



Practical conference about ML, AI and Deep Learning applications

# Machine Learning Prague 2018

MARCH 23 – 25 , 2018

[BUY YOUR TICKET](#)

Tutorial:  
Deep Learning for Music Classification  
using Keras  
Part III

# **Tutorial Agenda**

## **III. Instrumental, Genre and Mood Analysis:**

- Large-scale Music AI at Musimap
- Instrumental vs. Vocal Detection
- Genre Recognition
- Mood Detection
- Coding Examples

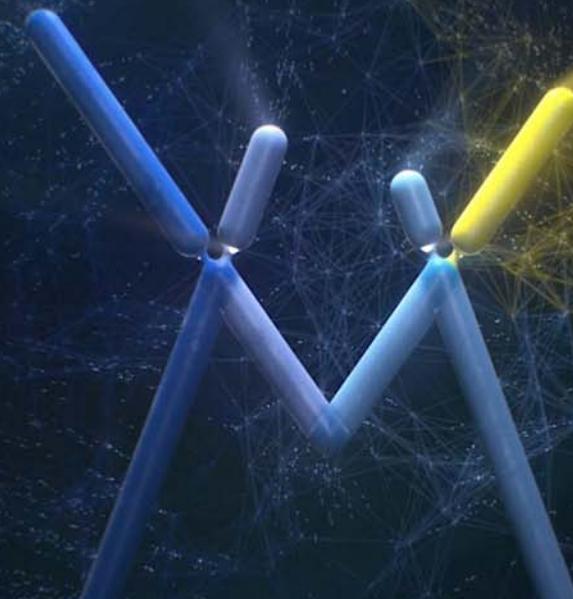
## **IV. Advanced Deep Learning:**

- Similarity Retrieval
- Siamese Networks
- Learning Audio Representation from Tag Similarity
- Coding Examples



