Assignment of Makam Labels by Hand versus Auto-Classification by Machine Learning for 325 'Hicaz Family' Pieces (FINAL REPORT OF AN INCONCLUSIVE PROJECT)

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Abstract

An earlier study by our team involved the exploitation of "unique melodic contour features" to check whether a selection of 4 Turkish art music pieces and 4 Turkish folk music pieces from the 'Hicaz family' were indeed categorized correctly makam-wise [Yarman et al., 2020, "*An Investigation of the Role of Diatonic Functions in the Seyir Phenomenon of Turkish Makam Music: Case of 'Hicaz Family'*", DYUMM conference proceedings, 292-340]. We now deliver an overview of both TRT repertory labellings and tagging efforts by 6 anonymized experts versus several machine learning classifications with regards to 325 pieces pertaining to makams falling under the so-called 'Hicaz family' denomination. Our analysis is once again based on our novel "trigram melodic contour information extraction procedure", where all of the pieces operated on were transcribed according to the "SymbTR" symbolic representation database. The findings gathered with respect to this area of research seem to point to the fact that, say, Hicaz frequently blurs into kindred makams such as Uzzal and Hümayun, and the success rate in correctly determining a piece's makam never exceeds the level of about 75 percent whatever the methodology used. It is suspected that something similar must also be the case for makams of the 'Uşşak-Hüseyni family', and this field awaits further investigation. We hence suggest a new theoretical insight for identifying a piece of the repertory that is said to be in a given makam but has characteristics of other makams as well, particularly seeing as our extensive and prolonged enquiry turned out to be inconclusive and the project died out as a result.

Keywords: Machine Learning, Music Information Retrieval, Melodic Contour, Makam, Hicaz

I. Introduction

To get straight to the point, our "theoretical insight" about correctly identifying a piece, which is said to be part of the 'Hicaz family', is to novelly say that it is probably, for example, "75 percent in CORE Hicaz, and 25 percent in CORE Uzzal", or suchlike, based on computational musicology findings that shall be demonstated hereunder using SymbTr+Mathematica+WEKA. That is because, there does not seem to be any widespread agreement on their categorization; whilst the frequent happenstance of phraseology such as "Hicaz (Uzzal)" in the Turkish Music repertory provides evidence for our abovementioned re-interpretation of the makam labels.

We report, as such, that the success rate in correctly ascertaining a piece's makam never exceeds the level of about 75 percent whatever the methodology used in this study. It is all the more relevant since labellings by hand from both the TRT archive (as facilitated under Notam.exe by Aytaç Ergen) and by 6 anonymized experts similarly exhibit significant incongruity for the 325 pieces stacked under the 'Hicaz family'. In particular, one may see that wholesome agreement between the experts of concern is at the level of about 20 percent!

The languishing project at hand finally died out in the face of the failure to reach a solid conclusion or any meaningful consensus in the end. This report is therefore a finality to our endeavor, penned down in the hopes that future researchers might benefit from our contributions.

What triggered and motivated this enterprise were the messagings below from October 2020 onwards:

* * *

On Oct 31, 2020, 4:50 PM -0400, Ozan Yarman <ozanyarman@ozanyarman.com>, wrote:

Dear Bill,

How are you and Anne in the second wake of the pandemic? I hope you are alright! We are all fine here and holding the fort. I am uploading my lecture videos to my YouTube Channel regularly. Things are all smooth-sailing at the moment...

Notice the fresh-out-of-the-oven presentation (in Turkish) by Kemal ağabey where he talks about machine learning and Turkish Maqam music:

TUMAC BSE No.14: Türk Müziği ' Araştırmaları ve Yapay Zekâ – Doç. Dr. M. Kemal Karaosmanoğlu
https://www.youtube.com/watch?v=u86cAhMNtZ4&feature=youtu.be

Specifically, he deliberates how successful the available algorithms are in determining the category of a makam based on a few simple attributes or parameters (such as the beginning note, the ending note, etc...).

While Kemal ağabey frequently argues that masters of Maqam music are always incontrovertible references for the correctness of a performance or composition, I defend that there are always quirks that need to be resolved by "science". This is just so that the role of quantitative musicology & theoretical computation is not downplayed. I cannot emphasize this point enough given the escalating wont to glorify "esoterism" and "mysticism" under the guise of acceptable knowledge hereabouts...

