Comparison between the features for music and songs

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For CIS 453

Date: 3/18/2016

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This report focuses on analyzing the characteristics that a music or song will have. By analyzing, we can find out the relationships between them. This is very useful for: a music composer; a music software developer; an AI that trying to recognize the music and anyone else.

Frequent sets for all the attributes:

For this part, we will analyze all the data we have, and try to generate some large frequent sets among all the attributes.

Frequent sets for a particular genre:

For this part, we will try to find some large frequent sets for a particular genre, and all the other attributes will not change.

Largest confidence for a particular genre:

For this part, we will try to find all patterns and rules for a particular genre. The rules with the same attributes but with the largest confidence will be the rules to predict the genre for one song.

Introduction:

Comparison between the features for music and songs

Music has a long history accompanied with the human beings. In the middle age, music has played the important role in human's society already. Based on more and more ideas and concepts about technology and art we discovered, many attributes have been added to this object, "music". such as the tempo and the beats, which somehow define the quality of song or a piece of melody.

Thus, if we are able to analyze these characteristics of a song, we can tell whether this song will be popular or not. Furthermore, if we apply this on an AI, the AI will be able appreciate some music since he could tell which genre it is, how fast it is, how loud it is and how does he feel when he heard this song, which will be fantastic.

Definitions:

This project aiming to analyze the characteristics for one music. Using the datasets from the Internet, it is able to find many interesting combination characteristics for the music. Here's a list for the interesting attributes for the music that we will use in the research:

● Genre:

Genre is the category of the music, mostly for one people, this attributes is the most interesting thing to choose a song or a piece of music to listen. Since that's the attributes

Definitions:

that people care most so that's also the attribute we care most. We will do a lot work to

analyze for the genre for this report.

The data I used for this report contains these genre:

Figure 1:

| No.	Label	Count
1	classic pop and rock	23895
2	punk	3200
3	folk	13192
4	pop	1617
5	dance and electronica	4935
6	metal	2103
7	jazz and blues	4334
8	classical	1874
9	hip-hop	434
10	soul and reggae	4016

Original genres from the dataset

● Tempo:

Tempo is the speed of the song or music, it is one of the most important features, so we

will use that to analyze for our conclusion.

Mostly, the tempo is expressed as the numerical numbers, like 128.28, 90.01. And this

the original data for tempo:

Figure 2:

Original data for tempo
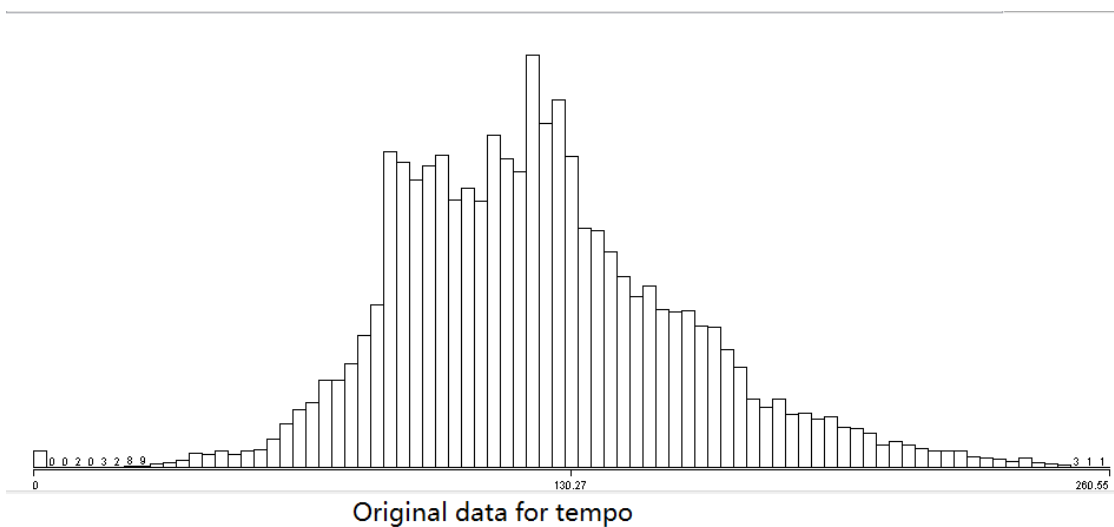
This is not very useful because the we don't really need to know what's the difference