Large-scale music emotion analysis at Musimap

# Human-fused AI



# music experts

1.6 Million tracks  
manually expertized

+

# machine learning &

# deep learning

35+ Million tracks  
analyzed

# ARTIFICIAL + HUMAN INTELLIGENCE - Humanized algorithm



## Hard Sciences

Signal Analysis

Machine learning

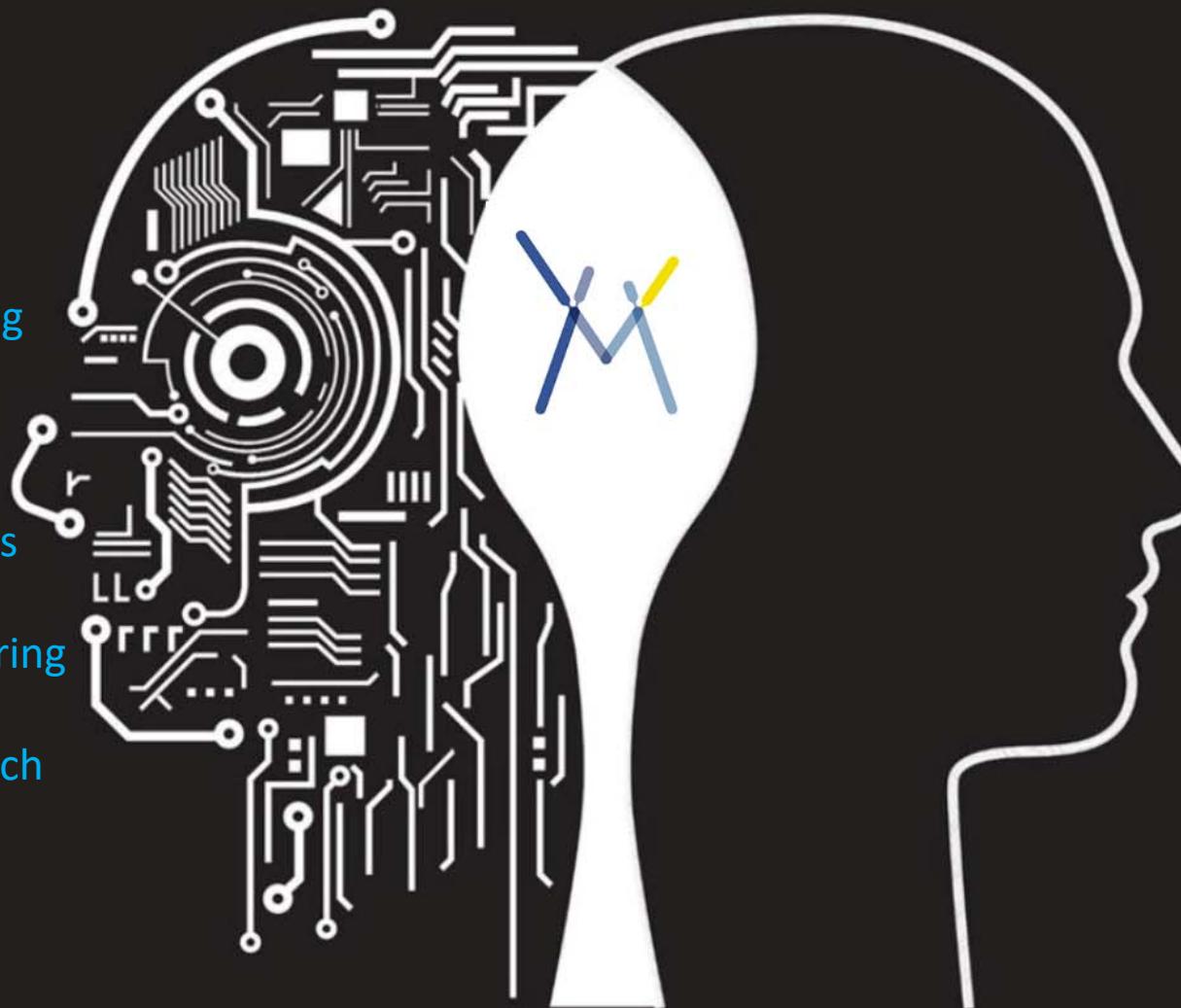
Deep learning

Neural Networks

Collaborative Filtering

Statistical approach

Neo4J



## Soft Sciences

60 Experts

Musicology

Neuroscience

Psychology

Lexicology

Philosophy

Sociology

Music Therapy



## BACKGROUND: 15 YEARS OF RESEARCH

---

60 experts – soft & hard science



**Karl Bartos**  
Kraftwerk



**Daniel Levitin**  
Neuroscientist



**Gilles Peterson**  
Worldwide BBC Radio



