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DIPLOMARBEIT

An Explorative, Hierarchical User Interface to Structured Music Repositories

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Zusammenfassung

Nachdem sowohl die Anzahl als auch der Umfang von digitalen Musiksammlungen in den letzten Jahren dank effizienter Kompressionsalgorithmen wie MP3 stark zugenommen haben, gewinnen effektive Methoden der Suche nach Musik in solchen Sammlungen immer mehr an Bedeutung. Herkömmliche Benutzerschnittstellen, welche textbasierte Suche anbieten, weisen allerdings den Nachteil auf, daß der Benutzer gewisse textliche Eigenschaften der gesuchten Musik kennen muß (z.B. Name des Künstlers oder des Albums). Die im Rahmen dieser Diplomarbeit entwickelte Benutzerschnittstelle basiert hingegen auf graphischen Visualisierungen von musikalischen Ähnlichkeiten zwischen den einzelnen Stücken der Sammlung. Dadurch wird ein exploratives Vorgehen, vor allem bei der Suche nach vorher unbekannten Musikstücken, ermöglicht.

Um dem Benutzer unterschiedliche Sichtweisen auf die Sammlung anbieten zu können, wurden fünf Algorithmen zur Ähnlichkeitsbestimmung von Musikstücken, welche auf einer Verarbeitung des Audiosignals basieren, untersucht. Hierfür wurde eine Evaluierung der Algorithmen unter Verwendung einer manuellen, vom Autor durchgeführten, Klassifikation einer aus über 800 MP3-Dateien bestehenden Testkollektion durchgeführt. Schließlich wurde je ein auf Rhythmus und Klangfarbe basierender Algorithmus ausgewählt.

Die entwickelte Benutzerschnittstelle "ViSMuC" (Visualization of Structured Music Collections) verwendet eine Methode zur Visualisierung von hochdimensionalen Daten, namentlich Aligned Self-Organizing Maps, mit deren Hilfe die Ergebnisse der Ähnlichkeitsbestimmung entsprechend der wählbaren Gewichtung von rhythmischen und klangfarblichen Eigenschaften auf einer 2-dimensionalen Karte dargestellt werden. Hierbei werden ähnliche Musikstücke gruppiert und die einzelnen Gruppen entsprechend der Anzahl an Stücken welche sie repräsentieren eingefärbt, wobei unterschiedliche Farbschemata zur Auswahl stehen. Da die Darstellung aller Musikstücke einer mittleren oder größeren Kollektion ausschließlich auf einer Karte sehr unübersichtlich wäre, enthält die Benutzerschnittstelle zwei hierarchische Komponenten. Einerseits wird für jede Region auf der Karte, welche eine zu große Anzahl an Musikstücken repäsentiert, eine neue Karte zur Verfügung gestellt. Andererseits definiert die Verzeichnisstruktur der Musiksammlung eine, durch den Benutzer in individueller Weise festlegbare, Hierarchie, welche ebenfalls berücksichtigt wird. Ein weiterer wichtiger Bestandteil der Benutzerschnittstelle ist die Visualisierung von beliebigen Metainformationen, welche beispielsweise von ID3-Attributen der MP3-Dateien oder aus externen Datenbanken stammen können. Die hierzu verwendete Technik stellt die Verteilung von Attributwerten über die gesamte Karte dar. Dies dient, neben Visualisierungen der der Karte zugrundeliegenden Ähnlichkeitseigenschaften, dazu, die Karte für den Benutzer des Systems besser interpretierbar zu machen.

Abstract

Due to efficient compression algorithms like MP3, the number and size of digital music repositories have increased dramatically over the past few years. Hence, effective methods for finding pieces of music in such repositories are becoming more and more important. Unfortunately, when working with traditional user interfaces which solely provide text-based search, the user already has to know certain textual properties of the songs he/she is looking for (e.g. name of the artist or album). In contrast, the user interface which has been developed for this thesis is based on graphical visualizations of musical similarities between the pieces contained in the repository. This enables the user to exploratively browse through the collection, an approach which is especially useful for discovering formerly unknown pieces of music.

In order to provide different views of the music collection, five algorithms which process the audio signals to measure musical similarities were analyzed. For this purpose, an evaluation using the results of a manual classification performed by the author was conducted. This manual classification is based on a test repository composed of more than 800 MP3-files. Eventually, one rhythm-based and one timbre-based algorithm were selected.

The developed user interface "ViSMuC" (Visualization of Structured Music Collections) implements a method called Aligned Self-Organizing Maps in which high-dimensional data is represented by a 2-dimensional map. The pieces of music are visualized according to an adjustable weighting of their rhythmic and timbral properties. Forming clusters of similar pieces, the resulting groups are colored with respect to the number of songs they represent. Different colormaps are available for this purpose. Since illustrating all pieces of a medium or large collection on a single map would yield a tremendously complex and thus unusable visualization, the user interface contains two hierarchical components. Firstly, for each region of the map that represents a large number of songs, a new map is provided. Secondly, the directory structure of the repository usually forms a user-defined hierarchy which is also taken into account. Another important part of the user interface is the visualization of arbitrary meta-information, which can be taken, for example, from ID3-attributes or external databases. The employed technique illustrates the distribution of the values assigned to the meta-information attributes over the complete map. Together with visualizations that are based on the features gained from the similarity measures and their projection to the map, the images showing these distributions facilitate the interpretation of the map.

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Chapter 1 Introduction

1.1 Motivation

Over the past few years, the demand for digitally stored music has risen drastically. The introduction of the MPEG-Layer 3 format, better known as MP3, motivated many computer users to create compressed music repositories by copying and converting the contents of various records to their harddisks. Furthermore, combined with high-speed Internet access, the MP3-format yielded a tremendous rise in the private exchange of music. Now, people can easily share their music files using peer-to-peer networks like *Kazaa*¹, although this behavior is not always legal.

The growing number of large music databases, which are also very important for commercial music stores like *AMG All Music Guide*², *Amazon*³ or *iTunes*⁴, just to name a few, raises the demand for methods to efficiently browse through and search in such repositories. Most of the existing interfaces perform quite well when the task is to find music by a given artist or on a specified album, i.e. when the user knows exactly what he/she is looking for, but are unsuitable to support the user in discovering unknown music. For this reason, a user interface based on *Self-Organizing Maps (SOMs)* – neural networks used to cluster high-dimensional data – has been developed. The data consist of feature vectors, each of which describes some musical properties, e.g. rhythm or timbre, of one piece of the repository.

The basic idea of the user interface is to visualize the repository on a map where songs that are similar according to a certain property can be found close together. Thus, there are regions representing a lot of pieces as well as very sparse areas on the map. These differences in density can be visualized by applying a colormap, which enables the user to distinguish certain clusters, each of which represents music with similar rhythmic or timbral properties. In the interface to be presented here, a colormap similar to the *"Islands of Music"* described in [Pam01] is used by default, because the metaphor of geographic maps where the clusters are represented by islands which are separated by the sea seemed to be very intuitive to the user. In addition, other colormaps are available.

In contrast to the approach presented in [Pam01], the system developed for this thesis also takes into account the hierarchical structure of the music repository, which comprises two aspects – the musical structure and the directory structure.

The former is given by the distribution of the pieces on the map. If the number of songs assigned to one region exceeds a fixed limit, a further refinement of this area is done by introducing a new hierarchical level, i.e. displaying a new map which contains only the pieces of the particular region. In this case, just a prototype piece that best represents the music of the underlying hierarchy level is displayed on the original map. Using this technique of hierarchically organizing the map according to the musical similarity structure of the pieces, the system is capable of visualizing an unlimited number of tracks.

¹*http://www.kazaa.com* (date of access: 2003-10-17)

²http://www.allmusic.com (date of access: 2003-10-17)

³*http://www.amazon.at* (date of access: 2003-10-17)

⁴*http://www.apple.com/itunes* (date of access: 2003-10-17)

The latter, the directory structure, is usually very important to the user since it provides an easy way to organize the repository on the harddisk according to personal preferences. For example, one user could create directories for each genre, whereas another may prefer to name them after the artists. For this reason, the user interface offers the possibility to easily jump into the directory of each displayed piece of music.

Moreover, the user can get deeper insights into the clustering of the pieces by browsing different views. This is done by shifting the focus between timbral and rhythmic aspects, which leads to different maps and clusters [PDW03a].

Another important part of the user interface is the visualization of additional meta-information. Since many people use the *ID3 tagging system*⁵ to label and categorize their songs, presenting these data is usually very valuable to the user. Therefore, they are visualized in two ways. Firstly, a textual presentation of the most frequently used ID3-attributes appears when the mouse is moved over the label of an arbitrary song. Secondly, a graphical visualization of the genre distribution is shown for each map, which supports the user in interpreting the clusters, i.e. assigning a genre to each cluster.

Due to the fact that the ID3-standard defines a limited number of attributes, one could prefer using a database providing advanced information for each track of the repository. The user interface also permits the visualization of such extra information given by an external database.

On the whole, the developed user interface offers a wide range of possibilities to exploratively discover formerly unknown music as well as to browse through well-known repositories. It can be used by private music lovers as well as commercial music stores that want to offer an explorative way of finding new music according to the personal taste of their customers.

1.2 Structure and Overview

This thesis covers the following aspects of musical information retrieval and visualization.

First, the issue of extracting information from the audio signal that can be used to calculate similarities between all pieces of a collection is discussed. Since the extraction of such low-level features is essential to create an appropriate explorative user interface and there exist quite a few measures for perceptual music similarity, five approaches have been chosen to be presented and evaluated in this thesis. The underlying techniques are explained in Chapter 2, which deals with two rhythm-based and three timbre-based similarity measures for music.

The most important aspect regarding the usability of the user interface is certainly the visualization of the data gained with the methods presented in Chapter 2. Therefore, in Chapter 3 some techniques for organizing and visualizing high-dimensional data, like low-level music features, are introduced and discussed. In particular, a very powerful and popular approach for clustering such data by the use of a neural network, namely the *Self-Organizing Map (SOM)*, is presented. Hereafter, some extensions of the basic SOM-algorithm, which were useful for the development of the user interface, are shown. Chapter 3 also deals with the compression of high-dimensional data, which was necessary to reduce the calculation time for the SOM. Thus, the *Principal Component Analysis (PCA)* is introduced. At the end of the chapter, a very simple but nevertheless sufficient technique for visualizing the SOM is presented – the *Smoothed Data Histogram (SDH)*. Chapter 2 and 3 together form the part in which the related work is presented.

For this thesis a music repository containing 834 pieces with a total play length of more than 60 hours has been created in order to evaluate the similarity measures and to illustrate the need for a hierarchical user interface, since displaying such a large number of labels on one single map is very confusing to the user. In

⁵*http://www.id3.org* (date of access: 2003-10-17)

CHAPTER 1. INTRODUCTION

Chapter 4 the creation of this test repository is described in detail. Extracting and compressing the audio data, naming the music files as well as choosing criteria for selecting appropriate pieces and structuring the collection are the main issues covered in the first part of the chapter. The second part deals with the manual categorization done by the author in order to evaluate the similarity measures. The considered attributes and their possible values are presented as well as some interesting issues that came up during the categorization process. A complete list of the pieces in the test repository can be found in Appendix A, together with the results of the manual classification.

Chapter 5 discusses some issues concerning the calculation of rhythmic and timbral features for the pieces of music. These features are obtained by applying the algorithms presented in Chapter 2. After the features had been extracted, the similarity measures were evaluated using the results of the manual categorization. Given the calculation times and some problems of the feature extraction, eventually, one rhythm-based and one timbre-based measure were chosen to be utilized for the user interface.

The main topic of this thesis, the development of an explorative user interface for hierarchically structured music collections, is addressed in Chapter 6. First, the used information sources – musical features, directory structure, ID3-tags, manual categorization – are reviewed. The user interface is generated by a few *Matlab*®-programs that perform the recursive calculations and visualizations of the SOMs and their codebooks, which show some interesting musical aspects of the underlying data. Furthermore, the distributions of the values assigned to the meta-information attributes are illustrated. The results of these various visualizations are stored as graphic files using the *Portable Network Graphics (PNG)* format. In order to achieve a high level of platform-independence, the user interface is based on HTML and JavaScript. Thus, a *Matlab*®-program serving as code generator has been developed. Moreover, some issues concerning structure and design of the user interface are discussed in Chapter 6. Hereafter, the user interface generated by the data of the test repository is analyzed in detail, regarding each component of the visualization. To conclude the chapter, the results of a qualitative usability study which was conducted to reveal possible shortcomings of the user interface are presented.

Finally, in Chapter 7 a short summary is given and conclusions are drawn. Moreover, some suggestions for possible further work based on the results of this thesis are made.

Last but not least, Chapter 8, "Acknowledgements", is dedicated to all the people who supported me in the realization of this work.

1.3 Existing Techniques and Novel Contributions

The user interface presented here is based on the visualization approach of "*Islands of Music*" [Pam01], the thesis of Elias Pampalk. Calculating the SOMs is done by using the *SOM Toolbox*⁶ for *Matlab*[®]. In order to visualize them, SDHs [PRM02b] – more precisely, functions of the *SDH Toolbox*⁷ – are used. Unlike in [Pam01], two existing similarity measures were chosen to let the user shift the view between a rhythmical and a timbral clustering of the repository. To reduce the dimensionality of the musical data, a PCA [Hot33, Jol86, KLK⁺97] is applied to them before calculating SOMs and SDHs.

The novel aspects of the work done for this thesis mainly incorporate the following issues:

 Creation of a test repository containing 834 MP3-files, manually categorizing its pieces of music according to eight attributes, and inserting the results into a database.

⁶http://www.cis.hut.fi/projects/somtoolbox (date of access: 2003-10-18)

⁷http://www.ai.univie.ac.at/~elias/sdh (date of access: 2003-10-18)

- Evaluation of the similarity measures by using the data gained from the manual categorization in order to choose one rhythmic and one timbral measure to be utilized for the user interface.
- Development of *Matlab®*-programs which extract ID3-tags and other descriptive data exported from external databases.
- Development of a *Matlab®*-program which automatically builds an HTML- and JavaScript-based user interface consisting of several hierarchy levels depending on both the number of pieces mapped together to one region and the directory structure of the music repository. Great importance was attached to following the design guidelines of *focusing* and *linking*, which are indispensable to create a good user interface. Furthermore, a simple and fast method was applied to create multiple views focusing on either rhythmic or timbral aspects of the music. Moreover, the meta-data from the ID3-tags and the manual categorization are visualized dynamically for each attribute, i.e. for each attribute value that occurs at least once in the meta-data, its distribution among all pieces is visualized.

1.4 Notation and Conventions

Since all programs which have been developed for this thesis, including the user interface, were created in $Matlab^{\textcircled{B}}$, it was obvious to use $Matlab^{\textcircled{B}}$'s naming convention also in the thesis. Therefore, in the mathematical notation an italic typeface is used for scalar variables which are indicated by lower case letters – e.g. i, j, k – whereas a bold typeface combined with lower case or upper case letters indicate vectors – e.g. \mathbf{x}, \mathbf{y} – and matrices – e.g. \mathbf{A}, \mathbf{B} – respectively. Moreover, all indices of vectors and matrices start with the value 1.

As for the textual conventions, an italic typeface is used to emphasize certain elements like names of enterprises and products, Internet addresses, meta-level expressions, e.g. names and values of attributes, and technical terms indicating algorithms, methods or measurements.

Chapter 2 Perceptual Music Similarity Measures

Finding similarities between pieces of music can be accomplished according to various properties, e.g. instrumentation, lyrics, tempo, mood, melody, rhythm or even emotions evoked by them. Thus, it is most likely that different listeners would assign different similarities to the same pieces of music. Nevertheless, there exist some algorithms which process the low-level audio signal in order to calculate rhythmic or timbral features. These features then can be used to compute similarities between arbitrary pieces.

In this chapter, five approaches for measuring musical similarities are presented. Each of these measures is applied to low-level *Pulse Code Modulation (PCM)* audio data using *Matlab*[®]-implementations of the corresponding algorithms. The PCM data is the discrete, i.e. sampled, representation of a continuous audio wave. For the experiments conducted for this thesis, a sampling frequency of 11025 *Hertz (Hz)* was used. Thus, the audio signal is scanned 11025 times per second – about every 91 microseconds. Furthermore, the original stereo signal was downmixed to only one channel.

Since the main focus of this thesis is the development of an explorative user interface based on results of existing perceptual music similarity measures, no in-depth analysis of the chosen measures can be given here. However, in the following sections the essential methods used by each technique are presented.

There exist quite a few basic concepts which are used by the measures. A short explanation of the most important ones is given in the first section of this chapter in order to facilitate the understanding of the algorithms.

2.1 Basic Concepts

Fourier Transformation

The raw data of a piece of music, i.e. the PCM data, consist of amplitude levels taken at different times. Thus, these data are given in the time domain. Since one of the most important aspects of music perception is the discerned frequencies, all algorithms presented here transform the audio signal from the time domain into the frequency domain before further processing is done. In the frequency domain the amplitude of the signal is given for several frequencies.

The Fourier transformation, named after Jean Baptiste Joseph Fourier, is based on the theorem that any continuous periodic function with a period of 2π can be represented as the sum of sine and/or cosine waves [Pap00].

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} \left[a_n \cdot \cos(n \cdot x) + b_n \cdot \sin(n \cdot x) \right] a_0 = \frac{1}{\pi} \cdot \int_0^{2\pi} f(x) dx a_n = \frac{1}{\pi} \cdot \int_0^{2\pi} f(x) \cdot \cos(n \cdot x) dx b_n = \frac{1}{\pi} \cdot \int_0^{2\pi} f(x) \cdot \sin(n \cdot x) dx$$
(2.1)

The coefficients a_n and b_n represent the amplitude at the frequency given by the term $n \cdot x$. Therefore, each

audio signal can be decomposed into an infinite number of overlapping waves. If the domain of the function is finite, e.g. the number of samples of a digital audio signal, a *Discrete Fourier Transformation (DFT)* is necessary to decompose the signal. However, calculating the integrals to obtain the coefficients is a very time-consuming task.

A computationally very fast algorithm to calculate the DFT was developed by James W. Cooley and John W. Tukey in 1965 [CT65] – namely the *Fast Fourier Transformation (FFT)*. It is based on a divide-and-conquer approach. Thus, the problem of computing the DFT for *n* samples is reduced to calculating two transforms on $\frac{n}{2}$ points each. This procedure is executed recursively. Regarding this approach, it is obvious that FFT works best for domains whose cardinality is a power of 2. A more detailed description of the FFT can be found, for example, in [Bri74].

Frame

In short-time signal processing, e.g. calculating the Fourier transformation, signals are usually cut into small pieces called frames, which are processed one at a time.

Windowing

Since each audio signal has to be periodic in order to calculate its FFT, a function suppressing the first and the last samples of each frame is applied. This process is referred to as *windowing* and essentially means multiplying the frame values with the windowing function point-by-point. A common choice for the windowing function is the Hanning window, named after the Austrian meteorologist Julius von Hann [BT59]. The Hanning function is given by

$$h(x) = \frac{1}{2} \cdot \left[1 + \cos\left(\frac{\pi \cdot x}{a}\right)\right].$$
(2.2)

An example of windowing a frame by applying the Hanning function can be found in Figure 2.1.



Figure 2.1: The upper graph shows a frame consisting of the first 256 samples of the song "*Come Cover Me*" by "*Nightwish*". The center plot depicts the Hanning function for the respective interval. The lower diagram shows the signal after having applied the Hanning function in a pointwise fashion.

Critical-band

Critical-bands are a perceptually uniform measure of frequency that reflects characteristics of the human auditory system. Below 500 Hz the critical-bands have a width of about 100 Hz. With rising frequency, it becomes increasingly difficult to distinguish between two frequencies of the same absolute interval apart. Thus, above 500 Hz the range between lower and upper bound of a critical-band increases rapidly.

The critical-bands are measured, according to the bark scale [ZF99], using the unit *bark* (after Barkhausen). Hence, 1 bark represents the width of one critical-band. In Figure 2.2 the different intervals of 24 critical-bands are depicted.



Figure 2.2: This plot shows the frequency ranges covered by the first 24 critical-bands according to the bark scale. The marked points indicate the frequency of the upper border for the respective band.

Loudness Measurement (Decibel, Phon, Sone)

Sound intensity *i* is defined as the sound power per unit area, measured in $\frac{watts}{m^2}$. Its usual context is the intensity measurement of sounds at the place where a listener is located. Many sound intensity measurements are made relative to the intensity of the hearing threshold $i_0 = 10^{-12} \frac{watts}{m^2}$. A very common approach to sound intensity measurement is the use of the *decibel* (*dB*) scale.

$$i_{dB} = 10 \cdot \log_{10} \left(\frac{i}{i_0}\right) \tag{2.3}$$

It is obvious that the sound intensity of the hearing threshold takes the value 0 dB. However, human loudness sensation varies with the frequency of a perceived sound while its sound intensity remains the same. Equal loudness curves [Fle40] can be used to describe these variations. In fact, the human ear is less sensitive to low frequencies, whereas the band from 3000 Hz to 4000 Hz represents the frequency range in which a human listener is most sensitive.

To model this non-linear relationship between sound intensity and human loudness sensation, the loudness can be measured in *phon*. The phon scale is defined using a reference frequency of 1000 Hz. If a sound is perceived to be as loud as an x dB tone at 1000 Hz, its loudness equals x phon. Considering, for example, a 40 dB tone at 1000 Hz, a sound with the same intensity but lower frequency is assigned a lower phon

value since the human ear is less sensitive to low frequencies. Phon values as well as decibel values are logarithmically scaled.

In contrast, the *sone* scale provides a linear measurement for human loudness sensation. While 1 sone is defined to be equivalent to 40 phon, a sound with 2 sone equals 50 phon, thus is perceived twice as loud as a 1 sone sound.

2.2 Rhythm Patterns/Modified Fluctuation Strength (RP/MFS)

This rhythm-based measure was originally presented by Markus Frühwirth in [Frü01] but substantially extended by Elias Pampalk in his thesis [Pam01]. Especially, the use of psychoacoustic models refines the feature extraction process, which is described in short in [PRM02a].

The feature extraction process starts by cutting the piece of music into sequences with a fixed length of 6 seconds. The first and the last sequence are discarded to avoid lead-in and fade-out effects. Moreover, only each third sequence is processed further in order to reduce the calculation time. The following steps are done for each of the remaining sequences.

Firstly, an FFT is applied to Hanning-windowed frames of 256 samples with 50 percent overlap. The frequencies of the resulting spectrum are then converted into 20 critical-bands according to the bark scale. Since the used PCM data is sampled at 11 025 Hz, the maximum frequency that can appear in the audio signal is 5512.5 Hz, because two samples per period (one for the positive and one for the negative peak) are needed to describe a sine wave. The 20th critical-band incorporates frequencies between 5 300 Hz and 6400 Hz. Thus, it is necessary to take the first 20 critical-bands. In the next step, spectral masking effects [SAH79], i.e. the occlusion of a quiet sound when a loud sound is played simultaneously, are taken into account. After applying several loudness transformations, which eventually result in sone values, the processed piece of music is described by a number of feature matrices, one for each of the 6-second-sequences. The matrices contain information about the perceived loudness at a specific point in time in a specific critical-band.

In the following stage of the feature extraction process, a time-invariant representation of the sequences is obtained by applying another FFT, which gives information about the amplitude modulation. These so-called fluctuations reveal how often a specific frequency reoccurs within the regarded 6-second-sequence. Thus, they describe its rhythmic properties. Since the perception of the fluctuations depends on their periodicity, e.g. reoccurring beats at 4 Hz are discerned most intensely, a psychoacoustic model of fluctuation strength is applied according to [Fas82]. Finally, the rhythm patterns are filtered, which yields modified values for the fluctuation strengths. This filtering mainly emphasizes distinctive beats, which are characterized by high fluctuation strengths at a specific modulation frequency.

After this elaborate processing, the resulting representation of each 6-second-sequence contains information about the modified fluctuation strengths for each of the 20 critical-bands and 60 levels of modulation frequencies ranging from 0 to 10 Hz, thus from 0 to 600 *beats per minute (bpm)*. In a final step, the median of all MFS representations for the processed piece, i.e. the feature vectors of all its sequences, is calculated to obtain a unique 1 200-dimensional feature matrix for each piece of music.

Visualizing the MFS values with respect to the critical-bands and the modulation frequencies results in images revealing specific rhythm patterns like those shown in Figure 2.3. For example, the upper left subfigure depicts the rhythm pattern of "*Anthem* #5" by "*Floorfilla*", which is a quite typical Trance track. In fact, the image reveals very strong MFS values for the lowest 5 critical-bands (frequencies below 500 Hz) at about 120 bpm and 260 bpm. In contrast, being far more melodious, the pieces "*Come Cover Me*" by "*Nightwish*" and "*Caislean Oir*" by "*Clannad*" show MFS values whose distributions are more widespread than those of the first track. However, the intensity of the rhythmic beats is much smaller (cf. the different scaling of the

MFS values). The last piece of music depicted in the figure is a piano sonata composed by "Wolfgang Amadeus Mozart" and played by "Vladimir Horowitz". The "Piano Sonata in C Major, K.330" has the lowest maximum MFS value of all of the 4 selected pieces. Moreover, it can be seen in the image that this piece contains no typical reoccurring beat, instead many variations in speed are obvious. Hence, the distribution of the MFS values shows a horizontal characteristic along the modulation frequency axis, which is quite typical for the majority of classical pieces of music.



Figure 2.3: Images of the rhythm patterns of four very different pieces of music. Regarding the colorbars beside each figure, the unequal scaling of the MFS values becomes obvious.

2.3 Periodicity Histograms (PH)

Periodicity histograms, the second regarded rhythm-based measure, were originally developed for beat tracking purposes [Sch98]. Thus, the main idea of the histograms described in [PDW03a] is to model only reoccurring beats, regardless of their frequency.

Before the periodicity histograms are calculated, a psychoacoustic preprocessing is applied to emphasize those parts of the signal which are most discernible to the human ear while removing less important information. The preprocessing starts by removing the first and the last 10 seconds of the piece of music to eliminate lead-in and fade-out effects. Then, the remaining signal is split into pieces of 256 samples with an overlap of 128 samples. At the chosen sampling frequency of 11025 Hz this results in 86 frames per second. Each of these frames is weighted by a Hanning function before an FFT is calculated. Hereafter, a model of the outer and middle ear is applied to weight the energies at different frequencies. Finally, the frequency domain is reduced to 20 critical-bands according to the bark scale, the loudness in sone is calculated and its maximum is

normalized to 1.

Using the preprocessed features, the first step in creating the actual periodicity histograms is to emphasize percussive sounds by applying a half-wave rectified difference filter to each critical-band. Then, the resulting representation is split into sequences of 12 seconds duration with 6 seconds overlap. Each of these sequences is weighted by a Hanning window before a comb filter with a resolution of 5 bpm in the range from 40 to 240 bpm is applied to each critical-band. Hereafter, a resonance model is applied and peaks at specific periodicities are emphasized. Finally, the amplitude values for each periodicity in all critical-bands are added up. To aggregate the information of each 12-second-sequence, a histogram matrix with 40 columns representing the periodicities and 50 rows describing different strength levels is created. Counting how often a specific strength is reached or exceeded in any of the sequences belonging to the same piece of music finally leads to periodicity histograms like those depicted in Figure 2.4.

Again, the distinctive rhythm of the Trance track "*Anthem* #5" can be observed. Like the RP/MFS-measure, the PH reveals a strong beat within a periodicity range between 90 and 140 bpm. But while a second intensive reoccurring beat can be found in the RP/MFS-visualizations (cf. Figure 2.3), the periodicity histogram ignores this second beat since its periodicity is about 260 bpm, thus out of the examined range. The song by "*Nightwish*" also reveals some reoccurring beats at about 90 bpm and 150 bpm. However, these beats are less intense than those of "*Anthem* #5". In contrast, "*Caislean Oir*" and the piano sonata both lack distinctive beats, which can be seen in the two lower subfigures. The corresponding histograms reveal very low strength levels at each periodicity.



Figure 2.4: Periodicity histograms of the selected pieces. The colorbar beside each histogram shows how many times a specific strength is reached or exceeded.

2.4 Spectrum Histograms (SH)

Spectrum histograms are used to describe timbral aspects of music. For this reason, it is necessary to take into account which frequency bands are active simultaneously. The approach presented in [PDW03a] is quite simple and very fast compared to the other techniques, but nevertheless yields respectable results (cf. Chapter 5). However, it is necessary to remark that this approach does not take into account many important aspects of timbre, such as attack of an instrument.

After having executed the same psychoacoustic preprocessing as already described for the periodicity histograms, a matrix with 20 rows and 50 columns is created. The rows represent the frequency bands, whereas the columns indicate the loudness level which can take values between 0 and 1, according to the normalized sone values. The calculation of the spectrum histogram matrix is simply done by counting how many times the regarded piece of music reaches or exceeds a specific loudness in each frequency band. Hereafter, the sum of the resulting matrix is normalized to 1 in order to cope with the different play lengths of the pieces.

Considering Figure 2.5, the different loudness levels for each of the 20 critical-bands become apparent for the selected pieces of music. The track "*Anthem* #5" by "*Floorfilla*" contains strong beats at lower frequencies and synthesized loops in the middle and upper parts of the frequency range. Interestingly, the high power of the bass beats is not revealed by the spectrum histogram. "*Come Cover Me*" by "*Nightwish*" is a very melodious but also powerful song. Thus, its spectrum histogram shows high loudness levels in all critical-bands, especially at higher frequencies. Listening to the track "*Caislean Oir*" by "*Clannad*" reveals one dominant human voice at rather low frequencies, which can also be seen in its spectrum histogram. Finally, the piano sonata shows quite low loudness levels over all frequency bands.



Figure 2.5: Spectrum histograms for the selected pieces. The colorbar beside each histogram shows the number of pieces into which each track is split.

2.5 Logan and Salomon (LS)

The measure by Beth Logan and Ariel Salomon, as presented in [LS01], is based on a different technique than the spectrum histograms – the use of *Mel Frequency Cepstral Coefficients (MFCCs)*. However, the aim is the same – to model timbral aspects of music.

MFCCs are short-term spectral-based features and are prevalently used for speech recognition [RJ93]. They describe audio signals by spectral envelopes. In [Log00] it is shown that MFCCs are also applicable to the problem of music modeling. The feature extraction process of the measure by Logan and Salomon is described below.

Firstly, each piece of music is split into frames with a duration of 25 milliseconds before the MFCCs are computed for all of these segments. Calculating the MFCCs involves applying a DFT, for example an FFT, to the Hanning-windowed frames. The resulting amplitudes in the frequency domain are weighted by the logarithm-function since the perceived loudness of a signal is approximately logarithmic. Then, the spectral components are grouped into a fixed number of frequency bands according to the mel scale [SVN37, CB96]. The mel scale is used in order to emphasize perceptually important frequencies since this scale, like the bark scale, takes into account the non-linear perception of different frequencies by the human ear. The final step of the MFCC-calculation is the decorrelation of the mel-spectral features. This is done by applying a *Discrete Cosine Transformation (DCT)*, which is a transformation similar to the DFT.

The result of the described signal processing is a vector containing cepstral features of the regarded frame. While the low order coefficients of this MFCC-feature vector describe the slowly changing spectral envelopes, the higher order ones consider the fast variations of the spectrum. Since the first MFCC represents the strength of the slowest changing parts of the signal, it reveals information about the average loudness.

After having calculated 20 MFCCs for each frame, the first one is discarded according to the algorithm of Logan and Salomon. The remaining 19 MFCCs of all frames belonging to a certain piece of music are grouped using one of the most popular clustering algorithm in the context of data mining, namely *k-means* [McQ67, BB02, Ord03]. Eventually, the piece of music is summarized by 16 clusters, which describe some of its typical spectral envelopes. Each of these clusters is characterized by the mean of the MFCCs belonging to it and its weight that is proportional to the number of frames which are represented by the particular cluster.

The calculated set of clusters for each piece of music, unlike the features used by the other measures described so far, cannot be used directly for similarity measurement since the order of the clusters within the set is not defined. In fact, two very similar pieces of music that contain clusters which are alike, could be rated as very different when presented to the SOM solely because of a different order of the clusters. Therefore, it is necessary to process the features by applying a distance measurement technique that is able to calculate distances between sets of elements. Logan and Salomon have chosen the *Earth Mover's Distance (EMD)* [RTG98, RTG00], which provides a highly efficient algorithm based on the linear programming task of finding a flow with minimal costs, also known as the *transportation problem*. Given two pieces of music, *song A* and *song B*, it is firstly necessary to calculate the distances $d_{A_iB_j}$ between each of the clusters *i* belonging to *song A* and the clusters *j* assigned to *song B*, e.g. by computing the Euclidean distance or the Kullback Leibler distance. The main idea of the EMD is to find a set of flows $f_{A_iB_j}$ that minimizes the overall costs of transforming the clusters of *song A* into those of *song B*. Hence, this task can be formulated as a minimization problem defined by min $\left(\sum_{i=1}^{m} \sum_{j=1}^{n} d_{A_iB_j} \cdot f_{A_iB_j}\right)$, where *m* and *n* are the total numbers of clusters belonging to *song A* and *song B*, respectively – thus both taking the value 16. The flows $f_{A_iB_j}$ are subject to the following constraints:

$$f_{A_i B_j} \ge 0 \tag{2.4}$$

$$\sum_{i=1}^{m} f_{A_i B_j} = w_{B_j} \tag{2.5}$$

$$\sum_{j=1}^{n} f_{A_i B_j} \le w_{A_i} \tag{2.6}$$

Constraint 2.4 allows only flows from clusters of *song* A to those of *song* B and not vice versa. Constraint 2.5 states that each cluster of *song* B has to get enough supply from the clusters of *song* A to reach its weight w_{B_j} , i.e. the number of frames the cluster represents. It is important to note that the total weight of *song* A has to equal or exceed that of *song* B. Otherwise, the constraint cannot be satisfied. However, by switching *song* A and *song* B it is always possible to fulfill this condition. Constraint 2.6 ensures that the total flows of each cluster of *song* A do not exceed its weight.

Having solved the minimization problem, the EMD is eventually calculated as shown in Equation 2.7, where the denominator is a normalization factor that avoids favoring sets of clusters with smaller total weights, i.e. shorter pieces of music.

$$EMD(A,B) = \left(\frac{\sum_{i=1}^{m} \sum_{j=1}^{n} d_{A_i B_j} \cdot f_{A_i B_j}}{\sum_{i=1}^{m} \sum_{j=1}^{n} f_{A_i B_j}}\right)$$
(2.7)

After having calculated the EMD for all pairs of songs, the resulting values are stored in a distance matrix that can be used to train a SOM.

2.6 Aucouturier and Pachet (AP)

Like the measure proposed by Logan and Salomon, the algorithm by Aucouturier and Pachet [AP02a, AP02b] uses MFCCs to calculate spectral envelopes of audio signals. Unlike the former, Aucouturier and Pachet cut the audio signal into short-time sequences with a duration of 50 milliseconds prior to applying the MFCC-algorithm, which is described above. Moreover, only the first 8 MFCCs, including the lowest order one, which describes the average loudness, are retained.

The main difference to the LS-measure is the further processing of the resulting spectral short-time descriptions, i.e. the manner of summarizing the MFCC-values for all frames belonging to a certain piece of music. The algorithm by Aucouturier and Pachet models all MFCCs of a song as a mixture of Gaussian distributions over the space of all MFCCs. This is accomplished by using *Gaussian Mixture Models* (*GMMs*) [Ben03, YML99], which estimate a probability density as the weighted sum of a fixed number *m* of simple Gaussian densities as shown in Equation 2.8, where **f** is a feature vector, in this context containing the MFCCs for a specific frame, *N* is a Gaussian probability density function with mean μ_i and covariance matrix Γ_i , and c_i is a mixture coefficient used to weight each of the Gaussians. The AP-measure uses a mixture of 3 Gaussians to model the distribution of the MFCCs, thus m = 3.

$$p(\mathbf{f}) = \sum_{i=1}^{m} c_i \cdot N(\mathbf{f}, \mu_i, \Gamma_i)$$
(2.8)

Having described each piece of music by a GMM, the next issue is the measurement of the distance between two arbitrary pieces, again referred to as *song A* and *song B*. A possible solution would be to compute the likelihood that the MFCCs of *song A* are generated by the GMM which represents *song B*. Since this method requires access to the MFCCs of all songs in order to compute a complete distance matrix, the needed disk space would be enormous. Therefore, another approach, which only uses the information given by the GMMs,

was chosen. According to Aucouturier and Pachet, calculating the distance between *song A* and *song B* is accomplished by firstly generating a sample of size 1 000 from the GMM of *song A* and secondly calculating the probability that this sample was created by the GMM of *song B*. Having processed all pairs of songs, the resulting distances are made symmetric since the method of sampling from one distribution and calculating the probability that the samples were generated by the other yields non-symmetric distances. Finally, the distance matrix is normalized to the range of 0 to 1.