Hence Kemal ağabey's presentation triggered an idea in my mind: Why don't we feed into the machine learning algorithm the percentages of any bar of our contour histograms? [Yarman et al., 2020] That is to say, for the case of "perde neva" with the trigram melodic contour analysis distribution:

30% ascent, 20% descent, 25% valley, 25% peak

for one piece, and then

40% ascent, 10% descent, 15% valley, 35% peak

for another piece, etc.. why don't we see if the artifical intelligence software can calculate and determine which perde bears what diatonic function (such as dominant, sub-dominant, leading tone, etc...)?

Kemal ağabey said that this idea is workable and can be done. I thus include the "elite squad" of our previous paper for a possible new article where we can utilize the already developed Mathematica resources.

Cordially,
Oz.

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On Nov 1, 2020, at 2:23 AM, Bill Sethares wrote:

Hi Ozan, good to hear from you. We are well _ I am in New Hampshire ..., while Ann is in Delaware ... .

Your idea of using the contour features in a neural network makes sense. Perhaps the simplest thing is a classification scenario where you try to identify the makam from the contour features. _ _ This is one of the things we were asked to do by some of the reviewers in the earlier reviews. In terms of the dominant 0 subdominant identification, this should also be possible as long as there is a reasonable amount of training data available - this would require a lot of data that is manually annotated. I suspect that Mathematica may be fine for the feature extraction but not for the deep learning part...

Bill

Sıddık Yarman <sbyarman@gmail.com>, 3 Kas 2020 Sal, 18:08 tarihinde şunu yazdı:

Dear Ozan and all,

Regarding Ozan's idea, I would like to take the opportunity to apply my new voice/music modeling technique called Sympes to determine the maqam of different tunes.

Sympes is a well established technique to identify information carried out by many one-dimensional bio-signals including voice, ECG, EMC, EEG signals etc.

The common features of the above mentioned signals are their repetitivity. I strongly believe that Sympes can yield outstanding scores in determining the different maqam tunes since they also present repetitive information.

In this line of research direction, firstly, I would like to spare some time to listen to Ozan in my research facility, which is located in Teknopark Istanbul, with my co-workers Osman Korkmaz and Prof. Dr. Fuat Ince and perhaps with Prof. Dr. Fatos Vural.

Then, we can discuss how to proceed.

The related literature on Sympes can be found in the following references produced by my research team. If you are interested in details, you can go through the first three papers.

1. "On the comparative results of "SYMPES: A new method of speech modeling", International Journal of Communication (AEU), Vol. 60, 2006, pp. 421-427.
2. "A New Method to Represent Speech Signals Via Predefined Signature and Envelope Sequences", EURASIP Journal on Advances in Signal Processing, Volume 2007, Article ID 56382, 17 pages
3. "Estimation of the fundamental frequency of the speech signal modeled by the SYMPES method", International Journal of Communication (AEU), Vol. 63, 2009, pp. 200-208.
4. "Compression of Medical Images via Sympes", Symposium Digest of Eleco 2008, pp. 55-63, Bursa, Turkey.
5. "A New Speech Modeling Method: SYMPES", IEEE ISCAS, 2006, pp.1860-1863.
6. "A Novel Fast Algorithm for Speech and Audio Coding", ECCT 2007, pp. 4020-4023.
7. "A Novel Noise Robust and Low Bit Rate Speech Coding Algorithm", ISCIS 2009, pp. 471-474.
8. "Compression of the CT Images Using Classified Energy and Pattern Blocks", 35th Annual International Conference of the IEEE EMBS, Osaka, Japan, 3 - 7 July 2013, pp. 6462-6465.
9. Compression of ECG signals using variable-length classified vector sets and wavelet transforms", Journal on Advances in Signal Processing 2012, pp.1-17.
10. "A New Speech Coding Algorithm using Zero Cross and Phoneme Based SYMPES", IEEE ISSCS 2013.
11. "A Novel Computed Tomography Image Compression Method based on Classified Energy and Pattern Blocks", IEEE ISSCS 2013.
12. "SYMPES Technique Encoded IP-Based Secure Voice Communication System", 2017 International Symposium on Signals, Circuits and Systems (ISSCS)
13. "Simplified Sympes Codec with Positive DC Offset", 2017 24th IEEE International Conference on Electronics, Circuits and Systems (ICECS).
14. "Network Packet Loss Sensitivity Analysis for SYMPES Codec", 2018 26th Signal Processing and Communications Applications Conference (SIU).
15. "Power of Mathematical Tools and Models from Circuit Designs to the Assessment of Human Interacted Events", 2019 International Symposium on Signals, Circuits and Systems (ISSCS)
16. "SYMPES Character Encoding Algorithm", 2019 27th Signal Processing and Communications Applications Conference (SIU).

