAV, FLAC, ..)
- Example of audio features :
  - Chroma: Chroma-based features represent the short-time energy of the signal in each of the 12 pitch classes
  - MFCC: representation of the short-term power spectrum of a sound, based on a linear cosine transform of a log power spectrum on a nonlinear mel scale of frequency
- Generation of 66,000 features describing the sound.
- Selection of 20 features for clustering known music
- Outperforms all existing feature sets on several music data sets.

AUDIO ATTRIBUTES

Name	Description	Hitlab	EchoNest
MFCC	Vector with unbounded values centered around 0 representing a high level abstraction of the spectral surface	Mean and standard deviation of first 20 MFCC	20 MFCC
Chroma	Vector ranging from 0 to 1 corresponding to the 12 pitch classes C, C#, to B	Mean and standard deviation of 12 Chroma tones	12 Chroma Tones
Other		Bass Presence, Bass Variation, Instrument Variation , Melody Variation, Percussion Variation, Spectral Variation, Spectrum Variation , Rolloff, …	Key, Mode, Tempo, Loudness, …

DIGITAL NUANCE ANALYSIS

Example of sound pattern similarity

To illustrate the similarity between the sound patterns of the songs in the previous, please listen to the songs individually and then mashed up together.

www.hitlab.com/dna-mix

Mary J Blidge “I’m Going Down”

Christina Aquilera “Hurt”

Mash Up

DNA HIT PREDICTION

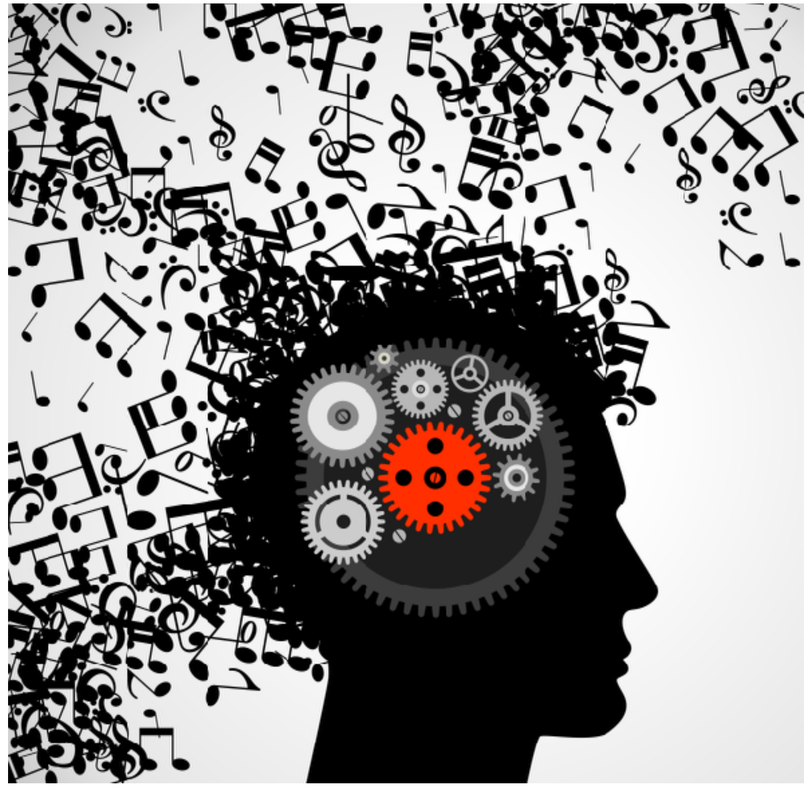
DNA HIT PREDICTION

Using science to predict hits

The human brain is wired to appreciate certain sound patterns which can be classified as musical attributes.

These attributes include: tempo, range, repetition of notes, chord progression and many others; once put together, they create songs.

Using mathematics and the history of hits of the past, Hitlab is able to identify the optimal combination of attributes for songs to be successful in each genre of music.



DNA HIT PREDICTION

Example of a song analysis

When we analyze a song we extract its attributes and find the songs with the most similar attributes in our database.

Each song in our database has a ranking which is a product of its number of weeks on the Billboard and its peak position. The proximity shows the coefficient of correlation between the attributes.

If a new song has a high proximity with songs that were hits in the past, it will get a good score. In this case “I’m Going Down” was unknown to our software and scored 85.74% because its sound patterns resembles the ones of songs (high proximity) that were successful (high ranking).