Chapter 3 Organization and Visualization of High-Dimensional Data

In this chapter, the problem of handling and presenting high-dimensional data is addressed. Since feature vectors in data mining applications usually represent many attributes, using them even for simple calculations can be very time- and space-consuming. Therefore, multivariate data projection aiming at dimensionality reduction is an important issue in this context.

Since calculating the SOMs for the developed user interface directly from the original feature vectors would lead to unacceptable computation times, a dimensionality reduction was performed by compressing the data using *Principal Component Analysis (PCA)*, a linear projection method, which is described in the first section of this chapter. Hereafter, probably the most important technique involved in the creation of the user interface – the *Self-Organizing Map (SOM)* – is presented. Two different training approaches for this non-linear projection method are explained: sequential and batch training. Furthermore, an extension of the standard SOM-algorithm is characterized, namely the *Aligned Self-Organizing Maps*, a very simple form of which was used to calculate the different views according to the balance of rhythmic and timbral features. Finally, the *Smoothed Data Histogram (SDH)*, a quite simple visualization technique that was chosen to illustrate the calculated SOMs, is introduced and explained.

3.1 Principal Component Analysis (PCA)

Principal Component Analysis [Hot33, Jol86, KLK⁺97], sometimes referred to as *Karhunen-Loeve transform*, is a popular and widely used technique for statistical data analysis and dimensionality reduction of multivariate data sets. It provides a linear projection that aims at preserving the most important information of the data set while discarding redundancies. Some of the areas in which PCA is used are data compression, image analysis, visualization, pattern recognition and regression.

The main idea of the PCA is to find those components of a given data set which possess the highest variances. The underlying assumption is that components with a large variance are most informative and therefore should be retained, whereas those revealing a small variance are dominated by noise and can be discarded.

Technically, the PCA is based on the diagonalization of the *covariance matrix* **C**, which is a symmetric $d \times d$ matrix, where d denotes the dimensionality of the data items. For $i \neq j$, the entries c_{ij} of the covariance matrix reveal the correlation between the *i*-th and *j*-th attribute of the data set, whereas the diagonal values c_{ii} are the variances of the respective *i*-th component. The covariance matrix is calculated as shown in Equation 3.1, where $\hat{\mathbf{X}}$ denotes the mean normalized data set. Thus, given the original data matrix \mathbf{X} , an $m \times d$ -matrix with m data items incorporating d values each, $\hat{\mathbf{X}}$ is obtained by subtracting the mean of the columns, i.e. a vector containing the average value for each dimension, from each row of \mathbf{X} .

$$\mathbf{C} = \hat{\mathbf{X}} \cdot \hat{\mathbf{X}}^{\mathrm{T}} \tag{3.1}$$

Having calculated **C**, the next task is to perform an *eigenvalue decomposition* (*EVD*) leading to a set of *eigenvectors* and *eigenvalues*. While the first eigenvector can be interpreted as an axis in the high-dimensional data space along which the variance of the data is maximal, the respective eigenvalue exactly reveals the variance value. The second eigenvector identifies an orthogonal direction with maximum variance, which is given by the corresponding eigenvalue, and so forth. Therefore, the complete set of eigenvectors consists of orthogonal directions with maximum variances. The eigenvectors and eigenvalues are the solutions of Equation 3.2, where \mathbf{e}_i and λ_i denote the *i*-th eigenvector and eigenvalue, respectively. Considering the matrices $\mathbf{E} = (\mathbf{e}_1, \dots, \mathbf{e}_d)$

and $\Lambda = \begin{pmatrix} \lambda_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \lambda_d \end{pmatrix}$, the eigenvalue decomposition can be formulated as shown in Equation 3.3, where

E denotes the eigenvector matrix and Λ the eigenvalue matrix.

$$\mathbf{C} \cdot \mathbf{e}_i = \lambda_i \cdot \mathbf{e}_i \tag{3.2}$$

$$\mathbf{C} \cdot \mathbf{E} = \mathbf{E} \cdot \Lambda \tag{3.3}$$

However, solving Equation 3.3 is a non-trivial task for which several methods have been developed. An overview of some of them can be found, for example, in [GvdV99].

Having calculated **E** and Λ , the principal components are given by **E** and the covariance matrix of the principal components is given by the diagonal eigenvalue matrix Λ . Considering the form of Λ , the principal components are uncorrelated and the variance of the *i*-th principal component is given by the *i*-th eigenvalue λ_i .

To illustrate the purpose of the calculations described so far, in Figure 3.1 a data set consisting of 200 points in a 2-dimensional data space is visualized together with the eigenvectors of its covariance matrix, i.e. its principal components. It is obvious that the first eigenvector, which is represented by the black line, depicts the direction of the highest variance in the data set. The second eigenvector, illustrated by the red line, is orthogonal to the first one. In this example, the 2-dimensional data set could be projected onto a 1-dimensional eigenspace without losing much information.

Having computed the principal components, the projection \mathbf{y} of a data item \mathbf{x} into the *k*-dimensional eigenspace is done by creating a matrix consisting of the first *k* eigenvectors, denoted as \mathbf{E}_k , and calculating \mathbf{y} according to Equation 3.4, where μ is a vector containing the mean of the columns of \mathbf{X} . This linear projection leads to a dimensionality reduction of the data set by the factor $\frac{d}{k}$.

$$\mathbf{y} = (\mathbf{x} - \boldsymbol{\mu}) \cdot \mathbf{E}_{k} \tag{3.4}$$

For the compression of the feature vectors obtained from the similarity measures, the first 80 principal components were taken to calculate a lower-dimensional representation of the data since this seemed to be a reasonable number for the 834 data items, i.e. pieces of music. In fact, regarding a SOM that is trained and visualized on the basis of the original data vectors reveals no visible differences to one whose training is performed on the values of feature vectors that were projected to the 80-dimensional eigenspace.

3.2 Self-Organizing Map (SOM)

The *Self-Organizing Map (SOM)* [Koh82, Koh01, SJ02, Ves00] is a powerful neural network algorithm based on unsupervised learning. It is used in a very wide range of applications belonging to the field of data mining,



Figure 3.1: This plot depicts a sample drawn from a modified bivariate Gaussian distribution for which the principal components were calculated. The black and the red line illustrate the first and the second eigenvector, respectively. Since the variance of the first component is much higher than that of the second ($\lambda_1 = 9.3340$ and $\lambda_2 = 0.0392$), the data could be well approximated by a 1-dimensional representation.

e.g. image and video processing, pattern recognition, speech analysis and recognition, engineering in biology and medicine, signal processing, business. An impressive list of more than 5000 related publications can be found in [KKK98, OKK02]. Unlike PCA, the SOM is a non-linear projection technique and thus able to handle non-linear structures in the data.

The main idea of the SOM is to organize multivariate data on a usually 2-dimensional map in such a way that data items which are similar in the high-dimensional data space are projected to locations which are close to each other on the map. Therefore, probably the most important application area of the SOM is the representation of high-dimensional data sets.

Basically, the SOM consists of an ordered set of map units, each of which is assigned a *model vector*¹ \mathbf{m}_i of the same dimensionality as the original data space. The map units are arranged either rectangularly or hexagonally to form a grid. The set of all model vectors of a certain SOM is referred to as its *codebook*.

Before training the SOM, the model vectors are initialized. This can be accomplished by assigning random values or by using more sophisticated methods. For example, the first m principal components can be calculated in order to linearly initialize the model vectors along the m greatest eigenvectors, where m denotes the cardinality of the codebook, i.e. the number of map units. If random initialization is used, two equally parameterized training runs performed on the same data set can yield differently folded SOMs.

The training process itself can either be performed sequentially or by using the *batch map* [Ves00]. Both of these methods are explained briefly below.

Figure 3.2 reveals the influence of the used initialization method and training algorithm on the SOM. For this purpose, a data set based on 5 modified Gaussian distributions each of which consists of 2002-dimensional samples was created. Hereafter, 4 SOMs were calculated and visualized for each combination of linear initialization, random initialization and sequential training, batch training.

¹In some publications the model vectors are denoted as *reference vectors*, *prototype vectors* or *weight vectors*.

3.2.1 Sequential Training

The basic algorithm for the SOM [Koh82] uses sequential training, also known as online training, which is performed iteratively. Each training iteration starts by choosing one randomly selected data item **x** out of the data set denoted by **X**. Subsequently, the distance between **x** and each model vector \mathbf{m}_i is calculated – e.g. according to the Euclidean norm. The map unit possessing the model vector \mathbf{m}_{bmu} that is closest to the data item **x** is referred to as *best matching unit (BMU)* and is further used to represent **x** on the map. Formally, the selection of the BMU is given by Expression 3.5.

$$\|\mathbf{x} - \mathbf{m}_{bmu}\| = \min\left\{\|\mathbf{x} - \mathbf{m}_i\|\right\}$$
(3.5)

In the next step, the model vectors are updated to reduce the distance between the data item **x** and the model vectors of the BMU and its surrounding units. Since an important aspect of the SOM is to preserve the distances between the items in the data space, a neighborhood kernel $h_{bmu,i}(t)$ centered on the BMU is defined. Hence, the model vectors of units close to the BMU are adapted more than those far away from the BMU, which ensures that neighboring map units represent similar data items. This is of particular importance since, especially at the beginning of the training process and when random initialization is used, the model vectors exceedingly differ from the data items. The neighborhood kernel can be defined by a Gaussian as shown in Expression 3.6, where \mathbf{r}_{bmu} and \mathbf{r}_i denote the 2-dimensional position of the respective units on the map. Thus, by $\|\mathbf{r}_{bmu} - \mathbf{r}_i\|$ the distance between the units bmu and i within the output space is given. The time-varying parameter δ ensures a decreasing size of the neighborhood kernel during the training process, which enables the formation of large clusters in the beginning as well as allowing a selective fine-tuning towards the end of the training.

$$h_{bmu,i}(t) = \exp\left(-\frac{\|\mathbf{r}_{bmu} - \mathbf{r}_i\|}{2 \cdot \delta(t)^2}\right)$$
(3.6)

Furthermore, a learning rate $\alpha(t)$ is used to gradually decrease the overall amount of adaptation. The complete update rule for the model vectors is given by Expression 3.7.

$$\mathbf{m}_{i}(t+1) = \mathbf{m}_{i}(t) + \alpha(t) \cdot h_{bmu,i}(t) \cdot [\mathbf{x} - \mathbf{m}_{i}(t)]$$
(3.7)

Either the learning rate and the neighborhood kernel decrease gradually with the iteration cycle t since high adaptations are necessary in the rough training phase at the beginning and smaller ones for the fine-tuning towards the end of the training.

The number of performed iterations mainly depends on the cardinality of the training set and the number of map units but should be at least one epoch, i.e. each data item is presented once to the map. For example, the implementation of the training algorithm contained in the *SOM Toolbox* for *Matlab*[®] executes $50 \cdot \frac{|\{\mathbf{m}_i\}|}{|\mathbf{X}|}$ epochs for a complete training (rough training and fine-tuning phase). In this case the number of iteration cycles is 50 times the number of map units.

3.2.2 Batch Map

The batch map version of the SOM-algorithm as proposed in [Koh92] is also performed iteratively, but instead of presenting a single data item to the SOM at a time, the whole data set is taken into account at each iteration step. The main advantage in comparison with the sequential training is that executing the batch map algorithm on the same data set with the same parameters more than once produces similar maps. However, it is necessary to have access to the complete data set in order to use the batch map. Since all data items are presented to the

map at the same time, no learning rate is needed.

Each training iteration involves two steps, which are executed until no further significant changes of the model vectors occur. First, the data set is divided according to the *Voronoi regions* of the map, i.e. the BMU for each data item is calculated (cf. Expression 3.5) and each map unit *i* is assigned a *Voronoi set* \mathbf{V}_i which points to all data items that are best represented by this unit. Having determined the Voronoi sets, in the second step, the new model vectors are calculated according to Expression 3.8, where *n* denotes the number of items in the data set and bmu_j is the best matching unit of data item \mathbf{x}_j . Therefore, the new model vector is the weighted average of the data items, where the weight of each item \mathbf{x}_j is given by the value of the neighborhood function $h_{bmu_j,i}(t)$ at its BMU. Hence, the Voronoi sets which are spatially close to map unit *i* influence the model vector \mathbf{m}_i more than those farther away.

$$\mathbf{m}_{i}(t+1) = \frac{\sum_{j=1}^{n} h_{bmu_{j},i}(t) \cdot \mathbf{x}_{j}}{\sum_{j=1}^{n} h_{bmu_{j},i}(t)}$$
(3.8)

The batch map is highly related to k-means clustering [McQ67]. In fact, if the neighborhood kernel is defined in such a way that only the Voronoi set \mathbf{V}_i is considered when updating model vector *i*, both algorithms behave identically. In this case, the neighborhood kernel $h_{bmu_j,i}(t)$ in Expression 3.8 is formally given by Function 3.9.

$$h_{bmu_j,i}(t) = \begin{cases} 1 & bmu_j(t) = i \\ 0 & bmu_j(t) \neq i \end{cases}$$
(3.9)

Using the Batch Map for the User Interface

As already mentioned, the batch map algorithm is stable with respect to repeated calculations performed on the same data set. This is why it has been chosen for the developed user interface. Since usability was one of the most important requirements, the user should not be compelled to learn totally new positions for the same pieces of music every time when he/she adds a few songs to the repository. Moreover, it is assumed that the complete data set is available at calculation time. Due to the fact that adding new songs to the repository requires the recreation of the user interface, the sequential algorithm does not provide any advantages over the batch version.

3.3 Aligned Self-Organizing Maps

Defining similarity is often a quite difficult task, which may involve several aspects. For example, images are distinguishable according to the used colors, shapes, textures or other criteria. These aspects can be extracted from different low-level features in various ways. For example, different methods for timbre measurement as presented in Chapter 2 are available. Furthermore, they can be weighted differently and also compared on the basis of diverse metrics.

Generating one SOM for each of the different aspects raises the problem that the resulting SOMs are difficult to compare directly since the same data items are located in different regions of the map and also the cluster structure differs heavily. Addressing this issue, *Aligned SOMs* as introduced in [Pam03, PDW03a] offer the possibility of gradually shifting the focus from one aspect to another by providing a number of aligned views. More precisely, multiple SOMs are trained on the same data using slightly but gradually modified parameters. The resulting stack consists of the SOMs that represent the two extreme values of the aspects and a number of SOM layers that are inserted between them to allow smooth transitions since neighboring SOM layers project same data items to similar regions.

CHAPTER 3. ORGANIZATION AND VISUALIZATION OF HIGH-DIMENSIONAL DATA





Figure 3.2: Some results of SOM training runs using either random initialization and linear initialization based on EVD. The upper plot depicts the used data set consisting of 1000 2-dimensional samples drawn from 5 Gaussians. In the figure below, the two leftmost columns show the results of applying the sequential training method for different progress, whereas the two rightmost columns illustrate the same for the batch map algorithm. Since the sequential version processes only one data item per iteration, the appropriate progress is measured in iteration cycles. In contrast, handling the complete data set at each iteration, the progress for the batch map is measured in epochs, i.e. one iteration considering all data items. It is obvious that using random initialization increases the number of necessary iterations to produce similar results as linear initialization. Like the standard SOM, also the Aligned SOMs can be trained either sequentially or using batch training. However, to align the SOMs during training, it is necessary to define a distance between layers that determines the smoothness of the transitions between them. Given this distance, it is possible to calculate the pairwise distances between arbitrary items within the complete stack. The inter-layer distances, i.e. the distances between units of different layers, are used to align the layers in the same way the intra-layer distances between units within a map are used to preserve the topology of the data space.

The sequential training process is basically the same as that for the standard SOM. In the first step of each iteration, a data item **x** and a layer *l* are randomly selected. Hereafter, the BMU for **x** is calculated within the chosen layer. The adaptations of the model vectors within layer *l* are calculated based on the intra-layer distances exactly as shown in Expression 3.7. The update function for all other layers takes into account the inter-layer distances and adapts the model vectors according to the representation of the data item in the respective layer. As for the representation of the same data item in different layers, each data item is assigned one feature vector \mathbf{x}_l for each layer *l*, where each \mathbf{x}_l is composed of at least two feature sets (one for each aspect), which are weighted differently according to the feature balance of the layer. After having updated all model vectors in all layers, the described process is repeated iteratively until a defined convergence or some other stop criterion.

As for the batch training version of the Aligned SOMs, a very good explanation can be found in [PDW03a]. However, since the calculation of aligned maps requires considering the relations between a large number of map units and different representations of same data items, the Aligned SOMs are computationally quite complex.

A Simpler Approach of Aligned Maps for the User Interface

Using the developed *Matlab®*-program in order to create a hierarchical user interface for a given music repository involves calculating a large number of visualizations on different hierarchy levels. Therefore, a simpler and less time-consuming approach was chosen to generate multiple SOMs for differently weighted feature sets. This approach involves a new form of codebook initialization. In particular, given an already calculated SOM, its neighboring (with respect to the feature balance) SOMs are initialized by taking the model vectors of the existing one as their codebook. Although this is a very simple approach, it usually yields smooth transitions between neighboring SOMs (cf. Figure 6.6).

3.4 Smoothed Data Histogram (SDH)

Several methods for visualizing Self-Organizing Maps have been developed. An overview is given, for example, in [KNK98, Ves99, Ves00]. Some of the most popular techniques are *U-matrices, component planes* and *data histograms*. While U-matrix visualizations illustrate the distances between the model vectors of neighboring map units, component planes reveal information about the distribution of each component of the model vectors, i.e. the values assigned to a single attribute of the model vectors are visualized for all map units, which is done sequentially for all dimensions of the model vectors.

However, U-matrices as well as component planes are incapable of revealing information on how many data items are represented by a specific region on the map. To answer this question, the response of the model vectors to each data item has to be surveyed and visualized. The usual method is taking the feature vector of each data item and finding its BMU by evaluating the distances between the feature vector and the model vectors of all map units and selecting the map unit for which this distance is minimal. This leads to a distribution that exhibits for each map unit the number of data items which are best represented by it.

The problem with this approach is that it offers no information about the accuracy of the match. Usually, a given data item is represented well not only by a single map unit but by several model vectors. Addressing this issue, the *Smoothed Data Histogram (SDH)* as proposed in [PRM02b] as a cluster visualization method for Self-Organizing Maps, aims at estimating and visualizing a probability density of the high-dimensional data items on the map. This estimation is based on a voting mechanism of the underlying multivariate feature vectors. Given a spread parameter *s*, each data item votes for the *s* map units whose model vectors best resembles the feature vector of the data item. Taking into account the increasing distances to the *s* BMUs, the closest map unit is assigned a value of *s*, the second closest a value of s - 1, and so forth, until the *s*-th closest one is eventually assigned the value 1. All other map units receive 0 of this "similarity points". Moreover, the values of each rating are normalized by $\sum_{i=1}^{s} i$ in order to ensure that the sum of the votes equals 1 for each data item.

After having processed all data items, the resulting distribution of the votes exhibits high values for regions on the map where the respective model vectors are similar to a large number of feature vectors. Therefore, visualizing this distribution shows typical clusters of the SOM. Since an important property of the SDHs are their smoothness, the distribution matrix is expanded by inserting interpolates between each pair of values in order to offer a more attractive view.

As for the influence of the spread parameter s on the visualization, in the case of s = 1, the SDH equals the standard data histogram since only the BMUs are taken into account. With increasing values of s, the apparent clusters grow until they begin to merge and eventually result in only one big cluster at very high values of s (cf. Figure 3.3).



Figure 3.3: This figure depicts examples for SDH-visualizations using different values for the spread parameter *s*. The upper left subplot shows the data items consisting of a mixture of 5 Gaussian distributions with 1 000 samples each and the model vectors of the trained 10×10 -SOM. The subplot in the upper center illustrates a non-smoothed visualization of a standard data histogram which is calculated with respect to the BMU of each data item, thus *s* = 1. The successive images show SDHs for increasing values of *s*.

Chapter 4 Repository Design and Results of the Manual Classification Process

A music repository has been created in order to test and evaluate both the regarded similarity measures and the developed user interface. This repository consists of 834 MP3-files in 81 directories. The total play length is 3666 minutes, thus about 61 hours. In the following sections the process of obtaining, structuring and manually categorizing the musical data is described. Subsequently, some interesting results gained from the task of manual structuring and classification are presented.

4.1 Audio Extraction, Naming and Compression

To create the repository, the contents of various compact discs were grabbed, i.e. copied, to a harddisk using the program *AudioCatalyst 2.1*. One problem arising when doing this task is that, in general, no information about properties like artist, track titles, etc. – which may be interesting to the user and often can be easily found in the booklet of the compact disc – is stored digitally on the disc. Therefore, it would be necessary to label each song manually. Fortunately there exists a search engine, named *CDDB*¹, based on a vast database of musical information. To acquire appropriate filenames containing artist, album title, track number, and track name for the grabbed raw data, the *query-CDDB* function of *AudioCatalyst 2.1* was used. However, the *CDDB* consists of information entered by a huge number of users, resulting in individual naming conventions, which yields inconsistent results. For instance, track names are sometimes entered with capitalized first letters for each word, sometimes just the nouns are capitalized, and sometimes the whole track name consists only of lower or upper case letters. Furthermore, it is evident that typing errors cannot be avoided as long as there are many users contributing to the *CDDB* who do not check their submissions before transmitting them to the *CDDB*-server. For this reason, it is necessary to be aware of the fact that the track list of the created repository may contain inconsistent naming conventions as well as some typing errors. However, the alternative to *CDDB* would be to label the tracks manually, which would be very exhausting.

After the tracks of one compact disc had been grabbed, they were encoded to the *MPEG Audio Layer 3* format [BP00] using either a constant bitrate of 192 kbit/s for some tracks and a variable bitrate for others. This procedure reflects the usual behavior of most people who store audio files on their computers, because the constant evolution in the development of audio compression algorithms leads to various available formats and bitrates. Therefore, it is likely that a typical user uses different bitrates to archive his/her music on harddisks or other electronic media. In any case, the difference between music compressed with a constant bitrate of 192 kbit/s and that compressed with a variable bitrate is not discernable to the human ear – at least not when listening to the tracks via the usual computer speakers.

¹Abbreviation for "Compact Disc Data Base". Further information can be found at *http://www.cddb.com* (date of access: 2003-06-30).

4.2 Selection and Structuring

After the MP3-files had been created, the next task was to choose which files to add to the repository and how to structure it by means of directories and filenames. On the one hand, it is crucial to have as many different genres and styles of music as possible in the test repository in order to base further examinations on a widespread database. On the other hand, the larger the repository, the longer the calculation times for the feature extraction process and the time needed to manually classify the tracks contained therein. Eventually, a sample of five tracks per grabbed compact disc has been used to satisfy both requirements – to create an acceptable music repository containing different genres and to minimize the calculation and classification times. It is evident that this approach is not appropriate for all types of compact discs, e.g. for samplers. For this reason, the content of some grabbed discs has been added to the repository as a whole.

Also, it is necessary to note that the repository includes a few very similar songs:

- There are two versions of "*Punk Rock Song*" by "*Bad Religion*" which differ only in the language of the lyrics (English vs. German). This is also true for "*Blu*" by "*Zucchero*" (Italian version) and "*Blue*" (English version).
- There are some tracks presented in different mixes, e.g. "Got To Get It" by "Culture Beat".
- Finally, two pairs of songs differ only in their filenames and recording dates, especially "*Il Volo*" and "*Sonio*" by "*Zucchero*" and "*Baila* (*Sexy Thing*)" and "*Baila Morena*" by "*Zucchero*".

The reason why these songs have been added to the repository is to analyze the behavior of the used similarity measures when confronted with very similar tracks.

As for the structuring process, a number of considerations were made regarding the different kinds of structuring methods that users normally apply to their music repositories. One of these methods is to use an individual directory structure. Users often create root directories referring to general genre names like "rock" or "classical". However, this was not done for the test repository mainly for two reasons. The first is that some artists create music of different genres. Therefore, to strictly comply with this structuring method, it would be necessary to split the tracks of one artist or sometimes even those found on the same album. The second reason is that the database used for manual classification was designed to offer the possibility of structuring the tracks by three genre-attributes – namely genre, subgenre and subsubgenre – with increasing accuracy. This fact makes a subtle directory structure for arranging the tracks by their genre obsolete. Therefore, the lowest level of the directory structure for the test repository consists of directories named after the artists, whereas one directory labeled "Various Artists" has been created for samplers. In this special directory, the next hierarchical subdivision has been made by creating a new subdirectory for each album. Those directories named after genuine artist names are generally not refined any further by introducing subdirectories. However, there are a few exceptions in which subdirectories, named after the album titles, have been created to reflect the inconsistent way in which users sometimes organize their music collections. A complete list of the created directories can be found in Table 4.1.

As for file naming, the majority of the files contained in the artist-directories are labeled using the pattern *artist name - album name - track number - track name*. Those files located in the subdirectories of the *"Various Artists"*-directory mostly fit into the pattern *track number - artist name - track name*. The reason for this difference in naming is that names of albums containing only music by one artist or group of artists usually can easily be assigned to that artist, whereas album names of samplers normally cannot. Thus, the latter do not play an important role in identifying a certain artist. Generally, album names are becoming less and less important, especially in electronic music distribution [Pac03].

CHAPTER 4. REPOSITORY DESIGN AND RESULTS OF THE MANUAL CLASSIFICATION PROCESS

/Angelo Branduardi	/Mike Oldfield
/Angra	/Nickelback
/Axel Rudi Pell	/Nightwish
/Ayreon	/Paradise Lost
/Bad Religion	/Patti Smith
/Blue Öyster Cult	/Queen
/Bryan Adams	/Rammstein
/Century	/Schandmaul
/Clawfinger	/Scooter
/Crematory	/Scorpions
/Culture Beat	/Soulfly
/Cyndi Lauper	/Stratovarius
/Deep Purple	/Subway To Sally
/Denis Azabagic	/t.A.T.u
/Denis Azabagic/Printemps de la Guitare 1996	/Therapy
/Die Toten Hosen	/To-Die-For
/Dimmu Borgir	/Type O Negative
/Dire Straits	/Van Halen
/Dunjingarav	/Vanessa Mae
/EAV	/Various Artists
/Eiffel 65	/Various Artists/A Treasury Of Gregorian Chants - Volume I
/Enya	/Various Artists/Celtic Myths (Disc 1)
/Floorfilla	/Various Artists/Frankfurt Beat Productions (Disc 1)
/France Gall	/Various Artists/Future Trance Vol. 12 (Disc 1)
/Frank Zappa	/Various Artists/Hartlauer - Golden Christmas Hits
/Frijid Pink	/Various Artists/History Of Punk Rock (Disc 1)
/Gary Moore	/Various Artists/Jazz Masters - Volume 1 (Disc 1)
/Gigi d'Agostino	/Various Artists/Kuschelrock Vol. 11 (Disc 1)
/Goldfrapp	/Various Artists/Kuschelrock Vol. 11 (Disc 2)
/Grupo Comarca Bia	/Various Artists/Mystera IX
/Hammerfall	/Various Artists/Mystery Trance Vol. 4 (Disc 1)
/Hubert von Goisern	/Various Artists/Reggae Fever - Reggae Hits zum Abtanzen (Disc 1)
/In Extremo	/Various Artists/Thunderdome IV - The Devil's Last Wish (Disc 1)
/JBO	/Various Artists/When Irish Eyes Are Smiling (Disc 1)
/Jean Michel Jarre	/Vladimir Horowitz
/Kansas	/Vladimir Horowitz/Mozart
/Led Zeppelin	/Westernhagen
/Lordi	/Wolfgang Ambros
/Lunasa	/Zucchero
/Manowar	/ZZ Top
/Marillion	

Table 4.1: This table shows the directory structure of the repository.

4.3 Setup of the Manual Classification Process

In order to perform a manual classification of the tracks contained in the repository, a database providing some important musical attributes has been created. Each piece of the collection is assigned values to the following musical attributes and genre descriptors. In addition, since the classification of pieces of music is a quite subjective issue – especially for the attributes *mood*, *complexity* and *emotion* – a typical example representing each value of these attributes is given.

Mood

The attribute *mood* describes the overall mood and temperament of the track. It can take the values *"sad"*, *"neutral"* and *"happy"*. While the values *"sad"* and *"happy"* need no further explanation, it is necessary to note that the value *"neutral"* was not only assigned to pieces of music with a neutral mood, but also to those for which the mood was undefinable.

According to the author, a typical sad track is "*Rest In Peace*" by "*Gary Moore*", a typical happy song is "*Girls Just Want To Have Fun*" by "*Cyndi Lauper*" and a song for which the mood is not definable – and therefore classified as "*neutral*" – is "*The Hypno*" by "*Floorfilla*".

Tempo

The attribute *tempo* refers to the average speed of a piece of music. It can take the values "*very slow*", "*slow*", "*medium*", "*fast*", "*very fast*" and "*varying*", where the value "*varying*" is assigned only to tracks exhibiting remarkable changes in their temporal structure.

Complexity

This attribute can take the values "*low*", "*medium*" and "*high*". It describes the musical complexity of the track. For instance, a song with many changes in melody or rhythm or a large number of instruments with different timbres is classified as having a high complexity, whereas a track containing few variations is rather classified as having a low one.

A typical song with a quite low complexity is "*Eisgekühlter Bommerlunder*" by "*Die Toten Hosen*", whereas nearly all songs by "*Frank Zappa*" – at least those contained in the test repository – seem to be rather complex according to the perception of the author (for instance "*The Purple Lagoon*"). The majority of the tracks (about 75 percent) have been classified as having a medium complexity. For some genres, the percentage is even higher – e.g. nearly 90 percent for songs belonging to the subgenre "*hard rock*". Thus, there exist many examples representing tracks with medium complexity, e.g. "*Run To You*" by "*Bryan Adams*".

Emotion

The attribute *emotion* refers to the softness or aggressiveness of the music. Consequently, it can take the values *"soft"*, *"neutral"* and *"aggressive"*. Tracks for which the aggressiveness is indeterminable and those possessing both soft and aggressive sequences are assigned the attribute *"neutral"*.

A typical soft track is "Journey To Schambala" by "Oliver Shanti", a typical aggressive one is "Fire" by "Scooter". The song "Fly" by "Crematory" is a good example of assigning the value "neutral" to this attribute because it combines a soft female voice with an aggressive male one. Moreover, this song includes both soft melodies and aggressive drum play.

Focus

This attribute describes the balance between the instrumental power and the strength of the voice or voices contained in a piece of music. For this purpose, it can take the values *"instruments"*, *"vocals"* and *"both"*, referring to either a remarkable dominance of instruments or to a strong vocal appearance or to equally distributed intensities of instruments and vocals.

Genre, Subgenre, Subsubgenre

To structure the repository according to the genres of the tracks, three attributes – namely *genre, subgenre* and *subsubgenre* – were introduced. While the attribute *genre* describes the main genre of the track, the other attributes provide a possibility to refine the style within the chosen main genre. The values for the three genre attributes were taken mainly from the genre and style descriptors of the *All Music Guide*², an Internet music database and store, and from the genre descriptors of the *ID3 tagging system*³ [Nil99]. The used attribute values can be found in Tables 4.2 and 4.3. A more detailed analysis of musical genre classifications is presented, for

²http://www.allmusic.com (date of access: 2003-10-17)

³*http://www.id3.org* (date of access: 2003-10-17)

example, in [PC00, AP03].

Certainly, a more detailed classification could include many other attributes, for example instrumentation, gender of the vocalist or vocalists, content of the lyrics, recording type, memorability of the melody, overall pitch level or "dancability". However, some of those attributes are quite difficult to evaluate – e.g. to analyze the lyrics, one has to listen very intently and to understand the vocal parts, which is not always a trivial matter. Therefore, including attributes referring to instrumentation or lyrics would go beyond the scope of this thesis.

genre	number of tracks
blues	11
classical	48
electronica	109
folk	19
jazz	12
new age	45
noise	1
rock	502
world	87

Table 4.2: This table shows the number of tracks assigned to main genre descriptors.

4.4 Results

In this section, the results of the classification process are presented. The classification and categorization of the tracks contained in the repository was done by the author.

Some artists produce music that incorporates only one style or genre, whereas others create very complex and dissimilar pieces. Furthermore, many artists change their style over time. As a consequence, the attributes referring to the genre were assigned to each track and not just to each album as done, for instance, in the database of the *All Music Guide*. The task of assigning a specific combination of values to the attributes *genre*, *subgenre* and *subsubgenre* for a track is sometimes quite complicated because of the ambiguity of the genre of some tracks. While the main genre of a track is usually unequivocal, the subgenre and especially the subsubgenre sometimes are not. In such cases, the genre with the most dominant influence on the track was chosen to describe it, if such a dominance was detectable. Otherwise, there was no further refinement of the genre with sub-attributes.

Another issue concerns the attribute *tempo*. More precisely, it is often unclear which features to choose when classifying the speed of a piece of music. For example, imagine a song with very fast instrumental play or a fast bass beat in the background, while lyrics are slowly sung simultaneously. In such a case, it has been tried to assign a value to the attribute *tempo* that describes the dominant speed of the track. If such an overall tempo descriptor was not detectable, the value "*varying*" was chosen. Certainly, this value was also assigned if a track contained segments of different speeds. Furthermore, it is obvious that the tempo is often predefined by the genre. For instance, a Speed Metal-track is by definition of its genre fast or very fast. This fact raises the question whether the value for the attribute *tempo* should be assigned according to the genre of the observed track or to represent a classification which is as universal as possible. The latter method was chosen in order to obtain results that are comparable, hence, to offer a possibility of comparing tracks belonging to different genres.

genre	subgenre	subsubgenre	number of tracks
blues	modern electric blues		11
classical	bells		4
classical	classical crossover		6
classical	gregorian chant		14
classical	guitar		8
classical	modern		2
classical	musical		1
classical	organ		1
classical	piano		12
electronica	euro-dance		13
electronica	hardcore techno		19
electronica	techno		19
electronica	trance		58
folk	christmas		19
jazz	bop		3
jazz	hard bop		1
jazz	jazz pop		1
jazz	souljazz		1
jazz	swing		6
new age			3
new age	celtic new age		7
new age	meditation		1
new age	progressive electronic		33
new age	techno-tribal		1
noise			1
rock	alternative rock		14
rock	arena rock		88
rock	blues rock		5
rock	experimental rock		12
rock	folk rock		25
rock	hard rock	alternative metal	15
rock	hard rock	death metal	5
rock	hard rock	gothic metal	30
rock	hard rock	heavy metal	58
rock	hard rock	melodic metal	27
rock	hard rock	pop metal	9
rock	hard rock	power metal	7
rock	hard rock	progressive metal	27
rock	hard rock	speed metal	2
rock	hard rock	true metal	15
rock	рор		34
rock	рор	adult contemporary	9
rock	рор	alternative pop	4
rock	рор	austro-pop	19
rock	рор	brit-pop	1
rock	pop	teen pop	3
rock	рор	urban	6
rock	progressive rock		5
rock	proto-punk		10
rock	psychedelic rock		5
rock	punk rock		57
rock	soft rock		10
world	africa		1
world	asia		10
world	celtic		1
world	celtic	celtic folk	18
world	celtic	celtic new age	2
world	celtic	celtic pop	2
world	chanson		4
world	irish folk		18
world	italy		6
world	latin		10
world	reggae		15

Table 4.3: This table shows a complete list of the genres, subgenres and subsubgenres to which at least one track was assigned. Furthermore, it depicts the number of tracks assigned to each combination of the formerly mentioned attributes.

Although it was tried to be as objective as possible during the classification, it is evident that no manual classification process can produce entirely objective results. Indeed, one and the same piece of music can affect the listener in different ways, depending on his/her current mood, thus leading to varying classifications. Moreover, it was observed that different listeners would assign different attributes to the same track. Especially, the attribute *mood* is strongly influenced by the temper and sentiment of the listener. For this reason, it is necessary to note that the classification of the same repository done by another person would probably yield slightly different results.