Let us determine a proper time to meet by next or the next after following weeks.

Warm regards to you all.
Sıddık

On Feb 18, 2022, 9:05 AM -0600, Ozan Yarman <ozan@ozanyarman.com>, wrote:

Dear Bill, I hope you are alright since last we talked. I conversed with Kemal agabey on the phone about our dormant idea which you will surely remember:

Yes, the procedure is quite as you delineate:

1) Pick a makam;
2) Select a bunch of pieces said to be in that makam;
3) Trigram-analyze the bunch;
4) Extract their summary & melodic contour histograms and find which perde has what kind of tiered distribution;
5) Feed the tiered distributions (up, down, valley, peak for each perde) into the neural network (alternatively, feed the summary contour data too!);
6) Re-iterate for another makam;
7) Let the machine learning algorithm do correlations in order to

a) identify which perde has what specific function (dominant, leading tone, etc...) for a given makam;
b) and pop out which pieces are in what makams at what confidence level based on its computation of the batch.

If all goes well, a different software than Mathematica (like WEKA) will hence be able spit out how a chosen AI algorithm identifies one piece with one particular makam at a very high confidence level based on the correlations vis-à-vis the diatonic functions of its perdes.

For the deep learning, Kemal ağabey announced that the 2020 version of SymbTr is almost ready to be publicly released with its 3000 annotated scores in 160 different makams, 60 different forms, 90 different usuls and composed by 600 different people. We can very well rely on it for the Mathematica automation.

We may then prepare and share our computational musicology code under the Mathematica online library or on a website.

What we ended up agreeing upon with Kemal agabey is as follows (especially given the lack of empathy shown by my uncle and aunt towards the groundbreaking enterprise this whole time):

A) We continue the trend with our melodic contour histogram analysis paper and sift throught the entirety of the notated Hijaz family in SymbTR.

B) I thus check the cataloguing by TRT of all of them using the Aytaç Ergen digital archive installed on my hardrive. This is to make sure that we have a one-to-one correspondence of monikers such as a TRT "Hümayun" piece matching the SymbTR's selfsame as "Hümayun". Otherwise I note the differences in an Excel spreadsheet.

C) We then have you provide Kemal agabey with a .csv file containing all the histogram bar information (ascending, descending, peak, valley) from the SymbTr scores using your excellent Mathematica code (that we may later develop as an executable for Macs and PCs).

D) Kemal agabey then feeds this data to his machine learning software and lets, say, 10 pieces out of 100 be examplars for the test procedure and the rest of them for machine learning. This process is iterative. Kemal agabey knows the ropes and he can deal with the way the program behaves.

E) Based on the outcome, the machine learning software spits out with some given confidence that xxx percent of the fed pieces are indeed in the specified makam, or else, so and so is likely in another makam like Uzzal instead of Hijaz.

F) We present this as a concise 6-page paper (maybe) to the ISMIR conference scheduled to be held in India in Autumn, with the option to present our findings via Zoom.

G) We then extend the paper with more machine learning and/or Kullback-Leibler divergence methods with comparisons against the rest of Buseliks, Ushshaqs, Nihavends, Rasts, etc... and publish the manuscript perhaps in JNMR.

Do we hence gain your support in this enterprise?

Cordially,
Oz.

On Feb 19, 2022, at 6:05 PM, Bill Sethares wrote:

Hi Oz,

I still don't get exactly how this is going to work… but in any case, it sounds like my part would be the feature extraction.

I attach one of the files with various analyses of Hijaz makams (a list of the included files is at the bottom).

In the bulk of the file you can see numerous different ways of grouping, graphing and displaying the data.

I can translate the histogram images into data (you suggest a csv) without problem, but I need to know exactly which of the features/data is wanted.