**Jerrold Levinson**  
Musicologist & Philosopher



**Stephen Davies**  
Philosopher of Music



**VIOLAINE PRINCE**  
Linguist, LIRRM



## AN EXPERIENCED TEAM: 14 people

---



**Pierre Lebecque**

Head of Research

- Canal+ Belgium (dir. Prod.)
- nWave Pictures (prod.)
- Sound designer for film/tv
- Ph.D on Musical Morphing



**Vincent Favrat**

CEO

- CEO of Just Temptation
- Montreux Jazz Festival
- Swiss Music Union



**Olivier Lebeau**

Head of Content

- EMI France (Marketing Manager)
- Roadrunner France (CEO)
- Naïve Records (A&R Director)



**Frédéric Notet**

CTO

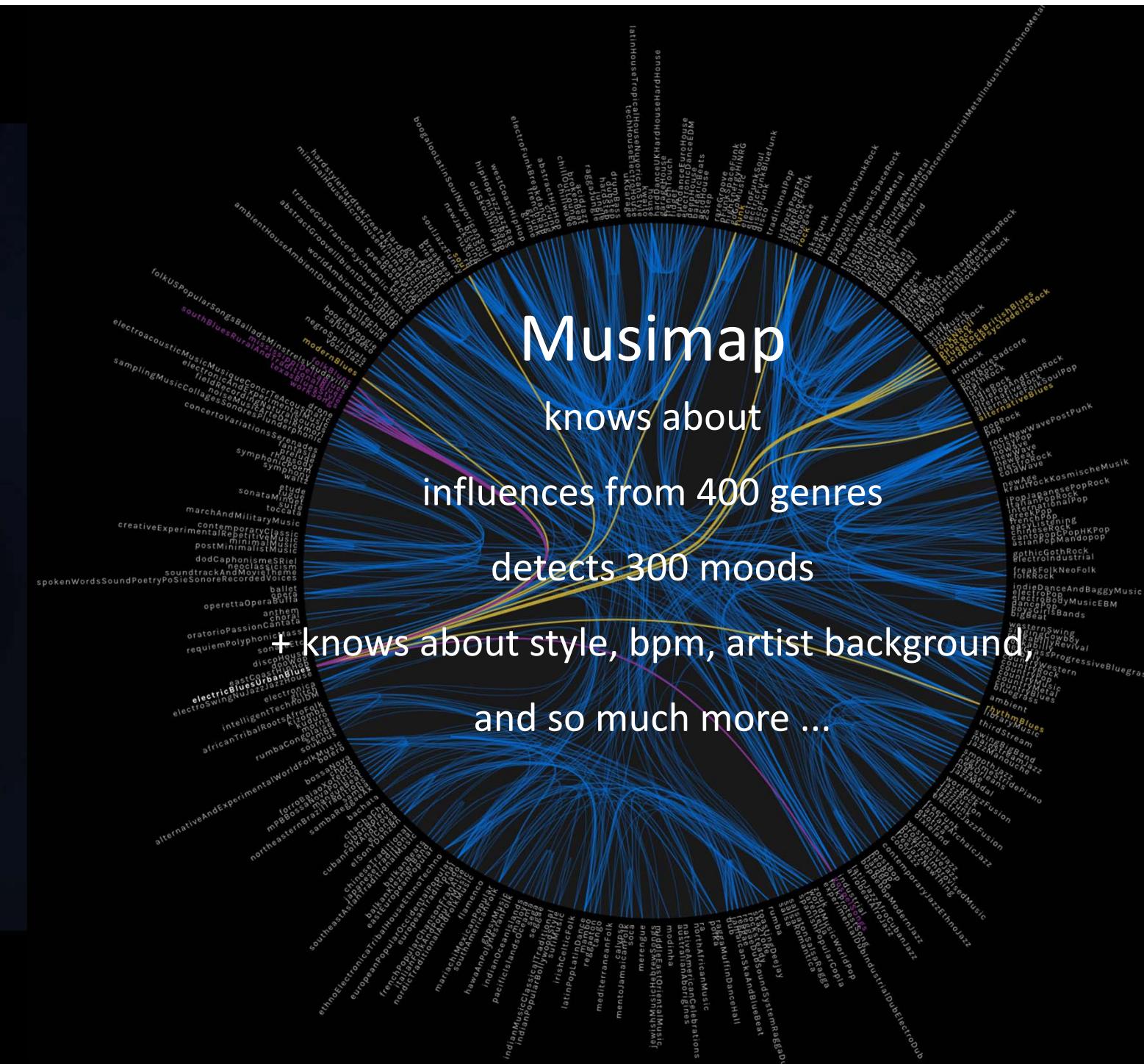
- Thalys and Eurostar (TPM)
- Database specialist
- Trained as music conductor