Mary J. Blige - I'm Going Down (92.46%)

Genre: Pop

Artist	Title	Week	Peak	Year	Proximity	Rank	Rating
Christina Aguilera	Hurt	60	9	2006	0.825	85.19	4
Leona Lewis	Better In Time	88	4	2008	0.801	92.458	4
The Pussycat Dolls	I Hate This Part	124	10	2008	0.756	89	4
A Rocket To The Moon	Like We Used To	5	81	2010	0.73	16.986	1.5
Cherish	Unappreciated	77	65	2006	0.722	31.856	2
Demi Lovato	Don't Forget	12	62	2009	0.721	21.839	2
Danity Kane	Ride For You	4	55	2006	0.72	19.657	1.5
Leona Lewis	Happy	1	90	2010	0.715	5.931	1.5
Keyshia Cole	I Remember	3	100	2008	0.7	0.624	1
Jason Mraz	Geek In The Pink	4	90	2006	0.676	6.768	1.5


DNA FOR ONE
MUSIC RECOMMENDATIONS

TODAY'S RECOMMENDATION SOFTWARE

When music labels provide content to distributors, each song is associated with tags such as: (Adel, UK, pop, soul, RnB, ballad, vocals, guitar, keyboards, bass guitar, percussion)

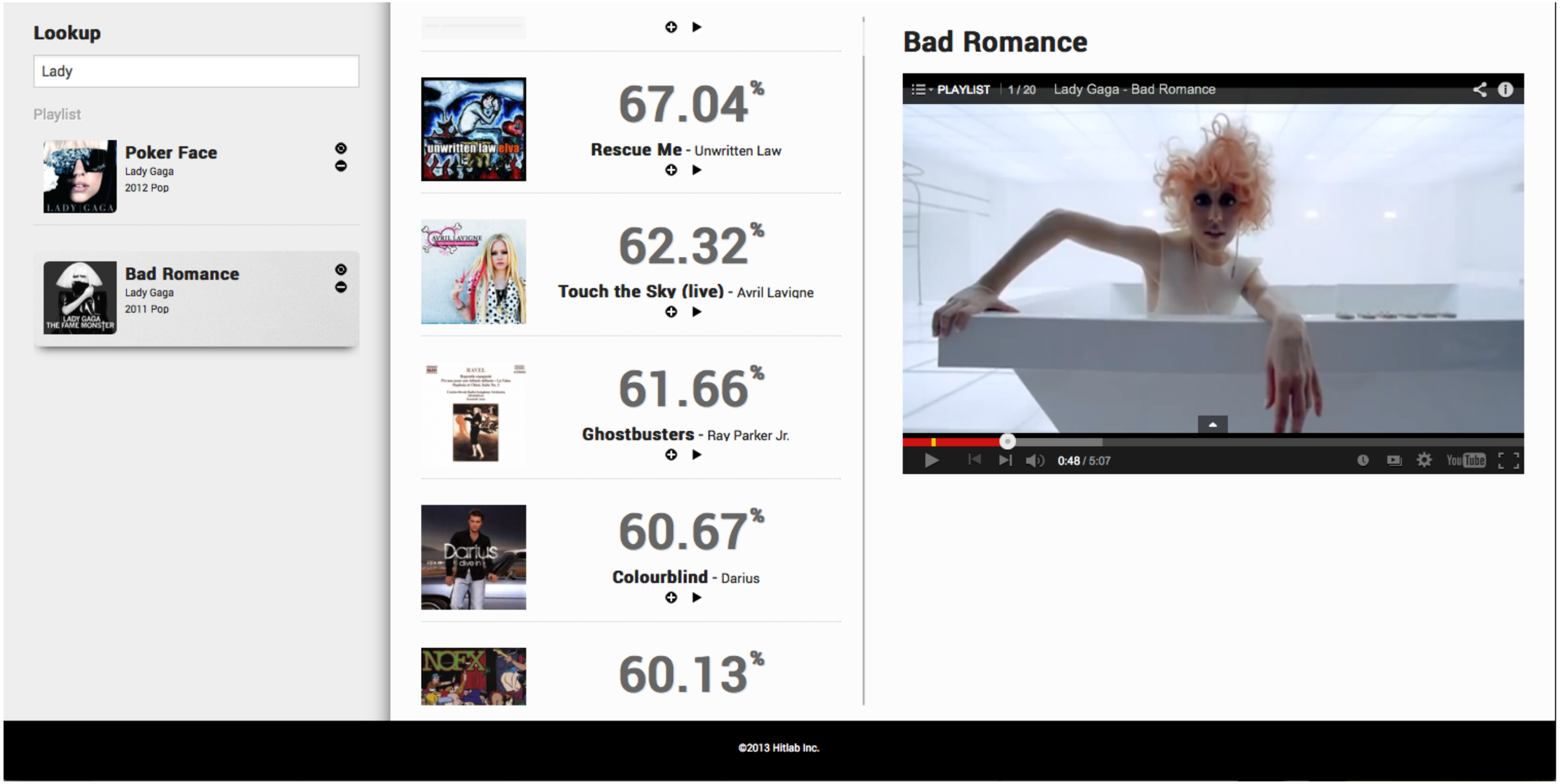
Historically, the most powerful recommendation algorithms use tags generated from humans who listen to each song. The more tags, the better the recommendation. Generating these tags is not only subjective to the individual listening to the music but also a lengthy and expensive process.