—Bill

On Feb 19, 2022, 10:07 AM -0600, Ozan Yarman <ozan@ozanyarman.com>, wrote:

If my earlier idea of diatonic function feature matching in article 7a fails, then we have a recourse to article 7b in this fashion:

-- Provide the normalized percentages for "ascending", "descending", "peak" and "valley" of each histogram bar for the entirety of pieces in, say, Uzzal. These percentages of each superposed perde do not need to add up to 100 percent, for we are looking for the occurrence numbers overall.

-- Feed into WEKA as the test group the cumulative "ascending", "descending", "peak" and "valley" occurrence numbers for all perdes, which constitutes, say, an Uzzal general profile.

-- Compare with individual Uzzal pieces to identify how close a match the individual piece's tiered histogram bar distribution is to the general profile.

In case this does not constitute a sufficient test, my earlier idea was to identify by hand the diatonic functions of each perde and create a test group out of those pieces to compare with the rest out of the same makam category.

I got your file. I remember the wonderful code that generated these histograms. Great job once more! They are all good. Kemal agabey needs a csv output for the normalized percentages for "ascending", "descending", "peak" and "valley" of each histogram bar pertaining to each makam category. He just needs the cumulative occurrences.

So, for instance, in the octave normalized all-Hijaz cumulative histogram, La (perde dügah) seems to be 25 percent peak, 15 percent ascending, 10 percent descending and 50 percent valley (thus adding up to 100). In comparison, Sol or perde rast seems to be 20 percent peak, 5 percent ascending, 10 percent descending and 10 percent valley (summing up to 45), thus not adding up to a 100 because everything is normalized according to the highest bar of note La.

Cordially,
Oz.

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On 20 Feb 2022, at 22:24, M. Kemal Karaosmanoğlu <mkemalkaraosmanoglu@gmail.com> wrote:

Dear Friends,

I haven't been able to join your correspondence for our new joint paper work so far. Because I had some chores. Now I will be able to forward my various notes.

The first is about current data counts in SymbTr. There are now about 3000 artifacts in the database. Nearly 10% of them are from the makams of the Hicaz family. The list of them is attached. I will share the actual files in txt format shortly.

Good luck with.

Kemal

* * *

Communications on this subject continued for years until this day, and several other possible participants (not mentioned here by name) were informed of the many stages of our progress, among whom were those that contributed their precious ideas and materials despite being preoccupied with many other facets of life. However, the whole idea ultimately did not come to fruition and eventually failed to develop beyond our initial expectations.

In the next section, the dataset used in this study will be presented.

II. The dataset

The final batch of files (LINK HERE) we ended up running under WEKA (University of *Waikato*, New Zealand, *Environment* for *Knowledge Analysis*) – following a novel 'trigram melodic contour feature extraction process' (yielding normalized occurrences of "valley notes" [*e.g.*, E-**D**-E], "descending notes" [*e.g.*, E-**D**-C], "ascending notes" [*e.g.*, C-**D**-E] and "peak notes" [*e.g.*, C-**D**-C] for every piece [Yarman et al., 2020]) via Wolfram Mathematica (as per the code of the second co-author IN THIS LINK) from the SymbTR database (as maintained by Assoc. Prof. Dr. M. K. Karaosmanoğlu) – pertaining to a set of 325 'Hicaz family' pieces, were:

1) allHicaz24.csv =Arel-Ezgi-Uzdilek *octave unreduced* pitch set from our trigram analysis,
2) allHicaz24OctRed.csv =Arel-Ezgi-Uzdilek *octave reduced* pitch set from our trigram analysis,
3) allHicaz53.csv =53-tET *octave unreduced* pitch set from our trigram analysis,
4) allHicaz53OctRed.csv =53-tET *octave reduced* pitch set from our trigram analysis.

We hence operated on either strictly 24-tone Pythagorean *Arel-Ezgi-Uzdilek* symbolic pitch representations that were, on the one hand octave-normalized, or on the other hand, not restricted in terms of register; OR the wholesomely 53-tone Equal Temperament (53-tET) resolution extended pitches vis-à-vis the DataSoft *Mus2okur* gestalt of Karaosmanoğlu that were, once again octave-normalized on the one hand, or not restricted in terms of register on the other hand.

In addition, the sum total of all occurrences of "valley notes", "descending notes", "ascending notes" and "peak notes" throughout any given piece were normalized to 1, so as to facilitate a fair comparison between different members of the chosen batch of 325 compositions under WEKA.