**Thomas Lidy**

Head of Machine Learning

- 12+ years in machine learning
- Head of Incubation in #MusicBricks
- CEO of SpectralMind
- winning algorithms in MIREX



## MUSIMAP's engine: 5 levels of data integration

Web & Social Data



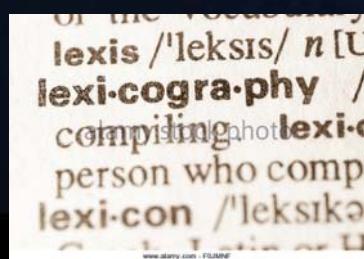
Music Expert Data



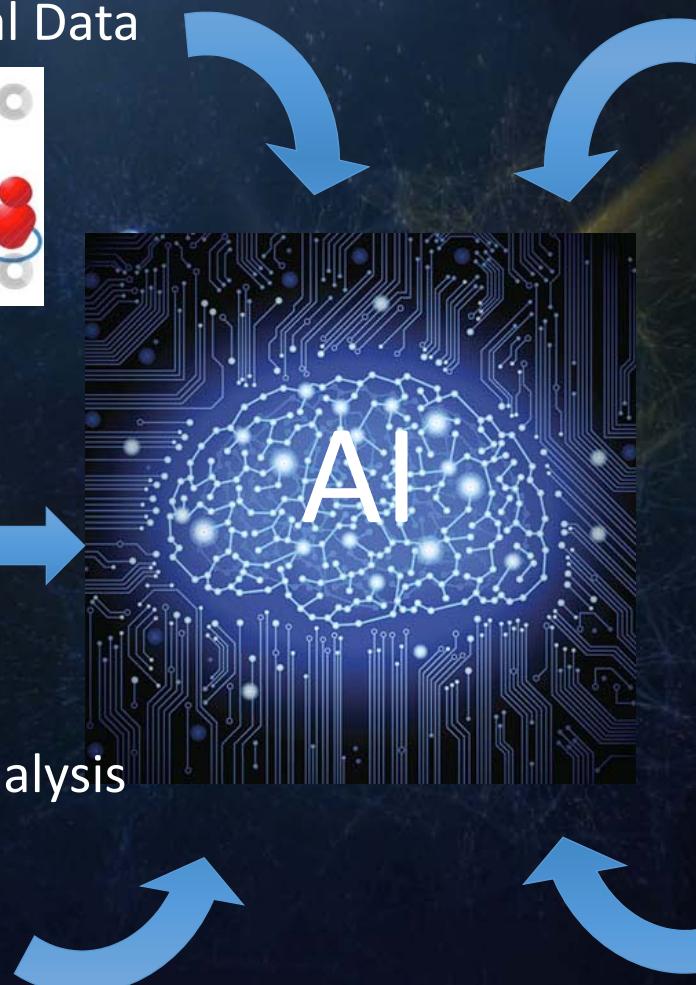
Audio Analysis



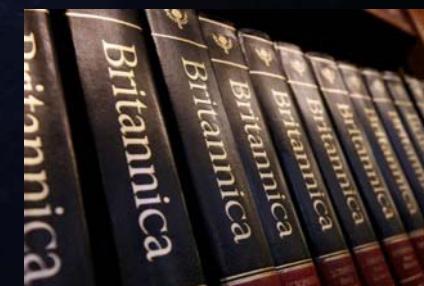
Lexicographic Analysis



AI

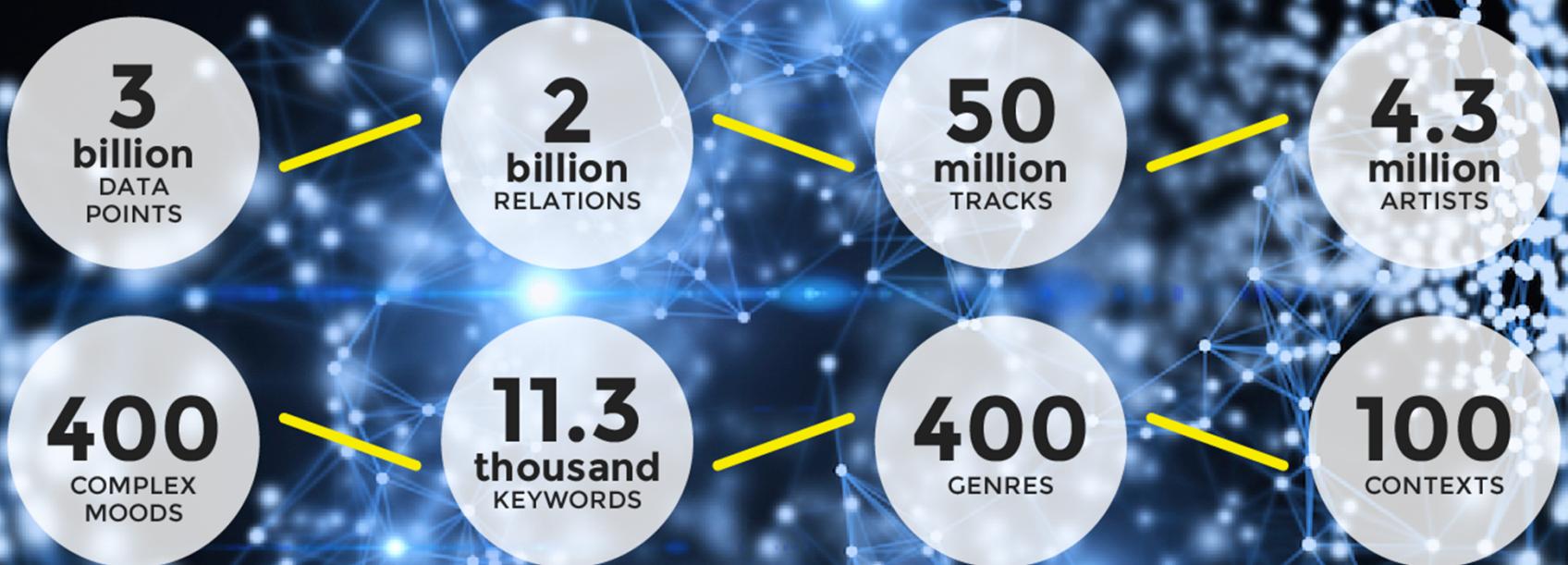


Encyclopedic Info



# THE ALGORITHM - Cross-weighted taxonomy

---





# Use Cases



**RICH METADATA** – styles, moods, instrumentation, situation...

Bohemian Rhapsody - Queen

**110 tags**  
per each track and artist!

in 35+ M tracks



- styles
- genres
- situations
- moods
- tonality/key
- voice
- bpm
- country
- language
- instruments
- ...

All parameters are weighted!