A complete list containing all filenames and assigned attributes can be found in Table A.1. Some statistical results referring to the number of tracks that were assigned to each value of the analyzed attributes are given in Table 4.4. The total time needed to perform the classification was about 50 hours. One reason for this quite large amount of time is that it was often necessary to listen to one and the same track more than once in order to compare it with other pieces. Furthermore, the repository contains a large number of tracks that had been unknown to the author before the classification was performed. Nevertheless, it was not always necessary to listen to the complete track because some of the songs turned out to be quite monotonous, e.g. several songs categorized as *"techno"* or *"trance"*. When analyzing those songs, the author sometimes skipped some segments of the track.

mood	number of tracks	complexity	number of tracks
happy	238	low	150
neutral	419	medium	629
sad	177	high	55

emotion	number of tracks	focus	number of tracks
soft	218	instruments	216
neutral	372	vocals	46
aggressive	244	both	572

tempo	number of tracks
very slow	33
slow	167
medium	357
fast	198
very fast	44
varying	35

Table 4.4: Some statistical results concerning the evaluated attributes mood, complexity, emotion, focus and tempo.

Chapter 5 Calculation of the Features and Evaluation of the Similarity Measures

This chapter discusses the calculation of the musical features. First, the setup of the calculation process is presented. Furthermore, the similarity measures have been evaluated using the results of the manual classification described in Chapter 4. The outcomes of this evaluation are presented in the second part of this chapter.

5.1 Calculation of the Features

To obtain descriptive data for the visualizations needed to create the user interface, the algorithms presented in Chapter 2 were used to extract features from the music files of the test repository and quantify their similarities. For the measures RP/MFS, PH and SH [Frü01, Pam01, PDW03a] just the feature extraction process has to be performed to obtain the required data vectors. Comparing two songs using one of these measures is simply done by calculating the distance of their feature vectors in Euclidean space. Whereas, for the measures LS [LS01] and AP [AP02a, AP02b] more advanced techniques are used.

Obtaining the features for a given MP3-repository consists of three steps, which are described in the following subsections. Some calculation times for the processing of the test repository can be found in Table 5.1.

5.1.1 Preprocessing

MPEG-Layer 3 [BP00, Bra99], also known as MP3, has become the most popular format for music exchange since its introduction in 1991. Especially in private repositories it is also commonly used for archiving music files because of its good sound quality despite its high compression rates. For this reason, the MPEG-Layer 3 format was chosen for the music files in the test repository. Unfortunately, it was not possible to find a method for reading MPEG-Layer 3 data directly from an MP3-file into the *Matlab*[®]-environment. Therefore, converting the given MP3-files to their *Pulse Code Modulation (PCM)* representation was necessary. This can be done using one of the various currently available MP3-decoders. For this thesis *Lame Ain't an MP3 Encoder (LAME)*¹, *release* 3.93.1 was chosen because of its free availability due to its open source license.

As for the PCM data, also known as WAV in $Microsoft^{(B)}$ operating systems and as AU in Unix systems, it is the discrete, i.e. sampled, representation of a continuous audio wave. A very common choice for the sampling frequency is 44 100 *Hertz* (*Hz*), which means that the amplitude value of the audio signal is scanned and stored 44 100 times per second – thus, about every 23 microseconds. *LAME* also uses a sampling frequency of 44 100 Hz for transforming the MP3-files to their PCM representation. For lower quality demands a sampling frequency of 11 025 Hz is often chosen. The sampled amplitude values are usually coded with 16 bits per sample, leading to 65 536 possible values to describe the amplitude. Taking into account the duplication of the data when using stereo sound, it is obvious that storing high quality music data in PCM format is very

¹http://lame.sourceforge.net (date of access: 2003-07-23)
space-consuming. Equation 5.1 shows that a high quality PCM audio stream has a data throughput of 176400 bytes per second, which is approximately 172 kilobytes per second.

$$\frac{44\,100\,Hz\,\cdot\,16\,bits\,\cdot\,2\,channels}{8\,bits\,per\,byte} = 176\,400\,bytes\,per\,second \tag{5.1}$$

To avoid a huge consumption of harddisk space and an extremely long duration for importing the PCM data into *Matlab*[®], it was decided to resample the data with a sampling frequency of 11 025 Hz and to use only one sound channel instead of two, i.e. to mix the two channels of the stereo sound to obtain a mono signal. For this purpose, the program *SoX - Sound eXchange*², *release 12.17.3* was used – also because it is an open source tool. Alternatively, it would be possible to use the *Matlab*[®]-functions *resample* or *downsample*. Using these internal *Matlab*[®]-functions to downsample a test repository consisting of 96 files (mainly classified as "*rock*" and "*electronica*") required nearly half an hour, whereas downsampling the same repository with *SoX* finished in less than 10 minutes. ³ Moreover, *Matlab*[®] refused importing WAV-files with a size greater than 80 MB by displaying an "*out of memory*" error message.

5.1.2 Feature Extraction

After having converted the 834 MP3-files of the test repository to mono WAV-files with a sampling frequency of 11 025 Hz, the feature extraction process was performed by using the same $Matlab^{\textcircled{B}}$ -implementations as in [PDW03b]⁴. For this reason, each of the directories in the structure of the test repository was accessed to calculate the features for all the files contained therein. Subsequently, the features have been stored in $Matlab^{\textcircled{B}}$ MAT-files.

Unfortunately, none of the available *Matlab*[®]-implementations of the feature extractors is stable enough to calculate the features for arbitrary WAV-files in a given folder without having troubles – at least from time to time. Especially, the AP-measure – more precisely, the calculation of the Gaussian Mixture Model – seems to be very sensitive. Some of the problems encountered when extracting the features as well as some interesting aspects of the feature extraction process itself are presented below.

Creating the Gaussian Mixture Model for the AP-features for the song "9 11 01" by "Soulfly" led to a "division by zero" error message. It is most likely that this happened due to the fact that this song consists only of silence – for a duration of one minute. Therefore, the song was removed from the repository. The same behavior occurred for the track "Anthem of the World" by "Stratovarius", although this song is very melodious. Here, no explanation for the "division by zero" message could be found. In any case, the song was replaced by "4000 Rainy Nights" by the same artist.

Other problems were encountered when processing the files of the compact disc "*Hartlauer - Golden Christmas Hits*", which includes some quite short tracks. As a result of the removal of the first and last few seconds of each track to eliminate lead-in and fade-out effects from the audio signal, these short tracks also needed to be removed from the repository. Indeed, it does not make sense to calculate features for an half-minute-song if its first and its last 12 seconds are discarded.

5.1.3 Postprocessing

After the feature extraction process had been finished, the next and final step consisted of applying the distance measures to the LS- and AP-features as well as calculating the principal components for the RP/MFS-, PH- and

²http://sox.sourceforge.net (date of access: 2003-07-23)

³This performance test was conducted on a notebook containing an Intel-PentiumTM 4 mobile processor and 512 MB of main memory. ⁴Unfortunately, the implementation of the measure by Logan and Salomon is erroneous since the Kullback Leibler distance should be

used to calculate the distances between pairs of clusters. Whereas, in the used implementation the Euclidean distance was taken.

SH-features in order to compress the data, i.e. to reduce its dimensionality. For the test repository the first 80 principal components were taken, leading to 80-dimensional data vectors. This choice yielded adequate results since it was not possible to discern between the visualizations of a SOM generated by the original data vectors and one having as input the compressed data.

Regarding the calculation times for the Principal Component Analysis, Table 5.1 reveals an interesting fact. Although the feature vectors of the periodicity histograms have much more dimensions than those of the RP/MFS-measure (2000 vs. 1200), the calculation of the principal components performed more quickly for the former. This observation can be explained by looking at the zero values in the respective feature matrices. While the data matrix of the RP-features shows only 180 zero values, that of the PH-features includes nearly 1500 000 zero-value-entries.

Moreover, the computational requirements for the postprocessing of the AP-features are extremely high compared to those of its competitors. In general, the calculation of the AP-features and distances is a very time-consuming process.

task	time	throughput
preprocessing		
conversion of MP3-files to PCM/WAV (44100 Hz, stereo) using LAME	2 hours	418 files/hour
conversion of MP3-files to PCM/WAV (11025 Hz, mono) using LAME and	10.5 hours	80 files/hour
SoX		
feature extraction		
calculation of features_rp on 11025 Hz, mono data	5 hours	167 files/hour
calculation of features_ls on 11025 Hz, mono data	11.5 hours	73 files/hour
calculation of features_ap on 11 025 Hz, mono data	17 hours	49 files/hour
calculation of features_ph on 11 025 Hz, mono data	5 hours	167 files/hour
calculation of features_sh on 11025 Hz, mono data	2.5 hours	334 files/hour
postprocessing		
combination and PCA of features_rp (recursively done for all subdirectories)	35 minutes	
combination and calculation of distances_ls (recursively done for all subdi-	33 minutes	
rectories)		
combination and calculation of distances_ap (recursively done for all subdi-	17 hours	
rectories)		
combination and PCA of features_ph (recursively done for all subdirectories)	28 minutes	
combination and PCA of features_sh (recursively done for all subdirectories)	12 minutes	

Table 5.1: A list of calculation times and performance values for some executed tasks on a repository of 834 MP3-files. The calculations have been done on a personal computer containing a 1.2 GHz AMD-AthlonTM CPU and 768 MB of main memory.

5.2 Evaluation of the Similarity Measures

Although there exist quite a few approaches and measurements for perceptual music similarity, for example [Foo97, Frü01, TEC01, Pam01, LS01, AP02b, AP02a, PRM02a, BEL03, PDW03a], little effort has been made to compare their performance. Indeed, even though most of the publications on this topic include some sort of evaluation, the authors usually consider only their own measures. Moreover, due to the fact that there exists no common test repository, it is very difficult to compare the results of these evaluations. Unfortunately, most digital music is protected by copyright law, making it very difficult to build up a common data collection for scientific use. One attempt was presented in [GHNO02]. However, the complete database of this collection – consisting of a "*Popular Music Database*", the "*Royalty-Free Music Database*", a "*Classical Music Database*" and a

"Jazz Music Database"– includes only 215 pieces of music. Thus, it is not clear if this database will be able to become a worldwide standard music collection for research purposes – also because the copyright owner, the Japan's National Institute of Advanced Industrial Science and Technology, imposes several severe restrictions on the users of the so-called *"RWC Music Database"*.

The few available publications on the evaluation of music similarity measures - e.g. [PDW03b, BLEW03, LEB03, EWBL02] - mostly present quite simple approaches to gather subjective information. For example, the large-scale evaluation presented in [BLEW03, LEB03] incorporated a survey for which human informants were asked to find the most similar artist out of ten for a given one. Thus, this evaluation mainly focused on artist similarity, whereas the one performed for this thesis has its focus on similarities between individual songs. Unlike those evaluations presented in the mentioned publications, the one conducted for this thesis compares all the measures explained in Chapter 2 and uses a widespread set of attributes for the manual assessment of the repository (cf. Section 4.3). In [PDW03b] the same measures were analyzed, but on a larger test repository. However, the musical meta-data for the large-scale evaluation presented in [PDW03b] were gained solely from the All Music Guide. The attributes artist, album, genre, style and tones were used. Unfortunately, the All Music *Guide* does not provide information about each individual song, but about each artist. Since songs by the same artist and even on the same album are often very different, the categorization made for this thesis is probably more accurate. Indeed, the overall results for the attribute genre are slightly better than those of [PDW03b]. The tones from the All Music Guide roughly describe similar properties like the attributes mood, tempo, complexity, emotion and focus of the evaluation conducted for this thesis. Also, the performance of the measures was relatively bad for tones as well as for the other mentioned attributes. However, using five attributes to describe general musical properties allows for a more detailed investigation.

5.2.1 Methodology

The evaluation was conducted as follows. First, for those measures for which a distance matrix indicating the similarity of two arbitrary pieces did not exist – RP/MFS, PH, SH – such a matrix \mathbf{D}_{dist} was created by calculating the Euclidean distance between the original feature vectors of all pairs of tracks. Hence, \mathbf{D}_{dist}^{SH} for example, is an $m \times m$ -matrix formed by the feature vectors of the SH-measure where each column (and row) *i* represents a vector indicating the distances between the *i*-th piece of the repository and all other pieces.

Hereafter, for each measure, the mean of all distance vectors belonging to songs assigned a specific value to one attribute is calculated. For example, the distance vectors of all songs categorized as belonging to the genre "rock" are taken from \mathbf{D}_{dist} , which leads to a new $n \times n$ -matrix $\mathbf{D}_{dist}^{genre:rock}$ containing the intra-group distances of the *n* songs classified as "rock". Then, the average distance between two songs of the group is calculated, e.g. $d_{avg}^{genre:rock}$. Furthermore, the average of the data vectors of all pieces of the repository d_{avg} is computed. Finally, the ratio between the mean of the data within the groups formed by (attribute, value)-pairs and the average of all data vectors is calculated.

A ratio of one or less for a specific attribute value and similarity measure means that this measure is able to distinguish songs according to the chosen attribute value. The higher the ratio, the worse the respective measure performs. Subtracting one from the ratio and subsequently multiplying with -100 finally lead to a value representing the percentual deviation $p^{attribute:value}$ of d_{avg} and $d^{attribute:value}_{avg}$. The complete calculation performed for each value of each attribute is shown in Equation 5.2.

$$p^{attribute:value} = \left(\frac{d_{avg}^{attribute:value}}{d_{avg}} - 1\right) \cdot -100$$
(5.2)

5.2.2 Results

Table 5.2 lists the ratios described above for all similarity measures and all attribute values. The deviations are given in percent. In Figures 5.1, 5.2 and 5.3 a summary of the results is depicted as bar graph. Here, only the weighted means of the deviations of all attribute values are drawn for each measure. The results for each attribute are discussed below.

Mood

Compared to the ratios of the other attributes, those gained for the attribute *mood* seem to be quite bad. However, this fact is not very astonishing since this attribute reflects rather subjective feelings of music. A remarkable point is that the performance of the rhythm-based measures, namely RP/MFS and PH, is slightly better than that of the timbre-based ones.

Tempo

The results for the attribute *tempo* are much better than those for the previous attribute because the tempo of a certain piece of music is not as subjective as, for example, moods or emotions evoked by it. The AP-, PH- and SH-measures perform quite well here – AP especially for the attribute values *"medium"*, *"fast"* and *"varying"*, PH for slow pieces and SH for mid-tempo and up-tempo ones. Furthermore, like for nearly all attributes, the performance of the LS-measure is quite bad.

Complexity

The most remarkable observation concerning the attribute *complexity* is the bad performance of all measures. In particular, the ratio for low complexity is negative for each measure, which means that the average distance between the pieces classified as having a low complexity is larger than that between all pieces of the repository. AP performs slightly better than the other measures, but nevertheless its achieved deviation remains under 4 percent.

Emotion

The evaluation for the attribute *emotion* yields quite good results – especially for the timbral measures. Since emotions are a very subjective basis for classification, this is an interesting outcome. In particular, the LS-, AP- and SH-measures perform very well when it comes to detecting aggressive pieces of music (deviations of more than 20 percent for LS and AP and nearly 40 percent for SH). Pieces categorized as *"soft"* are distinguishable also by the RP-measure. However, the overall performance of RP and PH for this attribute is about the same as for the attribute *complexity*.

Focus

When it comes to distinguishing music according to the presence of instruments and strength of voices, the APmeasure performs best. Nevertheless, the resulting deviations for detecting pieces with strong instrumental influence are negative for all measures. This high intra-group dissimilarity could be explained by the variety of purely or predominantly instrumental music – e.g. orchestral music, electronic music, solo pieces. In terms of aggregated performance, also the SH-measure performs quite well.

Genre, Subgenre, Subsubgenre

As for the evaluation results for the attributes *genre*, *subgenre* and *subsubgenre*, in general, they are better than those of the previously discussed attributes. Again, the measure by Aucouturier and Pachet, together with the spectrum histograms, perform best. The rhythm-based measures – namely RP and PH – perform a bit worse, the ratios of PH always being below those of RP. LS performs worst.

Some more precise observations are summarized below. However, only groups containing at least 20 pieces of music are analyzed because the results for smaller groups could be distorted, e.g. when a certain group is formed by very few pieces of the same artist, it is more probable that its intra-group similarity is higher than that of a group containing hundreds of pieces by various artists.

- For the genre *"world"* AP and SH perform much better than the other measures. A reason could be that the instrumentation of world music often differs strongly from other genres, which favors timbre-based measures.
- The ratio for the distinction of the genre "*classical*" is quite good for the RP-, but disastrous for the SHmeasure. A possible explanation could be that the RP- and PH-measures strongly focus on periodicity, whereas the SH-measure does not take it into account. Since classical music usually possesses no distinctive beats, periodicity-based measures have an advantage.
- Rock songs are best detected by AP, RP and SH. It is also noticeable that the deviation is greater than 15 percent for all measures. Hence, none of them perform really badly when it comes to detecting this genre. The very similar deviations of the AP-, RP- and SH-measures show that Rock songs differ in both the rhythmical and timbral properties from the other genres.
- For the genre *"electronica"* it is remarkable that the RP-measure performs very badly, whereas the results of AP and SH are good. This is curious as the RP-measure should perform well in detecting music with distinctive beats in certain frequency bands. Maybe different positions of the periodicity peaks, which are a result of varying beats per minute within different styles in this genre, are responsible for the bad results.
- Music belonging to the genre "*new age*" can be identified best by the AP- and RP-measures while PH and SH perform very badly on this task.
- AP and SH perform very well on the subgenres "hard rock", "punk rock", "arena rock" and "pop". However, "punk rock" is best detected by the LS-measure, which performs rather badly for most other attribute values.
- When it comes to discovering Trance songs, AP and SH also perform best. Interestingly, the RP-measure, although it is rhythm-based, yields very bad results for *"trance"* and *"techno"*. A possible explanation for this was already given above in the discussion of the genre *"electronica"*.
- Celtic songs are detected best by the AP-, RP- and PH-measures.
- The SH-measure reaches a deviation of nearly 60 percent for songs classified as "folk rock". It seems that
 the preferred instruments in neo-medieval music that belongs to this genre for instance, bagpipes and
 hurdy-gurdies used by the artists "In Extremo", "Schandmaul" or "Subway To Sally" can be detected well
 by the timbre-based SH-measure.
- The performance of the AP- and RP-measures is much better than that of the other ones for the subgenre *"progressive electronic"*.

• Some subsubgenres of the subgenre "hard rock" – namely "heavy metal" and "melodic metal" – can be identified very well by the AP- and SH-measures; "gothic metal" is best detected by the RP-measure, which also performs well for "progressive metal" and "melodic metal". When it comes to distinguishing "progressive metal", the measure by Aucouturier and Pachet also works fine. All other subsubgenres do not provide enough pieces of music assigned to them to reveal statistically significant information.

property	value	number of tracks	LS	AP	RP	PH	SH
mood	sad	177	0.24	6.33	30.83	18.73	-1.31
	neutral	418	-2.39	-11.42	-3.87	-1.78	-3.53
	happy	239	5.88	16.07	-9.42	-3.85	9.84
	weighted mean	834	0.54	0.22	1.90	1.98	0.77
tempo	very slow	33	-11.90	-8.76	42.97	40.79	-41.96
	slow	167	-2.50	7.97	23.81	22.09	-0.91
	medium	358	6.87	14.90	7.50	7.37	17.71
	fast	198	11.11	13.18	-8.93	-0.70	9.76
	very fast	43	18.58	0.16	-21.14	0.26	41.58
	varying	35	-8.34	20.41	37.79	32.45	-0.37
	weighted mean	834	5.23	11.64	8.06	10.41	10.20
complexity	low	149	-13.76	-46.62	-47.50	-23.83	-5.76
	medium	630	7.23	16.96	13.21	8.48	11.22
	high	55	-26.24	-8.39	24.78	15.32	-66.02
	weighted mean	834	1.28	3.93	3.13	3.16	3.09
emotion	soft	244	2.40	18.04	13.50	6.42	2.58
	neutral	373	-1.55	-0.11	-2.67	-1.79	-1.46
	aggressive	217	23.30	28.46	0.39	8.49	37.18
	weighted mean	834	6.07	12.63	2.86	3.29	9.78
focus	instruments	216	-23.02	-32.22	-30.71	-17.69	-26.74
	vocals	46	-16.37	-15.39	5.21	26.27	-14.58
	both	572	14.51	25.04	16.59	10.17	19.83
	weighted mean	834	3.09	7.98	3.71	3.84	5.87
genre	world	87	5.27	19.39	3.59	7.70	15.95
	classical	48	-42.14	-31.14	39.59	25.34	-72.76
	rock	503	15.91	24.36	25.75	16.09	23.15
	electronica	108	2.22	37.35	-41.41	4.65	34.44
	new age	45	5.54	24.73	29.12	-1.53	-7.65
	folk	19	12.35	16.76	31.75	58.49	26.60
	jazz	12	-31.85	22.35	22.38	34.99	6.68
	blues	11	39.16	52.08	19.50	16.70	48.59
	weighted mean	833	8.66	22.51	15.71	14.56	16.85

property	value	number of tracks	LS	AP	RP	PH	SH
subgenre	italy	6	14.40	41.09	52.22	21.01	16.06
	modern	2	43.06	57.36	81.46	63.98	62.80
	hard rock	195	16.77	28.50	32.77	19.19	34.72
	punk rock	57	41.13	38.02	25.16	21.60	40.54
	arena rock	89	25.03	41.34	35.17	13.26	41.41
	euro-dance	13	4.42	46.80	2.48	11.51	40.30
	рор	76	21.29	37.29	13.63	12.78	28.89
	guitar	8	6.97	37.53	63.95	43.58	7.39
	asia	10	-34.97	2.84	25.33	16.27	16.62
	celtic new age	7	-1.33	28.77	44.44	13.59	-23.86
	trance	58	11.34	39.87	-26.52	12.97	45.96
	chanson	4	42.73	51.87	55.48	35.36	68.44
	celtic	23	-2.22	22.45	23.19	20.37	9.85
	experimental rock	12	13.91	39.98	47.88	37.09	18.82
	piano	12	3.91	39.29	68.59	51.53	21.10
	psychedelic rock	5	41.53	40.00	47.96	49.10	61.38
	blues rock	5	-12.76	38.10	-4.59	25.36	10.95
	alternative rock	14	-26.00	23.08	44.91	20.33	-7.78
	latin	10	26.98	49.79	16.49	24.80	9.64
	folk rock	25	26.24	24.48	29.26	31.51	56.59
	progressive electronic	33	13.74	29.03	28.44	-0.63	5.73
	progressive rock	5	11.19	43.11	76.65	45.50	28.84
	proto-punk	10	20.47	39.40	32.00	23.63	17.58
	techno	19	16.23	40.47	-24.64	18.90	33.42
	classical crossover	6	18.14	57.90	46.60	19.51	59.23
	gregorian chant	14	-11.34	15.46	80.66	58.30	-37.45
	bells	4	3.07	9.84	64.87	50.60	47.52
	irish folk	18	32.91	19.63	48.40	23.15	32.10
	christmas	19	12.35	16.76	31.75	58.49	26.60
	swing	6	-43.33	12.60	19.99	34.56	-16.43
	bop	3	20.08	44.49	52.25	75.26	79.30
	SOFT FOCK	10	25.73	45.45	33.67	7.41	34.73
	reggae	15	38.70	45.17	11.05	7.61	28.27
	madam alastria bluas	10	-7.10	40.97 E2.09	-41.24	4.30	30.37 48 E0
	modern electric blues	822	39.10	32.00	19.30	10.70	40.39
	weighten mean	022	10.05	34.01	24.94	20.32	31.39
subsubgenre	progressive metal	27	17.31	34.36	38.69	27.74	26.59
	speed metal	2	72.06	79.44	80.55	67.98	70.62
	neavy metal	58	23.03	35.76	28.13	15.32	36.51
	melodic metal	2/	24.11	46.55	48.60	25.46	25.20
	alternative metal	15	16.18	32.93 24 EE	19.41	24.06	35.39
	gounic metal	50	14.91 62.9E	54.55 70.21	79.47	24.03 62.E6	59.75
		3	02.00	79.51	12.00	10.22	25.09
	true motel	19	27.30	40.17	13.90	25.25	62 70
	coltic folk	15	_1 26	03.07	44.01 23.42	25.55	7.01
	non metal	18	-4.20 13.25	3/ 20	23.43	20.30	7.01
	pop metal		63.45	72.04	43.00	42.34	73.90
	colfic new ago	2	48.00	72.04 56.80	79.69	+2.00 81.48	79.30
	celtic non	2	65.61	62 30	64.47	59.58	67.51
	alternative pop		52.43	59.52	67.99	47 74	53.66
	urban	4	30.27	54.94	42 50	39.42	68.78
	teen pop	3	63.67	57.03	16.48	18.18	71 42
	adult contemporary	9	37.82	49.31	40.77	9.89	36.88
	weighted mean	258	24.60	41.06	36.67	24.89	40.76

Table 5.2: This table shows the results of the evaluation for each of the regarded similarity measures. It depicts the percentage of the difference between the mean of the distances of tracks assigned a specific attribute value and the mean of the distances between all tracks. For instance, a value of 10 (-10) for a fixed property value means that the average distance within the group of songs formed by this property value is 10 percent lower (higher) than the average distance between all songs of the repository.

CHAPTER 5. CALCULATION OF THE FEATURES AND EVALUATION OF THE SIMILARITY MEASURES



Figure 5.1: Results of the evaluation for the attributes *mood*, *tempo*, *complexity*, *emotion* and *focus*.



Figure 5.2: Results of the evaluation for the attributes *genre, subgenre* and *subsubgenre*. It is necessary to note the different scaling of the vertical axis compared to Figure 5.1.



Figure 5.3: Overall performance of the evaluated similarity measures.

Chapter 6 User Interface

In this chapter, the user interface for the *"Visualization of Structured Music Collections"* (*ViSMuC*) and the underlying considerations which led to its final form are described. Basically, the principal motivation for creating a user interface that is based on results of perceptual similarity measures was to support the user in exploring formerly unknown music as well as in browsing through repositories in order to find songs that would be difficult to discover with traditional text-based search engines. Since users do not always know how to specify what they are seeking, nor even what they are looking for, developing solutions that address this issues is an important and challenging task [Pac03].

The user interface strongly focuses on graphical representations of the music repository. Alternative ways of searching in and browsing through music collections, like text-based systems (e.g. *All Music Guide*¹) or tune matching systems which involve, for example, score comparison or query by humming (e.g. *MelodieSuchmaschine*² or [GLCS95, HP01]) surely also have their application areas. However, the usability of such systems, which is analyzed for example in [BS02], reveals serious deficiencies. Especially for novices, search engines that are based on score matching or singing/humming are difficult to use since they require at least basic musical knowledge and abilities. In contrast, the ViSMuC-user interface was designed to offer an easy and intuitive way for exploring music repositories. Thus, not only music experts, but also people who just enjoy listening to good music are addressed.

To generate the user interface for a given repository, a *Matlab*[®]-program, which processes the available data and finally creates a set of linked HTML-files and pictures was developed. HTML and JavaScript were used to ensure the independence from the operating system since web browsers supporting JavaScript are available for nearly all platforms. Future applications could even use the visualizations on mobile devices like *Personal Digital Assistants (PDAs)* or MP3-players with built-in screens. Unfortunately, today's screen resolutions of such devices are too low to use the current version of the user interface.

The remainder of this chapter is organized as follows. In the first section, the data sources that can be used by the code generating *Matlab*[®]-program are reviewed. Hereafter, the structure and design of the user interface are presented as well as its functions. Section 6.3 then illustrates the different parts of the user interface that was generated based on the data of the test repository. Finally, the last section provides some results of a short usability study that was conducted to reveal shortcomings and gather suggestions for improvement.

6.1 Available Data Sources

In this section, the various data sources that can be exploited to generate the user interface for a given repository are discussed. Since the user interface is constructed by a *Matlab*[®]-program, the data need to be importable into the respective environment. Therefore, the applied methods for converting the data to a format that is readable by *Matlab* are presented for those data sources for which such a conversion is necessary.

¹http://www.allmusic.com (date of access: 2003-10-17)

²http://www.musicline.de/de/melodiesuche (date of access: 2003-11-13)

6.1.1 Similarity Measures

Considering the results of the conducted evaluation (cf. Figure 5.3), the RP/MFS-measure was chosen to calculate the rhythmic features for the user interface. As for the timbre-based measures, in spite of the fact that the AP-measure performed best in the evaluation, the spectrum histograms were selected to be used as timbral measure because their calculation times are much lower (less than 3 hours in comparison to 34 hours for the test repository – cf. Table 5.1) and the performance difference of about 2 percent does not justify such an enormous increase in time consumption.

Since *Matlab*[®]-implementations of the RP/MFS- and SH-measures are used, the resulting data are directly available to the code generating program.

6.1.2 User-Defined Directory Structure

Most users organize their music repositories with respect to some individual ontology. For this reason, they often create a directory structure that consists of folders for different genres, artists, albums or other criteria. This user-defined directory structure is taken into account by recursively accessing all directories of a given repository and creating visualizations for every visited folder. Regarding the SDH-visualizations of the user interface, for each piece of music that is not situated on a map which already represents the content of the directory containing the piece, a link to the appropriate folder enables the user to browse according to his/her familiar directory structure.

6.1.3 ID3-Tags

Using the tool *mp3info³*, *release* 1.6.0d4, the ID3-tags of all MP3-files contained in the repository are extracted by a *Matlab*[®]-program. More precisely, this program recursively accesses all directories of the repository and invokes *mp3info* for each music file in order to create a text file containing the ID3-tags of the MP3-file. The content of this text file is read and the values of the most frequently used ID3-tags are extracted and finally inserted into a *Matlab*[®]-structure holding these values for the complete directory. Hereafter, the structure is saved to a *Matlab*[®]-file in the directory of the actual recursion, but also propagated to all directories at higher levels. Eventually, each folder contains a *Matlab*[®]-readable file consisting of ID3-tags⁴ of all music files that reside either in this folder or in directories at deeper levels.

6.1.4 Results of the Manual Classification

As described in Chapter 4, a database containing categorizations for each piece of music in the test repository was created. Using these data requires exporting the respective table of the database to a standard text file. This can be accomplished with all currently available database systems. Hence, the usage of external meta-data for creating the user interface is not restricted to a specific database format. Given the text file, a *Matlab*[®]-program similar to the one described above for the ID3-tags is used to process the data and convert them to a *Matlab*[®]-readable file.

³*http://sourceforge.net/projects/mp3info* (date of access: 2003-06-12)

⁴The following ID3-tags are used: *title, artist, album, year, genre, comment, bitrate, bitrate2, playtime.* In case of variable bitrate encoding the attributes *bitrate* and *bitrate2* indicate the minimum and maximum data throughput, respectively. If the encoding is performed using a constant bitrate, *bitrate* and *bitrate2* are the same.

6.2 Structure and Design

The structure and design of the user interface were elaborated in accordance with the most common principles for data visualization, namely *focusing* and *linking* [BMMS91]. Moreover, additional guidelines and rules for using multiple views in information visualization can be found in [BWK00]. These concepts and their application to the developed ViSMuC-interface are explained in the second part of this section. First, the functions and visualizations that are provided by the user interface are described.

6.2.1 The Different Parts and Functions of the User Interface

To get a first impression of the user interface, the reader is invited to take a look at Figure 6.1. This figure shows the three main parts of the ViSMuC-interface: control panel, main visualization area for SOMs and codebooks, and meta-data visualization area.

The leftmost frame contains the control panel (cf. Figure 6.2) that is used to change the content of the other two areas. This control panel is split into four parts. At the very top of it, three navigation buttons can be found. Since the "back"- and "forward"-buttons of all popular Internet browsers are incapable of updating more than one frame at a single click, correctly working functions to go back and forward one view are provided by the leftmost and the rightmost of the three buttons, respectively. By clicking on the center button the user can always jump to a standard view of the root level directory that uses the colormap "islands" and is based solely on the rhythmic features. The metaphor of arrows as symbols on the navigation buttons was chosen because most users are familiar with it since it is very common. Below the navigation buttons, the feature balance selector is situated. Depending on the chosen number of aligned SOMs, the influence of either rhythmic and timbral features on the visualization can be adjusted gradually with this selector. Moving the mouse slowly from the topmost blue square over the intermediate links to the lowermost square results in loading aligned SOMs that successively shift their focus from rhythmic to timbral properties of the music. The next part of the control panel is the colormap selector, which is used to change the appearance of the actually displayed SOM by applying different color models. Finally, the lowermost part of the panel offers links to visualizations of the model vectors. These codebook illustrations are a very useful aid for interpreting the structure of the SOM. Since they can best be explained by considering some examples, the reader is referred to Subsection 6.3.4 for a more detailed discussion.

Occupying the most space on the screen, the main visualization area, situated in the center frame, is used to display the SDH-visualizations or alternatively the codebooks – based on the settings of the control panel. Furthermore, some important additional information can be found above the graphical representation: the root directory on which the actual visualization is based, the feature balance, and the current hierarchy level. As for the images of the SOMs/SDHs, displaying a grid on the map leads to easily distinguishable map units. The labels showing the song titles are truncated to either 15 or 20 characters depending on the total number of map units in order to fit into the grid elements. They directly link to the corresponding MP3-files. Furthermore, moving the mouse over a label opens a pop-up window containing the full name of the piece of music as well as additional information gained from its ID3-tags. An example of such an *"id3-tag info"*-box can be found in Figure 6.5. As for the red and yellow squares on the map, their function is explained in the next subsection.

The rightmost frame of the user interface represents the meta-data visualization area. Here, the distribution of attribute values given, for example, by ID3-tags or external databases is illustrated. This is accomplished by counting the number of songs that satisfy a certain (attribute, value)-assignment for each map unit and visualizing a smoothed version of the resulting quantity matrix. Like the codebook images, these meta-data visualizations support identifying the clusters formed by the SOM.

6.2.2 Using Focusing and Linking in the Hierarchical Structure

When it comes to displaying complicated or complex information, visualizing approaches that use dense encoding, i.e. presenting complicated pictures to the user, are seldom successful. It is usually more effective to construct a number of simple descriptions which are easier to understand than very complex visualizations that try to display as much information as possible on a single screen. This concept of creating easy to understand illustrations each of which focuses on a particular aspect of the underlying data is usually referred to as focusing [BMMS91].

Very common focusing techniques are *selecting subsets* and *dimensionality reduction*. Both are applied each time a ViSMuC-user interface is created. Dimensionality reduction is achieved by using the data projection techniques PCA and SOM (cf. Sections 3.1 and 3.2, respectively), whereas subset selection mainly aims at choosing those pieces of music that are displayed on each SOM. In the developed *Matlab®*-program, the cardinality of such a subset is determined by two factors: the number of map units of the SOM and the number of songs mapped to each unit.

Since the number of map units should be dependent on the number of data items, the map size is determined by taking the square root of the cardinality of the data set and multiplying it with a constant value. The result is rounded to obtain a column/row-ratio of 3:2. Moreover, there is a minimum map size of 2×3 since creating smaller maps does not make sense and furthermore would violate the constraint given by the column/row-ratio. Also the maximum number of map units is limited by a constant of the program that forces greater maps to reduce their size to either 54 or 96 map units, which leads to 6×9- or 8×12-SOMs, respectively. This was necessary in order to avoid visual overloading of the user as a result of displaying too many song titles on a single map. The presented approach for determining the map size works very well for the investigated repositories that contained between 15 and 834 pieces of music. Due to the size restrictions it is also appropriate for larger collections.

As for the number of songs that are projected to each map unit, it has been decided to display a maximum of five on a single unit. Nevertheless, the user can identify the real quantity by considering the number at the lower left corner of each map unit. If more than five pieces of music are projected to a certain map unit, the best matching data item in the respective Voronoi set, i.e. the song with the minimum Euclidean distance between its feature vector and the model vector, is chosen to represent a prototype of the map unit. Since this selection usually hides great parts of the repository, the omitted pieces of music have to be made available to the user by other views. For this purpose, each Voronoi set containing more than five pieces is visualized by a new SOM that is situated on a lower hierarchy level. The need for connecting the different hierarchy levels accounts for the second design principle – linking.