Before we delve into the computational musicology aspects of our endeavor, let us point to the relevant documents containing the older TRT repertory labellings (as extracted by the first co-author) and newer tagging efforts by 6 anonymized experts (as organized by the retired Assoc. Prof. Dr. Mustafa Kemal Karaosmanoğlu who later excused himself from this project) for the batch of 325 pieces of the 'Hicaz family':

LINK TO TRT LABELLINGS (Extracted from the Notam.exe archive by the first co-author.)

LINK TO LABELLINGS BY 6 ANONYMIZED EXPERTS (Organized by Karaosmanoğlu.)

Let the reader take into consideration that the cataloguing toil of the first co-author regarding the batch of 325 'Hicaz family' pieces from the repertory, which involved scrutinizing hundreds of sometimes barely legible scanned documents from the Notam.exe program as meticulously prepared by the TRT employee Aytaç Ergen, allows the straightforward screening of all ambiguous entries to result in the display of only the RECURRENT entries as accessible below:

LINK TO ALL RECURRENTLY LABELLED TRT LABELLINGS (Prepared in the same way through Notam.exe by the first co-author)

III. Promising findings that did not quite reach the mark

One will immediately notice that an EXTREMELY GENEROUS elimination of SOLELY the incontrovertibly ambiguous labels of the TRT repertory leads to the preservation, under the same recurrent category such as Hicaz, of pieces that were additionally described as "Hicaz (Uzzal)" or "Garip Hicaz", *etc*...; assuming the latter (Garip) to be only intonationally-related.

Therefore, with respect to ONLY the recurrent score instances of any piece under the TRT repertory, where the scanned graphics verily contain the same or almost the same makam label, we have:

5 sure Uzzal out of 325 pieces, 236 of which are recurrent labels,
10 sure Hümayun out of 325 pieces, 236 of which are recurrent labels,
11 sure Zirgüle(li Hicaz) out of 325 pieces, 236 of which are recurrent labels,
210 sure Hicaz out of 325 pieces, 236 of which are recurrent labels.

(210+11+10+5=236)

5/236 = 2.1 % Uzzal out of all recurrent labels,
10/236 = 4.2 % Hümayun out of all recurrent labels,
11/236 = 4.7 % Zirgüle(li Hicaz) out of all recurrent labels,
210/236 = 89 % Hicaz out of all recurrent labels.

Also take heed that the sum total of all recurrently labelled entries here is **72.6 percent** of the entire batch. The significance of this ratio from the TRT repertory will be made manifest in a moment when analyzing the SymbTR dataset under WEKA.

In contrast, the ratio of all agreeing expert opinions to the entire 'Hicaz family' batch, or all save one expert opinion to the entire batch, gives us the following percentages:

Category A, as given in this LINK, is all the experts together, whose consensus rate is **13 %**.
Category B, in once more the same LINK, is all the experts together except for F., where the consensus rate jumps to **25 %**.

Even assuming F. knows less about correctly identifying members of the 'Hicaz family' compared to the other participants in the list, the improvement is still not significative! In juxtaposition to the rather haphazard, but seemingly more consistent, centennial assignment of makam labels in the TRT repertory, opinions from our gracious contributors are highly discordant and pose many concerns.

As a result, Machine Learning, contingent upon exploiting the symbolic representation data existing under SymbTR (LINK HERE), becomes a more attractive option to try to categorize the makams in question, and this gives us even more incentive to share a summary of our findings, no matter how inconclusive, herein.

IV. Analysis of the dataset

We present below an extensive list of printouts, shown as tables, from various consequential classification algorithms under WEKA. These pertain, in order of appearance, to

a) allHicaz24.csv =Arel-Ezgi-Uzdilek *octave unreduced* pitch set from our trigram analysis,
b) allHicaz24OctRed.csv =Arel-Ezgi-Uzdilek *octave reduced* pitch set from our trigram analysis,
c) allHicaz53.csv =53-tET *octave unreduced* pitch set from our trigram analysis,
d) allHicaz53OctRed.csv =53-tET *octave reduced* pitch set from our trigram analysis.