# MUSIC RECOMMENDATION



musimap

Enter new search  REVERSED SEARCH MY PROJECTS Olivier

BACK TO DASHBOARD SUMMARY

Styles

- Opera
- Electronic
- Ambient
- Breakbeat
- Drum & Bass
- Electro
- Eurodance
- Opera
- Electronic
- Drum & Bass

35 styles

91 styles

70 styles

77 styles

19 styles

29 styles

Rock pop

Ethno World

Classic

Jazz

Blues Gospel

Soul Electro

Funk Hip Hop

Your Style Mix

- Rock Pop 23 %
- Soul Electro Funk Hip Hop 35 %
- Jazz 12 %
- Blues Gospel 20 %
- Ethno World 6 %
- Classic 4 %

APPLY

38 RESULTS > SHOW MORE

98% SNACKS

85% ARETHA FRANKLIN

83% HUMPTER

75% SNACKS

68% EL ESCORAR

63% DELA SOUL



# PLAYLISTS – for every situation, automatically generated

MOODS RANDO





# PLAYLISTS – adapted to the users' tastes

The image shows a dark-themed user interface for the Musimap app. At the top left is a vertical list of songs:

- My Ship, Speak low et Mack the Knife de Kurt Weill  
The Testament Of Dr Mabuse - Classic Movies  
(Das Testament des Dr Mabuse)
- Kurt Weill - Wie lange noch
- Teresa Stratas - Berlin im Licht-Song
- Time Pieces: Jay Electronica  
(Directed by Jason Goldwatch)
- Lotte Lenya - Moon of Alabama  
(Good Quality Audio)
- Last Week Tonight with John Oliver:  
Voting (HBO)
- Mike Posner - I Took A Pill In Ibiza

In the center is a video player showing a concert stage with a large screen displaying "DUA LIPA". The video player has a play button, a progress bar at 0:35 / 2:25, and other control icons.

To the right of the video player are several controls:

- FRIENDS AND ACTIVITIES
- YOUTUBE  MUSIMAP
- SLIDE TO SELECT A STYLE
- Vocal Jazz
- GENERATE

At the bottom of the screen are five hexagonal callout boxes with white outlines and green highlights:

- FORGIVENESS
- VISUAL: SUPER HEROES (DC COMICS AND MARVEL COMICS)
- HALLS, RESTAURANTS, ELEVATORS AND WAITING ROOMS
- CARS, TRANSPORTS AND TRAVELLING
- ADRENALINE / X-TREME SPORT

# EXPERT SEARCH – for music supervisors and sync



pingtrax By Musimap

Enter new search  SEARCH ADVANCED SEARCH MY PROJECTS Olivier

**DASHBOARD** < SUMMARY <

Styles

Moods

Instrumental YES NO ANY

Rhythmic signature 4/4 OTHER

BPM min 60 max 300

Years min 1900 max 2015

Duration min 1 max

+ Sub-Genres  
Keywords\*  
Special Facts

+ Instrumentation  
Main Keys  
Vocal

+ Situation  
Rhythm  
Lyrics

APPLY

38 RESULTS > SHOW MORE

98%  
SNACKS  
Between you and me

85%  
ROY ORBISON  
Pretty Woman

83%  
JIMPSTER  
English Rose and Fire

75%  
SNACKS  
Purdie

68%  
ELI ESCOBAR  
Seein' U

63%  
DE LA SOUL  
God it

# MUSIMATCH – search by sound similarity



MUSI MATCH  
by musimap

Gerome Perrier ▾

Best track similarities found by Musimatch

File source ▶ 00:00

Search	Track	Album	Artist	Relevance	Media	Rate	Comment
Q	Here Comes Your Man	Doolittle	By ...	98.65	▶ 00:00	98.65	I love this song !
Q	Psycho Killer	Talking Heads Best Hits	By ...	96.50	▶ 00:00	96.50	Same intensity in the song
Q	Just Like Heaven	Greatest Hits	By ...	92.65	▶ 00:00	92.65	Greatest song ever...
Q	Odyssey and Oracle	Time of The Season	By ...	90.24	▶ 00:00	90.24	Too cool to be true !
Q	Morrissey	Everyday Is Like Sunday	By ...	90.18	▶ 00:00	90.18	I love this song !
Q	Let's Dance	Modern Love	By ...	88.39	▶ 00:00	88.39	I love this song !
Q	All The Young Dudes	All The Young Dudes	By ...	87.24	▶ 00:00	90.24	Same intensity in the song
Q	The Killing Moon	Songs To Learn and Sing	By ...	85.18	▶ 00:00	90.18	Greatest song ever...
Q	Love Will Tear Us Apart	Total	By ...	83.39	▶ 00:00	88.39	Too cool to be true !