Definitions:

between 100 and 100.01. We can just treat them as 100-120, which will save a lot of work. So, after changing data, this is what it looks like:

Figure 3:

No.	Label	Count
1	(104.2188-156.3282]	30620
2	(52.1094-104.2188]	18471
3	(208.4376-inf)	1161
4	(156.3282-208.4376]	8634
5	(-inf-52.1094]	714

Temop after change

- Time signature:

  Time signature shows that how many beats are to be contained in each bar, this is a very classic feature, which can trace to the mid-age time, so we will analyze that attribute, too.

  Figure 4:

  Time signature

- Loudness:

  Loudness will show how loud a song is. Sometimes people will care the loudness much, like for the metal, people will seek some loud music. Thus, this is also an attribute we care.

  Same as the Time signature, it contains the numeric data in loudness. After discretize it will be like:

  Figure 5:

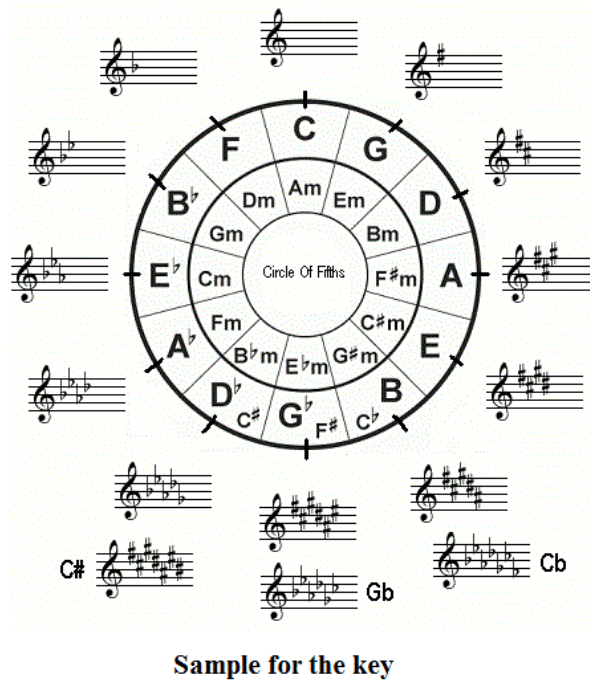| No.	Label	Count
1	(-20.0218—8.5784]	35031
2	(-31.4652—20.0218]	4121
3	(-8.5784-inf)	20083
4	(-42.9086—31.4652]	356
5	(-inf—42.9086]	9

Loudness after change

- Key:

  Key will show which tone(pitch) will this music start. It is also a very classic feature so

Definitions:

we will use that.

Figure 6:

Sample for the key

Frequent sets for all the attributes:

After we figuring out what are meanings for these attributes, we can start to find the relationships between them.

The first thing we will do is combine all the data, and try to find the largest frequent sets for this data. And for finding the frequent sets we will use the algorism – Apriori. Apriori is a very good algorism for finding the frequent sets, by generating the candidates and filtering. Also, it is available on Weka, which can be very convenient.

After using the Weka, we got this result:

Frequent sets for all the attributes:

Figure 7:

```
Size of set of large itemsets L(5): 4

Large Itemsets L(5):
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=0 838
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=2 677
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=7 750
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=9 740
```

Result for frequent sets

In Figure 7 we can see that we got 4 conclusions for L(5). That mans these combinations of attributes are frequently used among all the music in the data, which also means that these combinations are very popular in these years. Here, for the first one, it tells that a genre with classic pop and rock, in the median loudness, a little fast speed, in 4/4-time signature and started with C major is the world most popular type of songs (Based on the limited data provided), which is right based on the common knowledge. What's more, if we do not need this accuracy, like we only need four attributes combination, here's a list (not complete) for some songs that should be popular:

Figure 8:

```
Size of set of large itemsets L(4): 87

Large Itemsets L(4):
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=1 1136
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=3 814
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 5859
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] key=0 1155
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] key=2 972
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] key=4 755
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] key=7 1080
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] key=9 1054
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] key=11 600
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=1 831
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=3 852
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 2646
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] key=0 683
genre=classic pop and rock loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] key=7 660
```