Remember that the numbers in the cells of each row in any given comma-seperated values file are calibrated to sum up to 1. In other words, for every piece, the occurrence amount of every "valley note" [*e.g.*, E-**D**-E], "descending note" [*e.g.*, E-**D**-C], "ascending note" [*e.g.*, C-**D**-E] and "peak note" [*e.g.*, C-**D**-C] is scaled down from their original integer value so that their total makes 100 %. This is to ensure that the melodic contour features are comparable in a standardized way between the 325 'Hicaz family' pieces when running a chosen WEKA classifier or clusterer.

After each table below, we deliver our short remarks about the performance of the algorithm.

Table 1a via BayesNet for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "BayesNet" is Bayes Network learning using various search algorithms and quality measures, where the batch size is chosen to be 325; it uses "SimpleEstimator" that is used for estimating the conditional probability tables of a Bayes network once the structure has been learned.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         181               55.6923 %
Incorrectly Classified Instances       144               44.3077 %
Kappa statistic                          0.1943
Mean absolute error                      0.2288
Root mean squared error                  0.3989
Relative absolute error                 91.4693 %
Root relative squared error            113.1605 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.622     0.515     0.723      0.622    0.668      0.101    0.605     0.742
Hicaz
                 0.222     0.117     0.146      0.222    0.176      0.087    0.717     0.159
Uzzal
                 0.367     0.185     0.261      0.367    0.305      0.160    0.660     0.226
Hümayun
                 0.704     0.017     0.792      0.704    0.745      0.725    0.981     0.882
Zirgüle
Weighted Avg.    0.557     0.390     0.611      0.557    0.579      0.161    0.653     0.627

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 138  31  49   4 |   a = Hicaz
  20   6   1   0 |   b = Uzzal
  26   4  18   1 |   c = Hümayun
   7   0   1  19 |   d = Zirgüle
```

REMARKS ON TABLE 1a... The correct classification percentage for "BayesNet" is rather low (merely 56 %), but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (19 members in bold).

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (20), and 1 even with Hümayun, instead of actually Uzzal (6).

While the majority of Hümayun pieces is catalogued under Hicaz (26) instead of Hümayun (18), the fact that only very few are grouped under Uzzal (4) and only 1 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (138) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (31) and Hümayun (49), while very few are confused as Zirgüle (4).

All this seems to hint that the authors of the current report are on the right track with their computational methodology.

Table 2a via Logistic for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "Logistic" is a class for building and using a multinomial logistic regression model with a ridge estimator, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         176               54.1538 %
Incorrectly Classified Instances       149               45.8462 %
Kappa statistic                          0.1594
Mean absolute error                      0.2278
Root mean squared error                  0.4752
Relative absolute error                 91.0596 %
Root relative squared error            134.7999 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.649     0.466     0.750      0.649     0.696      0.173    0.614     0.749
Hicaz
                 0.148     0.107     0.111      0.148     0.127      0.036    0.614     0.117
Uzzal
                 0.367     0.232     0.220      0.367     0.275      0.112    0.642     0.211
Hümayun
                 0.370     0.017     0.667      0.370     0.476      0.465    0.680     0.353
Zirgüle
Weighted Avg.    0.542     0.364     0.610      0.542     0.567      0.176    0.623     0.582

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 144  25  49   4 |   a = Hicaz
  15   4   8   0 |   b = Uzzal
  26   4  18   1 |   c = Hümayun
   7   3   7  10 |   d = Zirgüle
```

REMARKS ON TABLE 2a... The correct classification percentage for "Logistic" is rather low, too (merely 54 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (10 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (7), Uzzal (3) and even Hümayun (7). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (15) and Hümayun (8). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the (identical) majority of Hümayun pieces is again catalogued under Hicaz (26) instead of Hümayun (18), the fact that only very few are grouped under Uzzal (4) and only 1 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (144) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (25) and Hümayun (49), while very few are confused as Zirgüle (4). The latter two occurence numbers for Hümayun (26) and Zirgüle (7) are identical to those given by "BayesNet".