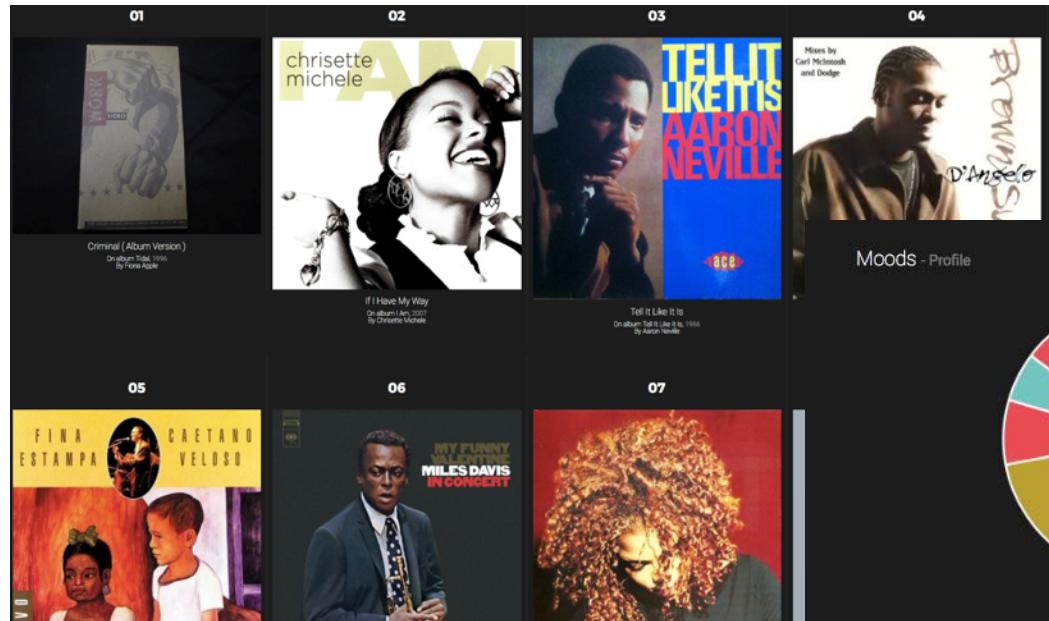
© 2017 Musimap - All rights reserved

Privacy Policy Help & FAQ

# MUSIME: PSYCH-EMOTIONAL PROFILING

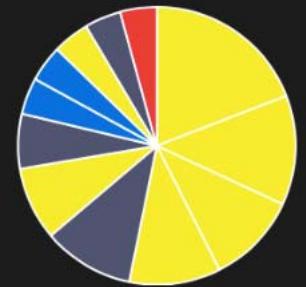
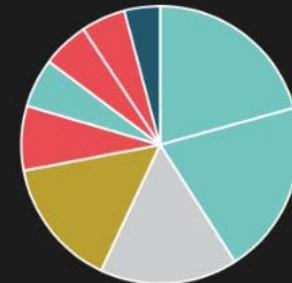


matching emotions in music to people's mood & personality



Moods - Profile

Genres - Top 12 by relevance



Profile - Psych-Emotional translation - NB. The background color indicates the prevalent mood family!

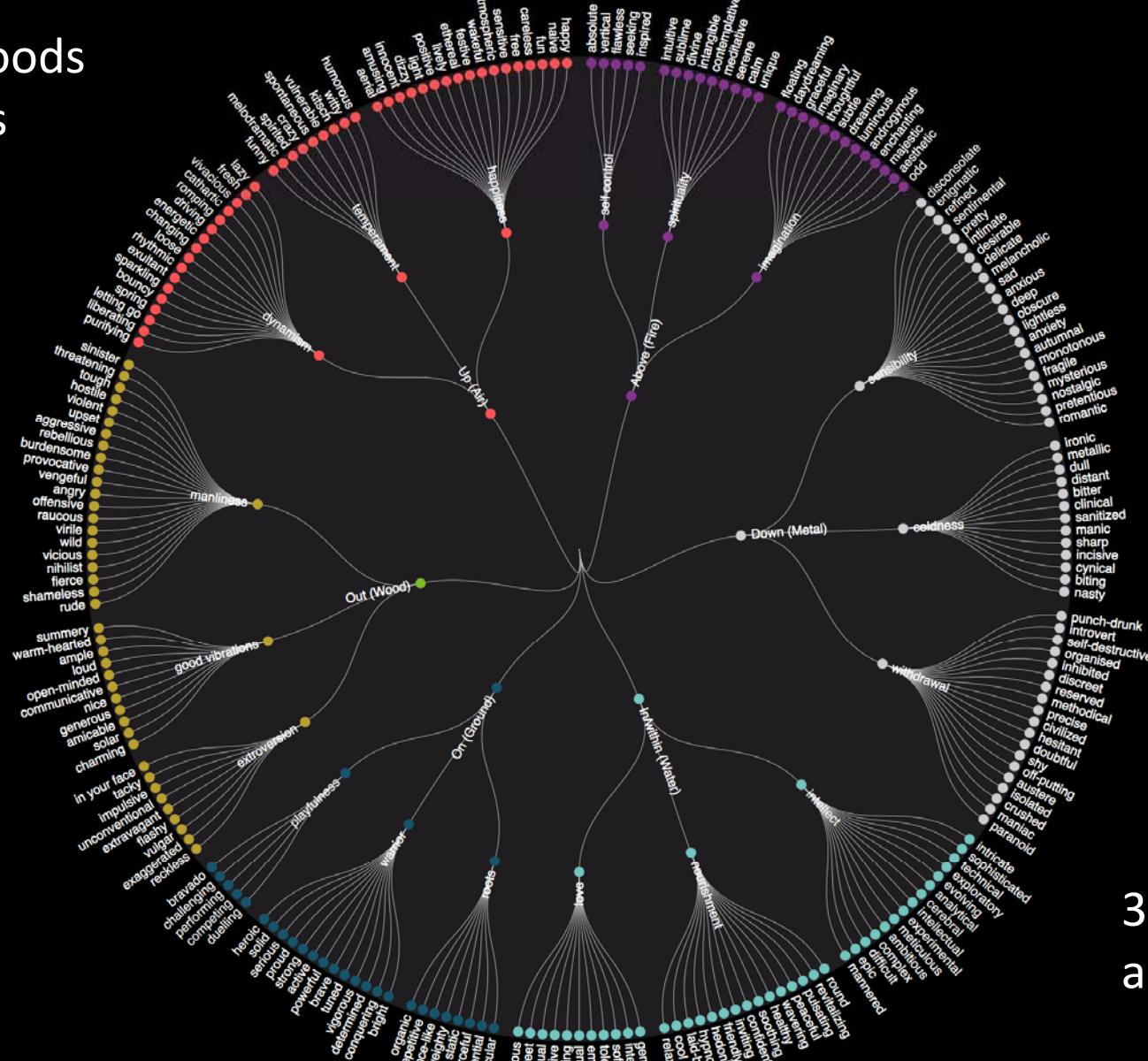
- Advertising
- Targeted Music
- Branding Campaigns
- Stress Reduction, Healthcare