L(4) lists (not complete)

■ Usage

The reason we cared about this is that these conclusions can help the music composers and the music software developers. For the composers, with this knowledge, they will

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Frequent sets for all the attributes:

know which combinations will be popular among the listeners and other composers so they can work on these attributes. Also, a music software will be using this method to get information, too. This method can find the most or most not popular combinations for the features for the music, so when apply on a music software, it can help it to find the most popular feature combinations, so the music software can use this features to find the popular music can recommend to the listeners. Moreover, for if the music software has its own database, then the developer can figure out the largest frequent set for all the music that just for this user listened, so the developer will be able to know what kind of features that person like to listen and recommend similar songs to the listener.

Frequent sets for a particular genre

This one will be more likely applied in the musician level. We know that we can find the frequent sets for the all the attributes, but if we do some change to the data, it is also not hard to find the largest frequent sets just for one genre. The reason I chose the genre as the class label is that mostly the genre already contains many information in it. When people, talk about the metal, they have an idea that it might be very loud, a little fast and something else. So when we apply this method on the data, we can find that what is the popular features for the particular genre.

To use the data, we need to change it first. Firstly, delete all the other rows that is not for the interested genre. For example, if we want "metal", simply delete all the other rows that is for "classic pop and rock", "punk", "folk" and so on. Just leave the rows that contain the metal for genre (I did it by using the Excel).

Frequent sets for a particular genre:

Figure 9:

No.	Label	Count
1	metal	2103

All the genres after changing data

As long as we done that, we can remove the genre label from the Weka, and it will be a pure data just for metal. And by using the Apriori, we can know the frequent sets for the genre metal, also the popular sets.

Figure 10:


```
Size of set of large itemsets L(4): 22

Large Itemsets L(4):
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=0 23
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=1 40
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=2 24
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=4 22
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=7 27
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=9 26
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=11 24
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=0 36
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=1 69
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=2 67
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=4 74
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=5 25
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=6 62
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=7 54
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=8 41
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=9 64
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=10 35
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=11 66
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=1 29
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=2 26
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=7 28
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=11 28
```

Frequent sets for metal

All the other results will be listed in the appendix page.

■ Usage

For this one the best usage will be for the composers. Mostly a composer has his own genre. Like a composer for the Jazz will always want to do the Jazz music, because he likes the Jazz very much. So, for a metal music composer, he will look into the popular features just for metal, which is I'm doing for on method. By using this, the composers will have a good view that which feature combination is used a lot, which is not. And much efficient than the first method.

Largest confidence for a particular genre:

Largest confidence for a particular genre

In this part, we will focus on finding the rules can confidences. Basically it is a part for machine learning for the artificial intelligence. By using the data in the first method, which include all the genres and data, we can find many patterns and rules for the frequent sets, and we are interested in the rules that the genre is the class label. That means that we are telling the machine that by this feature or these combination of features, how much percentage will it be that it is a "rock" or "metal" or something else. For generating this rules, I used two methods. First is the Apriori. It can generate many rules for the data. Thus, my work is collect all the rules with the genre as the class label, and try to find the largest confidence number by comparing a list that contains all the entries with the same sequence of features. After that, we can let the AI learn that this sequence of features is more likely to be a "Jazz" or a "folk" song.

Figure 11:


```
67. genre=folk 13192 ==> tempo=(104.2188-156.3282] 6515    conf:(0.49)
68. loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 11888 ==> genre=classic pop and rock 5859    conf:(0.49)
69. genre=folk loudness=(-20.0218--8.5784] 9677 ==> tempo=(104.2188-156.3282] 4768    conf:(0.49)
```

An examlpe of using the Apriori

Another method will be the J48 tree, which is a machine learning tree. It will pop out a whole data tree with the genre as the leaves so that the AI can tell the information from the tree. This will be a better way for the AI training, because it listed out all the possible sequences for features of the music. That is a large information and covered all the possible things that could happen.