Table 3a via MultilayerPerceptron for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "MultilayerPerceptron" is a classifier that uses backpropagation to learn a multi-layer perceptron to classify instances, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         200               61.5385 %
Incorrectly Classified Instances       125               38.4615 %
Kappa statistic                          0.1374
Mean absolute error                      0.1981
Root mean squared error                  0.4169
Relative absolute error                 79.1797 %
Root relative squared error            118.2712 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.797    0.728    0.702      0.797    0.747      0.077    0.572     0.717
Hicaz
                 0.037    0.023    0.125      0.037    0.057      0.024    0.607     0.161
Uzzal
                 0.122    0.080    0.214      0.122    0.156      0.055    0.631     0.218
Hümayun
                 0.593    0.070    0.432      0.593    0.500      0.454    0.825     0.517
Zirgüle
Weighted Avg.    0.615    0.517    0.558      0.615    0.580      0.101    0.605     0.579

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 177   7  21  17 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  39   0   6   4 |   c = Hümayun
  10   0   1  16 |   d = Zirgüle
```

REMARKS ON TABLE 3a... The correct classification percentage for "MultilayerPerceptron" is relatively higher (62 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (16 members in bold). However, there still turns out to be some uncertainty where part of them may instead be in Hicaz (10) and even Hümayun (1). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun; nor is any Hümayun piece mistaken for Uzzal; whereas 4 Hümayun pieces are evidently falsely categorized under Zirgüle and even 39 under Hicaz! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun from its relatively distant neighbors Hicaz and Zirgüle.

Moreover, most Uzzals here are imagined to be in Hicaz (26), and only 1 to be actually in Uzzal. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (177) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (7) and Hümayun (21), while a substantial portion is confused as Zirgüle (17).

Table 4a via SimpleLogistic for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "SimpleLogistic" is a classifier for building linear logistic regression models, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         229               70.4615 %
Incorrectly Classified Instances        96               29.5385 %
Kappa statistic                          0.1914
Mean absolute error                      0.214
Root mean squared error                  0.3314
Relative absolute error                 85.5352 %
Root relative squared error             94.0183 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.955     0.835     0.711      0.955    0.815      0.202    0.625     0.759
Hicaz
                 0.037     0.003     0.500      0.037    0.069      0.119    0.828     0.303
Uzzal
                 0.000     0.025     0.000      0.000    0.000      -0.063   0.670     0.224
Hümayun
                 0.593     0.007     0.889      0.593    0.711      0.707    0.902     0.687
Zirgüle
Weighted Avg.    0.705     0.575     0.601      0.705    0.622      0.197    0.672     0.635

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 212   1   7   2 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  11   0   0  16 |   d = Zirgüle
```

REMARKS ON TABLE 4a... The correct classification percentage for "SimpleLogistic" is even higher (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (16 members in bold again). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (11). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, no Hümayun piece is conceived to fit under any category other than Hicaz (49), either!

Once again, most Uzzals here are imagined to be in Hicaz (26), and only 1 to be actually in Uzzal. It is not realistic that Uzzal and Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (212) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (1), Hümayun (7) and even Zirgüle (2). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 5a via SMO for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: Implements John Platt's "sequential minimal optimization" (SMO) algorithm for training a support vector classifier, where the batch size is chosen to be 325, and the training data is standardized; it uses "Logistic" with the same batch size, that is a class for building and using a multinomial logistic regression model with a ridge estimator, alongside the "polynomial kernel" K(x, y) = <x, y>^p or K(x, y) = (<x, y>+1)^p.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         197               60.6154 %
Incorrectly Classified Instances       128               39.3846 %
Kappa statistic                          0.2142
Mean absolute error                      0.2972
Root mean squared error                  0.3784
Relative absolute error                118.787  %
Root relative squared error            107.3458 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.721    0.583    0.727      0.721    0.724      0.137    0.567     0.714
Hicaz
                 0.259    0.084    0.219      0.259    0.237      0.162    0.708     0.163
Uzzal
                 0.224    0.127    0.239      0.224    0.232      0.100    0.621     0.195
Hümayun
                 0.704    0.027    0.704      0.704    0.704      0.677    0.918     0.605
Zirgüle
Weighted Avg.    0.606    0.426    0.609      0.606    0.608      0.179    0.616     0.581