TODAY’S RECOMMENDATION SOFTWARE

- Pandora hires musicologists to take surveys.
- Last.fm uses activity data, tags, and acoustic analysis.
- All Music Guide employs music editors & writers.
- Amazon data mines purchase & browsing history.
- iTunes' Genius makes recommendations by mining purchase and activity data from iTunes.

If someone likes Adele's song, the currently available recommendation software would look for tags similar to Adele’s. The recommendation could end up being an RnB artist from the UK that sings and uses keyboards but this new recommended song could end up, and often does end up, sounding nothing like the Adele song that was just played.

RECOMMENDATION OF SIMILAR



“USERS AND MUSIC” MODEL

- A user model is represented by a prediction model (machine learning) where learning is done on user attributes.
- A music model is represented by a prediction model (machine learning) where learning is done on song attributes.
- Applications:
  - Playlist Personalization
  - Similar Personalization
  - User & Song Recommendation
  - User Profiling: user profiling (musical tastes, …), matching (distance, similarity, …), user clustering (by genre, by multi-genre, …), interesting feature finding (timbre, rythm, …)
  - Logical algebra (∧,∨,¬) to manipulate models

AUTOMATIC ATTRIBUTE WEIGHT

As DNA requires no human input to extract attributes it can calibrate weight automatically by tracking user behaviour, feed back, and social data using artificial intelligence and machine learning for an unlimited amount of attributes.