Largest confidence for a particular genre:

Figure 12:

```
J48 pruned tree
------------------

loudness = (-20.0218--8.5784]: classic pop and rock (35031.0/19887.0)
loudness = (-31.4652--20.0218]
|   time_signature = 0: classical (1.0)
|   time_signature = 1
|   |   key = 0: classical (169.0/109.0)
|   |   key = 1
|   |   |   tempo = (104.2188-156.3282]: folk (33.0/21.0)
|   |   |   tempo = (52.1094-104.2188]: classical (58.0/37.0)
|   |   |   tempo = (208.4376-inf): classical (0.0)
|   |   |   tempo = (156.3282-208.4376]: folk (6.0/2.0)
|   |   |   tempo = (-inf-52.1094]: classical (8.0/3.0)
|   |   key = 2: folk (151.0/95.0)
|   |   key = 3: classical (58.0/34.0)
|   |   key = 4: classical (96.0/65.0)
|   |   key = 5: classical (120.0/74.0)
|   |   key = 6: folk (52.0/36.0)
|   |   key = 7: classical (163.0/107.0)
|   |   key = 8
|   |   |   tempo = (104.2188-156.3282]: folk (22.0/15.0)
|   |   |   tempo = (52.1094-104.2188]: classical (33.0/22.0)
|   |   |   tempo = (208.4376-inf): dance and electronica (2.0/1.0)
|   |   |   tempo = (156.3282-208.4376]: jazz and blues (6.0/2.0)
|   |   |   tempo = (-inf-52.1094]: classical (7.0/4.0)
|   |   key = 9: classical (105.0/67.0)
|   |   key = 10: classical (96.0/64.0)
|   |   key = 11: folk (62.0/36.0)
|   time_signature = 3
|   |   key = 0
|   |   |   tempo = (104.2188-156.3282]: folk (48.0/33.0)
|   |   |   tempo = (52.1094-104.2188]: folk (55.0/38.0)
|   |   |   tempo = (208.4376-inf): jazz and blues (3.0/1.0)
|   |   |   tempo = (156.3282-208.4376]: jazz and blues (14.0/8.0)
|   |   |   tempo = (-inf-52.1094]: jazz and blues (1.0)
```

Part of the j48 tree

- **Usage**

  As I said, it will be very good to implement this method on the artificial intelligence. With the developing of the technology, AI will be more and more smart, and an ability to appreciate the music will be a good way to build the personality for the AI. Also, this method can be well used on other data, like the pixel analyze for good paintings, so the AI can appreciate the paintings, and the music notes analyze for the music, so the AI can even compose some good melodies. What's more, if we combined the "Frequent sets for a particular genre" part with the "notes analyze for the music", good music will be composed by the AI someday.