*You lean toward empathy and openness even when life is not easy  
You enjoy tranquility and peace but often end up overthinking  
You are aware that love and passion are difficult to unite  
You want to be an optimist yet are often left with a bittersweet feeling  
You are caring and enjoy to be of good company  
You want to be pleasing, sensual and exciting  
You are a romantic and keep away from hostility  
You are guided by the heart and value emotions first  
You are proud and charming and enjoy to seduce glamorously*

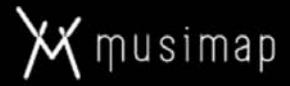
**MOODS & EMOTION in music are a big focus**



256 moods  
3 levels



35M+ tracks  
analyzed



# SMART HOME – Berlin Hack Winner “Moodify” with Philips’ Hue, Senic and Spotify

---



# DEEP LEARNING at Musimap



Musicologists  
Groundtruth

1.6 M tracks  
annotated

Genres

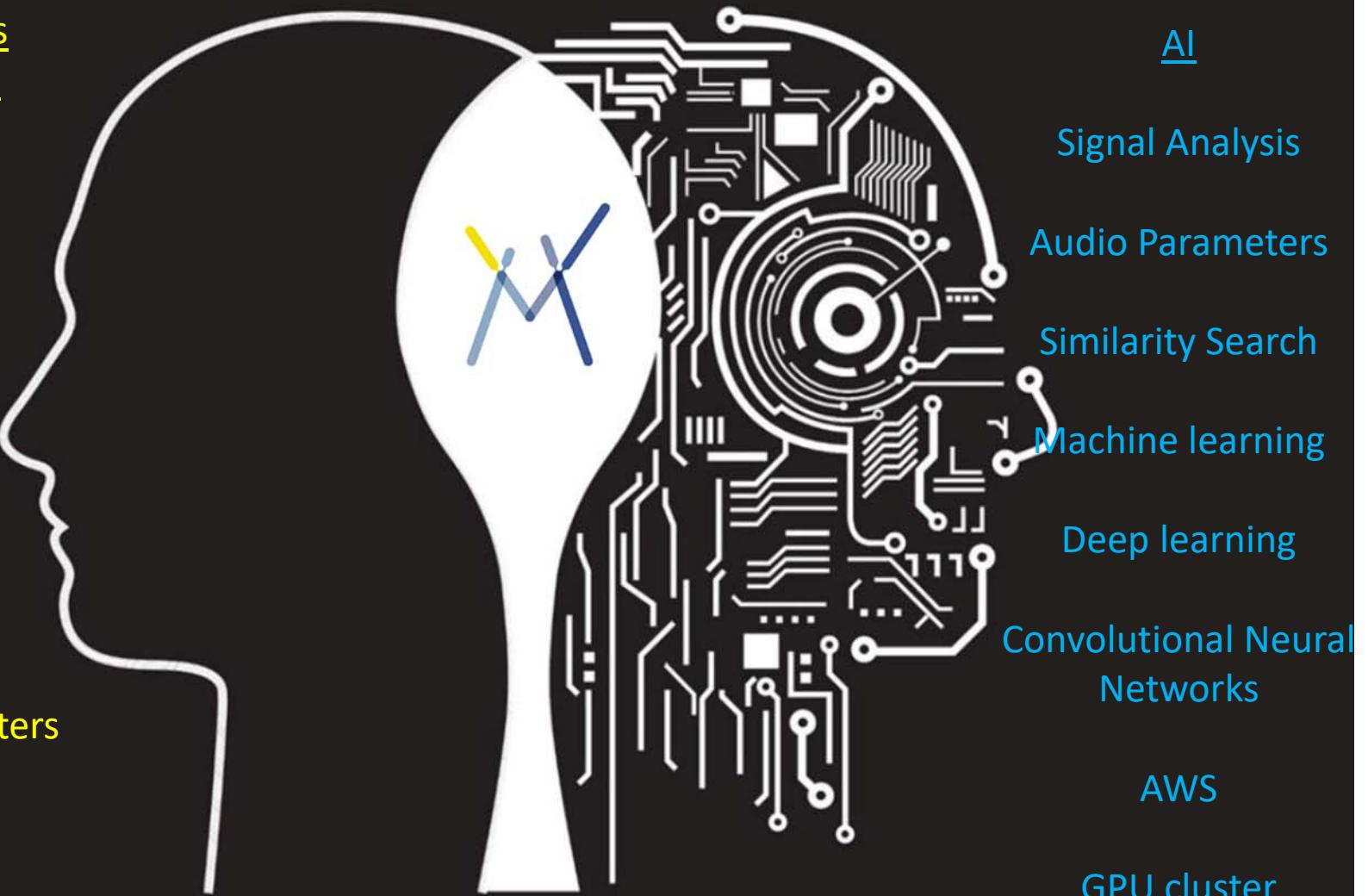
(Sub)styles

Moods

Instrumental

Musical Parameters

Tempo



# API for DEVELOPERS



developers.musimap.net

## Dev Overview of API /2

Welcome to the latest version of the Musimap API: version/2. All new development should use this version of the API.

API version /2 is based on REST principles, is secured by OAuth 2.0, and provides JSON messages, search, pagination, sorting, and filtering.

<b>Genres</b> <a href="#">GET Search for genres</a> <a href="#">GET Retrieve genres hierarchy</a>	<b>Security</b> <a href="#">POST Generate an Access Token</a>
<b>Artists</b> <a href="#">GET Search for artists</a> <a href="#">GET Retrieve artists recommendation</a>	<b>References</b> <a href="#">GET Search for references</a>