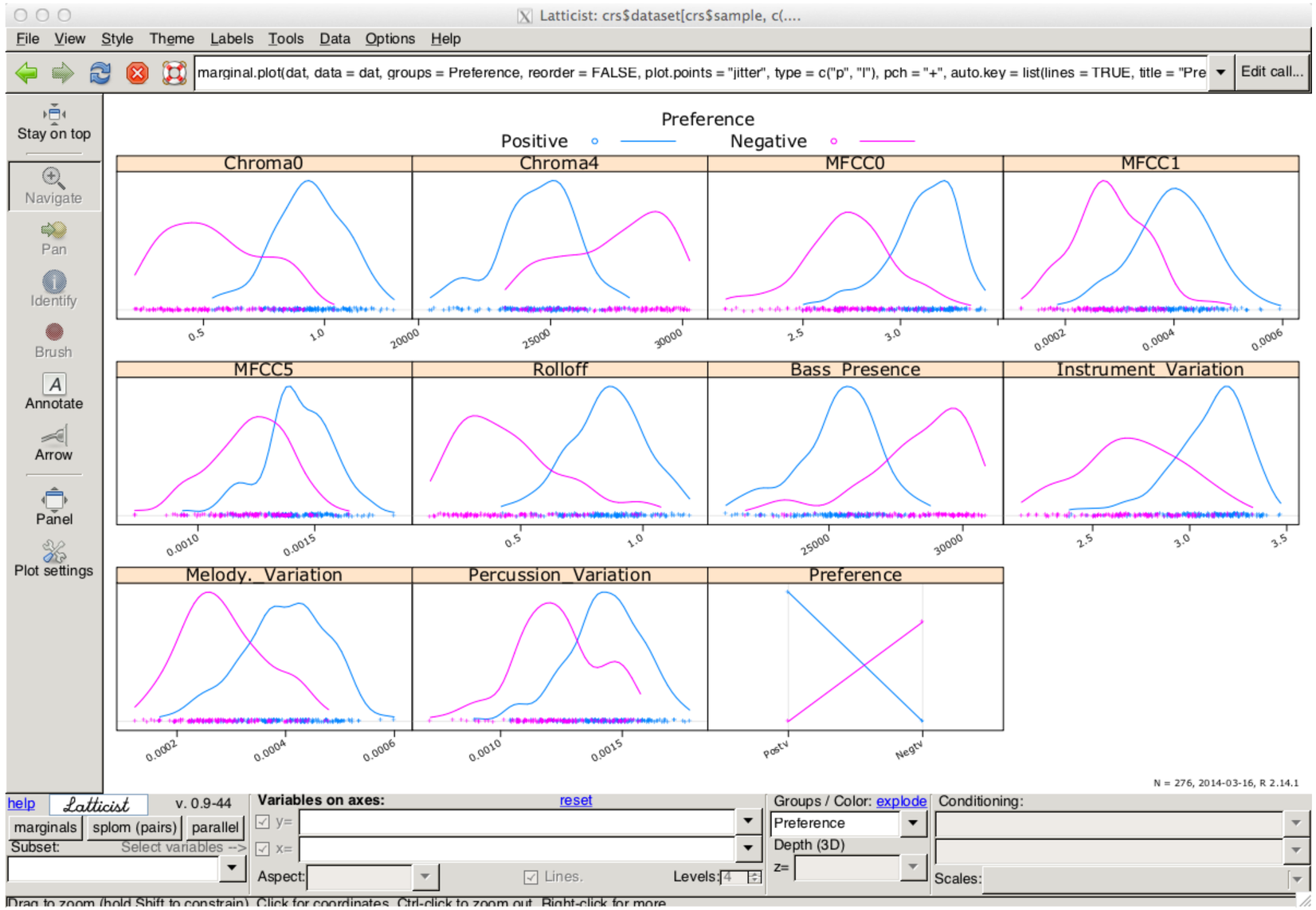
AUTOMATIC ATTRIBUTE WEIGHT

User feedback allows DNA to automatically weight the attributes which are important to a specific user.

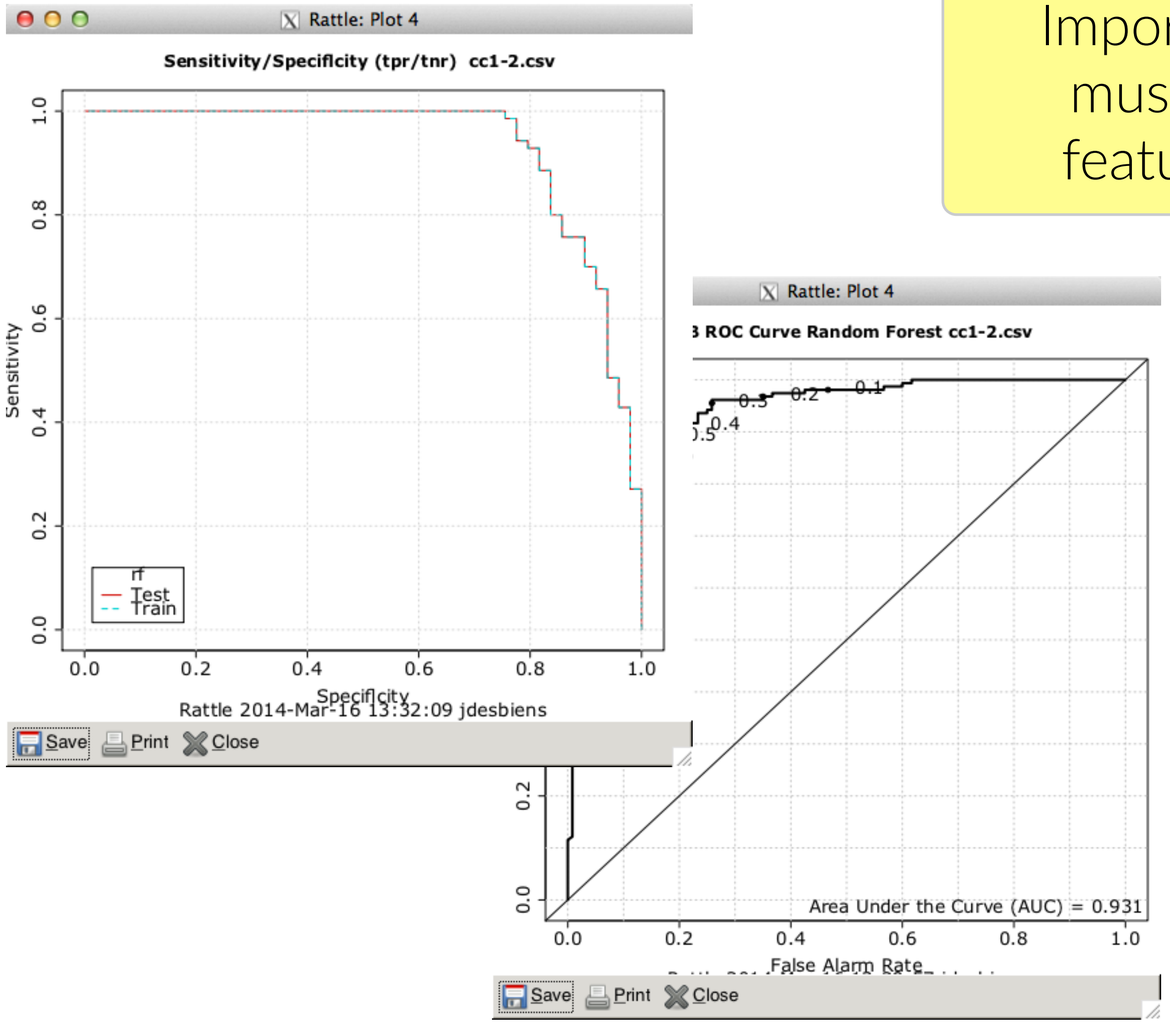
Does the user like a particular:

- Genre(s)
- Tempo
- Combination of notes
- Progression in music
- At the end of the day it's all math, what equations does the user prefer?
  - (weightA*attributeX)+ (weightB*attributeY)= recommendation
  - (100*genre)+ (50*tempo) = recommendation

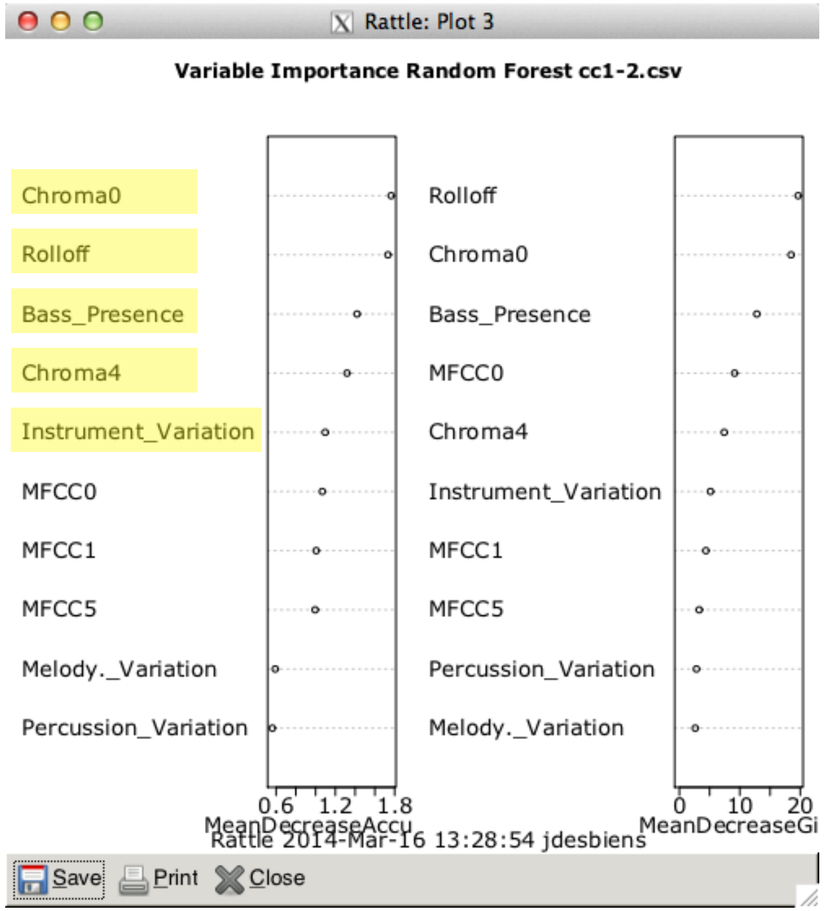
AUTOMATIC ATTRIBUTE WEIGHT



AUTOMATIC ATTRIBUTE WEIGHT



Important musical features



TOMORROW'S RECOMMENDATION SOFTWARE

Not only can we find songs that sound the same but, by using artificial intelligence to capture and analyze a user's social activity, feedback and behaviour, we can identify what exact attributes a specific user appreciates Therefore creating recommendations tailored to each fan's taste.

The same way human DNA is passed from parent to child, Hitlab's DNA artificial intelligence algorithm is continually evolving, increasing in accuracy with additional data from each fan. The more feedback, the better the recommendation.

DNA PRO
MUSIC PRODUCTION

IV

DNA PRO

Musicians and music producers can use DNA Pro at every stage of the recording process. Use DNA to find out which guitar rift, or which melody evokes the most emotions in the human brain. Musical creators can even test a finished product and DNA pro will suggest edits for the song to be adjusted in order to have the optimal musical patterns for specific or multiple genres of music.