In general, a consequence of focusing is that each view only presents partial information about the underlying data. Connecting these single views by inserting links between them is crucial to form a coherent image of the whole data. In the ViSMuC-interface, views of different hierarchy levels are linked by either yellow and red squares at the bottom of the map units at the higher level SOMs. While the red links point to those SOMs that were generated because the number of songs represented by a single map unit exceeded five, the yellow ones offer a convenient way to browse the directory in which the displayed song is stored.

In Figures 6.3 and 6.4 the results of the focusing and linking techniques, as described above, can be seen.

6.3 Visualization of the Test Repository

Since the different visualization types that are provided by the user interface are easier to understand when appropriate example images are considered, in this section, the ViSMuC-visualizations of the test repository

are regarded in order to discuss the four main kinds of images that are used. Basically, all images produced by the ViSMuC-program are stored in the *Portable Network Graphics (PNG)* format [RPea99] since it combines lossless compression with small file sizes, even for truecolor images. Furthermore, using a color depth of 24 bits was crucial to preserve smooth color shadings.

6.3.1 Aligned SOMs/SDHs

An example of aligned SOMs that are visualized by SDHs can be found in Figure 6.6, which reveals the changing cluster structure when the feature balance is shifted gradually from 100 percent rhythm to 100 percent timbre.

Comparing the two extreme views, the different clustering criteria become obvious. While the RP/MFSmeasure clusters the pieces of music according to reoccurring activations in each of the 20 frequency bands, the SH-measure takes into account the intensity and recurrency of sounds that are quantized according to the critical-bands. Therefore, the SOM that is based solely on the results of the RP/MFS-measure projects songs with similar rhythm patterns, e.g. frequently reoccurring strong beats at low frequencies, to similar locations on the map. In contrast, the map which was generated exclusively on the basis of the timbral SH-features arranges the pieces of music according to the similarity of their spectral shapes.

Taking a closer look at the rhythmic perspective, it can be observed that the clustering coincides quite well with a distinction by genre. While all Gregorian chants are grouped together on an island situated in the upper right corner of the map, folk music that also exhibits strong vocal parts – e.g. tracks from the compact disc "*Hartlauer - Golden Christmas Hits*", a collection of Christmas songs – can be found exclusively in the first row of the map unit grid. Furthermore, also some soft pieces of Jazz music are projected to map units situated in the upper left. In contrast, the electronic music of the genres "*techno*" and "*trance*" – e.g. the albums "*Thunderdome IV - The Devil's Last Wish*" or "*Future Trance Vol. 12*" – has a totally different rhythmic shape and thus is mapped to the lower regions, far away from the voice-oriented folk songs. However, also a considerable number of Punk Rock songs is grouped on and around a very small island in the lower center of the SOM. Like Techno or Trance music, these pieces reveal strong drum beats in the lower frequency bands and just a few activations in the upper ones. Nevertheless, although for example the songs "*Nice 'n' Sleazy*" by "*The Stranglers*" taken from the album "*History of Punk Rock (Disc 1)*" and "*Zimboculture*" by "*E-De-Cologne*" from "*Thunderdome IV - The Devil's Last Wish* (*Disc 1*)" can be found on the same map unit, it is very unlikely that any human listener would define them as similar. On the timbre-based SOM they are mapped to different islands even though the distance between the respective map units is not very large.

Analyzing the SOM based on the SH-measure reveals one huge island which occupies the center and right regions of the map. Another much smaller one is spread along the leftmost two columns. Basically, these two islands differ in regard to the emotions the respective pieces of music are likely to invoke. In fact, while moving from the right areas of the map to the left ones, an increase in aggressiveness (and also in loudness) is noticeable. The peninsula with the little mountain which resides in the lower right corner is composed mainly of very soft songs – e.g. tracks from the albums *"Kuschelrock Vol. 11"*, *"Celtic Myths"* and *"Mystera IX"* – while the leftmost island on the map primarily represents Techno and Trance music – e.g. *"Thunderdome IV"* or *"Frankfurt Beat Productions"*. However, some outliers can be found in each of the mentioned regions. Considering, for example, the pieces of music that are projected to the map unit in the third row and first column reveals not only six very aggressive tracks from the album *"Thunderdome IV - The Devil's Last Wish (Disc 1)"* but also the Punk song *"Bear Cage"* by *"The Stranglers"* and, most surprisingly, the quite soft New Age song *"Quo Vadis"* by *"Highland"*. With the aid of the codebook visualization, the reason for this can be uncovered quickly. The two outliers and some of the Techno songs possess similarly loud sounds in equal frequency

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bands. However, hardly anyone would suspect "*Quo Vadis*" to be situated next to the Hardcore Techno track "*Help Germany (Ware House E.P. 2)*" by "*Car & Drive*".

6.3.2 Colormaps

To address the varying preferences of different users in regard to the visual representation of the music repository, more precisely the visualization of the SDHs, three very dissimilar colormaps are made available. In Figures 6.7, 6.8 and 6.9 each of the colormaps is illustrated.

Islands

The colormap denoted as *"islands"* is a modified version of the one used in [Pam01]. It has been slightly adapted in order to better resemble the usual color scale of printed maps, e.g. [Geo90]. However, the idea of emphasizing the transitions between seas and islands by inserting a "beach level" was preserved.

Basically, areas with few pieces of music mapped to them form oceans and lakes on the map, thus being colored in shades of blue. The darker the blue, the fewer songs are represented by the area. Those songs which lie in such regions are mostly outliers and often differ heavily from the main clusters which are illustrated by islands. As already mentioned, the borders between water and land are colored yellow since they represent beaches. For the clusters themselves the color scale covers a range from dark green (dense woods) to light green (light forests and veldts) to brown (hills) and finally to hues of gray and white (glaciers and snow-covered mountain tops).

Fire

This newly created colormap emphasizes regions with many votes according to the calculation of the SDH (cf. Section 3.4). Dark colors ranging from black to red are used in nearly two thirds of the available shades in order to suppress areas with few votes. The remaining third is a color gradient from orange to yellow. Due to the glowing appearance of the maps visualized with this colormap, it was named "*fire*".

Jet

Providing the highest contrasts between neighboring color levels, the colormap "*jet*" is capable of visualizing even small differences in the probability distribution calculated by the SDH. It is a standard colormap of the *Matlab*[®]-environment whose colors begin with dark blue, range through shades of blue, cyan, green, yellow and red, and end with dark red.

6.3.3 Distribution of Meta-Data Values

Visualizing meta-data – for example, those gained from the manual categorization or from ID3-tags – is accomplished by using an approach that is commonly known as *component planes* [KNK98]. A component plane normally visualizes the influence of each variable in the feature set on the cluster structure of the SOM. Since also (attribute, value)-pairs from databases or other data sources can be considered as features, it is possible to apply the same technique, which has already been explained in Section 6.2.

In Figure 6.10 an assortment of component planes based on the left SOM in Figure 6.11 is presented. The leftmost group shows the distribution of the genres "*Classical*", "*Rock*" and "*Electronica*" according to the ID3-tags. It can be observed that classical music is mapped exclusively to the island with the high mountain, which is situated in the upper right corner of the map. Furthermore, the lowermost component plane reveals

that electronic music can be found in regions either at the lower right and the lower left. At first sight, it seems that the SOM was not able to cluster the pieces of electronic music appropriately. However, considering the more precise attribute *subgenre* of the manual classification, it becomes obvious that there is a difference between the two clusters. In fact, the electronic music on the lower left island is categorized as *"hardcore techno"* and thus much more aggressive than that grouped around the lower right corner of the map, which mainly belongs to the subgenre *"trance"*. As for the center component plane for the attribute *"id3-genre"*, it depicts the distribution of Rock music. Since the genre *"Rock"* is a very general one and includes a large number of quite different subgenres, no prominent clusters can be identified.

The other four groups of component planes show the distributions of some attribute values from the manual classification. The illustrated attributes are *emotion*, *tempo*, *complexity* and *focus*. Analyzing these distributions, several interesting correlations between some of the attribute values can be observed. For example, the ID3-genre *"Classical"* coincides with neutral emotion, slow tempo, low complexity, and strong vocal appearance. Indeed, the music of the respective island in the upper right corner of the map predominantly consists of Gregorian chants. Another interdependence can be stated between electronic music and focus on instruments, although the instruments used in this kind of music are mostly virtual. Furthermore, regarding the component plane for aggressiveness, it becomes obvious that the cluster in the lower left, which is mainly formed of electronic music, contains more aggressive tracks than the other *"Electronica"* cluster residing in the lower right corner of the map.

The component plane visualization also confirms the results of the similarity measure evaluation (cf. Figure 5.1). The disappointing performance of the RP/MFS-measure for the attributes *complexity, emotion* and *focus* coincides well with the diffuse distribution of the respective attribute values. In particular, the regions containing different values for the property *emotion* overlap considerably. As for the tempo, the respective component planes show quite well that slow pieces of music can be found in the upper regions of the map, whereas the lower areas mainly contain fast songs. This fairly precise partitioning of the map validates the better performance when it comes to distinguishing music with respect to the attribute *tempo*.

6.3.4 Codebooks

In Figure 6.11 the codebooks of two SOMs are illustrated. In order to create such a codebook visualization, all model vectors of a SOM are visualized with respect to the features of the underlying similarity measure. Presenting these codebook visualizations to the user is done in such a way that the positions of the model vector images correspond to the respective map units on the SOM.

The upper two images of Figure 6.11 show SDH-visualizations for 6×9-SOMs trained on the content of the directory "*Various Artists*". While the upper left map only uses rhythmic features (RP/MFS), the one residing in the upper right was created exclusively from the timbral measure (SH). Therefore, the codebook visualizations situated in the left column were created using the same technique as applied for illustrating the feature vectors in Figure 2.3, whereas those residing in the right column were generated similarly to the ones shown in Figure 2.5.

Since space on the codebook visualization screen is strongly limited, the axes and colorbars are removed. Unfortunately, this leads to the problem of not knowing the real value – e.g. the effective fluctuation strength in case of RP/MFS-codebooks – at an arbitrary position on a model vector visualization. In order to solve this problem, two codebook visualizations are created for each SOM and each of the used similarity measure ⁵. While the first one is based on locally scaled values, i.e. an independent scaling for each model vector repre-

⁵According to the used approach of aligned SOMs, each model vector contains a mixture of weighted data derived from either the RP/MFS- and the SH-features. Thus, illustrating the codebook for a given SOM involves splitting all model vectors and generating visualizations for both features.

sentation is used, the values of the second one are globally scaled. This global scaling involves searching the minimum and maximum of all values in all model vectors of a given SOM. In each model vector visualization, this constant global minimum is mapped to the lower end of the color scale, whereas the global maximum is mapped to its upper end. The values between the maxima are projected linearly to the color scale.

The images in the second row of Figure 6.11 show codebook visualizations that are locally scaled, the lower two pictures show globally scaled codebooks. Comparing the second with the third row, some interesting differences can be seen. For example, although the locally scaled RP/MFS-visualization indicates strong beats in the center and lower right areas, and also in the lower left corner of the map, the real strength of those beats is not discernable until the image based on global scaling is observed. In fact, the mentioned regions contain almost solely music that can be classified as *"techno"* or *"trance"*. However, if the user intends to get an idea of the overall shape of the model vectors, looking at the globally scaled codebooks is the wrong choice since model vectors whose values lie within a small domain are illustrated using very few color shadings.

6.4 Usability Considerations

Since the author is highly interested in the usability of the developed ViSMuC-system, a small qualitative usability study has been conducted in order to reveal possible shortcomings. Unfortunately, due to time limits, only three persons could be surveyed. Nevertheless, the setup and results of the evaluation are presented in this section.

According to [GB99], information exploration activities can be characterized by the three dimensions of *users*, *tasks/goals* and *environment*. Each dimension is assigned a value that varies from *"real"* to *"synthetic"*. All possible combinations of values for each of these dimensions form the design space for evaluation experiments.

Users

As for the participating persons, neither of them is a music expert but all enjoy listening to music of various genres. Two of the test persons can be regarded as computer experts since they are advanced in their studies of computer science, whereas the third one has just basic knowledge in this field. Furthermore, each of the test persons stated that a system for exploring music collections by using different graphical visualizations would be useful. Therefore, they can be considered as real users.

Tasks/Goals

The following tasks and goals were elaborated.

- 1. Find music of the genre "electronica" (according to ID3-genres).
- 2. Find soft pieces of music as well as aggressive ones.
- 3. Find all songs by the artist "Nightwish" and also some similar pieces of music.
- 4. Find folk songs (according to results of the manual categorization).
- 5. Try out the different colormaps. Which one do you prefer?
- 6. Investigate different settings for the feature balance. Can you observe remarkable changes when the focus is shifted from rhythm to timbre?

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The first four tasks illustrate typical queries a user may want to raise when searching for music. Hence, these tasks could be regarded as real. The fifth issue on the list takes into account the personal taste of the test persons. Eventually, the sixth one aims at examining the usefulness of presenting different views according to musical properties.

Environment

The evaluation was carried out using the complete test repository composed of 834 pieces. Since a large number of songs contained therein were completely unknown to the test persons, the setting is rather synthetic according to the dimension *environment*. The ViSMuC-interface for the usability study was generated utilizing all available meta-data visualizations and three different views with respect to the feature balance. However, it was decided to omit the codebook visualizations in order to decrease the complexity of the system.

Results

Tasks 1, 2 and 4 were completed quickly and successfully by all test persons making intensive use of the metadata visualizations to interpret the map. However, it was very interesting to observe the different approaches of the experienced computer users and the novice. While the former used the trial-and-error method, the actions performed by the latter were more intended and planned. In fact, the experienced users discovered the functions of the system by clicking on all that seemed to be a link. In contrast, the novice was a bit afraid of doing something wrong. After an introduction to the system, however, the novice performed the mentioned tasks efficiently without unnecessary clicks.

Task 3 – finding songs by "*Nightwish*" – turned out to be more difficult. Since neither of the three test persons knew any songs by "*Nightwish*", they had moved the mouse over a lot of labels to view the ID3-tags before they finally succeeded. A possible solution to this problem would be to display another set of component planes that illustrates the distribution of the songs according to their artists. As for issue 5, while both of the computer experts were in favor of the colormap "*islands*", the third test person preferred "*jet*" due to its high color contrasts. Finally, the results of the last task are quite disappointing since the different feature balances rather confused the test persons than supported them in gaining new insights.

Furthermore, some general remarks and suggestions for improvement were made. At first, considering the labels of the component planes, the experienced computer users were a bit confused by their positions since those referring to the attribute values are placed below the respective visualization, which is rather uncommon. According to the testers, these labels should be positioned above the visualizations. Another source of annoyance was the mouse-over effect used by the feature balance selector. Wanting to reach one of the navigation buttons, which are situated directly above the feature balance selector, the risk of accidentally moving the mouse over a respective link is quite high. Hence, these links should be activated rather by mouse clicks than by mouse-over events. Eventually, it was proposed to combine the user interface with a text-based search engine in order to facilitate locating pieces of music which are already known to the user.

6.5 Screenshots of the ViSMuC-User Interface

The next pages contain the screenshots that were used to explain the different functions and visualizations provided by the ViSMuC-system.



Figure 6.1: The user interface for the root directory of the test repository (hierarchy level 0) incorporating a SOM with 54 map units. The left frame represents a control panel, the centered one exhibits the actual SDH-visualization, and that at the right displays information about the distribution of meta-data values over the map.



Figure 6.2: A close view of the complete control panel. From top to bottom: navigation buttons, feature balance adjustment, colormap selector, links to codebook visualizations.



Figure 6.3: A close view of 6 map units. The number in the lower left corner of each unit indicates the quantity of songs represented by it. If this number is greater than 4, a map containing only the pieces of the particular unit can be accessed by clicking on the red square. The yellow squares are links to maps of those directories where the displayed tracks reside.



Figure 6.4: Depiction of two SDHs in hierarchy level 1, which are both accessible through links of the map unit in hierarchy level 0 (cf. Figure 6.1) whose prototype is "*Master of the Wind*" (situated at the very lower left). The upper visualization was created according to the directory structure of the repository, thus showing the contents of the folder "*Manowar*", where the mentioned prototype song resides. The lower one contains a view showing all pieces of music that are projected to the same map unit as the prototype. Hence, this view is based on the results of the similarity measures.



Figure 6.5: Example of the pop-up window that appears when the user moves the mouse over the label of an arbitrary piece of music. In this case, the ID3-information of the respective song is displayed.



Figure 6.6: Illustration of the modifications of the cluster structure when the focus is gradually shifted from 100 percent rhythm to 100 percent timbre in 5 steps (100/0, 75/25, 50/50, 25/75, 0/100). The user interface was created using a 6×9 -SOM and taking "*Various Artists*" as root directory.



Figure 6.7: SDH-visualization of the complete test repository at its root directory (hierarchy level 0) using colormap *"islands"*.



Figure 6.8: SDH-visualization of the complete test repository at its root directory (hierarchy level 0) using colormap *"fire"*.



Figure 6.9: SDH-visualization of the complete test repository at its root directory (hierarchy level 0) using colormap "jet".



Figure 6.10: Illustration of distributions of some attribute values. The leftmost picture visualizes the distribution of the values assigned to the ID3-tag *genre*. The other images provide information about some of the attributes that were used in the manual classification.



Figure 6.11: Codebook visualizations for two SOMs that are based on the RP/MFS- (left column) and the SH-features (right column), respectively. The center visualizations are locally scaled, whereas the lower ones use global scaling.

Chapter 7 Conclusions and Future Work

In this chapter, the work presented in this thesis is summarized. In addition, some suggestions for future research are made.

The research done for this thesis mainly focused on developing a user interface that facilitates explorative browsing through music repositories which can be composed of an arbitrary number of songs. Since descriptive musical data of the songs are usually unavailable, at first, five approaches for perceptual music similarity measurement were analyzed. For this purpose, a collection containing more than 800 pieces of music from very different genres was created. Subsequently, all songs of this collection were manually categorized according to several attributes. An evaluation of the five measures was then performed on the basis of the manual categorization. Since its results revealed great differences regarding performance as well as computational complexity, two algorithms which performed relatively well in their respective categories (rhythmic vs. timbral measures) were selected. However, since the categorization was performed by the author, the results are at least partly subjective. Hence, a classification done by a larger number of persons could incorporate a wider spectrum of opinions and thus allow for a more accurate evaluation of the measures.

On the basis of the two selected algorithms, the ViSMuC-user interface has been developed. A simplified version of Aligned Self-Organizing Maps was used to provide different views according to different weightings of rhythmic and timbral features. The hierarchical structure of the visualizations – taking into account the clusters formed by the musical similarity measures as well as the directory structure of the repository – is automatically generated and allows for an unlimited number of songs in the repository. Furthermore, the codebook visualizations permit interpretation of the map on the basis of the model vectors of the SOM, which also reveal interesting rhythmic and timbral properties of the underlying pieces of music. Finally, it was shown that arbitrary meta-information can be illustrated relatively easily by visualizing the smoothed distribution of the respective attribute values over the map.

However, there are still some possibilities for improvement. A major disadvantage of the current version is the time and space consumption of both the feature and similarity calculations and the generation of the various visualizations. For example, given the RP/MFS- and the SH-measures for the 834 pieces of the test repository, the program is busy for several hours creating a user interface with three feature balances and 96 map units on hierarchy level 0. Since all types of visualizations (SOMs for different feature balances and colormaps, codebooks, component planes for various attribute values) have to be generated with respect to each of the two hierarchical components (clustering according to the musical features and directory structure), the resulting user interface consists of nearly 20 000 files and occupies more than 400 MB of harddisk space. Also considering the fact that adding new pieces of music to the repository makes it necessary to recalculate the SOMs and SDHs, the huge time consumption is especially disadvantageous. Thus, improving the computational complexity, for example by optimizing the algorithms and/or using a more performant programming language, is a major requirement for the next version. Ideally, the calculation times should be reduced to a level on which, given the musical features, the visualizations can be calculated on demand.

In addition, the conducted usability study uncovered another problem of the user interface. Since the SDH-

visualizations are based solely on the results of the similarity measures, finding music by a specific artist can be quite difficult, especially when none of his/her songs are mapped to hierarchy level 0. Therefore, a future version of the user interface should offer a possibility for text-based search or another functionality that also supports the user in quickly finding known songs. Possible solutions to this issue could involve visualizing the distributions of the artists over the map or displaying a list which contains all artist names and providing a masking function, i.e. emphasizing the songs by a certain artist by hiding all other ones.

Finally, the similarity measures themselves could be improved since they are still far away from yielding reliable results. In fact, the results of the evaluation and the flaws in some regions of the maps that were generated from the test repository show that there is room for improvement.

Chapter 8 Acknowledgements

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Appendix A Specification of the Test Repository

In this appendix, a complete list of all music files included in the test repository is presented. For each track in the list, the results of the manual classification are depicted. The list is ordered alphabetically by the names of the directories and the files contained therein.

The repository consists of 834 pieces of music, representing several different genres. The total play length is about 61 hours. The shortest track has a duration of barely 19 seconds (*Hartlauer - Golden Christmas Hits - 15 - Glocken des Mainzer Doms*), the longest contains exactly 21 minutes of music (*Frank Zappa - Läther (Disc 3) - 04 - The Adventures Of Greggery Peccary*). The average duration is 4 minutes and 24 seconds.

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Angelo Branduardi / Angelo Branduardi - La Pul	ce D'Acqua - 0	1 - Ballo In Fa Die	esis Minore.mp3			10		0
	neutral	medium	medium	neutral	both	world	italy	
Angelo Branduardi / Angelo Branduardi - La Pul	ce D'Acqua - 0	5 - Il Marinaio.m	p3 modium	coft	both	world	italır	1
Angelo Branduardi / Angelo Branduardi - La Pul	ce D'Acqua - 0	5 - La Pulce D'Ac	qua.mp3	Soft	bour	world	italy	
	happy	fast	medium	neutral	both	world	italy	
Angelo Branduardi / Angelo Branduardi - La Pul	ce D'Acqua - 0 sad	7 - La Sposa Ruba medium	ata.mp3 medium	neutral	both	world	italy	
Angelo Branduardi / Angelo Branduardi - La Pul	ce D'Acqua - 0	8 - La Lepre Nelle	e Luna.mp3	neutiti	bour	world	illiy	
	neutral	medium	medium	neutral	both	world	italy	
Angra / Angra - Angels Cry - 01 - Unfinished Alle	egro.mp3 neutral	varving	medium	neutral	instruments	classical	modern	
Angra / Angra - Angels Cry - 06 - Never Underst	and.mp3							
	neutral	fast	high	aggressive	both	rock	hard rock	progressive metal
Angra / Angra - Angels Cry - 0/ - Wuthering Hei	ghts.mp3 neutral	medium	medium	neutral	both	rock	hard rock	progressive metal
Angra / Angra - Angels Cry - 08 - Streets Of Tome	orrow.mp3	1					1	1 0
Anore (Anore Anole Cre. 10 Lecting Childre	sad	medium	medium	neutral	both	rock	hard rock	progressive metal
Angra / Angra - Angels Cry - 10 - Lasting Child.	neutral	varying	high	neutral	both	rock	hard rock	progressive metal
Angra / Angra - Fireworks - 01 - Wings Of Reality	y.mp3		0	1		1		
Apgra / Apgra - Eiroworke - 02 - Patrified Ever m	neutral	fast	medium	neutral	both	rock	hard rock	progressive metal
Tuigia / Tuigia - Theworks - 62 - Feather Lyes.in	neutral	varying	high	neutral	instruments	rock	hard rock	progressive metal
Angra / Angra - Fireworks - 03 - Lisbon.mp3				T		T		1
Angra / Angra - Fireworks - 07 - Fireworke mp3	neutral	medium	medium	neutral	vocals	rock	hard rock	progressive metal
	neutral	varying	medium	neutral	both	rock	hard rock	progressive metal
Angra / Angra - Fireworks - 10 - Speed.mp3	maritan	rooms fact			hath	made	hand made	anand motol
Angra / Angra - Holy Land - 01 - Crossing.mp3	neutrai	very last	meanum	aggressive	bour	IOCK	Hald lock	speed metai
	neutral	very slow	medium	soft	both	rock	hard rock	progressive metal
Angra / Angra - Holy Land - 02 - Nothing to Say.	mp3 neutral	medium	high	aggressive	both	rock	hard rock	progressive metal
Angra / Angra - Holy Land - 05 - Holy Land.mp3			0	00				1.0
Angra / Angra Holy Land 08 ZITO mp2	neutral	slow	high	neutral	both	rock	hard rock	progressive metal
Tuigia / Tuigia - Hory Lana - 00 - 2.1.10.11105	neutral	fast	high	neutral	both	rock	hard rock	progressive metal
Angra / Angra - Holy Land - 09 - Deep Blue.mp3	г.		l				I	1
Angra / Angra - Rebirth - 01 - In Excelsis.mp3	sad	slow	high	neutral	both	rock	hard rock	progressive metal
	neutral	very slow	medium	neutral	instruments	rock	hard rock	progressive metal
Angra / Angra - Rebirth - 02 - Nova Era.mp3	neutral	fast	medium	aggressive	both	rock	hard rock	speed metal
Angra / Angra - Rebirth - 05 - Heroes of Sand.mp	3		-					.1
Angra / Angra - Rebirth - 08 - Judgement Day mr	neutral	medium	high	neutral	both	rock	hard rock	progressive metal
ingu / ingu neonu oo judgenen bujing	neutral	varying	high	neutral	both	rock	hard rock	progressive metal
Angra / Angra - Rebirth - 10 - Visions Prelude.mp	3		1.		1.4			
Axel Rudi Pell / Axel Rudi Pell - Cry Of The Gyp	sad sy.mp3	slow	medium	neutral	both	rock	hard rock	progressive metal
· · · · ·	neutral	medium	medium	neutral	instruments	rock	hard rock	heavy metal
Axel Rudi Pell / Axel Rudi Pell - Hot Wheels.mp2	neutral	medium	medium	aggressive	both	rock	hard rock	heavy metal
Axel Rudi Pell / Axel Rudi Pell - Ride The Rainbo	ow.mp3			188-100111				
	neutral	medium	medium	neutral	both	rock	hard rock	heavy metal
Axel Ruul Fell / Axel Ruul Fell - Taik Of The Gu	neutral	fast	medium	aggressive	both	rock	hard rock	heavy metal
Axel Rudi Pell / Axel Rudi Pell - The Line.mp3				T		T		1
Axel Rudi Pell / Axel Rudi Pell - The Masquerade	neutral Ball.mp3	slow	medium	neutral	both	rock	hard rock	heavy metal
· · · · · · · · · · · · · · · · · · ·	neutral	medium	medium	neutral	instruments	rock	hard rock	heavy metal
Axel Rudi Pell / Axel Rudi Pell - The Temple Of T	The Holy.mp3	clow	modium	coft	both	rock	hand mak	hower motal
Axel Rudi Pell / Axel Rudi Pell - Time Of The Tru	th.mp3	310W	inculuit	3011	bour	IOCK	hard lock	icavy inclai
	neutral	medium	medium	neutral	both	rock	hard rock	heavy metal
Axel Ruai Pell / Axel Ruai Pell - Voodoo Nights.	np3 neutral	medium	medium	neutral	both	rock	hard rock	heavy metal
Axel Rudi Pell / Axel Rudi Pell - Warrior.mp3		1			T			
Avreon / Avreon - The Dream Sequencer - 01 - Th	neutral e Dream Secure	medium encer.mp3	medium	neutral	both	rock	hard rock	heavy metal
	neutral	slow	high	neutral	instruments	rock	hard rock	progressive metal
Ayreon / Ayreon - The Dream Sequencer - 02 - M	y House On Ma	ars.mp3	medium	neutral	instruments	rock	hard rock	prograssivo metal
Ayreon / Ayreon - The Dream Sequencer - 03 - 20	540 84.mp3	510W	meurulli	neutial	msuuments	IUCK	Halu IUCK	progressive metal
	neutral	slow	high	neutral	instruments	rock	hard rock	progressive metal
Ayreon / Ayreon - The Dream Sequencer - 06 - Dr	agon On The S neutral	ea.mp3 medium	high	neutral	instruments	rock	hard rock	progressive metal
Ayreon / Ayreon - The Dream Sequencer - 10 - Th	e First Man Or	Earth.mp3						
	neutral	medium	high	neutral	both	rock	hard rock	progressive metal

APPENDIX A. SPECIFICATION OF THE TEST REPOSITORY

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Bad Religion / Bad Religion - No Substance - 01 -	Hear It.mp3	T	1	I	I		T	1
Bad Religion / Bad Religion - No Substance - 02 -	neutral Shades Of Trut	very fast	low	aggressive	both	rock	punk rock	
	neutral	medium	low	neutral	both	rock	punk rock	
Bad Religion / Bad Religion - No Substance - 04 -	The Biggest Ki	ller In American	History.mp3	aggressive	both	rock	nunk rock	
Bad Religion / Bad Religion - No Substance - 11 -	Mediocre Mine	ds.mp3	low	aggressive	bour	IOCK	punk lock	
Pad Palinian / Pad Palinian Na Cabatanan 16	neutral	fast	low	aggressive	both	rock	punk rock	
bad Keligion / bad Keligion - No Substance - 16 -	neutral	fast	low	aggressive	both	rock	punk rock	
Bad Religion / Bad Religion - The Gray Race - 01	- The Gray Rac	e.mp3						l
Bad Religion / Bad Religion - The Gray Race - 03	- A Walk.mp3	fast	medium	aggressive	both	rock	punk rock	
	neutral	fast	medium	aggressive	both	rock	punk rock	
Bad Religion / Bad Religion - The Gray Race - 05	 Punk Rock So neutral 	ng.mp3 fast	low	aggressive	both	rock	punk rock	
Bad Religion / Bad Religion - The Gray Race - 11	- Ten In 2010.m	ip3	10W	depressive	bour	Iota	Punktock	
Rad Polician / Rad Polician The Cray Page 12	neutral Drupk Sincor	fast	medium	aggressive	both	rock	punk rock	
bad Kengion / bad Kengion - The Gray Kace - 15	neutral	fast	low	neutral	both	rock	punk rock	
Bad Religion / Bad Religion - The New America	01 - You've Go	ot A Chance.mp3		1				
Bad Religion / Bad Religion - The New America	neutral 02 - It's A Lon	fast g Way To The Pro	low omise Land.mp3	aggressive	both	rock	punk rock	
	neutral	fast	medium	neutral	both	rock	punk rock	
Bad Religion / Bad Religion - The New America -	05 - 1000 Mem	ories.mp3		m ocching l	hath	made	and the second	1
Bad Religion / Bad Religion - The New America -	· 09 - I Love My	Computer.mp3	medium	neutral	Doth	TOCK	рипк госк	
	neutral	medium	medium	neutral	both	rock	punk rock	
Bad Religion / Bad Religion - The New America -	12 - Let It Buri	n.mp3 fast	low	aggressive	both	rock	punk rock	
Bad Religion / Bad Religion - The Process Of Beli	ef - 01 - Superse	onic.mp3	10W	uggressive	bour	Iota	Pullik lock	
	neutral	very fast	low	aggressive	both	rock	punk rock	
Bad Religion / Bad Religion - The Process Of Beli	ef - 05 - Destine neutral	d For Nothing.m fast	low	aggressive	both	rock	punk rock	
Bad Religion / Bad Religion - The Process Of Beli	ef - 06 - Materia	alist.mp3					T	
Bad Religion / Bad Religion - The Process Of Beli	neutral ef - 09 - Epipha	fast	medium	aggressive	both	rock	punk rock	
bau kengion / bau kengion - me nocess of ben	neutral	medium	medium	neutral	both	rock	punk rock	
Bad Religion / Bad Religion - The Process Of Beli	ef - 12 - The Lie	.mp3						1
Blue Övster Cult / Blue Övster Cult - Cult Classic	neutral - 01 - Don't Fe	fast ar The Reaper.mi	low o3	neutral	both	rock	punk rock	
	neutral	medium	medium	neutral	both	rock	arena rock	
Blue Öyster Cult / Blue Öyster Cult - Cult Classic	- 04 - This Ain	't The Summer O	f Love.mp3 modium	noutral	both	rock	amna mek	1
Blue Öyster Cult / Blue Öyster Cult - Cult Classic	- 05 - Burning	For You.mp3	inecium	neutrai	bour	IOCK	alelia lock	
	neutral	medium	medium	neutral	both	rock	arena rock	
Blue Oyster Cult / Blue Oyster Cult - Cult Classic	r - 07 - Flaming neutral	Telepaths.mp3 medium	medium	neutral	both	rock	arena rock	
Blue Öyster Cult / Blue Öyster Cult - Cult Classic	- 09 - Astronom	ny.mp3	-					
Bruan Adame / Bruan Adame 18 Til I Dia 01	neutral	varying That Looks Coo	high d On Momp?	neutral	both	rock	arena rock	
bryan Adams / bryan Adams - 10 111 Die - 01 -	neutral	medium	medium	neutral	both	rock	arena rock	
Bryan Adams / Bryan Adams - 18 Til I Die - 02 - 1	Do To You.mp3							I
Brvan Adams / Brvan Adams - 18 Til I Die - 08 - 1	neutral Think About \	medium (ou.mp3	medium	neutral	both	rock	arena rock	l
	neutral	slow	medium	soft	both	rock	arena rock	
Bryan Adams / Bryan Adams - 18 Til I Die - 11 - I	Black Pearl.mp3	3		n oo daal	hoth	male	anna male	
Bryan Adams / Bryan Adams - 18 Til I Die - 13 - I	Have You Ever	Really Loved A V	Noman.mp3	neutrai	bout	IOCK	атепа тоск	
	neutral	slow	medium	soft	both	rock	arena rock	
Bryan Adams / Bryan Adams - So Far So Good -	01 - Summer O happy	f '69.mp3 medium	medium	neutral	both	rock	arena rock	
Bryan Adams / Bryan Adams - So Far So Good -	02 - Straight Fro	om The Heart.mp	3					
Record Laws (Record Laws, Contractor Contra	neutral	medium	medium	soft	both	rock	arena rock	
bryan Adams / bryan Adams - 50 Far 50 Good -	happy	nedium	medium	neutral	both	rock	arena rock	
Bryan Adams / Bryan Adams - So Far So Good -	09 - Cuts Like A	A Knife.mp3						
Bryan Adams / Bryan Adams - So Far So Good -	neutral 14 - Please Fors	medium rive Me mp3	medium	neutral	both	rock	arena rock	
	sad	slow	medium	soft	both	rock	arena rock	
Century / Century - Melancholia - 01 - Perfect Lie	e.mp3	manutir :			hoth	male	hand male	mala dia matri
Century / Century - Melancholia - 03 - I Regret.m	ip3	varying	meanum	aggressive	Dout	TOCK	naru iock	meiouic metai
	neutral	medium	medium	neutral	both	rock	hard rock	melodic metal
Century / Century - Melancholia - 07 - I Would K	now.mp3 neutral	fast	medium	aggressive	both	rock	hard rock	melodic metal
Century / Century - Melancholia - 08 - Melanchol	lia Light.mp3			00-000				
Comburns / Comburns Malarda H. 40. 01	happy	medium	medium	soft	both	rock	hard rock	melodic metal
Century / Century - Melancholia - 10 - Shine.mp	neutral	fast	medium	neutral	both	rock	hard rock	melodic metal