9

Appentix:
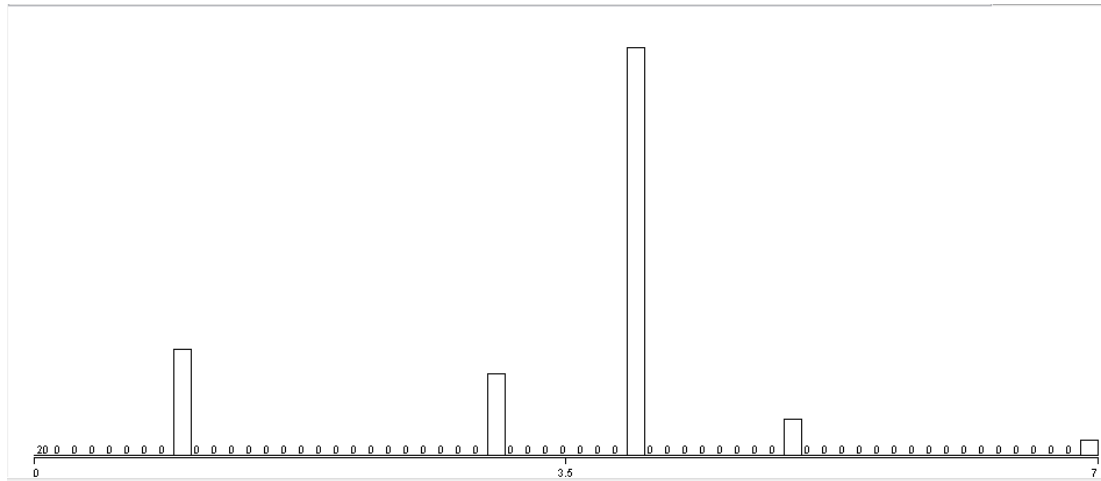
Original data for time signature
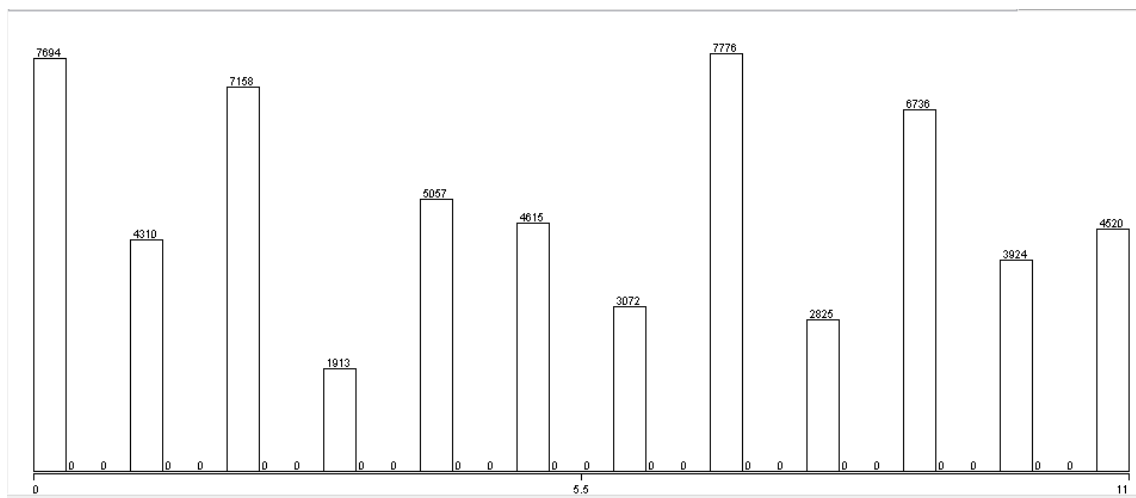
Original data for he key

```
Size of set of large itemsets L(4): 25

Large Itemsets L(4):
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=0 838
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=1 391
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=2 677
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=4 538
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=5 409
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=6 271
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=7 750
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=8 247
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=9 740
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=10 377
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=11 459
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=0 346
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=2 304
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=4 239
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=7 355
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=9 300
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=0 557
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=1 291
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=2 447
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=4 322
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=5 251
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=7 500
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=9 482
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=10 239
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=11 403
```

Frequent set result for classic pop and rock

Appentix:

```
Size of set of large itemsets L(4): 9

Large Itemsets L(4):
loudness=(-31.4652--20.0218] tempo=(52.1094-104.2188] time_signature=1 key=0 27
loudness=(-31.4652--20.0218] tempo=(52.1094-104.2188] time_signature=1 key=1 21
loudness=(-31.4652--20.0218] tempo=(52.1094-104.2188] time_signature=1 key=2 23
loudness=(-31.4652--20.0218] tempo=(52.1094-104.2188] time_signature=1 key=5 24
loudness=(-31.4652--20.0218] tempo=(52.1094-104.2188] time_signature=4 key=2 19
loudness=(-31.4652--20.0218] tempo=(52.1094-104.2188] time_signature=4 key=7 19
loudness=(-31.4652--20.0218] tempo=(104.2188-156.3282] time_signature=1 key=0 22
loudness=(-31.4652--20.0218] tempo=(104.2188-156.3282] time_signature=1 key=7 27
loudness=(-31.4652--20.0218] tempo=(104.2188-156.3282] time_signature=1 key=9 20
```

Frequent set result for classical

```
Size of set of large itemsets L(4): 20

Large Itemsets L(4):
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=0 123
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=1 114
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=2 66
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=4 60
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=5 55
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=6 82
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=7 123
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=9 65
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=10 88
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=11 106
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=0 134
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=1 151
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=2 73
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=5 64
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=6 107
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=7 107
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=8 53
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=9 85
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=10 91
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=11 139
```