<b>Albums</b> <a href="#">GET Search for albums</a>	<b>Properties</b> <a href="#">GET Search for properties</a> <a href="#">GET Retrieve moods hierarchy</a>
<b>Tracks</b> <a href="#">GET Search for tracks</a> <a href="#">GET Retrieve tracks recommendation</a>	<b>Audio Analysis</b> <a href="#">POST Retrieve audio analysis</a>

[developers.musimap.net](http://developers.musimap.net)



## REFERENCES and PARTNERS



UNIVERSAL MUSIC GROUP



Soundtrack  
Your Brand®





**Thomas Lidy**  
**Head of Machine Learning**  
[tom@musimap.com](mailto:tom@musimap.com)

[www.musimap.com](http://www.musimap.com)

Demos:  
[developers.musimap.net/gallery](http://developers.musimap.net/gallery)

**Hiring!**  
**Python**  
**Developers**  
**Data Scientists /**  
**ML**  
**AWS Cloud**  
**Experts**  
**Music Experts**  
...

Large-scale music emotion analysis at Musimap

# **Tutorial Agenda**

## **III. Instrumental, Genre and Mood Analysis:**

- Large-scale Music AI at Musimap
- Instrumental vs. Vocal Detection
- Genre Recognition
- Mood Detection
- Coding Examples

## **IV. Advanced Deep Learning:**

- Similarity Retrieval
- Siamese Networks
- Learning Audio Representation from Tag Similarity
- Coding Examples

# Binary vs. multi-class vs. multi-label classification

Binary classification: (e.g. instrumental vs. vocal):

- 2 classes – 1 output neuron – binary cross-entropy – sigmoid act.

Single label multi-class classification: (e.g. genre):

- n classes – n output neurons – categorical cross-entropy – softmax
- goal is to decide for one output class

Multi-label classification: (e.g. moods):

- n classes – n output neurons – binary cross-entropy – sigmoid act.
- multiple classes can be 1
- no StratifiedSplit possible