APPENDIX A. SPECIFICATION OF THE TEST REPOSITORY

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Century / Century - The Secret Inside - 01 - Here	Is The Rain.mp	3				0		
	neutral	medium	medium	neutral	both	rock	hard rock	melodic metal
Century / Century - The Secret Inside - 02 - Lost.	np3		1					
Century / Century - The Secret Inside - 04 - Save	neutral The Pain mp3	medium	medium	aggressive	both	rock	hard rock	melodic metal
century / century - The Scelet Inside - 64 - Save	sad	slow	medium	soft	both	rock	hard rock	melodic metal
Century / Century - The Secret Inside - 08 - The S	ecret Inside.mp	53						
	sad	medium	medium	neutral	both	rock	hard rock	melodic metal
Century / Century - The Secret Inside - 10 - Noho	ld.mp3	slow	medium	soft	both	rock	hard rock	melodic metal
Clawfinger / Clawfinger - Use Your Brain - 01 - P	ower.mp3	510W	medium	Soft	bout	IOCK	hard lock	melocic metai
	neutral	fast	low	aggressive	both	rock	hard rock	alternative metal
Clawfinger / Clawfinger - Use Your Brain - 04 - W	/ipe My Ass.mj	p3	,		1.4	1		
Clawfinger / Clawfinger - Use Your Brain - 08 - 1	neutral	fast	low	aggressive	both	rock	hard rock	alternative metal
Chawlinger / Chawlinger - Ose Tour Brani - 66 - 6	neutral	fast	medium	aggressive	both	rock	hard rock	alternative metal
Clawfinger / Clawfinger - Use Your Brain - 10 - B	ack To The Bas	ics.mp3		•		•		
	neutral	fast	medium	aggressive	both	rock	hard rock	alternative metal
Clawfinger / Clawfinger - Use Your Brain - 12 - 16	peutral	fact	medium	aggressive	both	rock	hard rock	alternative metal
Crematory / Crematory - Act Seven - 02 - I Never	Die.mp3	luot	inculain	aggressive	bour	TOLK	hard fock	unernanive mean
	sad	medium	medium	aggressive	both	rock	hard rock	gothic metal
Crematory / Crematory - Act Seven - 04 - Fly.mp2	3		1					
Crematory / Crematory - Act Seven - 07 - The Ga	neutral	fast	medium	neutral	both	rock	hard rock	gothic metal
Cicinatory / Cicinatory - Act Seven - 67 - The Ga	sad	varying	medium	neutral	both	rock	hard rock	gothic metal
Crematory / Crematory - Act Seven - 08 - Waiting	g.mp3					•		
	neutral	medium	medium	neutral	both	rock	hard rock	gothic metal
Crematory / Crematory - Act Seven - 10 - Tale.mp	neutral	medium	medium	soft	both	rock	hard rock	gothic metal
Crematory / Crematory - Believe - 01 - Redemption	on Of Faith.mp	3	medium	Soft	bout	IOCK	hald lock	goune metai
	sad	very slow	medium	neutral	both	rock	hard rock	gothic metal
Crematory / Crematory - Believe - 02 - Endless.m	р3		I .		1		T	
Cromatory / Cromatory Baliava 04 Take mp2	sad	fast	medium	neutral	both	rock	hard rock	gothic metal
Crematory / Crematory - beneve - 04 - take.mp5	sad	fast	medium	neutral	both	rock	hard rock	gothic metal
Crematory / Crematory - Believe - 05 - Act Seven	.mp3							0
	neutral	fast	high	neutral	both	rock	hard rock	gothic metal
Crematory / Crematory - Believe - 12 - Perils Of 1	he Wind.mp3	elow	medium	soft	vocale	rock	hard rock	gothic metal
Cyndi Lauper / Cyndi Lauper - Best Of Cyndi La	uper - 01 - Girl	s Just Want To Ha	ave Fun.mp3	Soft	vocais	IOCK	hard lock	goune metai
	happy	medium	medium	neutral	vocals	rock	рор	
Cyndi Lauper / Cyndi Lauper - Best Of Cyndi La	uper - 02 - Tim	e After Time.mp3	3		1			1
Cundi Launer / Cundi Launer - Beet Of Cundi La	neutral	medium nge Of Heart mp	medium	soft	both	rock	pop	
Cynar Eauper / Cynar Eauper - Dest of Cynar Ea	neutral	medium	medium	neutral	both	rock	рор	
Cyndi Lauper / Cyndi Lauper - Best Of Cyndi La	uper - 09 - Mor	ney Changes Ever	rything.mp3					
	neutral	medium	medium	neutral	both	rock	pop	
Cyndi Lauper / Cyndi Lauper - Best Of Cyndi La	uper - 11 - I Dr	ove All Night.mp medium	medium	neutral	both	rock	pop	
Deep Purple / Deep Purple - Purplexed - 02 - The	Battle Rages C	n.mp3	inculum	neutrai	bour	IOCK	рор	
	neutral	medium	medium	aggressive	both	rock	arena rock	
Deep Purple / Deep Purple - Purplexed - 03 - Kin	g Of Dreams.m	ip3		-	1			1
Deep Purple / Deep Purple - Purpleyed - 04 - Spe	neutral ed King (live) r	medium	medium	neutral	both	rock	arena rock	
Deep I uiple / Deep I uiple - I uiplexed - 04 - 3pe	neutral	fast	medium	aggressive	instruments	rock	hard rock	heavy metal
Deep Purple / Deep Purple - Purplexed - 10 - Chi	ld In Time (live	e).mp3		00				
	neutral	varying	high	aggressive	instruments	rock	arena rock	
Deep Purple / Deep Purple - Purplexed - 11 - Sm	oke On The Wa	ter (live).mp3	high	aggressive	instruments	rock	arana rock	
Denis Azabagic / Printemps de la Guitare 1996 /	Denis Azabagi	c - Printemps de	la Guitare 1996 - 04 - Le	o Brouwer - Le Dec	ameron Noir - La fu	ite des Amants pa	r la Vallee des Echos.mp3	
	neutral	slow	medium	soft	instruments	classical	guitar	
Denis Azabagic / Printemps de la Guitare 1996 /	Denis Azabagi	c - Printemps de	la Guitare 1996 - 06 - Joa	aquin Rodrigo - Cor	ncierto de Aranjuez	- Allegro con spiri	to.mp3	1
Donie Azabagie / Printempe do la Cuitare 1996 /	happy Donic Azəbəgi	medium Printompo do l	high	neutral Brouwer Le Dec	instruments	classical	guitar	
Denis Azabagic / Timenips de la Guitale 1990 /	neutral	medium	medium	soft	instruments	classical	guitar	
Denis Azabagic / Printemps de la Guitare 1996 /	Denis Azabagi	c - Printemps de	la Guitare 1996 - 07 - Joa	aquin Rodrigo - Cor	ncierto de Aranjuez	- Adagio.mp3	0	
	sad	slow	high	neutral	instruments	classical	guitar	
Denis Azabagic / Printemps de la Guitare 1996 /	Denis Azabagi	c - Printemps de	la Guitare 1996 - 03 - Le medium	o Brouwer - Le Dec	ameron Noir - La H	larpe du Guerrier.n	np3 guitar	1
Denis Azabagic / Printemps de la Guitare 1996 /	Denis Azabagi	c - Printemps de	la Guitare 1996 - 01 - Cl	audy Frederic - Peu	it etre qu'un Valse.n	np3	Банат	1
	neutral	slow	medium	soft	instruments	classical	guitar	
Denis Azabagic / Printemps de la Guitare 1996 /	Denis Azabagi	c - Printemps de	la Guitare 1996 - 02 - Ag	gustin Barrios - Una	Limosna por Amo	r de Dios.mp3		1
Denis Azabagic / Printemps de la Guitare 1996 /	neutral Denis Azabagi	medium	medium la Guitare 1996 - 08 - Ior	neutral aquin Rodrigo - Cor	instruments	- Allegro gentile m	guitar m3	
raddige / rindenps de la Guitale 1990 /	happy	medium	high	soft	instruments	classical	guitar	
Die Toten Hosen / Die Toten Hosen - Auswärtssp	viel - 04 - Ausw	ärtsspiel.mp3						
	happy	very fast	medium	aggressive	both	rock	punk rock	
Die loten Hosen / Die loten Hosen - Auswärtssp	neutral	fast	medium	aggressive	both	rock	punk rock	

APPENDIX A. SPECIFICATION OF THE TEST REPOSITORY

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Die Toten Hosen / Die Toten Hosen - Auswärtssp	viel - 10 - Dankb	ar.mp3	1	1	1	ſ		1
Die Teten Hecen / Die Teten Hecen Auswärteer	neutral	fast	medium Bodon bist mp?	aggressive	both	rock	punk rock	
Die Ioten Hosen / Die Ioten Hosen - Auswartss	sad	medium	medium	soft	vocals	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Auswärtssp	viel - 17 - Vencer	remos - Wir werd	en siegen.mp3					
Distriction II and (Distriction II and Astron	happy	medium	medium	neutral	both	rock	punk rock	
Die loten Hosen / Die loten Hosen - Im Auftrag	des Herrn 0 neutral	1 - Niemals einer verv fast	medium	aggressive	both	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Im Auftrag	des Herrn 0	6 - Bonnie & Clyo	de.mp3	00			1	
	happy	very fast	medium	aggressive	both	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Im Auftrag	des Herrn 0 sad	9 - Paradies.mp3 fast	medium	aggressive	both	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Im Auftrag	des Herrn 1	5 - Mehr davon.n	np3	466100110	bour	IOCK	punktock	
	sad	medium	medium	aggressive	both	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Im Auftrag	des Herm 1	6 - Böser Wolf.mj	p3 modium	coft	both	rock	nunk rock	1
Die Toten Hosen / Die Toten Hosen - Reich & Sex	y - 01 - Hier ko	mmt Alex.mp3	incutain	3011	bour	IOCK	pulk lock	
	neutral	varying	medium	aggressive	both	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Reich & Sex	y - 04 - Azzuro	.mp3		a sustana l	hath	male	mumb mode	1
Die Toten Hosen / Die Toten Hosen - Reich & Sex	y - 10 - Wort zu	im Sonntag.mp3	medium	neutrai	Dom	IUCK	ринк юск	
	sad	medium	medium	soft	both	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Reich & Sex	y - 14 - All die	ganzen Jahre.mp	3		11		a contrar de	
Die Toten Hosen / Die Toten Hosen - Reich & Sex	sad v - 18 - Eisgekü	fast hlter Bommerlur	nder.mp3	aggressive	both	TOCK	рипк госк	
· · · · · · · · · · · · · · · · · · ·	happy	varying	low	neutral	vocals	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Unsterblich	- 01 - Entschule	digung , es tut un	is leid.mp3			· .		1
Die Toten Hosen / Die Toten Hosen - Unsterblich	- 12 - Call of th	tast e wild mp3	medium	neutral	vocals	rock	punk rock	
Die Ioten nosen, Die Ioten nosen "enstelblief	neutral	fast	medium	aggressive	both	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Unsterblich	- 14 - Regen.m	р3						
Die Teter Hener / Die Teter Hener Unstadilich	sad	fast dan Kuahlaahn	medium	aggressive	both	rock	punk rock	
Die Ioten Hosen / Die Ioten Hosen - Unsterblich	happy	medium	medium	neutral	both	rock	punk rock	
Die Toten Hosen / Die Toten Hosen - Unsterblich	- 18 - Die Unen	dlichkeit.mp3		1			1	
	sad	slow	medium	soft	both	rock	punk rock	
Dimmu borgir / Dimmu borgir - Godiess Savage	sad	fast	m.mp3 medium	aggressive	instruments	rock	hard rock	death metal
Dimmu Borgir / Dimmu Borgir - Godless Savage	Garden - 02 - H	Iunnerkongen.m	р3					
	sad	very fast	medium	aggressive	instruments	rock	hard rock	death metal
Dimmu Borgir / Dimmu Borgir - Godless Savage	Garden - 03 - C sad	haos Without Pro medium	ophecy.mp3 medium	aggressive	both	rock	hard rock	death metal
Dimmu Borgir / Dimmu Borgir - Godless Savage	Garden - 06 - S	tormblast (live).n	np3	-88				
	sad	fast	medium	aggressive	both	rock	hard rock	death metal
Dimmu Borgir / Dimmu Borgir - Godless Savage	Garden - 08 - Ii	n Death's Embrac	ce (live).mp3	aggreesive	both	rock	hard rock	dooth motol
Dire Straits / Dire Straits - On The Night - 01 - Ca	lling Elvis.mp3	lust	incutain	aggressive	bour	IOCK	hard lock	ucaurmean
	happy	medium	medium	soft	instruments	rock	pop	
Dire Straits / Dire Straits - On The Night - 02 - Wa	alk Of Life.mp3			ant	hoth	male		
Dire Straits / Dire Straits - On The Night - 05 - Pri	vate Investigat	ions.mp3	medium	SOIL	Dom	IUCK	рор	
	neutral	slow	medium	neutral	instruments	rock	pop	
Dire Straits / Dire Straits - On The Night - 09 - Mo	oney For Nothin	ng.mp3			1.4	,	1	
Dire Straits / Dire Straits - On The Night - 10 - Bro	others In Arms.	medium mp3	medium	neutrai	both	TOCK	рор	
	sad	slow	medium	soft	both	rock	pop	
Dunjingarav / Dunjingarav - Traditional Mongoli	ian Art - 01 - In	tro - Instrumenta	1.mp3		1		1.	1
Duniingaray / Duniingaray - Traditional Mongoli	sad ian Art - 02 - Bu	medium ddyn shashny ay	medium valguut maani.mp3	soft	instruments	world	asia	
Dullingurut / Dullingurut Indutional Mongol	neutral	slow	medium	soft	vocals	world	asia	
Dunjingarav / Dunjingarav - Traditional Mongoli	ian Art - 04 - Ul	geriin kholboo.m	up3					1
Duniingaray / Duniingaray Traditional Mongoli	happy	fast	medium	neutral	instruments	world	asia	
Durjingarav / Durjingarav - Iraunonar wongon	neutral	medium	medium	neutral	instruments	world	asia	
Dunjingarav / Dunjingarav - Traditional Mongoli	ian Art - 09 - Al	tayn magtaal.mp	3					
FAV (FAV Cill by both of Cill by	happy	medium	medium	neutral	both	world	asia	
EAV / EAV - Geid öder Leben! - 01 - Geid öder Le	neutral	medium	medium	neutral	both	rock	pop	austro-pop
EAV / EAV - Geld oder Leben! - 03 - Ba-Ba-Bankt	iberfall.mp3						1 1	
	happy	medium	medium	neutral	both	rock	рор	austro-pop
EAV / EAV - Geld oder Leben! - 05 - Heiße Nächt	e.mp3 happy	medium	medium	neutral	both	rock	pop	austro-pop
EAV / EAV - Geld oder Leben! - 07 - Fata Morgan	a.mp3						1.1	
	neutral	medium	medium	neutral	both	rock	рор	austro-pop
EAV / EAV - Geld oder Leben! - 08 - Märchenprir	nz.mp3	medium	medium	neutral	both	rock	pop	austro-pop
EAV / EAV - Im Himmel ist die Hölle los! - 02 - Ir	n Himmel ist d	ie Hölle los.mp3	inculum	ncutiai	5011	ICLK	Loh.	ausito-pop
	happy	medium	medium	aggressive	both	rock	рор	austro-pop
EAV / EAV - Im Himmel ist die Hölle los! - 05 - S	chau wie's schr	eit.mp3			11			
	nappy	medium	meaium	neutral	DOTH	TOCK	рор	austro-pop

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
EAV / EAV - Im Himmel ist die Hölle los! - 07 - B	ongo Boy.mp3							
TANY (WAY / Y Y) I - I - Y WILL I - A A TO	happy	medium	medium	neutral	both	rock	рор	austro-pop
EAV / EAV - Im Himmel ist die Hölle los! - 11 - D	er Teufel.mp3 neutral	slow	medium	neutral	vocals	rock	рор	austro-pop
EAV / EAV - Im Himmel ist die Hölle los! - 17 - Ja	ja der Alkohol	.mp3					1 1	11
	neutral	slow	medium	neutral	vocals	rock	рор	austro-pop
Eiffel 65 / Eiffel 65 - Blue.mp3	happy	medium	medium	neutral	instruments	electronica	euro-dance	
Eiffel 65 / Eiffel 65 - Dub In Life.mp3								
	happy	medium	medium	neutral	instruments	electronica	euro-dance	
Eiffel 65 / Eiffel 65 - Move Your Body.mp3	happy	medium	medium	neutral	instruments	electronica	euro-dance	1
Enya / Enya - Paint The Sky With Stars - The Best	Of Enya - 01 -	Orinoco Flow.mp	3	neutiai	nistruments	ciccuonica	culo-dance	
	happy	medium	medium	soft	both	new age	celtic new age	
Enya / Enya - Paint The Sky With Stars - The Best	Of Enya - 02 -	Caribbean Blue.n	np3 modium	coft	both	2014 2020	coltic pour ago	
Enya / Enya - Paint The Sky With Stars - The Best	Of Enya - 08 -	Shepherd Moons	.mp3	3011	bour	new age	cente new age	
	neutral	very slow	medium	soft	instruments	new age	celtic new age	
Enya / Enya - Paint The Sky With Stars - The Best	Of Enya - 13 -	Marble Halls.mp	3	auft	hath			
Enya / Enya - Paint The Sky With Stars - The Best	Of Enva - 16 -	Boadicea.mp3	medium	son	boun	new age	cente new age	
	neutral	slow	low	soft	both	new age	celtic new age	
Floorfilla / Floorfilla - Anthem #1.mp3	1				1	di stanati s	tere er	
Floorfilla / Floorfilla - Anthem #2.mp3	парру	medium	meaium	neutral	instruments	electronica	trance	I
F	happy	medium	low	aggressive	both	electronica	trance	
Floorfilla / Floorfilla - Anthem #3.mp3	1		1		11	4.4		
Floorfilla / Floorfilla - Anthem #4 mp3	happy	medium	low	neutral	both	electronica	trance	1
Tioonna / Tioonna Tuttient # Impo	happy	medium	medium	aggressive	instruments	electronica	trance	
Floorfilla / Floorfilla - Anthem #5.mp3	T.		1 -					
Eloorfilla / Eloorfilla - Est-ce Que Enter The Aren	happy mp3	medium	low	aggressive	instruments	electronica	trance	
Piorinia / Piorinia - Est-ce Que Enter The Arena	happy	medium	medium	aggressive	both	electronica	trance	
Floorfilla / Floorfilla - Le Délire (Extended Mix).n	np3							
Eleorfilla / Eleorfilla Technoromance mp2	happy	medium	medium	aggressive	instruments	electronica	trance	
rioonnia / rioonnia - iechioromance.mps	happy	medium	medium	neutral	both	electronica	trance	
Floorfilla / Floorfilla - The Hypno.mp3								
Energy Coll / Energy Coll, Constant Utile, M. L.	neutral	medium	low	neutral	both	electronica	trance	
France Gail / France Gail - Greatest Hits - 01 - Lai	happy	medium	medium	soft	both	world	chanson	
France Gall / France Gall - Greatest Hits - 02 - Pou	apée De Cire Po	oupée De Son.mp	3					
	happy	medium	medium	neutral	both	world	chanson	
France Gall / France Gall - Greatest Hits - 03 - Bet	neutral	medium	medium	soft	both	world	chanson	
France Gall / France Gall - Greatest Hits - 06 - Jaz	z A Gogo.mp3							
	neutral	fast	medium	neutral	both	world	chanson	
France Gall / France Gall - Greatest Hits - 08 - Ne	Soit Pas Si Beb neutral	e.mp3 medium	medium	soft	both	world	celtic	
Frank Zappa / Frank Zappa - Läther (Disc 1) - 01	- Re-gyptian St	rut.mp3						
	neutral	medium	high	neutral	instruments	rock	experimental rock	
Frank Zappa / Frank Zappa - Läther (Disc 1) - 07	- Tryin' To Gro neutral	w A Chin.mp3 medium	high	aggressive	both	rock	experimental rock	
Frank Zappa / Frank Zappa - Läther (Disc 1) - 12	- Rdnzl.mp3		8	-58				
	happy	medium	high	neutral	instruments	rock	experimental rock	
Frank Zappa / Frank Zappa - Läther (Disc 2) - 01	 Honey, Don't happy 	You Want A Mar medium	n Like Me.mp3 high	neutral	both	rock	experimental rock	
Frank Zappa / Frank Zappa - Läther (Disc 2) - 06	- The Purple La	igoon.mp3					-T	I
	neutral	medium	high	neutral	instruments	rock	experimental rock	
Frank Zappa / Frank Zappa - Läther (Disc 2) - 09	- Spider Of Des	stiny.mp3 medium	high	neutral	instruments	rock	experimental rock	
Frank Zappa / Frank Zappa - Läther (Disc 3) - 01	- Filthy Habits.	mp3	ingh	neutrai	nistruncius	IOCK	experimentar lock	
	neutral	medium	high	neutral	instruments	rock	experimental rock	
Frank Zappa / Frank Zappa - Läther (Disc 3) - 04	- The Adventu	res Of Greggery I	Peccary.mp3	noutral	both	rock	ovporimontal rock	
Frank Zappa / Frank Zappa - Läther (Disc 3) - 08	- Time Is Mone	y.mp3	nigh	neutiai	bour	IOCK	experimentariock	
	happy	medium	high	neutral	instruments	rock	experimental rock	
Frank Zappa / Frank Zappa - The Yellow Shark -	09 - Ruth Is Sle	eping.mp3	madium		in stars t -	alassia;1		1
Frank Zappa / Frank Zappa - The Yellow Shark -	12 - Questi Caz	zi Di Piccione.m	p3	aggressive	insuuments	ciassical	рано	1
	sad	varying	high	neutral	instruments	classical	modern	
Frank Zappa / Frank Zappa - The Yellow Shark -	15 - Welcome T	o The United Sta	tes.mp3	a many 1	hath	made	annanine t-1 1	
Frank Zappa / Frank Zappa - The Yellow Shark -	neutral 18 - Get White	varying /.mp3	nign	aggressive	DOIN	TOCK	experimental rock	1
	neutral	varying	high	neutral	instruments	rock	experimental rock	
Frank Zappa / Frank Zappa - The Yellow Shark -	19 - G-Spot Tor	nado.mp3	1.1.1		Terretorius			
Frijid Pink / Frijid Pink - Frijid Pink - 01 - God Ga	happy we Me You mp	medium 3	nigh	aggressive	instruments	TOCK	experimental rock	1
, , , ,	happy	slow	medium	soft	both	rock	psychedelic rock	
filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
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Frijid Pink / Frijid Pink - Frijid Pink - 05 - Tell Me	Why.mp3	-	-			-		-
Emild Bink / Emild Bink Emild Bink 07 Harras	sad Of The Bising C	medium	medium	aggressive	both	rock	psychedelic rock	
Frijia Pink / Frijia Pink - Frijia Pink - 07 - House (sad	un.mp3 medium	medium	aggressive	both	rock	psychedelic rock	
Frijid Pink / Frijid Pink - Frijid Pink - 10 - Heartbr	reak Hotel.mp3							
Friiid Pink / Friiid Pink Friiid Pink 11 Music F	sad For The People	medium	medium	aggressive	both	rock	psychedelic rock	
riju i nik / riju i nik - riju i nik - ii - Music i	happy	slow	medium	soft	both	rock	psychedelic rock	1
Gary Moore / Gary Moore - Back To The Blues - 0	1 - Enough Of	The Blues.mp3	1					
Came Magne / Came Magne Bask To The Place 0	neutral	medium	medium	aggressive	both	rock	blues rock	
Gary Moore / Gary Moore - back to the blues - 0	neutral	medium	medium	neutral	both	rock	blues rock	
Gary Moore / Gary Moore - Back To The Blues - 0	4 - Stormy Mor	nday.mp3						
Came Magne / Came Magne Bask To The Place 0	neutral The Brenches	slow	medium	neutral	both	rock	blues rock	
Gary Moore / Gary Moore - back to the blues - 0	sad	slow	medium	neutral	instruments	rock	blues rock	
Gary Moore / Gary Moore - Back To The Blues - 1	0 - Drowning I	n Tears.mp3						
Came Maama / Came Maama Cameidana Of Passan	sad	slow	medium	soft	both	rock	blues rock	
Gary Moore / Gary Moore - Corndors Of Power-	neutral	medium	medium	neutral	both	rock	arena rock	
Gary Moore / Gary Moore - Corridors Of Power -	03 - Wishing V	Vell.mp3						
Came Maama / Came Maama Cameidana Of Passan	neutral	medium	medium	neutral	both	rock	arena rock	
Gary Moore / Gary Moore - Corndors Of Power-	sad	medium	medium	neutral	both	rock	arena rock	
Gary Moore / Gary Moore - Corridors Of Power -	07 - Rockin' E	very Night.mp3						
Com Mann / Com Marine Co. 11 - 2017	happy	fast	medium	aggressive	both	rock	arena rock	L
Gary Moore / Gary Moore - Corridors Of Power -	sad	slow	w.mp3 medium	soft	both	rock	arena rock	
Gary Moore / Gary Moore - Dirty Fingers - 01 - H	liroshima.mp3			•	•			·
	sad	fast	medium	aggressive	both	rock	arena rock	
Gary Moore / Gary Moore - Dirty Fingers - 05 - R	un To Your Ma neutral	na.mp3 fast	medium	aggressive	both	rock	arena rock	[
Gary Moore / Gary Moore - Dirty Fingers - 06 - N	uclear Attack.r	np3						
	sad	medium	medium	aggressive	both	rock	arena rock	
Gary Moore / Gary Moore - Dirty Fingers - 09 - Lo	onely Nights.m sad	p3 medium	medium	neutral	both	rock	arena rock	[
Gary Moore / Gary Moore - Dirty Fingers - 10 - R	est In Peace.mp	3						
	sad	slow	medium	soft	both	rock	arena rock	
Gary Moore / Gary Moore - Run For Cover - 01 -	Run For Cover. neutral	mp3 fast	medium	aggressive	both	rock	arena rock	[
Gary Moore / Gary Moore - Run For Cover - 02 -	Reach For The	Sky.mp3	meenum	466100110	bour	Iock	uleila lock	
	happy	medium	medium	neutral	both	rock	arena rock	
Gary Moore / Gary Moore - Run For Cover - 04 -	Empty Rooms. sad	mp3 slow	medium	soft	both	rock	arena rock	<u> </u>
Gary Moore / Gary Moore - Run For Cover - 06 -	Out In The Fiel	ds.mp3	meenum	bolt	bour	lock	ultim lock	<u> </u>
	neutral	fast	medium	aggressive	both	rock	arena rock	
Gary Moore / Gary Moore - Run For Cover - 10 -	Listen To Your neutral	Heartbeat.mp3 medium	medium	soft	both	rock	arena rock	<u> </u>
Gigi d'Agostino / Gigi d'Agostino - Another Way	(Extended Ver	sion).mp3						
	neutral	medium	low	neutral	instruments	electronica	trance	
Gigi d'Agostino / Gigi d'Agostino - Another Way	.mp3 neutral	medium	low	neutral	instruments	electronica	trance	I
Gigi d'Agostino / Gigi d'Agostino - Bla Bla Bla.m	p3	meanum	1011	neutun	instrumento	ciccionici	timitt	<u>I</u>
	neutral	medium	low	aggressive	instruments	electronica	trance	
Gigi d'Agostino / Gigi d'Agostino - Elisir.mp3	neutral	medium	medium	soft	both	electronica	trance	<u> </u>
Gigi d'Agostino / Gigi d'Agostino - Gigi Dag.mp	3	inculum	incentin	3011	bour	cicettonica	unice	<u>I</u>
	neutral	medium	low	aggressive	instruments	electronica	trance	
Gigi d'Agostino / Gigi d'Agostino - Ice Ice Baby 2	2001.mp3	medium	medium	aggressive	instruments	electronica	trance	1
Gigi d'Agostino / Gigi d'Agostino - L'Amour Tou	ijours.mp3	meanum	inecium	aggressive	instruments	electronica	trance	l
	sad	slow	medium	soft	both	electronica	trance	
Gigi d'Agostino / Gigi d'Agostino - La Danse (Tai	nzen Vision Re	mix).mp3 medium	low	aggressive	instruments	electronica	trance	1
Gigi d'Agostino / Gigi d'Agostino - La Passion.m	p3	incertain	1014	aggressive	nistruments	cicculonica	tiance	
	happy	medium	low	soft	both	electronica	trance	
Gigi d'Agostino / Gigi d'Agostino - Super (Extend	ded Version).m	p3 modium	madium	aggreceive	instruments	alactropics	tranco	
Gigi d'Agostino / Gigi d'Agostino - Super 123.mp	3	meanum	incurum	appressive	monuments	ciccuonica	lance	1
	neutral	medium	medium	aggressive	instruments	electronica	trance	
Gigi d'Agostino / Gigi d'Agostino - The Riddle.m	1p3 happy	medium	medium	neutral	both	electropics	trance	
Gigi d'Agostino / Gigi d'Agostino - The Way.mp3	парру	meurum	meulum	neutrai	Jour	ciecuonica	uance	<u>I</u>
	happy	medium	medium	neutral	both	electronica	trance	
Gigi d'Agostino / Gigi d'Agostino - You Spin Me	Round.mp3	medium	medium	neutral	both	electropics	trance	
Goldfrapp / Goldfrapp - Felt Mountain - 01 - Lov	ely Head.mp3	ancurum	inculum	ncutiai	5000	ciccuonica	cance	L
	sad	slow	medium	soft	both	rock	alternative rock	
Goldfrapp / Goldfrapp - Felt Mountain - 02 - Pap	er Bag.mp3	slow	medium	soft	both	rock	alternative rock	
	June							1

filmana	mood	tamma	comularity	amotion	forme	anna	auhaanna	auhauhaanna
Jitenume	тоои	iempo	complexity	emotion	Jocus	genie	subgente	subsubgente
Goldfrapp / Goldfrapp - Felt Mountain - 03 - Hu	nan.mp3	alaru	m a diama	n sustanal	hath	an als	altomativo no ale	1
Goldfrapp / Goldfrapp - Felt Mountain - 04 - Pilo	ts.mp3	SIOW	medium	neutrai	bour	IOCK	alternative fock	
Columpy / Columpy Tel Mountain 01 The	neutral	slow	medium	soft	both	rock	alternative rock	
Goldfrapp / Goldfrapp - Felt Mountain - 05 - Dee	r Stop.mp3							
•	sad	very slow	medium	soft	both	rock	alternative rock	
Goldfrapp / Goldfrapp - Felt Mountain - 06 - Felt	Mountain.mp3					-		
	neutral	very slow	medium	soft	both	rock	alternative rock	
Goldfrapp / Goldfrapp - Felt Mountain - 07 - Oor	npa Radar.mp3							1
Caldfrom / Caldfrom Tak Mauntain 08 Uka	sad	slow	high	neutral	instruments	rock	alternative rock	
Goldirapp / Goldirapp - Feit Mountain - 08 - 010	sad	slow	medium	neutral	both	rock	alternative rock	
Goldfrapp / Goldfrapp - Felt Mountain - 09 - Hor	se Tears.mp3	51011	medium	neutur	bour	IOCK	unchildrer fock	
country country country	sad	very slow	medium	soft	both	rock	alternative rock	
Grupo Comarca Bolivia / Grupo Comarca Bolivia	- Ilusión Herio	la - 01 - Ilusion H	erida (Carnavalito).mp	3				
-	happy	medium	medium	neutral	both	world	latin	
Grupo Comarca Bolivia / Grupo Comarca Bolivia	- Ilusión Herio	la - 02 - Boliviam	anta (Tinku).mp3					
	happy	medium	medium	neutral	both	world	latin	
Grupo Comarca Bolivia / Grupo Comarca Bolivia	- Ilusión Herio	la - 03 - Al Partiti	r (Sicuriada).mp3	1	1	1		1
	happy	medium	medium	neutral	both	world	latin	
Grupo Comarca Bolivia / Grupo Comarca Bolivia	- Ilusión Heric	la - 04 - Puerta de	el Sol (Motivo).mp3		1		1.05	
Crupo Comarca Bolivia / Crupo Comarca Bolivia	sad Ilución Horic	slow	a Dal Silancia (Carnava	lito) mp2	instruments	world	latin	
Grupo Contarca bonvia / Grupo Contarca bonvia	happy	medium	medium	neutral	instruments	world	latin	
Grupo Comarca Bolivia / Grupo Comarca Bolivia	- Ilusión Herio	a - 09 - En Carna	val (Tonada), mp3	neutur	notuniens	wond	intin	
	neutral	fast	medium	neutral	instruments	world	latin	
Grupo Comarca Bolivia / Grupo Comarca Bolivia	- Ilusión Heric	la - 10 - Viento D	e Los Andes.mp3					
	neutral	slow	medium	neutral	instruments	world	latin	
Grupo Comarca Bolivia / Grupo Comarca Bolivia	- Ilusión Heric	la - 12 - Ch Askos	sita (Sicuriada).mp3	•	•	•		•
	happy	medium	medium	neutral	both	world	latin	
Hammerfall / Hammerfall - Crimson Thunder - 0	1 - Riders Of T	he Storm.mp3	-			-		
	neutral	medium	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Crimson Thunder - (2 - Hearts On I	ire.mp3		1				
	neutral	fast	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Crimson Thunder - C	4 - Crimson Th	under.mp3			1		hand as de	1
Hammerfall / Hammerfall - Crimson Thunder - (neutral 9 - The Unform	iving Blade mp3	medium	aggressive	both	TOCK	nard rock	true metal
Hannichan / Hannichan - Chinson Hunder - C	neutral	medium	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Crimson Thunder - 1	2 - Rising Force	e.mp3	meanum	appressive	bour	IOCK	hand lock	uue meun
	neutral	very fast	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Glory To The Brave -	01 - The Drago	n Lies Bleeding.r	np3	00	•			•
<u>.</u>	neutral	very fast	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Glory To The Brave -	03 - Hammerfa	all.mp3						
	happy	fast	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Glory To The Brave -	05 - Child Of T	he Damned.mp3				-		
	neutral	fast	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Glory To The Brave -	06 - Steel Meet	s Steel.mp3		1				
	neutral	fast	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Glory to The Brave -	09 - Glory Io I	he Brave.mp3			1	- as at	hand an de	1
Hammerfall / Hammerfall - Legacy of Kings - 01	sad Heeding the (all mp3	medium	sort	both	TOCK	hard rock	true metal
Hammerian / Hammerian - Legacy of Kings - of	neutral	fast	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Legacy of Kings - 02	- Legacy of Kir	gs.mp3		199.0001.0				
	neutral	fast	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Legacy of Kings - 05	- Remember Ye	sterday.mp3						
	sad	slow	medium	neutral	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Legacy of Kings - 09	- Warriors of Fa	aith.mp3						
	neutral	very fast	medium	aggressive	both	rock	hard rock	true metal
Hammerfall / Hammerfall - Legacy of Kings - 10	- The Fallen Or	ie.mp3		1	1		1	1
	sad	slow	medium	neutral	both	rock	hard rock	true metal
Hubert von Goisern / Hubert von Goisern - Inext	1 (1ibet) - 01 - Y	erketamu.mp3	1.				r .	1
U. h. et al. C. data (U. h. et al. C. data h. h. et	happy	medium	medium	neutral	instruments	world	asia	
Hubert von Goisern / Hubert von Goisern - Inext	1 (11bet) - 02 - P	anchen Lama.mp	modium	coft	both	world	acia	
Hubert von Coisern / Hubert von Coisern - Inevi	1 (Tibet) - 07 - N	Ivelu mp3	medium	5011	bour	wond	asia	
Hubert von Golsent / Hubert von Golsent - Inex	sad	very slow	medium	soft	both	world	asia	
Hubert von Goisern / Hubert von Goisern - Inexi	l (Tibet) - 09 - S	ugkinyima.mp3						1
	neutral	fast	high	neutral	both	world	asia	
Hubert von Goisern / Hubert von Goisern - Inexi	l (Tibet) - 10 - 1	0. März 1959.mp	3					
	happy	medium	medium	neutral	both	world	asia	
In Extremo / In Extremo - Verehrt und Angespier	n - 01 - Mersebu	rger Zaubersprü	che.mp3					
	sad	slow	medium	aggressive	both	rock	folk rock	
In Extremo / In Extremo - Verehrt und Angespier	1 - 03 - Herr Ma	nnelig.mp3				-		
	neutral	medium	medium	neutral	both	rock	folk rock	
In Extremo / In Extremo - Verehrt und Angespier	n - 05 - Spielma	nnsfluch.mp3			h - d		(allowed)	1
In Endermond / In Endermond - March et al. 3.4	sad	tast	medium	aggressive	both	rock	IOIK TOCK	
in Extenio / in Extenio - verenrt und Angespier	neutral	fast	medium	aggreeeive	both	rock	folk rock	
In Extremo / In Extremo - Verebrt und Angespier	1- 12 - In Extror	no.mp3	ancunulli	аббиеззике	Dout	IULK	JUIK IUCK	1
,	happy	fast	medium	aggressive	instruments	rock	folk rock	