Frequent set result for dance and electronica

```
Size of set of large itemsets L(4): 35

Large Itemsets L(4):
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=1 12
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=2 6
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=7 4
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=9 4
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=10 8
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=11 8
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=5 key=1 5
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=0 6
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=1 20
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=2 6
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=4 8
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=6 10
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=7 8
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=8 8
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=9 13
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=10 12
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=11 12
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=1 8
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=2 5
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=6 7
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=7 5
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=9 5
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=10 6
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=11 6
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=0 5
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=1 6
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=7 5
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=8 6
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=9 8
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=10 6
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=11 4
loudness=(-20.0218--8.5784] tempo=(156.3282-208.4376] time_signature=4 key=0 5
loudness=(-20.0218--8.5784] tempo=(156.3282-208.4376] time_signature=4 key=1 4
loudness=(-20.0218--8.5784] tempo=(156.3282-208.4376] time_signature=4 key=6 6
loudness=(-20.0218--8.5784] tempo=(156.3282-208.4376] time_signature=4 key=8 4
```

Frequent set result for hip-hop

Appentix:

```
Size of set of large itemsets L(4): 13

Large Itemsets L(4):
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=0 58
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=2 51
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=5 62
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=7 49
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=0 99
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=1 67
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=2 62
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=4 44
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=5 109
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=7 99
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=8 71
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=9 68
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=10 66
```

Frequent results for jazz and blues

```
Size of set of large itemsets L(4): 18

Large Itemsets L(4):
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=0 197
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=2 226
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=4 152
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=5 134
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=7 230
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=9 195
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=1 key=2 171
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=1 key=7 151
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=0 371
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=2 410
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=4 288
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=5 199
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=7 442
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=9 367
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=11 167
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=2 135
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=7 163
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=9 135
```

Frequent set result for folk

```
Size of set of large itemsets L(4): 29

Large Itemsets L(4):
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=0 47
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=1 22
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=2 48
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=4 41
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=5 41
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=6 22
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=7 61
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=8 21
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=9 56
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=10 25
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=11 37
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=0 27
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=2 26
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=5 16
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=7 29
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=9 21
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=11 16
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=0 37
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=2 25
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=4 21
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=5 21
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=7 21
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=9 32
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=11 18
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=0 26
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=2 19
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=7 23
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=9 22
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=10 18
```

Frequent set result for pop

Appentix:

```
Size of set of large itemsets L(4): 28

Large Itemsets L(4):
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=0 32
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=2 34
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=7 33
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=9 43
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=11 32
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=1 key=2 34
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=1 key=9 34
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=0 47
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=1 40
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=2 64
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=4 58
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=7 62
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=9 64
loudness=(-8.5784-inf) tempo=(156.3282-208.4376] time_signature=4 key=11 51
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=1 key=2 35
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=1 key=4 32
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=1 key=9 33
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=0 72
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=1 38
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=2 107
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=4 64
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=5 39
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=7 83
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=9 103
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=11 57
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=0 37
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=2 36
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=9 32
```

Frequent set result for punk

```
Size of set of large itemsets L(4): 29

Large Itemsets L(4):
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=0 115
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=1 82
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=2 64
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=4 44
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=5 65
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=6 56
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=7 101
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=8 40
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=9 74
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=10 61
loudness=(-20.0218--8.5784] tempo=(104.2188-156.3282] time_signature=4 key=11 61
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=0 56
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=1 46
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=2 41
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=7 40
loudness=(-20.0218--8.5784] tempo=(52.1094-104.2188] time_signature=4 key=10 45
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=0 68
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=1 85
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=2 44
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=5 51
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=6 45
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=7 51
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=8 60
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=9 48
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=10 43
loudness=(-8.5784-inf) tempo=(104.2188-156.3282] time_signature=4 key=11 72
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=0 42
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=1 58
loudness=(-8.5784-inf) tempo=(52.1094-104.2188] time_signature=4 key=10 54
```

Frequent set result for soul and reggae

Sources:

Sources

- Data set:

  "Million Song Dataset", http://labrosa.ee.columbia.edu/millionsong/

  "MSD   genre   dataset",

  http://labrosa.ee.columbia.edu/millionsong/blog/11-2-28-deriving-genre-dataset

- Tools:

  Weka-3-6: http://www.cs.waikato.ac.nz/ml/weka/

- Other pictures:

  Time signature, https://en.wikipedia.org/wiki/Time_signature

  Key, http://www.piano-keyboard-guide.com/key-signatures.html