filename	mood	temvo	complexity	emotion	focus	genre	subgenre	subsubgenre
In Extremo / In Extremo - Weckt die Toten! - 01 -	Ai vis lo lop.mi	n3	y)	80000		the the gener
	neutral	fast	medium	aggressive	both	rock	folk rock	
In Extremo / In Extremo - Weckt die Toten! - 03 -	Hiemali Tempo	ore.mp3						
To Estimate (To Estimate Market States) 04	neutral	medium	medium	neutral	both	rock	folk rock	
In Extremo / In Extremo - Weckt die Toten! - 04 -	sad	medium	medium	neutral	both	rock	folk rock	
In Extremo / In Extremo - Weckt die Toten! - 07 -	Palästinalied.m	ip3						
	sad	medium	medium	aggressive	both	rock	folk rock	
In Extremo / In Extremo - Weckt die Toten! - 11 -	Der Galgen.mp	3 faat			hath	made	follo mode	1
IBO / IBO - Anti-Teletubbie.mp3	sau	last	medium	aggressive	bour	IOCK	101K TOCK	
	happy	slow	medium	soft	both	rock	рор	
JBO / JBO - Arbeitslos Und Spaß Dabei.mp3	г. —		1				1	1
IBO / IBO - Bolle mp3	happy	medium	medium	neutral	both	rock	рор	
Jbo / Jbo - boncantpo	happy	medium	medium	neutral	both	rock	рор	
JBO / JBO - Born In Der Nase.mp3								
	happy	medium	medium	neutral	both	rock	pop	
JBO / JBO - Das Goldene Stück Scheiße.mp3	and	clow	modium	noutral	both	rock	non	1
JBO / JBO - Die Schlümpfe.mp3	344	31014	incentain	neutia	bour	IOCK	pop	
	happy	medium	medium	neutral	both	rock	pop	
JBO / JBO - Frauen.mp3			1				1	1
IBO / IBO - Gimme Done Joanna mn3	neutral	fast	medium	neutral	both	rock	рор	
Joe / Joe Chinic Dope Journaumpo	happy	medium	medium	neutral	both	rock	рор	
JBO / JBO - Jump.mp3								
	happy	medium	medium	neutral	vocals	rock	рор	
JBO / JBO - Live Sex - 05 - Hose Runter.mp3	happy	medium	medium	neutral	both	rock	pop	
JBO / JBO - Live Sex - 09 - Ich Sag' J.B.Omp3	парру	meann	incutain	neutiai	bour	IOCK	pop	
	neutral	medium	medium	aggressive	both	rock	рор	
JBO / JBO - Live Sex - 11 - Verteidiger Des Blödsin	nns.mp3		1				1	1
IBO / IBO - Moskau mp3	happy	medium	medium	neutral	both	rock	pop	
jbo / jbo - Moskatinipo	happy	medium	medium	neutral	both	rock	рор	
JBO / JBO - Nur Geträumt.mp3								
	happy	varying	medium	neutral	vocals	rock	pop	
Bad Religion / Bad Religion - The Gray Race - 16	- Punk Rock So	ng (German Lan	guage - Bonus Track).m	aggressive	both	rock	punk rock	
Culture Beat / Culture Beat - Got To Get It - 01 - 0	Got To Get It (Ra	aw Deal Mix).mp	3	aggressive	bour	IOCK	pulk lock	
	happy	fast	medium	neutral	both	electronica	euro-dance	
Culture Beat / Culture Beat - Got To Get It - 02 - C	Got To Get It (Cl	lub Mix).mp3	1					1
Culture Beat / Culture Beat - Got To Get It - 03 - 0	happy Got To Get It (F)	tast stended Album N	fix) mp3	neutral	both	electronica	euro-dance	
Canale Barry Canale Barr Obrio Cerir 00 C	happy	fast	medium	neutral	both	electronica	euro-dance	
Culture Beat / Culture Beat - Got To Get It - 04 - 0	Got To Get It (H	ypnotic Mix).mp	3					
Colum Bart / Colum Bart Col To Col Barts	happy	fast	medium	neutral	instruments	electronica	euro-dance	
Culture Beat / Culture Beat - Got 10 Get II - 05 - C	happy	fast	medium	neutral	both	electronica	euro-dance	
Jean Michel Jarre / Jean Michel Jarre - Oxygene 7-	-13 - 01 - Oxyge	ne 7.mp3						
	neutral	medium	medium	neutral	instruments	new age	progressive electronic	
Jean Michel Jarre / Jean Michel Jarre - Oxygene 7-	-13 - 02 - Oxyge	ne 8.mp3 modium	high	noutral	instruments	2014 2020	progracivo electropio	1
Jean Michel Jarre / Jean Michel Jarre - Oxygene 7-	-13 - 03 - Oxyge	me 9.mp3	nign	neutrai	instruments	new age	progressive electronic	
	sad	slow	high	soft	instruments	new age	progressive electronic	
Jean Michel Jarre / Jean Michel Jarre - Oxygene 7-	-13 - 04 - Oxyge	ne 10.mp3				1		1
Joan Michal Jarm / Joan Michal Jarm Ovygono 7	happy	medium	medium	neutral	instruments	new age	progressive electronic	
Jean Michel Jane / Jean Michel Jane - Oxygene /	neutral	fast	high	aggressive	instruments	new age	progressive electronic	
Jean Michel Jarre / Jean Michel Jarre - Oxygene 7-	-13 - 06 - Oxyge	ne 12.mp3					14 0	
	neutral	fast	high	neutral	instruments	new age	progressive electronic	
Jean Michel Jarre / Jean Michel Jarre - Oxygene 7-	-13 - 07 - Oxyge	ne 13.mp3	medium	soft	instruments	Dew 309	progressive electronic	
Kansas / Kansas - Point Of Know Return - 01 - Po	oint Of Know R	eturn.mp3	incontaint	3011	instruments	new age	progressive electronic	
	happy	medium	medium	aggressive	both	rock	arena rock	
Kansas / Kansas - Point Of Know Return - 02 - Pa	radox.mp3		1					1
Kansas / Kansas - Point Of Know Return - 04 - Po	neutral ortrait (He Kney	medium	medium	neutral	both	rock	arena rock	
	neutral	medium	medium	aggressive	both	rock	arena rock	
Kansas / Kansas - Point Of Know Return - 07 - De	ust In The Wind	1.mp3						
V /V D	sad	slow	medium	soft	both	rock	arena rock	
Kansas / Kansas - Point Of Know Return - 10 - Ho	neutral	an.mp3 medium	medium	aggressive	both	rock	arena rock	
Led Zeppelin / Led Zeppelin - Remasters - 01 - C	ommunication	Breakdown.mp3		.00.000470				1
	neutral	fast	medium	aggressive	both	rock	hard rock	heavy metal
Led Zeppelin / Led Zeppelin - Remasters - 03 - G	ood Times Bad	Times.mp3	modium	noutral	both	rock	hand male	home matal
Led Zeppelin / Led Zeppelin - Remasters - 05 - W	hole Lotta Lov	e.mp3	meululli	neutfal	DOUI	IUCK	natu totk	neavy metai
<u> </u>	neutral	medium	medium	aggressive	both	rock	hard rock	heavy metal

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Led Zeppelin / Led Zeppelin - Remasters - 06 - H	eartbreaker.mp	3	1	I				1
Led Zeppelin / Led Zeppelin - Remasters - 10 - Si	neutral nce I've Been I	varying oving You.mp3	medium	aggressive	both	rock	hard rock	heavy metal
	sad	slow	medium	neutral	both	rock	hard rock	heavy metal
Led Zeppelin / Led Zeppelin - Remasters - 15 - St	airway To Hea	ven.mp3 slow	medium	soft	both	rock	hard rock	heavy metal
Lordi / Lordi - Biomechanic Man.mp3	Suu	51011	meanin	bolt	bour	IOCK	haird fock	neavy near
Lordi / Lordi - Devil Is A Loser mp3	neutral	fast	medium	aggressive	both	rock	hard rock	heavy metal
Lordi / Lordi - Devil is / Losenings	neutral	fast	medium	aggressive	both	rock	hard rock	heavy metal
Lordi / Lordi - Dynamite Tonite.mp3	noutral	fact	modium	aggregeive	both	rock	hand mak	hopyry motal
Lordi / Lordi - Get Heavy.mp3	ileutiai	last	inection	aggressive	bour	IOCK	hard lock	neavy metai
Lordi / Lordi Loop Of Dominance mp?	neutral	fast	medium	aggressive	both	rock	hard rock	heavy metal
Lorui / Lorui - Icon Or Dominance.mp5	sad	medium	medium	aggressive	both	rock	hard rock	heavy metal
Lordi / Lordi - Last Kiss Good Bye.mp3	1	6.1			11		hand on the	have a state
Lordi / Lordi - Monsters Monsters.mp3	sad	rast	meaium	aggressive	both	TOCK	nard rock	neavy metai
	happy	fast	medium	aggressive	both	rock	hard rock	heavy metal
Lordi / Lordi - Not The Nicest Guy.mp3	neutral	medium	medium	aggressive	both	rock	hard rock	heavy metal
Lordi / Lordi - Rock The Hell Outta You.mp3		1		00	1	1		
Lordi / Lordi - Scarctic Cricle Gathering.mp3	neutral	medium	medium	aggressive	both	rock	hard rock	heavy metal
	sad	slow	medium	neutral	instruments	rock	hard rock	heavy metal
Lordi / Lordi - Would You Love A Monsterman.m	np3 neutral	fast	medium	aggressive	both	rock	hard rock	heavy metal
Lunasa / Lunasa - Otherworld - 01 - Goobye Miss	s Goodavich - F	losie's Reel.mp3	incentuin	uggicssive	bout	IOCK	hard lock	icavy netai
Lunce / Lunce Otherwoold 02 The Election	happy Growbar Met	fast	medium	neutral	instruments	world	celtic	celtic folk
Lunasa / Lunasa - Otnerworld - 02 - The Floating	happy	very fast	medium	neutral	instruments	world	celtic	celtic folk
Lunasa / Lunasa - Otherworld - 03 - The Butlers 0	Of Glen Avenue	- Sliabh Russel -	Cathal McConnell's.m	р3				
Lunasa / Lunasa - Otherworld - 08 - Stolen Apple	neutral es.mp3	fast	medium	neutral	instruments	world	celtic	celtic folk
	neutral	medium	medium	soft	instruments	world	celtic	celtic folk
Lunasa / Lunasa - Otherworld - 11 - O'Carolan's	Welcome - Roll sad	ing in the Barrel. medium	mp3 medium	soft	instruments	world	celtic	celtic folk
Lunasa / Lunasa - The Merry Sisters Of Fate - 01	- Aoibhneas.mj	53	-					
Lunasa / Lunasa - The Merry Sisters Of Fate - 03	happy Killarney Boy	medium of Pleasure mp	medium 3	neutral	instruments	world	celtic	celtic folk
Eurasa / Eurasa - The Merry Sisters Of Pare - 05	neutral	medium	medium	neutral	instruments	world	celtic	celtic folk
Lunasa / Lunasa - The Merry Sisters Of Fate - 07	- Paistin Fionn.	mp3	madium	soft	inctrumonte	world	coltic	coltic folk
Lunasa / Lunasa - The Merry Sisters Of Fate - 09	- Scully's.mp3	31014	incentuin	3011	nistruments	world	cente	cente loik
Lungon / Lungon The Marry Sisters Of Esta 11	neutral Morring Nick	medium	medium	neutral	instruments	world	celtic	celtic folk
Lunasa / Lunasa - The Merry Sisters Of Fate - 11	neutral	fast	medium	neutral	instruments	world	celtic	celtic folk
Manowar / Manowar - Louder Than Hell - 01 - R	eturn Of The W	arlord.mp3			11		hand as de	have a state
Manowar / Manowar - Louder Than Hell - 02 - B	neutral rothers Of Meta	fast al Pt.1.mp3	medium	aggressive	both	rock	hard rock	heavy metal
	happy	medium	medium	neutral	both	rock	hard rock	heavy metal
Manowar / Manowar - Louder Than Hell - 03 - T	he Gods Made neutral	Heavy Metal.mp medium	3 medium	aggressive	both	rock	hard rock	heavy metal
Manowar / Manowar - Louder Than Hell - 05 - N	umber 1.mp3							
Manowar / Manowar - Louder Than Hell - 10 - T	neutral he Power.mp3	medium	medium	aggressive	both	rock	hard rock	heavy metal
	neutral	fast	medium	aggressive	both	rock	hard rock	heavy metal
Manowar / Manowar - The Hell Of Steel - Best O	f Manowar - 01	- Fighting The W	/orld.mp3		hath	made	hand male	horrer motol
Manowar / Manowar - The Hell Of Steel - Best O	f Manowar - 02	- Kings Of Metal	I.mp3	aggressive	bout	IUCK	пати юск	neavy metai
	neutral	medium	medium	aggressive	both	rock	hard rock	heavy metal
Manowar / Manowar - The Hell Of Steel - best O	sad	 The Demon s v varying 	medium	aggressive	both	rock	hard rock	heavy metal
Manowar / Manowar - The Hell Of Steel - Best O	f Manowar - 05	- Defender.mp3						· ·
Manowar / Manowar - The Hell Of Steel - Best O	sad f Manowar - 12	- Herz Aus Stahl	medium I.mp3	neutral	both	rock	hard rock	heavy metal
	neutral	slow	medium	neutral	both	rock	hard rock	heavy metal
Manowar / Manowar - The Hell Of Steel - Best O	f Manowar - 14 neutral	- Master Of The slow	Wind.mp3 medium	soft	both	rock	hard rock	heavy metal
Marillion / Marillion - Fugazi - 01 - Assassing.mp	3	1		1	1	1		
Marillion / Marillion - Fugazi - 03 - Jiosaw mp3	neutral	medium	medium	neutral	both	rock	progressive rock	
and a second sec	sad	slow	medium	neutral	both	rock	progressive rock	
Marillion / Marillion - Fugazi - 04 - Emerald Lies	mp3	varving	medium	neutral	both	rock	progressive rock	
Marillion / Marillion - Fugazi - 06 - Incubus.mp3	incutal	varynig	incurulit	incutidi	bour	IULK	Progressive lock	I
Marillian / Marillian French 07 French 0	sad	varying	medium	neutral	both	rock	progressive rock	
ivianiiion / ivianiiion - Fugazi - 0/ - Fugazi.mp3	sad	varying	high	neutral	both	rock	progressive rock	

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Mike Oldfield / Mike Oldfield - Guitars - 01 - Mu	se.mp3	tempe	complexity	enterrent	Jeene	80000	Sucgenite	Succuegenie
	sad	slow	medium	soft	instruments	new age	progressive electronic	
Mike Oldfield / Mike Oldfield - Guitars - 03 - Em	bers.mp3							
Miles Oldfield / Miles Oldfield Creiterer 04 Sur	neutral	slow	medium	soft	instruments	new age	progressive electronic	<u> </u>
Mike Oldheid / Mike Oldheid - Guitars - 04 - Sur	neutral	slow	medium	soft	instruments	new age	progressive electronic	1
Mike Oldfield / Mike Oldfield - Guitars - 09 - Ou	t Of Mind.mp3					0	1 0	
	neutral	medium	medium	neutral	instruments	new age	progressive electronic	
Mike Oldfield / Mike Oldfield - Guitars - 10 - Fro	m The Ashes.n	np3 clow	modium	coft	instruments	2014 200	progracivo electropio	1
Mike Oldfield / Mike Oldfield - Tubular Bells II -	01 - Sentinel.m	p3	medium	5011	insu unients	new age	piogressive electronic	
	neutral	medium	medium	soft	instruments	new age	progressive electronic	
Mike Oldfield / Mike Oldfield - Tubular Bells II -	03 - Clear Ligh	t.mp3				1		T
Mike Oldfield / Mike Oldfield - Tubular Bells II -	08 - Weightless	medium	high	soft	instruments	new age	progressive electronic	
	neutral	slow	medium	soft	instruments	new age	progressive electronic	
Mike Oldfield / Mike Oldfield - Tubular Bells II -	11 - Tattoo.mp	3						
Mike Oldfield / Mike Oldfield Tubular Balle II	neutral	medium	medium	soft	instruments	new age	progressive electronic	
Mike Oldheid / Mike Oldheid - Tubulai bens ii -	happy	fast	medium	neutral	instruments	new age	progressive electronic	
Mike Oldfield / Mike Oldfield - Tubular Bells III	- 01 - The Source	e Of Secrets.mp3				0		
	sad	medium	medium	soft	instruments	new age	progressive electronic	
Mike Oldfield / Mike Oldfield - Tubular Bells III	- 02 - The Watch neutral	nful Eye.mp3 very slow	medium	soft	instruments	new age	progressive electronic	T
Mike Oldfield / Mike Oldfield - Tubular Bells III	- 03 - Jewel In t	he Crown.mp3	incutain	5011	not uncito	nen uge	progressive electronic	1
	neutral	slow	medium	soft	instruments	new age	progressive electronic	
Mike Oldfield / Mike Oldfield - Tubular Bells III	- 05 - Serpent D	ream.mp3	modium	coft	instruments	2014 200	progracivo electropio	1
Mike Oldfield / Mike Oldfield - Tubular Bells III	- 09 - Moonwat	ch.mp3	medium	5011	insu unients	new age	progressive electronic	
	neutral	very slow	medium	soft	instruments	new age	progressive electronic	
Nickelback / Nickelback - Hero.mp3		1:			1.0		1	T
Nickelback / Nickelback - How You Remind Me	neutral mp3	medium	medium	neutral	both	rock	alternative rock	
Herebiew / Herebiew How Fourteman and	neutral	medium	medium	aggressive	both	rock	alternative rock	T
Nickelback / Nickelback - Just For (Remix From	Curb).mp3							
Nickelback / Nickelback Just Fourmp?	neutral	medium	medium	aggressive	both	rock	alternative rock	
Nickelback / Nickelback - Just Pourinips	neutral	medium	medium	aggressive	both	rock	alternative rock	<u> </u>
Nickelback / Nickelback - Pusher.mp3								
	neutral	medium	medium	aggressive	both	rock	alternative rock	
Nightwish / Nightwish - 10th Man Down.mp3	sad	medium	medium	aggressive	both	rock	hard rock	melodic metal
Nightwish / Nightwish - Angels Fall First.mp3								
	sad	slow	medium	soft	both	rock	hard rock	melodic metal
Nightwish / Nightwish - Bless The Child.mp3	poutral	modium	modium	noutral	both	rock	hard rock	maladiamatal
Nightwish / Nightwish - Come Cover Me.mp3	neutrai	meanam	medium	neutiai	bour	IOCK	hard lock	melodic metar
	neutral	medium	medium	neutral	both	rock	hard rock	melodic metal
Nightwish / Nightwish - Crimson Tide Deep Blu	e Sea.mp3	11						1 12 11
Nightwish / Nightwish - End Of All Hope (2).mr	happy 3	medium	medium	aggressive	instruments	rock	hard rock	melodic metal
	sad	fast	medium	aggressive	both	rock	hard rock	melodic metal
Nightwish / Nightwish - Over the Hills And Far	Away.mp3							
Nucleurich (Nucleurich, Character, Caracter, 2	happy	fast	medium	neutral	both	rock	hard rock	melodic metal
Nightwish / Nightwish - Sleeping Suit.htps	sad	slow	medium	soft	both	rock	hard rock	melodic metal
Nightwish / Nightwish - Walking In The Air.mp2	3							
	neutral	varying	medium	soft	both	rock	hard rock	melodic metal
raradise Lost / Paradise Lost - Draconian Times	- UI - Enchantm sad	ent.mp3 medium	medium	neutral	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - Draconian Times	- 05 - Once Sole	mn.mp3						
	neutral	fast	medium	aggressive	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - Draconian Times	- 06 - Shadowki	ngs.mp3		an ana tana l	hath	made	hand made	authia matal
Paradise Lost / Paradise Lost - Draconian Times	- 09 - Shades Of	God.mp3	medium	neutrai	both	TOCK	nard rock	gotnic metai
	sad	medium	medium	neutral	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - Draconian Times	- 12 - Jaded.mp	3				I	T	1
Paradice Lost / Paradice Lost - Host - 01 - So Mu	sad	medium	medium	neutral	both	rock	hard rock	gothic metal
- manye box / randine box - nost - 01 - 50 Mut	sad	medium	medium	neutral	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - Host - 02 - Nothin	g Sacred.mp3	T		1	1	T		-
Develop Look / Develop Look Just 11. 10. 04. 11. 1	neutral	medium	medium	neutral	both	rock	hard rock	gothic metal
r aradise Lost / r aradise Lost - Host - 04 - Harbot	sad	slow	medium	soft	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - Host - 08 - Behind	The Grey.mp3		•					
	neutral	medium	medium	neutral	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - Host - 13 - Host.m	ip3 sad	slow	medium	soft	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - One Second - 01 -	One Second.m	p3			50m	-008		Bound menth
	sad	medium	medium	neutral	both	rock	hard rock	gothic metal

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Paradise Lost / Paradise Lost - One Second - 02 - 9	Say Just Words	.mp3	-					
	neutral	medium	medium	aggressive	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - One Second - 09 -	Blood Of Anotl	ner.mp3				1		
	sad	medium	medium	aggressive	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - One Second - 10 - 1	Disappear.mp3							
	sad	slow	medium	neutral	both	rock	hard rock	gothic metal
Paradise Lost / Paradise Lost - One Second - 12 -	lake Me Down	.mp3			1	and a	Lord and	and the second of
Patti Smith / Patti Smith Easter 01 Till Victory	sau mp2	very slow	meanum	neutrai	both	IOCK	naru rock	goune metai
Fatu Shifut / Fatu Shifut - Easter - 01 - Thi Victory	happy	modium	modium	poutral	both	rock	proto pupk	
Patti Smith / Patti Smith - Faster - 03 - Because Th	nappy Night mp3	meanum	medium	neutrai	bour	IOCK	рюю-ринк	
Tatti Shiftir / Tatti Shiftir - Laster - 05 - Decadse Th	neutral	medium	medium	neutral	both	rock	proto-punk	
Patti Smith / Patti Smith - Easter - 06 - Rock N Ro	ll Nigger.mp3						From Firms	
	happy	medium	medium	neutral	both	rock	proto-punk	
Patti Smith / Patti Smith - Easter - 10 - High On R	ebellion.mp3						1 1	
	neutral	fast	medium	aggressive	both	rock	proto-punk	
Patti Smith / Patti Smith - Easter - 12 - Godspeed.	mp3	•	•			•		•
	sad	very slow	medium	neutral	both	rock	proto-punk	
Patti Smith / Patti Smith - Gone Again - 01 - Gone	e Again.mp3							
	neutral	medium	medium	neutral	both	rock	proto-punk	
Patti Smith / Patti Smith - Gone Again - 03 - Abou	ıt A Boy.mp3		-	-	-			
	sad	very slow	low	neutral	both	rock	proto-punk	
Patti Smith / Patti Smith - Gone Again - 07 - Wing	g.mp3		r				1	1
	sad	very slow	low	soft	both	rock	proto-punk	
Patti Smith / Patti Smith - Gone Again - 10 - Firefl	ies.mp3			r	r			
	sad	very slow	low	soft	both	rock	proto-punk	
Patti Smith / Patti Smith - Gone Again - 11 - Farev	well Reel.mp3							
	neutral	slow	low	neutral	both	rock	proto-punk	
Queen / Queen - Greatest Hits - 01 - Bohemian Rh	hapsody.mp3			<i>6</i>	1.4		,	
Owner (Owner Constant Miles 02) Amerikan Owner	sad	slow	medium	soft	both	rock	arena rock	
Queen / Queen - Greatest Hits - 02 - Another One	bites The Dus	.mp3	modium	poutral	both	rock	ampa mek	1
Queen / Queen Createst Hits 02 Killer Queen	mp ²	meanum	meanum	neutrai	boui	IOCK	arena rock	
Queen / Queen - Greatest This - 03 - Killer Queen	happy	medium	medium	neutral	both	rock	arena rock	
Queen / Queen - Greatest Hits - 05 - Bicycle Race	mp3	incentain	inculuit	neutrai	bour	IOCK	archarlock	
Queen / Queen - Oreatest This - 05 - Dicycle Race.	happy	medium	medium	neutral	both	rock	arena rock	
Oueen / Oueen - Greatest Hits - 09 - Crazy Little	Thing Called L	ove.mp3	medium	neutrui	bour	TOCK	utera rock	I
2007/2007/00000000000000000000000000000	happy	varying	medium	soft	both	rock	arena rock	
Queen / Queen - Greatest Hits - 14 - Flash.mp3	117							
_	neutral	medium	medium	aggressive	both	rock	arena rock	
Queen / Queen - Greatest Hits - 15 - Seven Seas C	of Rhye.mp3	•		00				
	happy	medium	medium	neutral	both	rock	arena rock	
Queen / Queen - Greatest Hits - 16 - We Will Rock	k You.mp3							
	neutral	medium	medium	aggressive	vocals	rock	arena rock	
Queen / Queen - Greatest Hits - 17 - We Are The G	Champions.mp	3						
	neutral	slow	medium	soft	both	rock	arena rock	
Queen / Queen - Greatest Hits II - 01 - A Kind Of	Magic.mp3							
	happy	medium	medium	neutral	both	rock	arena rock	
Queen / Queen - Greatest Hits II - 02 - Under Pres	ssure.mp3	1				1	1	1
	sad	medium	medium	aggressive	both	rock	arena rock	
Queen / Queen - Greatest Hits II - 03 - Radio Ga G	Ga.mp3							
	neutral	medium	medium	neutral	both	rock	arena rock	
Queen / Queen - Greatest Hits II - 04 - I Want It A	ll.mp3							
Owner (Owner Constant Hills H. OF, HWALLT, H.	neutral	varying	medium	aggressive	both	rock	arena rock	
Queen / Queen - Greatest Hits II - 05 - I Want To I	Sreak Free.mp3				1	and i		1
Queen / Queen Createst Hits II 07 It's A Hard	neutrai	medium	medium	neutral	both	TOCK	arena rock	
Queen / Queen - Greatest This II - 0/ - It s A Halo	neutral	slow	medium	soft	both	rock	arena rock	
Queen / Queen - Greatest Hits II - 08 - Breakthrun	mp3	SIOW	medium	Soft	bour	IOCK	alena lock	
Queen / Queen - Oreatest This II - 00 - Breakting	happy	medium	medium	aggressive	both	rock	arena rock	
Oueen / Oueen - Greatest Hits II - 13 - The Invisit	ole Man.mp3	meanum	medium	455100110	bour	TOCK	utera rock	I
Queen / Queen Orealestino II 10 Incluitor	neutral	fast	medium	neutral	both	rock	arena rock	
Queen / Queen - Greatest Hits II - 14 - Hammer T	o Fall.mp3							
×···· / ×···	neutral	medium	medium	neutral	both	rock	arena rock	
Queen / Queen - Greatest Hits II - 15 - Friends Wi	ill Be Friends.m	p3						
	neutral	slow	medium	soft	both	rock	arena rock	
Queen / Queen - Innuendo - 01 - Innuendo.mp3		•	•			•		
	neutral	varying	medium	neutral	both	rock	arena rock	
Queen / Queen - Innuendo - 02 - Im Going Slight	ly Mad.mp3							
	neutral	medium	medium	soft	both	rock	arena rock	
Queen / Queen - Innuendo - 03 - Headlong.mp3								
	neutral	medium	medium	aggressive	both	rock	arena rock	
Queen / Queen - Innuendo - 06 - Ride The Wild W	Vind.mp3							
	neutral	fast	medium	aggressive	both	rock	arena rock	
Queen / Queen - Innuendo - 08 - These Are The D	Days Of Our Liv	ves.mp3						1
	neutral	slow	medium	soft	both	rock	arena rock	
Queen / Queen - Innuendo - 11 - Bijou.mp3			1.				,	
Oursen / Oursen Transition 10 mil 01	sad	slow	medium	neutral	instruments	rock	arena rock	
Queen / Queen - Innuendo - 12 - The Show Must	Go On.mp3	slow	medium	neutral	both	rock	arona rock	
	oud	31011	incurati	ncuudi	Dom	IUCK	arcia iUCK	

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Rammstein / Rammstein - Mutter - 01 - Mein Her	z Brennt.mp3							
	sad	medium	medium	aggressive	both	rock	hard rock	progressive metal
Rammstein / Rammstein - Mutter - 02 - Links 2 3	4.mp3	hast			hath	mo ale	hand male	ann annainn an stal
Rammstein / Rammstein - Mutter - 06 - Mutter m	n3	last	medium	aggressive	bour	IOCK	паги юск	progressive metai
	sad	medium	medium	neutral	both	rock	hard rock	progressive metal
Rammstein / Rammstein - Mutter - 07 - Spieluhr.	np3							
	neutral	medium	medium	neutral	both	rock	hard rock	progressive metal
Rammstein / Rammstein - Mutter - 11 - Nebel.mp	3 cod	clow	modium	poutral	both	rock	hard rock	prograccivo motal
Schandmaul / Schandmaul - Narrenkönig - 01 - V	alpugisnacht.r	np3	medium	neutrai	bout	IOCK	Hald lock	piogressive metai
	happy	fast	medium	neutral	both	rock	folk rock	
Schandmaul / Schandmaul - Narrenkönig - 02 - D	as Seemannsgi	rab.mp3	T	1	1	1	1	1
Charlen I (Charlen I Namel Sci. 04 F	sad	medium	medium	soft	both	rock	folk rock	
Schandmaul / Schandmaul - Narrenkonig - 04 - L	happy	medium	medium	soft	both	rock	folk rock	
Schandmaul / Schandmaul - Narrenkönig - 05 - D	ie drei Prüfung	gen.mp3						
	happy	fast	medium	neutral	both	rock	folk rock	
Schandmaul / Schandmaul - Narrenkönig - 14 - D	er Wandersma	nn.mp3	1.					1
Scooter / Scooter - Back In The U.K. mp3	neutral	medium	low	neutral	vocals	rock	folk rock	
Scoter / Scoter - Back in the O.K.imps	happy	very fast	low	aggressive	both	electronica	techno	
Scooter / Scooter - Fire.mp3								
	happy	very fast	low	aggressive	both	electronica	techno	
Scooter / Scooter - Forever.mp3	1	6.4	1			destaund es	to do a c	
Scooter / Scooter - How Much Is The Fish.mp3	парру	rast	low	neutrai	instruments	electronica	tecnno	
Scould / Scould They stude to the Holmapo	happy	fast	medium	neutral	both	electronica	techno	
Scooter / Scooter - I'm Your Pusher.mp3								
	happy	very fast	medium	aggressive	both	electronica	techno	
Scooter / Scooter - Nessaja (Original mix).mp3	hamma	hast	law	a system l	in star and s	alaatuoniaa	tashna	1
Scooter / Scooter - Ramp! (The Logical Song).mp	парру	rast	low	neutral	instruments	electronica	tecnno	
	happy	very fast	low	aggressive	both	electronica	techno	
Scorpions / Scorpions - Animal Magnetism - 01 -	Make It Real.m	р3	•	•	•			•
	happy	medium	medium	neutral	both	rock	hard rock	heavy metal
Scorpions / Scorpions - Animal Magnetism - 03 -	Hold Me Tight.	mp3 medium	medium	aggressive	both	rock	hard rock	heavy metal
Scorpions / Scorpions - Animal Magnetism - 06 -	Falling In Love	.mp3	incontain	aggressive	bour	IOCK	hard lock	neavy netai
	-	-						
	happy	medium	medium	neutral	both	rock	hard rock	heavy metal
Scorpions / Scorpions - Animal Magnetism - 08 -	happy The Zoo.mp3	medium	medium	neutral	both	rock	hard rock	heavy metal
Scorpions / Scorpions - Animal Magnetism - 08 -	happy The Zoo.mp3 neutral	medium medium	medium	neutral aggressive	both	rock	hard rock	heavy metal
Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 -	happy The Zoo.mp3 neutral Animal Magne sad	medium medium tism.mp3 slow	medium medium medium	neutral aggressive aggressive	both both	rock rock	hard rock hard rock	heavy metal
Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m	happy The Zoo.mp3 neutral Animal Magne sad p3	medium medium tism.mp3 slow	medium medium medium	neutral aggressive aggressive	both both	rock rock rock	hard rock hard rock hard rock	heavy metal heavy metal heavy metal
Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m	happy The Zoo.mp3 neutral Animal Magne sad p3 neutral	medium medium tism.mp3 slow very fast	medium medium medium medium	neutral aggressive aggressive aggressive	both both both both	rock rock rock rock	hard rock hard rock hard rock hard rock	heavy metal heavy metal heavy metal
Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior	happy The Zoo.mp3 neutral Animal Magne sad p3 neutral as.mp3	medium medium tism.mp3 slow very fast	medium medium medium	neutral aggressive aggressive aggressive	both both both both	rock rock rock rock rock	hard rock hard rock hard rock hard rock	heavy metal heavy metal heavy metal
Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 02 - To Be No	happy The Zoo.mp3 neutral Animal Magne sad p3 neutral is.mp3 neutral 1 mp3	medium medium tism.mp3 slow very fast medium	medium medium medium medium	neutral aggressive aggressive aggressive neutral	both both both both both	rock rock rock rock rock rock	hard rock hard rock hard rock hard rock hard rock	heavy metal heavy metal heavy metal heavy metal pop metal
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Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 02 - To Be No Scorpions / Scorpions - Eye II Eye - 02 - To Be No	happy The Zoo.mp3 neutral Animal Magne sad p3 neutral is.mp3 neutral 1.mp3 happy queezed.mp3	medium medium tism.mp3 slow very fast medium fast	medium medium medium medium medium	neutral aggressive aggressive neutral neutral	both both both both both both	rock rock rock rock rock rock rock rock	hard rock	heavy metal heavy metal heavy metal heavy metal pop metal pop metal
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Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 02 - To Be No Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 13 - Aleyah.m Scorpions / Scorpions - Eye II Eye - 13 - Aleyah.m	happy The Zoo.mp3 neutral Animal Magne sad p3 neutral is.mp3 neutral i.mp3 happy queezed.mp3 neutral p3 happy tin A Million	medium medium tism.mp3 slow very fast medium fast medium medium Years.mp3	medium medium medium medium medium medium medium	neutral aggressive aggressive neutral neutral neutral neutral	both both both both both both both both	rock rock rock rock rock rock rock rock	hard rock	heavy metal heavy metal heavy metal pop metal pop metal pop metal pop metal
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Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 02 - To Be No Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 13 - Aleyah.m Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Face the Heat - 01 - Alien Scorpions / Scorpions - Face the Heat - 07 - Hate Scorpions / Scorpions - Face the Heat - 07 - Hate Scorpions / Scorpions - Face the Heat - 10 - Night Scorpions / Scorpions - Face the Heat - 11 - Lonel Scorpions / Scorpions - Pure Instinct - 01 - Wild C	happy he Zoo.mp3 neutral Animal Magne sad p3 neutral 1.mp3 happy neutral 1.mp3 happy dueezed.mp3 neutral p3 happy t In A Million sad Nation.mp3 neutral in No Gain.mp3 neutral mare Avenue n neutral y Nights.mp3 sad hild.mp3 happy	medium medium medium tism.mp3 slow very fast medium fast medium fast medium rears.mp3 slow medium ran medium rears.mp3 fast slow fast fast	medium	neutral aggressive aggressive neutral neutral neutral neutral soft aggressive aggressive aggressive aggressive aggressive aggressive neutral aggressive aggressive aggressive	both both both both both both both both	rock rock rock rock rock rock rock rock	hard rock	heavy metal heavy metal heavy metal heavy metal pop metal pop metal pop metal pop metal heavy metal heavy metal heavy metal heavy metal heavy metal heavy metal
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Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 02 - To Be No Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 13 - Aleyah.m Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Face the Heat - 01 - Alien Scorpions / Scorpions - Face the Heat - 07 - Hate' Scorpions / Scorpions - Face the Heat - 07 - Hate' Scorpions / Scorpions - Face the Heat - 10 - Night Scorpions / Scorpions - Face the Heat - 11 - Lonel Scorpions / Scorpions - Pure Instinct - 01 - Wild C Scorpions / Scorpions - Pure Instinct - 04 - Stone I	happy he Zoo.mp3 neutral Animal Magne sad p3 neutral 1.mp3 happy happy queezed.mp3 neutral neutral p3 happy t In A Million sad No Gain.mp3 neutral in No Gain.mp3 neutral in No Gain.mp3 neutral mare Avenue.n neutral w Nights.mp3 sad happy neutral mare Avenue.n neutral y Nights.mp3 sad happy n My Shoe.mp1 neutral happy n My Shoe.mp1 neutral	medium medium ism.mp3 slow very fast medium fast medium fast medium medium slow medium medium slow fast slow fast fast fast fast fast fast fast	medium	neutral aggressive aggressive neutral neutral neutral neutral neutral aggressive aggressive aggressive aggressive aggressive aggressive neutral neutral neutral	both both both both both both both both	rock rock rock rock rock rock rock rock	hard rock	heavy metal heavy metal heavy metal heavy metal pop metal pop metal pop metal pop metal pop metal heavy metal heavy metal heavy metal heavy metal heavy metal heavy metal heavy metal
Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 02 - To Be No Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 13 - Aleyah.m Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Face the Heat - 01 - Alien Scorpions / Scorpions - Face the Heat - 02 - No Pa Scorpions / Scorpions - Face the Heat - 07 - Hate Scorpions / Scorpions - Face the Heat - 10 - Night Scorpions / Scorpions - Face the Heat - 11 - Lonel Scorpions / Scorpions - Pure Instinct - 01 - Wild C Scorpions / Scorpions - Pure Instinct - 04 - Stone I Scorpions / Scorpions - Pure Instinct - 05 - Soul B	happy he Zoo.mp3 neutral Animal Magne sad p3 neutral 1.mp3 happy happy happy t In A Million sad No Gain.mp3 neutral in No Gain.mp3 neutral in No Gain.mp3 neutral mare Avenue.n neutral mare Avenue.n neutral y Nights.mp3 sad happy n My Shoe.mp1 neutral ehind The Face sad	medium medium ism.mp3 slow very fast medium fast medium fast medium medium slow medium medium slow fast slow fast fast fast fast fast mp3 fast fast medium	medium	neutral aggressive aggressive neutral neutral neutral neutral neutral aggressive aggressive aggressive aggressive aggressive aggressive neutral neutral neutral	both both both both both both both both	rock rock rock rock rock rock rock rock	hard rock	heavy metal heavy metal heavy metal heavy metal pop metal pop metal pop metal pop metal pop metal heavy metal heavy metal heavy metal heavy metal heavy metal heavy metal heavy metal
Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 02 - To Be No Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 13 - Aleyah.m Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Face the Heat - 01 - Alien Scorpions / Scorpions - Face the Heat - 02 - No Pa Scorpions / Scorpions - Face the Heat - 07 - Hate Scorpions / Scorpions - Face the Heat - 07 - Hate Scorpions / Scorpions - Face the Heat - 10 - Night Scorpions / Scorpions - Face the Heat - 11 - Lonel Scorpions / Scorpions - Pure Instinct - 01 - Wild C Scorpions / Scorpions - Pure Instinct - 04 - Stone I Scorpions / Scorpions - Pure Instinct - 05 - Soul Be Scorpions / Scorpions - Pure Instinct - 05 - Soul Be	happy he Zoo.mp3 neutral Animal Magne sad p3 neutral 1.mp3 happy neutral 1.mp3 happy neutral neutral neutral neutral in A Million sad No Gain.mp3 neutral in No Gain.mp3 neutral in No Gain.mp3 neutral mare Avenue.n neutral mare Avenue.n neutral y Nights.mp3 sad happy n My Shoe.mp3 nay Shoe.mp3 nay Shoe.mp3 happy n My Shoe.mp3 nay	medium medium ism.mp3 slow very fast medium fast medium fast medium medium medium medium medium slow fast fast fast fast fast medium fast fast	medium	neutral aggressive aggressive neutral neutral neutral neutral neutral aggressive aggressive aggressive aggressive aggressive aggressive neutral neutral neutral	both both both both both both both both	rock rock rock rock rock rock rock rock	hard rock	heavy metal heavy metal heavy metal heavy metal pop metal pop metal pop metal pop metal pop metal heavy metal heavy metal heavy metal heavy metal heavy metal heavy metal
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Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 02 - To Be No Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 13 - Aleyah.m Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Face the Heat - 01 - Alien Scorpions / Scorpions - Face the Heat - 02 - No Pa Scorpions / Scorpions - Face the Heat - 07 - Hate ' Scorpions / Scorpions - Face the Heat - 10 - Night Scorpions / Scorpions - Face the Heat - 10 - Night Scorpions / Scorpions - Face the Heat - 11 - Lonel Scorpions / Scorpions - Pure Instinct - 01 - Wild C Scorpions / Scorpions - Pure Instinct - 05 - Soul B Scorpions / Scorpions - Pure Instinct - 05 - Soul B Scorpions / Scorpions - Pure Instinct - 11 - Are Yo	happy happy The Zoo.mp3 neutral Animal Magne sad p3 neutral 1.mp3 happy happy neutral neutral neutral p3 happy ti In A Million sad Nation.mp3 neutral in No Gain.mp3 neutral in No Gain.mp3 neutral in No Gain.mp3 neutral mare Avenue.n neutral v Nights.mp3 sad happy n My Shoe.mp1 neutral chappy n My Shoe.mp1 neutral happy n My Shoe.mp2 neutral happy n My Shoe.mp1 neutral happy n My Shoe.mp1 neutral happy n My Shoe.mp1 neutral happy n My Shoe.mp2 neutral happy n My Shoe.mp1 neutral happy n My Shoe.mp1 neutral happy n My Shoe.mp1 neutral happy n My Shoe.mp2 neutral happy n My Shoe.mp2 neutral happy n My Shoe.mp3 neutral happy n My Shoe.mp1 neutral happy n My Shoe.mp1 neutral happy n My Shoe.mp1 neutral happy n My Shoe.mp2 neutral happy n My Shoe.mp3 neutral happy n My Shoe.mp3 neutral happy n My Shoe.mp3 neutral happy n My Shoe.mp3 neutral happy n My Shoe.mp3 neutral No Reiter Flow	medium medium ism.mp3 slow very fast medium fast medium fast medium medium medium medium medium medium medium medium fast fast fast fast fast fast fast fast	medium	neutral aggressive aggressive neutral neutral neutral neutral neutral soft aggressive aggressive aggressive aggressive aggressive neutral neutral neutral	both both both both both both both both	rock rock rock rock rock rock rock rock	hard rock	heavy metal heavy metal heavy metal heavy metal pop metal pop metal pop metal pop metal pop metal heavy metal heavy metal heavy metal heavy metal heavy metal heavy metal heavy metal
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Scorpions / Scorpions - Animal Magnetism - 08 - Scorpions / Scorpions - Animal Magnetism - 09 - Scorpions / Scorpions - Another Piece Of Meat.m Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 01 - Mysterior Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 10 - Freshly S Scorpions / Scorpions - Eye II Eye - 11 - Aleyah.m Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Eye II Eye - 14 - A Momen Scorpions / Scorpions - Face the Heat - 01 - Alien Scorpions / Scorpions - Face the Heat - 02 - No Pa Scorpions / Scorpions - Face the Heat - 07 - Hate' Scorpions / Scorpions - Face the Heat - 10 - Night Scorpions / Scorpions - Face the Heat - 11 - Lonel Scorpions / Scorpions - Pure Instinct - 04 - Stone I Scorpions / Scorpions - Pure Instinct - 04 - Stone I Scorpions / Scorpions - Pure Instinct - 05 - Soul B Scorpions / Scorpions - Pure Instinct - 08 - Where Scorpions / Scorpions - Pure Instinct - 11 - Are Yo Soulfly / Soulfly - Enterfaith.mp3	happy he Zoo.mp3 neutral Animal Magne sad p3 neutral 1.mp3 happy neutral 1.mp3 happy neutral neutral neutral in A Million sad Nation.mp3 neutral in No Gain.mp3 neutral in No Gain.mp3 neutral in No Gain.mp3 neutral in No Gain.mp3 neutral in No Gain.mp3 neutral v Nights.mp3 sad hild.mp3 happy n My Shoe.mp1 neutral hild.mp3 happy n My Shoe.mp1 neutral u The One.mp2 sad sad	medium medium ism.mp3 slow very fast medium fast medium fast medium medium medium medium medium medium fast fast fast fast fast fast fast fast	medium	neutral aggressive aggressive neutral neutral neutral neutral neutral aggressive aggressive aggressive aggressive aggressive aggressive neutral neutral soft aggressive	both both both both both both both both	rock rock rock rock rock rock rock rock	hard rock	heavy metal heavy metal heavy metal heavy metal pop metal pop metal pop metal pop metal pop metal pop metal heavy metal

filename	mood	temno	complexity	emotion	focus	aonro	subaenre	subsubaouro
Souldy / Souldy Pain mp2	тоой	iempo	complexity	cmotion	Jocus	genie	Subgenite	Subsubgenite
Souny / Souny - Lancings	sad	fast	medium	aggressive	both	rock	hard rock	alternative metal
Soulfly / Soulfly - Soulfly III.mp3							•	
	neutral	medium	medium	soft	instruments	rock	hard rock	alternative metal
Soulfly / Soulfly - Tribe.mp3	ead	fact	medium	aggressive	both	rock	hard rock	alternative metal
Stratovarius / Stratovarius - Destiny - 01 - Destir	iy.mp3	1051	incutain	aggressive	bour	IOCK	hard lock	anchiative nicual
	neutral	fast	medium	neutral	instruments	rock	hard rock	power metal
Stratovarius / Stratovarius - Destiny - 03 - No Tu	rning Back.mp3	3			1		I	
Stratovarius / Stratovarius - Destiny - 04 - 4000 B	happy ainy Nighte m	very fast	medium	aggressive	both	rock	hard rock	power metal
Stratovanus / Stratovanus - Desury - 04 - 4000 P	neutral	medium	medium	neutral	both	rock	hard rock	melodic metal
Stratovarius / Stratovarius - Destiny - 07 - Playin	g With Fire.mp	3					•	
	neutral	fast	medium	aggressive	both	rock	hard rock	power metal
Stratovarius / Stratovarius - Destiny - 10 - Cold V	Winter Nights.n	1p3 fact	modium	aggregoive	both	rock	hard mek	maladiamatal
Stratovarius / Stratovarius - Infinite - 01 - Huntin	ng High And Lo	w.mp3	incutain	aggressive	bour	IOCK	hard lock	incloute inclui
	happy	fast	medium	aggressive	both	rock	hard rock	power metal
Stratovarius / Stratovarius - Infinite - 02 - Millen	nium.mp3				1		I	
Stratovarius / Stratovarius - Infinite - 05 - Clory	neutral Of The World m	very fast	medium	aggressive	both	rock	hard rock	power metal
Statestande, Statestande Landet of Staty	happy	very fast	medium	aggressive	both	rock	hard rock	power metal
Stratovarius / Stratovarius - Infinite - 08 - Infinity	y.mp3							
	sad	fast	medium	neutral	both	rock	hard rock	power metal
Stratovarius / Stratovarius - Infinite - 09 - Celesti	al Dream.mp3	medium	medium	soft	both	rock	hard rock	melodic metal
Subway To Sally / Subway To Sally - Herzblut -)1 - Die Schlach	t.mp3						
	neutral	medium	medium	aggressive	both	rock	folk rock	
Subway To Sally / Subway To Sally - Herzblut - ()2 - Veitstanz.m	p3		a sector 1	h a ch		Cillion d	T
Subway To Sally / Subway To Sally - Herzblut -	happy 13 - Das Messer	tast mp3	medium	neutral	both	rock	folk rock	
Subway to Sany / Subway to Sany Tietzbaar	neutral	medium	medium	neutral	both	rock	folk rock	
Subway To Sally / Subway To Sally - Herzblut - (09 - So Rot.mp3							
	sad	slow	medium	soft	both	rock	folk rock	
Subway Io Sally / Subway Io Sally - Herzblut -	sad	np3 medium	medium	neutral	vocals	rock	folk rock	1
Subway To Sally / Subway To Sally - Schrei! - 02	- Böses Erwach	en.mp3	inculain	neutur	vocato	ioca	TolkTock	
	sad	medium	medium	aggressive	both	rock	folk rock	
Subway To Sally / Subway To Sally - Schrei! - 04	- Das Opfer.mp	3			1.4			
Subway To Sally / Subway To Sally - Schrei! - 05	- Unterm Galge	medium	medium	aggressive	both	rock	hard rock	heavy metal
Sabiray to saily , sabiray to saily schen. so	neutral	medium	medium	aggressive	both	rock	folk rock	
Subway To Sally / Subway To Sally - Schrei! - 10	- Minne.mp3							
Characterized and the contraction of the contractio	sad	slow 2	medium	soft	both	rock	folk rock	
Subway to Sally / Subway to Sally - Schrei! - 16	- Julia und die	verv fast	medium	neutral	instruments	rock	folk rock	1
t.A.T.u / t.A.T.u 200 kmh In The Wrong Lane -	01 - Not Gonna	Get Us.mp3						
	neutral	fast	low	aggressive	both	electronica	euro-dance	
t.A.T.u / t.A.T.u 200 kmh In The Wrong Lane -	02 - All The Thi	ngs She Said.mp	3		1	destaund se		1
t.A.T.u / t.A.T.u 200 kmh In The Wrong Lane -	04 - 30 Minutes	.mp3	medium	aggressive	both	electronica	euro-dance	
	sad	slow	medium	soft	both	electronica	euro-dance	
t.A.T.u / t.A.T.u 200 kmh In The Wrong Lane -	07 - Malchik Ga	iy.mp3						
IAT (IAT 200 Luck Is The Mount I and	sad	medium	low	neutral	both	electronica	euro-dance	
LA.I.u / LA.I.u 200 kmn in The wrong Lane -	neutral	fast	low	aggressive	both	electronica	euro-dance	
Therapy / Therapy - Pleasure Death - 01 - Skinni	ng Pit.mp3	•	•	00	•			•
	neutral	fast	low	aggressive	instruments	rock	hard rock	alternative metal
Therapy / Therapy - Pleasure Death - 02 - Fantas	y Bag.mp3	medium	low	aggreeivo	both	rock	hard rock	alternative motal
Therapy / Therapy - Pleasure Death - 03 - Shit Ki	icker.mp3	medium	2011	адыссолие	bour	IULK	Juild IOCK	anemative meldi
	sad	fast	low	aggressive	instruments	rock	hard rock	alternative metal
Therapy / Therapy - Pleasure Death - 04 - Prison	Breaker.mp3							
Therapy / Therapy - Pleasure Death - 05 - D. L. (sad mp3	fast	medium	aggressive	both	rock	hard rock	alternative metal
inclupy / inclupy - inclusure Death - 65 - D. E. C	sad	fast	low	aggressive	instruments	rock	hard rock	alternative metal
To-Die-For / To-Die-For - All Eternity - 01 - Farew	vell.mp3						•	
	sad	medium	medium	neutral	both	rock	hard rock	melodic metal
10-Die-For / 10-Die-For - All Eternity - 04 - Our	andle Melts A	way.mp3 medium	medium	neutral	both	rock	hard rock	melodic metal
To-Die-For / To-Die-For - All Eternity - 06 - Sea (Df Sin.mp3	incurum	incontain	neutia	bour	IOCK	hard lock	incloute inclui
· · · · · ·	sad	fast	medium	aggressive	both	rock	hard rock	melodic metal
To-Die-For / To-Die-For - All Eternity - 10 - Toger	ther Complete.	np3			11		hand an de	
To-Die-For / To-Die-For - All Eternity - 12 - Lacri	sad marum.mp3	Iast	meaium	aggressive	DOEN	TOCK	nara rock	ineiodic metal
	sad	medium	medium	soft	both	rock	hard rock	melodic metal
Type O Negative / Type O Negative - The Least	Worst Of - 01 - 1	The Misinterpreta	tion Of Silence And Its	Disastrous Consequ	uences (Wombs And	d Tombs Mix).mp3		1
Type O Negative / Type O Negative The Local	neutral Worst Of 02	medium	low Pead mp2	neutral	instruments	noise		
spectregative / type Onegative - the Least	sad	medium	medium	neutral	both	rock	hard rock	gothic metal

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Type O Negative / Type O Negative - The Least V	Vorst Of - 04 - It	t's Never Enough	1.mp3					
	sad	medium	medium	neutral	both	rock	hard rock	gothic metal
Type O Negative / Type O Negative - The Least V	Vorst Of - 07 - C	Christian Woman	.mp3 modium	noutral	both	rock	hard rock	gothic motal
Type O Negative / Type O Negative - The Least V	Vorst Of - 08 - 1	2 Black Rainbow	s.mp3	neutrai	bout	IOCK	hard lock	goune metar
<u> </u>	sad	slow	medium	neutral	both	rock	hard rock	gothic metal
Type O Negative / Type O Negative - The Least V	Vorst Of - 14 - S	itay Out Of My D	reams.mp3				-	1
Van Halen / Van Halen 1084 01 1084 mm?	sad	varying	medium	neutral	both	rock	hard rock	gothic metal
van Halen / van Halen - 1964 - 01 - 1964.mp5	neutral	slow	medium	soft	instruments	rock	arena rock	
Van Halen / Van Halen - 1984 - 02 - Jump.mp3								
	happy	medium	medium	neutral	both	rock	arena rock	
Van Halen / Van Halen - 1984 - 03 - Panama.mp3	hanna	madium		n system]	hath	an als	anona no de	
Van Halen / Van Halen - 1984 - 07 - I'll Wait.mp3	парру	medium	medium	neutral	both	TOCK	arena rock	
Marriada, Marriada, 1901 09 Tarriadanipo	neutral	medium	medium	soft	both	rock	arena rock	
Van Halen / Van Halen - 1984 - 09 - House Of Pai	n.mp3							
	neutral	fast	medium	neutral	both	rock	hard rock	heavy metal
Van Halen / Van Halen - Van Halen III - 01 - New	orld.mp3	slow	medium	neutral	instruments	rock	hard rock	pop metal
Van Halen / Van Halen - Van Halen III - 02 - With	iout You.mp3	51011	incutant	neutrui	houtunento	Iota	hard fock	popinican
	neutral	medium	medium	neutral	both	rock	hard rock	heavy metal
Van Halen / Van Halen - Van Halen III - 06 - Once	e.mp3		1					
Van Halen / Van Halen - Van Halen III - 09 - Vear	sad	medium	medium	soft	both	rock	hard rock	pop metal
var Hach / var Hach - var Hach III - 0) - Ica	neutral	varying	medium	neutral	both	rock	hard rock	pop metal
Van Halen / Van Halen - Van Halen III - 12 - How	Many Say I.m	p3						
	neutral	varying	medium	soft	both	rock	hard rock	pop metal
Vanessa Mae / Vanessa Mae - The Violin Player -	01 - Toccata An	d Fugue In D Mi	nor.mp3	n system]	in star an to	alaoniaal		
Vanessa Mae / Vanessa Mae - The Violin Plaver -	02 - Contradan	za.mp3	medium	neutrai	instruments	classical	classical crossover	
,	happy	fast	medium	neutral	instruments	classical	classical crossover	
Vanessa Mae / Vanessa Mae - The Violin Player -	03 - Classical G	as.mp3					-	
Verse Mers / Verse Mers The Visite Discourse	neutral	medium	medium	soft	instruments	classical	classical crossover	
Vanessa Mae / Vanessa Mae - The Violin Player -	06 - Jazz Will E	at Itself.mp3 medium	medium	neutral	instruments	classical	classical crossover	
Vanessa Mae / Vanessa Mae - The Violin Player -	07 - Widescreer	n.mp3	incutain	neutrui	hiotitunicitto	chiosten	clussical clossover	1
	sad	medium	medium	soft	instruments	classical	classical crossover	
Vanessa Mae / Vanessa Mae - The Violin Player -	10 - Red Hot.m	.p3						1
Various Artists / A Treasury Of Gregorian Chant	neutral	tast Treasury Of Cre	medium agorian Chants - Volum	neutral e I - 01 - Christus N	instruments	classical	classical crossover	
various ritusts / reficustury of oregonan chant	neutral	very slow	low	neutral	vocals	classical	gregorian chant	
Various Artists / A Treasury Of Gregorian Chant	s - Volume I / A	Treasury Of Gre	egorian Chants - Volum	e I - 02 - Christe Red	demptor.mp3			
	neutral	slow	low	soft	vocals	classical	gregorian chant	
Various Artists / A Treasury Of Gregorian Chants	s - Volume I / A	A Treasury Of Gre	egorian Chants - Volum	e I - 03 - Hodie Chri	istus Natus Est.mp3	classical	amagarian chant	1
Various Artists / A Treasury Of Gregorian Chant	s - Volume I / A	Treasury Of Gre	gorian Chants - Volum	e I - 04 - Litany Of H	Easter Eve.mp3	classical	gregorian chant	
	neutral	slow	low	neutral	vocals	classical	gregorian chant	
Various Artists / A Treasury Of Gregorian Chants	s - Volume I / A	A Treasury Of Gre	egorian Chants - Volum	e I - 05 - Gloria.mp3	3			1
Various Artists / A Tracury Of Cragorian Chapt	neutral Volumo I / A	slow	low	soft	vocals	classical	gregorian chant	
various ritusts / reficustury of oregonan change	neutral	slow	low	neutral	vocals	classical	gregorian chant	
Various Artists / A Treasury Of Gregorian Chant	s - Volume I / A	A Treasury Of Gre	egorian Chants - Volum	e I - 07 - Salve Festa	Dies.mp3		00	
	neutral	slow	low	soft	vocals	classical	gregorian chant	
Various Artists / A Treasury Of Gregorian Chant	s - Volume I / A	Treasury Of Gre	egorian Chants - Volum	e I - 08 - Surrexit Do	ominus Vere.mp3	alaccian	amagin chant	
Various Artists / A Treasury Of Gregorian Chant	s - Volume I / A	Treasury Of Gre	egorian Chants - Volum	e I - 09 - Vidi Aquar	n.mp3	ciassical	gregorian chant	I
	neutral	very slow	low	neutral	vocals	classical	gregorian chant	
Various Artists / A Treasury Of Gregorian Chants	s - Volume I / A	A Treasury Of Gre	egorian Chants - Volum	e I - 10 - Sunday Pro	ocessional.mp3		-	1
Various Artists / A Tropoury Of Crosseries Chart	neutral	slow	low	neutral	vocals	classical	gregorian chant	
various Artists / A freasury of Gregorian Chants	neutral	slow	low	neutral	vocals	classical	gregorian chant	
Various Artists / A Treasury Of Gregorian Chants	s - Volume I / A	Treasury Of Gre	egorian Chants - Volum	e I - 12 - Improvisat	ion on 'Salve Festa	Dies'.mp3	0.0	
	neutral	slow	low	soft	instruments	classical	organ	
Various Artists / A Treasury Of Gregorian Chants	s - Volume I / A	Treasury Of Gre	egorian Chants - Volum	e I - 13 - Monastery	Bells.mp3	1	1	1
Various Artists / A Treasury Of Gregorian Chant	s - Volume I / A	Treasury Of Gre	row Peorian Chants - Volum	e I - 14 - La semence	é.mp3	classical	bells	
	neutral	very slow	low	neutral	vocals	classical	gregorian chant	
Various Artists / A Treasury Of Gregorian Chant	s - Volume I / A	Treasury Of Gre	egorian Chants - Volum	e I - 15 - L'abondan	ce Cibavit.mp3	•		
Notice Astron (ATter Of Commercial	neutral	very slow	low	neutral	vocals	classical	gregorian chant	
various Artists / A Treasury Of Gregorian Chant	s - voiume I / A neutral	very slow	gorian Chants - Volum	e 1 - 16 - L'esperance neutral	e Guademus.mp3 vocals	classical	gregorian chant	
Various Artists / Celtic Myths (Disc 1) / 01 - Alta	n - The Lass Of	Glanshee.mp3					00 mit cimit	1
	neutral	slow	medium	soft	both	world	celtic	celtic new age
Various Artists / Celtic Myths (Disc 1) / 02 - Déar	nta - Where Are	You.mp3		0	11			
Various Artists / Celtic Myths (Disc 1) / 03 - Carr	sad ercaillie - Fogen	il An Dorus - Nie	meaium zhean Bhuaidh'ruad mi	зоп 3	DOIN	world	centic	cettic new age
cente inguis (Disc 1) / 05- Cap	happy	fast	medium	neutral	both	world	celtic	celtic pop
Various Artists / Celtic Myths (Disc 1) / 04 - Silly	Wizard - The B	ank Of The Lee.1	np3			•	•	
	sad	very slow	medium	soft	both	world	celtic	celtic folk

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Various Artists / Celtic Myths (Disc 1) / 05 - And	y M. Stewart &	Manus Lunny -	Take Her In Your Arms	.mp3				
	happy	medium	medium	neutral	both	world	irish folk	
Various Artists / Celtic Myths (Disc 1) / 06 - Niar	nh Parsons - Al	exander.mp3	modium	coft	both	world	coltic	coltic folk
Various Artists / Celtic Myths (Disc 1) / 07 - Touc	hstone - Casad	h Cam Na Fearda	arnaighe.mp3	Soft	boun	wond	celuc	centic tork
	happy	fast	medium	neutral	both	world	irish folk	
Various Artists / Celtic Myths (Disc 1) / 08 - Kevi	n Burke & Micl	heál O Domhnail	l - Is Fada Lion Uaim.m	up3				
Variana Antiata / Caltia Matha (Dias 1) / 00 Wall	neutral	slow	medium	soft	both	world	irish folk	
various Artists / Celtic Myths (Disc 1) / 09 - Wolf	happy	medium	mona.mp3 medium	neutral	both	world	celtic	celtic pop
Various Artists / Celtic Myths (Disc 1) / 10 - The	Tannahill Weav	ers - A Night Vis	itor's Song.mp3					
	happy	medium	medium	soft	both	world	celtic	celtic folk
Various Artists / Celtic Myths (Disc 1) / 11 - Cher	ish The Ladies	- Carrigdhoun.m	ip3	~~ft		woodd	aultia	solais folls
Various Artists / Celtic Myths (Disc 1) / 12 - Old	neutrai Blind Dogs - To	The Beggin' I W	ill Go.mp3	SOIT	vocais	world	ceitic	centic roik
	happy	medium	medium	soft	both	world	celtic	celtic folk
Various Artists / Celtic Myths (Disc 1) / 13 - Mich	Moloney - The	e Limerick Rake.	mp3					
Variana Antiata / Caltia Matha (Dias 1) / 14 Real	neutral	medium	medium	soft	both	world	celtic	celtic folk
various Artists / Cetuc Myths (Disc 1) / 14 - Reel	sad	slow	medium	soft	both	world	celtic	celtic folk
Various Artists / Celtic Myths (Disc 1) / 15 - The	House Band - T	he Rocky Road 7	To Dublin.mp3					
	neutral	medium	medium	soft	both	world	celtic	celtic folk
Various Artists / Celtic Myths (Disc 1) / 16 - And	y M. Stewart &	Manus Lunny -	Freedom Is Like Gold.n	np3	hoth	woodd	inish falls	
Various Artists / Frankfurt Beat Productions (Dis	nappy c 1) / 01 - Brazi	lian Trancer - Ro	botnico.mp3	neutrai	boun	world	ITISH IOIK	
	neutral	fast	low	aggressive	instruments	electronica	trance	
Various Artists / Frankfurt Beat Productions (Dis	c 1) / 02 - Jeyer	ne - Kickin'.mp3	1	1	n	1	T	1
Various Antists / Engelsfunt Post Des dustions (Dis	neutral	fast	low	neutral	instruments	electronica	techno	
various Artists / Frankfurt beat Floductions (Dis	happy	medium	low	soft	instruments	electronica	trance	
Various Artists / Frankfurt Beat Productions (Dis	c 1) / 04 - Cryp	tic Diffusion II	Adhesiveness.mp3					
	neutral	fast	low	neutral	instruments	electronica	trance	
Various Artists / Frankfurt Beat Productions (Dis	c 1) / 05 - Anal	og Vogue II - Geo	graphic Excursion.mp3					
Various Artists / Frankfurt Beat Productions (Dis	neutral	very tast ral Love - Experie	low ence of a Beautiful Rain	aggressive bow.mp3	instruments	electronica	techno	
and as made in the set for the set of the se	happy	medium	low	soft	instruments	electronica	techno	
Various Artists / Frankfurt Beat Productions (Dis	c 1) / 07 - Temp	odrom - Tragic N	/yth.mp3					
Marine Addited Freedom Part Part and the Ob	neutral	fast	low	aggressive	instruments	electronica	techno	
various Artists / Frankfurt beat Floductions (Dis	neutral	verv fast	low	neutral	instruments	electronica	trance	
Various Artists / Frankfurt Beat Productions (Dis	c 1) / 09 - Energ	gy Raver - Heave	n Seven.mp3					
	neutral	fast	low	neutral	instruments	electronica	techno	
Various Artists / Frankfurt Beat Productions (Dis	c 1) / 10 - Nagh	achian - Magic k	keys.mp3			destaundes.		
Various Artists / Frankfurt Beat Productions (Dis	nappy c 1) / 11 - Every	tast thing Was Legal	- Paragon.mp3	SOIT	instruments	electronica	trance	
	neutral	very fast	low	aggressive	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	01 - ATB - The S	Summer (Airplay	Mix).mp3					1
Variana Antiata / Entrum Transa Val. 12 (Dias 1) /	happy	fast	low	soft	instruments	electronica	trance	
various Artists / Future Trance vol. 12 (Disc 1) /	neutral	fast	low	aggressive	instruments	electronica	techno	
Various Artists / Future Trance Vol. 12 (Disc 1) /	03 - Rom & Cor	nix - The Day Af	ter (Radio Version).mp3	3				
	neutral	fast	low	neutral	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	04 - Dumonde -	Just Feel Free (R	adio Mix).mp3	n sustan l	in a farma and a	alaataaniaa	turn on	
Various Artists / Future Trance Vol. 12 (Disc 1) /	nappy 05 - Blank & Ioi	rast nes - The Nightfly	v (Short Cut).mp3	neutrai	instruments	electronica	trance	
	happy	fast	low	neutral	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	06 - Fragma - To	oca's Miracle (Ra	dio Cut).mp3	1	n	1	T	1
Marine Astista / Estern Trans Mal 10 (Disc1) /	neutral	fast	medium	neutral	both	electronica	trance	
various Artists / Future Trance Vol. 12 (Disc 1) /	happy	fast	low	neutral	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	08 - Kay Cee - H	Escape 2000 (Rad	io Edit).mp3					
	happy	fast	low	neutral	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	09 - Paul Van D	yk - Tell Me Why	(The Riddle)(Radio M	ix).mp3	1	destaund se		
Various Artists / Future Trance Vol. 12 (Disc 1) /	neutrai 10 - Tomcraft V	s. Sunbeam - Ver	sus (Niels Van Gogh Re	son	both	electronica	trance	
	neutral	fast	low	neutral	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	11 - Mauro Picc	otto - Komodo (Sa	ave A Soul)(Alternativ 1	Mix).mp3				
	happy	varying	medium	neutral	instruments	electronica	trance	
various Artists / Future Trance Vol. 12 (Disc 1) /	i∠ - iviembers C happy	fast	pop (Snort).mp3 low	neutral	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	13 - Westbam -	Lovebass (Short)	.mp3					1
	neutral	medium	low	aggressive	instruments	electronica	techno	
Various Artists / Future Trance Vol. 12 (Disc 1) /	14 - Southside S	Spinners - Luvstr	uck (Marco V. & Benjan	nin 2000 Remix Edit).mp3	distant.	1	
Various Artists / Future Trance Vol. 12 (Disc 1) /	nappy 15 - Club Invad	ers Vs. Miss Thu	nderpussy - Mirage (Ra	neutrai adio).mp3	instruments	electronica	uance	1
(2001)	happy	fast	low	neutral	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	16 - Hypertrax	- The Darkside	(Video Cut).mp3	1	r			
Maniana Antiata / Entran Trans Mr. 12 (P) - 2 /	happy	medium	low	neutral	instruments	electronica	trance	
various Artists / ruture france vol. 12 (Disc 1) /	happy	fast	medium	neutral	instruments	electronica	trance	
	117							

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Various Artists / Future Trance Vol. 12 (Disc 1) /	18 - 2000 Canar	ias - Easy (Just N	love Some)(Single Edit)	.mp3				
	neutral	fast	low	aggressive	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	19 - The Trance happy	core Project - Fla fast	shback (Greencourt Rac low	tio Mix).mp3 neutral	instruments	electronica	trance	
Various Artists / Future Trance Vol. 12 (Disc 1) /	20 - Scooter - Tl	he Pusher 1.mp3						
	neutral	very fast	low	aggressive	instruments	electronica	techno	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 01 - Oh Du Fi	roehliche.mp3	vocale	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 03 - Allein Go	ott in der Hoeh sei H	Ehr.mp3	IOIK	curistitus	
	neutral	slow	low	soft	instruments	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 04 - Vom Hin	nmel hoch da komn	n ich her.mp3	6.11		
Various Artists / Hartlauer - Golden Christmas H	happy lits / Hartlauer	- Golden Christr	low mas Hits - 05 - Das Weil	soft	vocals nach Lukas.mp3	tolk	christmas	
	neutral	slow	low	neutral	vocals	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 07 - Es ist ein	Ros entsprungen.m	np3	1		
Variana Antiata / Hantlewan, Caldon Christman H	happy	very slow	low	soft	both	folk	christmas	
various Artists / Hartlauer - Golden Christinas H	happy	slow	low	soft	vocals	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 09 - Am Weih	nachtsbaum die Lie	chter brennen.mp3			
	happy	slow	low	soft	instruments	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	 Golden Christr very slow 	nas Hits - 11 - Suesser d	lie Glocken nie klin soft	gen.mp3 vocals	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 12 - Alle Jahr	e wieder.mp3	vocals	Ion	christinus	
	happy	slow	low	soft	vocals	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 14 - Leise ries	selt der Schnee.mp3				1
Various Artists / Hartlauer - Golden Christmas H	happy lits / Hartlauer	- Golden Christr	medium mas Hits - 15 - Glocken	soft des Mainzer Dome	both mp3	tolk	christmas	l
	neutral	medium	low	neutral	instruments	classical	bells	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 16 - O Tanner	nbaum.mp3				
	happy	slow	low	soft	vocals	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	happy	- Golden Christr	mas Hits - 17 - O du Fro medium	enliche.mp3 soft	instruments	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 18 - Glocken	des Doms zu Speye	r.mp3			
	neutral	medium	low	neutral	instruments	classical	bells	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 19 - Kommet	ihr Hirten.mp3		6.11	de de terrer	
Various Artists / Hartlauer - Golden Christmas H	nappy lits / Hartlauer	- Golden Christr	mas Hits - 20 - Vom Hin	nmel hoch.mp3	vocais	IOIK	christmas	
	happy	medium	low	soft	both	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 21 - Blasmusi	k.mp3		T	-	1
Various Artists / Hantleven, Colden Christman H	happy	slow Coldon Christe	low	soft	instruments	folk	christmas	
various Artists / Hartiauer - Golden Christinas F	happy	very slow	low	soft	vocals	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 23 - Glocken	der Marienkirche zi	u Danzig.mp3			
	neutral	medium	low	neutral	instruments	classical	bells	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 24 - Tochter 2	Lion.mp3	vocale	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 25 - Wie soll i	ich dich empfangen	(Blasmusik).mp3	IOIK	curistitus	
	happy	slow	low	soft	instruments	folk	christmas	
Various Artists / Hartlauer - Golden Christmas H	lits / Hartlauer	- Golden Christr	nas Hits - 26 - Stille Nac	cht Heilige Nacht.m	1p3	6.11	de de terrer	
Various Artists / History Of Punk Rock (Disc 1) /	01 - Sex Pistols	s - God Save The	Oueen.mp3	зоп	vocais	IOIK	christmas	
	sad	fast	medium	aggressive	both	rock	punk rock	
Various Artists / History Of Punk Rock (Disc 1) /	02 - Sex Pistols	s - Pretty Vacant.	mp3					
Various Artists / History Of Pupk Rock (Disc 1) /	neutral	fast - Anarchy In Th	medium ue UK mp3	aggressive	both	rock	punk rock	
	neutral	fast	medium	aggressive	both	rock	punk rock	
Various Artists / History Of Punk Rock (Disc 1) /	04 - Sex Pistols	s - EMI.mp3						
Notice Antice (West, OVB, U.B. 1977, 197	sad	fast	medium	aggressive	both	rock	punk rock	I
Various Artists / History Of Punk Rock (Disc 1) /	05 - The Strang	glers - Peaches.m medium	p3 medium	aggressive	both	rock	punk rock	
Various Artists / History Of Punk Rock (Disc 1) /	06 - The Strang	glers - Bear Cage	.mp3	-00-000110			1	I
	neutral	fast	medium	aggressive	both	rock	punk rock	
Various Artists / History Of Punk Rock (Disc 1) /	07 - The Strang	glers - Tank.mp3			1		and and	
Various Artists / History Of Punk Rock (Disc 1) /	08 - The Strans	glers - Nice 'n' Sl	eazy.mp3	aggressive	bour	IOCK	ринк юск	
,, _,, _	neutral	medium	medium	neutral	both	rock	punk rock	
Various Artists / History Of Punk Rock (Disc 1) /	09 - Eddie & T	he Hot Rods - Te	enage Depression.mp3					
Various Artists / History Of Purels Bash (D's 1)	neutral	fast	medium	neutral	both	rock	punk rock	
Autous rutusts / Thistory Of Fullk Rock (DISC1) /	neutral	fast	medium	neutral	both	rock	punk rock	
Various Artists / History Of Punk Rock (Disc 1) /	11 - Eddie & T	he Hot Rods - Te	lephone Girl.mp3					·
	neutral	fast	medium	neutral	both	rock	punk rock	
Various Artists / History Of Punk Rock (Disc 1) /	12 - Eddie & T sad	ne Hot Rods - M fast	oon Tears.mp3 medium	neutral	both	rock	punk rock	
Various Artists / History Of Punk Rock (Disc 1) /	13 - The Damr	ned - Fall.mp3			50m	-ven	runnier	I
· · · · · · · · · · · · · · · · · · ·	neutral	very fast	medium	aggressive	both	rock	punk rock	
Various Artists / History Of Punk Rock (Disc 1) /	14 - The Damr	ned - Ballroom Bl	itz.mp3		hath	made	anal as 1	1
Various Artists / History Of Punk Rock (Disc 1) /	15 - The Damr	very rast ned - New Rose r	meaium np3	aggressive	both	TOCK	рипк госк	1
	neutral	very fast	medium	aggressive	both	rock	punk rock	

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Various Artists / History Of Punk Rock (Disc 1) /	16 - The Damr	ed - Melody Lee	mp3	I	T	I	1	1
Various Artists / Jazz Masters - Volume 1 (Disc 1)	neutral / 01 - Ben Web	very fast ster - Stormy We	medium ather.mp3	aggressive	both	rock	punk rock	
	sad	very slow	medium	soft	instruments	jazz	swing	
Various Artists / Jazz Masters - Volume 1 (Disc 1)	/ 02 - Louis Ai	rmstrong - Do Yo	u Know What It Means	To Miss New Orle	ans.mp3 both	19.77	ewing	
Various Artists / Jazz Masters - Volume 1 (Disc 1)	/ 03 - Sonny St	titt - Autumn In I	New York.mp3	Soft	bour	Jazz	swing	
	happy	medium	medium	soft	instruments	jazz	bop	
Various Artists / Jazz Masters - Volume 1 (Disc 1)	/ 04 - Theloniu neutral	is Monk - Crepus slow	nedium	neutral	instruments	jazz	bop	
Various Artists / Jazz Masters - Volume 1 (Disc 1)	/ 05 - Miles Da	avis - Don't Expla	in To Me Baby.mp3			,	1	1
Various Artists / Jazz Mastars - Volume 1 (Disc 1)	happy	medium Grappelli - Lov	medium e For Sale mp3	soft	both	jazz	bop	
various musics / jazz masters - volume 1 (Disc 1)	neutral	fast	high	neutral	instruments	jazz	swing	
Various Artists / Jazz Masters - Volume 1 (Disc 1)	/ 07 - Donald	Byrd - Groovin' F	or Nat.mp3		· · ·			1
Various Artists / Jazz Masters - Volume 1 (Disc 1)	/ 08 - Nat King	rast g Cole - Black Ma	rket Stuff.mp3	neutral	instruments	jazz	nard bop	
	happy	medium	medium	soft	instruments	jazz	swing	
Various Artists / Jazz Masters - Volume 1 (Disc 1)	/ 09 - Art Tatu neutral	m - Body And So fast	ul.mp3 high	soft	instruments	iazz	swing	
Various Artists / Jazz Masters - Volume 1 (Disc 1)	/ 10 - Paul Gor	nsalves And Ray	Nance - B P Blues.mp3	bolt	nouunento	Junz	Sining	
Various Artists / Kusakalasak Val. 11 (Diss.1) / 0	happy No Doubt	medium	medium	neutral	instruments	jazz	swing	
various Artists / Ruscheirock vol. 11 (Disc 1) / 0.	sad	medium	medium	neutral	both	rock	рор	alternative pop
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 02	2 - Toni Braxton	- I Don't Want T	o.mp3	1		1		
Various Artists / Kuschelrock Vol. 11 (Disc.1) / 02	sad - Backstreet Be	slow	medium Games (With My Hea	soft rt) (Video Version)	both mp3	rock	pop	urban
various master in the contract of the contract	neutral	medium	low	soft	both	rock	рор	teen pop
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 04	I - R. Kelly - I B	elieve I Can Fly (Radio Edit).mp3	0	11			
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 05	happy - Eric Clapton	- Change The We	orld (Lp Version).mp3	soft	both	rock	рор	urban
	happy	medium	medium	soft	both	rock	soft rock	
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 06	5 - Paul Mccartı	ney - Yesterday.m	p3 medium	soft	vocale	rock	soft rock	
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 02	7 - Boyzone - W	ords (Radio Edit)	.mp3	3011	vocais	IOCK	SOILIOCK	
	happy	medium	medium	soft	both	rock	рор	teen pop
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 08	happy	slow	My Eyes (Kadio Edit).n medium	soft	both	rock	рор	adult contemporary
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 09	9 - En Vogue - E	Don't Let Go (Lov	e) (Radio Edit).mp3				1 1	1 7
Various Artists / Kuschelrock Vol 11 (Disc 1) / 10	neutral	medium he New Power G	medium eneration - Diamonds :	soft and Pearls (I p-vers	both ion) mp3	rock	рор	urban
various musis / Ruschenock vol. m (Disci) / ite	happy	medium	medium	soft	both	rock	soft rock	
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 11	l - Cranberrries	- When You're C	Gone (Edit).mp3		11			diama Cara ang
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 12	sad 2 - Oasis - Wond	derwall.mp3	medium	sort	both	TOCK	рор	aiternative pop
	happy	medium	medium	neutral	both	rock	рор	brit-pop
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 13	3 - Scorpions - V sad	White Dove.mp3 medium	medium	soft	both	rock	soft rock	
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 14	4 - Gloria Estefa	n - Reach (Albur	n Version).mp3					
Various Artists / Kuschalzack Val. 11 (Diss.1) / 15	happy Michael Jack	medium	medium Thora (Edit Varcian) m	soft	both	rock	рор	adult contemporary
various Artists / Ruschenock vol. 11 (Disc 1) / 1.	neutral	medium	medium	neutral	both	rock	pop	urban
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 16	6 - January Feat	. DJ Company - V	Wishing On The Same S	itar.mp3			I	
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 17	happy 7 - Youssou N'd	medium our and Neneh O	medium Therry - 7 Seconds (Rad	soft io Edit).mp3	both	rock	pop	adult contemporary
	sad	slow	medium	soft	both	world	africa	
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 18	3 - Spice Girls -	2 Become 1 (Sing	le Version).mp3	soft	both	rock	pop	teen non
Various Artists / Kuschelrock Vol. 11 (Disc 1) / 19	- Dune - Who	Wants To Live Fo	prever (Sixtysix Radio N	/ix).mp3	bour	IOCK	pop	techpop
Version Antipe (Versibility of Versibility of Versibility) (10	happy	very slow	medium	soft	both	rock	рор	adult contemporary
Various Artists / Ruscheirock Vol. 11 (Disc 2) / 01	sad	very slow	medium	soft	both	rock	рор	adult contemporary
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 02	2 - Eros Ramazo	otti - L'Aurora.mp	53	1	1	1	* *	
Various Artists / Kuschelrock Vol 11 (Disc 2) / 03	happy 3 - No Mercy - V	slow When I Die mp3	medium	soft	both	rock	soft rock	
various musis / Ruschenock vol. 11 (Disc 2) / 0.	happy	slow	medium	soft	both	rock	рор	adult contemporary
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 04	I - Jam and Spo I - Jam and Spo	on feat. Plavka -	Kaleidoscope Skies.mp	3	1.01			. 1. 1
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 05	nappy 5 - Amanda Ma	rshall - Dark Hor	se.mp3	sort	both	TOCK	рор	adult contemporary
	happy	medium	medium	soft	both	rock	рор	alternative pop
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 06	- Joan Osborn neutral	e - One Of Us.mp medium	nedium	soft	both	rock	рор	alternative pop
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 02	7 - Aerosmith -	Hole In My Soul.	mp3				1.1	
Various Artists / Kuechalrock Val. 11 (Dice 2) / 09	sad	medium	medium Time mp3	neutral	both	rock	arena rock	I
anous musis / Ruschenock Vol. 11 (Disc 2) / 0	happy	slow	medium	soft	both	rock	soft rock	
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 09	9 - Eternal - Son	neday.mp3	11		1.4			
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 10	neutral) - 3T - I Need Y	slow (ou.mp3	medium	soft	both	rock	рор	urban
	neutral	slow	medium	soft	both	rock	рор	urban

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 11	l - Soraya - Sud	denly.mp3						
Waises Astists / Keeshalas J. V.J. 11 (Disc.2) / 10	sad	slow	medium	soft	both	world	latin	
Various Artists / Ruscheirock Vol. 11 (Disc 2) / 12	neutral	slow	medium	soft	both	rock	soft rock	
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 13	3 - Chicago - Le	t's Take A Lifetin	ne.mp3					
	happy	slow	medium	soft	both	rock	pop	adult contemporary
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 14	4 - Billy Joel - Ju neutral	slow	Are.mp3 medium	soft	both	rock	soft rock	
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 15	- Ricky Martir	n - Fuego De Noc	he, Nieve De Dia.mp3	bolt	bour	lock	Son rock	
	neutral	slow	medium	soft	both	world	latin	
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 16	5 - Gary Barlow	- Forever Love.r	np3 modium	coft	both	rock	non	adult contemporary
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 12	7 - Journey - Wl	hen You Love A	Noman.mp3	Soft	bour	IOCK	рор	adult contemporary
	happy	slow	medium	soft	both	rock	soft rock	
Various Artists / Kuschelrock Vol. 11 (Disc 2) / 18	3 - Sarah Bright	man - Time To Sa	y Goodbye.mp3	ant	manla	alassiaal	musical	
Various Artists / Mystera IX / 01 - Era - Divano.n	np3	very slow	medium	Soft	vocais	classical	inusical	
	happy	medium	medium	soft	both	new age	progressive electronic	
Various Artists / Mystera IX / 02 - Vangelis - Ligh	nt And Shadow	.mp3			1.0	1		
Various Artists / Mystera IX / 03 - Highland - Ou	o Vadis.mp3	very slow	medium	soft	both	new age	progressive electronic	
	happy	medium	medium	soft	both	new age	progressive electronic	
Various Artists / Mystera IX / 04 - Oliver Shanti -	Journey To Sch	nambala.mp3			1	1		1
Various Artists / Mystera IX / 05 - Mike Oldfield	neutral	slow	medium	soft	instruments	new age	meditation	
various ratios / wysicia by / 05 - wike Okalela	happy	medium	medium	soft	both	new age	progressive electronic	
Various Artists / Mystera IX / 06 - Gregorian - Ch	uld In Time.mp	53						
Notes Addate (Marten IV / 07, Charach Cold	neutral	slow	medium	soft	both	new age	progressive electronic	
Various Artists / Mystera IX / 0/ - Clannad - Cals	neutral	slow	medium	soft	vocals	new age	celtic new age	
Various Artists / Mystera IX / 08 - Santana - Aqua	a Marine.mp3					9		
	happy	medium	medium	soft	instruments	rock	soft rock	
Various Artists / Mystera IX / 09 - Lesiem - Lesier	m.mp3	medium	medium	soft	both	DOW 300	progressive electronic	
Various Artists / Mystera IX / 10 - Unio Mystica -	Cuncti Simus	Concanentes Ave	Maria.mp3	3011	bour	new age	piogressive electionic	
	happy	medium	medium	soft	both	new age	progressive electronic	
Various Artists / Mystera IX / 11 - Evolution - Su	nrise.mp3	haat		ant	in starter on to		to have tailed	1
Various Artists / Mystera IX / 12 - Maire Ryham	- Mists Of Aval	on.mp3	medium	SOIL	instruments	new age	techno-tribai	
· · · ·	happy	varying	medium	soft	both	new age		
Various Artists / Mystera IX / 13 - Lingua Mystic	a - Gloria.mp3			0	te de contra		and the second s	
Various Artists / Mystera IX / 14 - Hazy Garden	Minia.mp3	medium	medium	soft	instruments	new age	progressive electronic	
	neutral	fast	medium	neutral	instruments	new age	progressive electronic	
Various Artists / Mystera IX / 15 - Gandalf - Four	ntain Of Secrets	.mp3	1	1	1	1		1
Various Artists / Mystera IX / 16 - Ortiga - Danza	happy La Luna mp3	varying	high	soft	instruments	new age	progressive electronic	
tanbas maso, mysela be, to enaga bana	happy	fast	medium	neutral	both	new age		
Various Artists / Mystera IX / 17 - Brighter Touch	a - Mother Natu	ire Ballade.mp3	1	1	1			1
Various Artists / Mystera IX / 18 - Capercaillie - 1	sad To The Moon m	medium	medium	soft	both	new age	progressive electronic	
various Artists / Wystera IX / 10 - Capercanne - 1	happy	medium	medium	neutral	both	new age	celtic new age	
Various Artists / Mystera IX / 19 - Sarah Brightm	an - La Lune.m	ıp3						-
	neutral	very slow	low	soft	instruments	new age		
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	01 - Elements C neutral	of Trance - Myste slow	ry Trance Intro.mp3	soft	instruments	electronica	trance	
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	02 - Hitch Hike	er & Dumondt - H	How Much Can You Tak	ke.mp3	nouunento	ciccuonicu	unice	
	happy	fast	low	neutral	instruments	electronica	trance	
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	03 - Ayla - Lieb happy	e.mp3	low	neutral	instruments	electronica	trance	
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	04 - Abel & Ka	in - Delirium.mp	3	neutrai	nistrunctus	cicettonica	trance	
	neutral	fast	low	aggressive	instruments	electronica	techno	
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	05 - Drax Ltd I	I - Amphetamine	.mp3		1	di staratar		1
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	06 - B.E Welc	rast come To Slavery.n	np3	neutral	instruments	electronica	trance	
	neutral	fast	low	neutral	instruments	electronica	techno	
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	07 - Desotot - F	Rainman.mp3	1.		1		1	1
Various Artists / Mystery Trance Vol. 4 (Disc.1) /	happy 08 - Kai Tracid	- Liquid Skies m	low p3	neutral	instruments	electronica	trance	
in the second state of a close 1)/	happy	fast	medium	neutral	instruments	electronica	trance	
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	09 - Lustral - E	verytime.mp3			1		1	1
Various Artists / Mustow Trops Val 4 (Dis 1) /	neutral	fast	low	neutral	instruments	electronica	trance	
satious ritusts / iviystery fiance vol. 4 (DISC1) /	neutral	fast	medium	neutral	instruments	electronica	trance	
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	11 - Chrome &	Price - SunRise.r	np3					
Various Antista / Musters Trans. V.1.4 (2014)	neutral	fast	low	neutral	instruments	electronica	trance	
various Artists / Mystery Irance Vol. 4 (Disc 1) /	12 - Paul Van L happy	јук - ror An Ang fast	low	neutral	instruments	electronica	trance	
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	13 - Traumatix	- Debut.mp3	L					·
	neutral	fast	low	aggressive	instruments	electronica	techno	

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	14 - Aquaplex i	meets Junk Proje	ct - Brightness.mp3					
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	happy 15 - Nuclear H	fast vde - X-Tension I	medium mp3	neutral	instruments	electronica	trance	
	neutral	fast	low	neutral	instruments	electronica	techno	
Various Artists / Mystery Trance Vol. 4 (Disc 1) /	16 - Blue Alpha	abet - Cyberdano	e.mp3 medium	neutral	instruments	electronica	trance	
Various Artists / Reggae Fever - Reggae Hits zun	happy Abtanzen (Dis	sc 1) / 01 - Jimmy	/ Cliff - I Can See Clearl	y Now.mp3	nistrumentis	cicetionica	Hance	
Various Antista / Desma Farmer Desma Hiteman	happy Abtennen (Die	medium	medium	soft	both	world	reggae	
various Artists / Keggae Fever - Keggae Filts Zun	neutral	medium	medium	neutral	both	world	reggae	
Various Artists / Reggae Fever - Reggae Hits zun	n Abtanzen (Dis	sc 1) / 03 - Peter	Tosh - Johnny B. Goode	.mp3				I
Various Artists / Reggae Fever - Reggae Hits zum	happy Abtanzen (Dis	medium sc 1) / 04 - Inner	Circle - Sweat.mp3	soft	both	world	reggae	
	happy	medium	medium	soft	both	world	reggae	
Various Artists / Reggae Fever - Reggae Hits zun	happy	sc 1) / 05 - Eddy fast	Grant - Gimme Hope Jo low	o'anna.mp3 neutral	both	world	reggae	
Various Artists / Reggae Fever - Reggae Hits zum	n Abtanzen (Dis	sc 1) / 06 - Cultur	re Club - Do You Really	Want To Hurt Me.r	np3			
Various Artists / Reggae Favor - Reggae Hits zum	sad Abtanzen (Die	medium	medium	soft You Honey mp3	both	world	reggae	
vanous musis / Regar rever - Regar mis zun	happy	medium	low	soft	both	world	reggae	
Various Artists / Reggae Fever - Reggae Hits zun	n Abtanzen (Dis	sc 1) / 08 - Yazz A	Aswad - How Long.mp	3	1.4			I
Various Artists / Reggae Fever - Reggae Hits zum	sad Abtanzen (Dis	medium sc 1) / 09 - Lee Ri	medium itenour - Waiting In Vai	soft n.mp3	both	world	reggae	
	neutral	slow	medium	soft	both	jazz	jazz pop	
Various Artists / Reggae Fever - Reggae Hits zum	h Abtanzen (Dis	sc 1) / 10 - Grove	r Washington Jr Jamm	nin'.mp3	instruments	iozz	couling	
Various Artists / Reggae Fever - Reggae Hits zum	nappy Abtanzen (Dis	sc 1) / 11 - Sonny	& Cher - I Got You Bab	pe.mp3	instruments	Jazz	sourjazz	
	happy	medium	medium	soft	both	rock	рор	
Various Artists / Reggae Fever - Reggae Hits zun	happy	sc 1) / 12 - Kate Y medium	anai - Summer Dreami medium	ng.mp3 soft	both	world	reggae	
Various Artists / Reggae Fever - Reggae Hits zun	n Abtanzen (Dis	sc 1) / 13 - Love &	& Peace - I Wanna Get I	Back Home.mp3	bour	wond	reggae	
	neutral	medium	low	soft	both	world	reggae	
Various Artists / Keggae Fever - Keggae Hits zum	happy	medium	medium	mp3 soft	both	world	reggae	
Various Artists / Reggae Fever - Reggae Hits zum	n Abtanzen (Dis	sc 1) / 15 - Garlar	nd Jeffreys - Matador.m	р3				
Various Artists / Poggao Favor Poggao Hits zup	neutral	medium	medium Circlo - I Shot The Shor	soft	both	world	reggae	
various Artists / Reggae rever - Reggae ritis zun	happy	medium	medium	soft	both	world	reggae	
Various Artists / Reggae Fever - Reggae Hits zun	n Abtanzen (Dis	sc 1) / 17 - Ziggy	Marley And The Meloo	dy Makers - Look W	'ho's Dancing.mp3	T	1	1
Various Artists / Reggae Fever - Reggae Hits zum	happy Abtanzen (Dis	fast sc 1) / 18 - Jimmy	medium v Cliff - You Can Get It l	neutral If You Really Want r	both np3	world	reggae	
	happy	medium	medium	soft	both	world	reggae	
Various Artists / Thunderdome IV - The Devil's I	ast Wish (Disc	1) / 01 - Hardsec	quencer Amiga E.P No	oise Is The Message	Rmx.mp3	alaataaniaa	handaana taabu a	
Various Artists / Thunderdome IV - The Devil's I	ast Wish (Disc	1) / 02 - Ilsa Gol	d II - Silke (The Speedfi	reak Rmx).mp3	instruments	electronica	hardcore techno	
	happy	very fast	medium	aggressive	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	.ast Wish (Disc neutral	1) / 03 - Tutti Fru verv fast	atti EP - Rotterdam Mix	.mp3 aggressive	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	ast Wish (Disc	1) / 04 - Charly I	Lownoise & Mental The	eo - Tiroler Kabome	sch.mp3			
Variana Antiata / Thun denderne IV. The Deville I	neutral	very fast	low	aggressive	instruments	electronica	hardcore techno	
various Artists / Intuiderdome IV - The Devil's I	neutral	very fast	low	aggressive	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	ast Wish (Disc	1) / 06 - RMB He	eaven & Hell E.P The	Place To Be.mp3		•		1
Various Artists / Thunderdome IV - The Devil's I	neutral ast Wish (Disc	very fast 1) / 07 - Sorcerer	low - Summer.mp3	aggressive	instruments	electronica	hardcore techno	
	neutral	very fast	low	aggressive	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	.ast Wish (Disc	1) / 08 - Nip Col	lective - Weekend.mp3		in structure sentes	alaataaniaa	handaana taabaa	
Various Artists / Thunderdome IV - The Devil's I	ast Wish (Disc	1) / 09 - DE 2017	SGE - Eyloco Remix.m	p3	instruments	electronica	hardcore techno	
	neutral	very fast	low	aggressive	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	.ast Wish (Disc neutral	1) / 10 - Casseop verv fast	oaya - 10 Seconds To Ter low	minate Live.mp3	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	.ast Wish (Disc	1) / 11 - E-De-Co	ologne - Zimboculture.r	np3	notunento	ciccuonica	initiatore techno	
	neutral	very fast	low	aggressive	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	ast Wish (Disc neutral	 1) / 12 - Speedtn very fast 	low	aggressive	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	ast Wish (Disc	1) / 13 - Yves De	Ruyter III - Rave City.r	np3	r			
Various Artists / Thunderdome IV - The Devil's I	neutral ast Wish (Disc	fast 1) / 14 - DI Bour	low tybunter - Demilitarize	aggressive of Zone mp3	instruments	electronica	hardcore techno	
	neutral	fast	low	aggressive	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	ast Wish (Disc	1) / 15 - E-De-Co	ologne - Ein Bisschen Fr	ieden.mp3	1	distant.	hander at 1	
Various Artists / Thunderdome IV - The Devil's I	neutral .ast Wish (Disc	very tast 1) / 16 - Leny De	iow ee & DJ Edge - Fucking	aggressive Hostile.mp3	both	electronica	nardcore techno	1
	neutral	fast	low	aggressive	instruments	electronica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	ast Wish (Disc	1) / 17 - Speedfn verv fast	eak - Red Poison Part 3	.mp3 aggressive	instruments	electropica	hardcore techno	
Various Artists / Thunderdome IV - The Devil's I	.ast Wish (Disc	1) / 18 - Omar Sa	antana - Edit Madness.	np3	assaultents	caccionica	-materie teento	1
· · · · · · · · · · · · · · · · · · ·	neutral	very fast	low	aggressive	instruments	electronica	hardcore techno	
various Artists / Thunderdome IV - The Devil's I	ast wish (Disc neutral	very fast	medium	aggressive	both	electronica	hardcore techno	
					•			

filename	mood	tempo	complexity	emotion	focus	genre	subgenre	subsubgenre
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 01 - Rol	y Daniels - Wher	n Irish Eyes Are Smiling	.mp3				
Various Artists / When Irish Eyes Are Smiling (D	happy isc 1) / 02 - Fra	medium nkie McBride - H	medium Iow Are Things In Gloc	soft camora.mp3	both	world	irish folk	
	happy	slow	medium	soft	both	world	irish folk	
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 03 - Dia	mond Accord - I	'll Tell Ma-Courtin' In T	he Kitchen-The Da	cent Irish Boy-Let F	Him Go Let Him Ta	rry.mp3 irich folk	1
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 04 - Bria	an Coll - I'll Take	You Home Again Kath	leen.mp3	instruments	world	INSILIOIK	
	happy	slow	medium	soft	both	world	irish folk	
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 05 - Kat neutral	hie Harrop - Con slow	nemara By The Lake.m	ip3 soft	vocals	world	irish folk	
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 06 - Big	Tom - The Old R	lustic Bridge.mp3					
Various Antista / When Irish Euro And Smiling (D	neutral	medium	medium	soft	both	world	irish folk	
various Artists / when insh Eyes Are Shining (D	neutral	slow	medium	soft	both	world	irish folk	
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 08 - Fly	ing Column - Old	d Maid In A Garrett-Go	lden Jubilee.mp3				
Various Artists / When Irish Eves Are Smiling (D	happy isc 1) / 09 - Bre	fast ndan Quinn - My	wild Irish Rose mp3	neutral	both	world	irish folk	
	happy	slow	medium	soft	both	world	irish folk	
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 10 - Brid	die Gallagher - A	Mother's Love's A Ble	ssing.mp3	hath	woodd	inish falls	
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 11 - Rol	y Daniels - The R	are Oul' Times.mp3	sort	both	world	ITISH TOIK	
	happy	slow	medium	soft	both	world	irish folk	
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 12 - The	Glenlock Four -	Ducks of Magheralin.n	np3 neutral	vocals	world	irish folk	
Various Artists / When Irish Eyes Are Smiling (D	isc 1) / 13 - Lec	McCaffrey - Mo	untains of Mourne-Phil	e The Fluter's Ball-	Come Back Paddy I	Reilly.mp3	in our total	
	happy	varying	medium	soft	both	world	irish folk	
Various Artists / When Irish Eyes Are Smiling (D	neutral	slow	medium	soft	both	world	irish folk	
Vladimir Horowitz / Mozart / Vladimir Horowit	z - Mozart - 01	- Piano Sonata In	B Flat Major, K.281 - A	llegro.mp3		1		
Vladimir Horowitz / Mozart / Vladimir Horowit	happy Mogart 02	fast Piano Sonata In	high B Flat Major K 281 - A	neutral ndanto Amoroco m	instruments	classical	piano	
Viadinini Holowitz / Wozart / Viadinini Holowit	neutral	medium	high	neutral	instruments	classical	piano	
Vladimir Horowitz / Mozart / Vladimir Horowit	z - Mozart - 03	- Piano Sonata In	B Flat Major, K.281 - R	ondeau Allegro.mp	3		<u> </u>	I
Vladimir Horowitz / Mozart / Vladimir Horowit	happy z - Mozart - 04	fast - Piano Sonata In	high C Maior, K.330 - Alleg	neutral ro Moderato.mp3	instruments	classical	piano	
· · · · · · · · · · · · · · · · · · ·	neutral	fast	high	neutral	instruments	classical	piano	
Vladimir Horowitz / Mozart / Vladimir Horowit	z - Mozart - 05	- Piano Sonata In	C Major, K.330 - Anda	nte Cantibile.mp3	in structure sentes	alassiaal		
Vladimir Horowitz / Mozart / Vladimir Horowit	z - Mozart - 06	- Piano Sonata In	C Major, K.330 - Alleg	retto.mp3	instruments	classical	piano	
	happy	fast	high	neutral	instruments	classical	piano	
Vladimir Horowitz / Mozart / Vladimir Horowit	z - Mozart - 07 happy	- Piano Sonata In fast	B Flat Major, K.333 - A	llegro.mp3 neutral	instruments	classical	piano	
Vladimir Horowitz / Mozart / Vladimir Horowit	z - Mozart - 08	- Piano Sonata In	B Flat Major, K.333 - A	ndante Cantibile.m	р3		Finite	
YT U . YY . / X/ . / YH U . YY	neutral	medium	high	neutral	instruments	classical	piano	
Vladimir Horowitz / Mozart / Vladimir Horowit	z - Mozart - 09 happy	- Piano Sonata In fast	high	neutral	np3 instruments	classical	piano	
Vladimir Horowitz / Mozart / Vladimir Horowit	z - Mozart - 10	- Adagio In B Mi	nor, K.540.mp3	1	r		1	
Vladimir Horowitz / Mozart / Vladimir Horowit	sad z - Mozart - 11	slow Rondo In D Ma	high ior K 485 mp3	neutral	instruments	classical	piano	
Viadmini Holowitz / Wozart / Viadmini Holowitz	neutral	medium	high	neutral	instruments	classical	piano	
Westernhagen / Westernhagen - Westernhagen - G)1 - Narbenherz	2.mp3	1.		1.4			
Westernhagen / Westernhagen - Westernhagen -	neutral)2 - Weisst Du,	medium dass ich glücklich	n bin.mp3	neutral	both	rock	рор	
	happy	slow	medium	soft	both	rock	рор	
Westernhagen / Westernhagen - Westernhagen - (03 - Depression	.mp3 medium	medium	soft	both	rock	pop	1
Westernhagen / Westernhagen - Westernhagen -)4 - Es geht wei	ter.mp3	incentin	3011	bour	IOCK	pop	
	neutral	fast	medium	neutral	both	rock	рор	
Westernhagen / Westernhagen - Westernhagen -	sad	3 slow	medium	soft	both	rock	рор	
Westernhagen / Westernhagen - Westernhagen -	06 - Nimm mich	n mit.mp3		1	r		1 1	
Westernhagen / Westernhagen Westernhagen (happy 7. Lich mich n	medium	medium	neutral	both	rock	рор	
westernnagen / westernnagen - westernnagen -	sad	medium	medium	neutral	both	rock	рор	
Westernhagen / Westernhagen - Westernhagen - O	08 - Hey Mama	.mp3						
Westernhagen / Westernhagen - Westernhagen -	neutral 09 - Ganz und g	ar.mp3	medium	aggressive	both	rock	рор	
	sad	slow	medium	soft	both	rock	рор	
Wolfgang Ambros / Wolfgang Ambros - A Gulas	ch Und A Seitl	Bier.mp3		n overhead	hath	made		austro non
Wolfgang Ambros / Wolfgang Ambros - A Menso	h mecht i bleib	'n.mp3	meanni	neutral	bour	IUCK	Pop	ausuo-pop
	sad	medium	medium	neutral	both	rock	рор	austro-pop
Wolfgang Ambros / Wolfgang Ambros - Alfred H	utter.mp3 neutral	medium	medium	soft	both	rock	рор	austro-pop
Wolfgang Ambros / Wolfgang Ambros - Der Berg	.mp3						1.1	F F
Wolfgang Ambros / Wolfgang Ambros Dis Citi	sad	slow	medium	soft	both	rock	рор	austro-pop
wongang Amoros / wongang Amoros - Die Gall	happy	medium	medium	neutral	vocals	rock	рор	austro-pop
Wolfgang Ambros / Wolfgang Ambros - Espresso	.mp3							I
	sad	slow	medium	soft	both	rock	pop	austro-pop

filename	mood	temno	complexity	emotion	focus	genre	subgenre	subsubgenre
Wolfgang Ambras / Wolfgang Ambras I C'enia	I Varliar mp2	i i i i i i i i i i i i i i i i i i i	temp temp)*****	0	0.000	
Woligang Anibios / Woligang Anibios - 1 G spia,	sad	slow	medium	neutral	both	rock	pop	austro-pop
Wolfgang Ambros / Wolfgang Ambros - Zentralfa	riedhof.mp3	51011	meenum	neutrui	bour	TOCK	POP	uusuo pop
	neutral	medium	medium	neutral	both	rock	рор	austro-pop
Wolfgang Ambros / Wolfgang Ambros - Zwickt's	Mi.mp3							
	happy	medium	medium	soft	both	rock	рор	austro-pop
Zucchero / Zucchero - Ahum.mp3								
Zee I and Zee I and Deilla (Committee) and 2	sad	medium	medium	soft	both	blues	modern electric blues	
Zucchero / Zucchero - Bana (Sexy Thing).mp5	neutral	medium	medium	neutral	both	blues	modern electric blues	
Zucchero / Zucchero - Baila Morena.mp3	neutur	incurum	meenum	neutur	bour	Dideo	modern electric braco	
	neutral	medium	medium	neutral	both	blues	modern electric blues	
Zucchero / Zucchero - Blu (Italian Version).mp3								
	sad	slow	medium	soft	both	blues	modern electric blues	
Zucchero / Zucchero - Blue.mp3		•						
	sad	slow	medium	soft	both	blues	modern electric blues	
Zucchero / Zucchero - Diavolo In Me.mp3								r
Zuschame / Zuschame Hai Cashta Mamm?	neutral	medium	medium	neutral	both	blues	modern electric blues	
Zucchero / Zucchero - Har Scerto Me.mps	ead	very clow	medium	soft	both	world	italy	
Zucchero / Zucchero - Il Volo.mp3	300	very slow	incentin	3011	bour	world	italy	
	sad	slow	medium	soft	both	blues	modern electric blues	
Zucchero / Zucchero - Porca L'oca.mp3								
	neutral	fast	medium	aggressive	both	rock	folk rock	
Zucchero / Zucchero - Rispetto.mp3								
	happy	medium	medium	soft	both	blues	modern electric blues	
Zucchero / Zucchero - Scintille.mp3				<i>6</i>	1.4			r
Zueshang / Zueshang Comto La Common mu?	neutral	slow	medium	soft	both	blues	modern electric blues	
Zucchero / Zucchero - Sento Le Campane.mps	neutral	medium	medium	neutral	both	blues	modern electric blues	
Zucchero / Zucchero - Sonio.mp3	neutur	incurum	meenum	neutrui	bour	Dideo	modelin electric braco	
	sad	slow	medium	soft	both	blues	modern electric blues	
ZZ Top / ZZ Top - Greatest Hits - 01 - Gimme All	Your Lovin'.m	р3	•	•	•		•	•
	happy	medium	low	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 02 - Sharp Dress	sed Man.mp3					•	1	r
	happy	medium	low	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 03 - Rough Boy.	mp3	alaru		anft	hath	male	anona naali	
ZZ Ton / ZZ Ton - Greatest Hits - 04 - Tush mp3	neutrai	SIOW	medium	SOIL	boun	IOCK	arena rock	
	happy	medium	low	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 05 - My Head's	In Mississippi.	mp3						
	neutral	medium	low	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 06 - Pearl Neck	lace.mp3							
	neutral	medium	medium	soft	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 07 - I'm Bad, I'm	n Nationwide.r	np3						
77 Ten / 77 Ten Createst Lite 08 Vine Lee V	neutral	medium	low	neutral	both	rock	arena rock	
ZZ 10p / ZZ 10p - Greatest Fills - 08 - Viva Las Ve	-gas.mp5 happy	medium	medium	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 09 - Doubleback	k.mp3	meanan	incentin	neutrai	bour	IOCK	arctia lock	
	neutral	medium	low	neutral	instruments	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 10 - Gun Love.r	np3		•			•		
	neutral	medium	low	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 11 - Got Me Un	der Pressure.m	р3	_				-	-
	neutral	fast	medium	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 12 - Give It Up.:	mp3							
77 Ten / 77 Ten Createst Hite 12 Chean Con	neutral	medium	low	neutral	both	rock	arena rock	
ZZ 10p / ZZ 10p - Gleatest Titls - 15 - Cheap Suig	neutral	medium	medium	neutral	instruments	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 14 - Sleeping Ba	ng.mp3			1				1
1. 1	neutral	medium	medium	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 15 - Planet Of W	Vomen.mp3	·	•	·	·	·	· · · · · · · · · · · · · · · · · · ·	
	neutral	fast	medium	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 16 - La Grange.	mp3							
<u></u>	neutral	medium	low	neutral	both	rock	arena rock	
ZZ Top / ZZ Top - Greatest Hits - 17 - Tube Snake	Boogie.mp3	an ordine ere	laur	a system 1	hath	maile	anona na di	
77 Ton / 77 Ton - Greatest Hite - 18 - Lever mn2	neutral	meurum	IOW	neutrai	boui	IUCK	arena rock	l
	happy	medium	medium	neutral	both	rock	arena rock	

Table A.1: This table shows the results of the manual classification process performed on the test repository.

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