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 160  24  30   8 |   a = Hicaz
  16   7   4   0 |   b = Uzzal
  38   0  11   0 |   c = Hümayun
   6   1   1  19 |   d = Zirgüle
```

REMARKS ON TABLE 5a... The correct classification percentage for "Sequential Minimal Optimization" (SMO) by John Platt is a bit lower (61 %) in comparison to the table before, but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (19 members in bold), while a few are confounded with Hicaz (6), Uzzal (1) and Hümayun (1).

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (16), and some even with Hümayun (4), instead of actually Uzzal (7).

While the majority of Hümayun pieces is catalogued under Hicaz (38) instead of Hümayun (11), the fact that none are grouped under Uzzal or Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (160) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (24), Hümayun (30) and even Zirgüle (8).

Table 6a via lBK for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "lazy.lbk" is K-nearest neighbours classifier, where the batch size is chosen to be 325, and the "nearest neighbor search algorithm" (LinearNNSearch) is a class implementing the brute force search algorithm for nearest neighbour search coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         203               62.4615 %
Incorrectly Classified Instances       122               37.5385 %
Kappa statistic                          0.2089
Mean absolute error                      0.1902
Root mean squared error                  0.4303
Relative absolute error                 76.0334 %
Root relative squared error            122.0729 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.761    0.621    0.725      0.761    0.743      0.144    0.594     0.733
Hicaz
                 0.074    0.030    0.182      0.074    0.105      0.067    0.543     0.093
Uzzal
                 0.306    0.159    0.254      0.306    0.278      0.136    0.614     0.212
Hümayun
                 0.630    0.017    0.773      0.630    0.694      0.673    0.825     0.536
Zirgüle
Weighted Avg.    0.625    0.452    0.613      0.625    0.616      0.181    0.612     0.585

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 169   9  39   5 |   a = Hicaz
  22   2   3   0 |   b = Uzzal
  34   0  15   0 |   c = Hümayun
   8   0   2  17 |   d = Zirgüle
```

REMARKS ON TABLE 6a... The correct classification percentage for "lBk" is almost the same (62 %) in comparison to the table before, and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold), while a few are confounded with Hicaz (8) and Hümayun (2). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (22), and some even with Hümayun (3), instead of actually Uzzal (2).

While the majority of Hümayun pieces is again catalogued under Hicaz (34) instead of Hümayun (15), the fact that none are grouped under Uzzal or Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (169) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (9), Hümayun (39) and even Zirgüle (5).

Table 7a via KStar for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "KStar" is an instance-based classifier (that is, the class of a test instance is based upon the class of those training instances similar to it) as determined by some similarity function, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         178               54.7692 %
Incorrectly Classified Instances       137               42.1538 %
Kappa statistic                          0.1205
Mean absolute error                      0.2165
Root mean squared error                  0.4471
Relative absolute error                 89.2231 %
Root relative squared error            128.7017 %
UnClassified Instances                  10                3.0769 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
                 0.698     0.660     0.694      0.698     0.696      0.038    0.519     0.687     Hicaz
                 0.074     0.104     0.063      0.074     0.068      -0.028   0.637     0.118     Uzzal
                 0.298     0.146     0.264      0.298     0.280      0.145    0.623     0.262     Hümayun
                 0.462     0.007     0.857      0.462     0.600      0.607    0.912     0.700     Zirgüle
Weighted Avg.    0.565     0.482     0.590      0.565     0.572      0.095    0.577     0.576

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 150  28  35   2 |   a = Hicaz
  21   2   4   0 |   b = Uzzal
  33   0  14   0 |   c = Hümayun
  12   2   0  12 |   d = Zirgüle
```

REMARKS ON TABLE 7a... The correct classification percentage for "KStar" is rather low (merely 55 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (12 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (12) and even Uzzal (2); yet it is still interesting that none are misidentified as Hümayun.

Next, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; and no Hümayun is misclassified as Uzzal, either. Most Uzzals here, however, are instead imagined to be Hicaz (21) and Hümayun (4), instead of actually Uzzal (2).

Also, while the majority of Hümayun pieces is again catalogued under Hicaz (33) instead of Hümayun (14), the fact that none are grouped under Uzzal and Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (150) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (28) and Hümayun (35), while very few are confused as Zirgüle (2). Not only is the success rate at overall classification meager, but the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 8a via LWL for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "Locally weighted learning" (LWL), where the batch size is chosen to be 325, uses the DecisionStump classifier with the same batch size, that is a class for building and using a decision stump, and the "nearest neighbor search algorithm" (LinearNNSearch), which is a class implementing the brute force search algorithm for nearest neighbour search, coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         227               69.8462 %
Incorrectly Classified Instances        98               30.1538 %
Kappa statistic                          0.1566
Mean absolute error                      0.2269
Root mean squared error                  0.3454
Relative absolute error                 90.6837 %
Root relative squared error             97.9768 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.964    0.864    0.706      0.964    0.815      0.185    0.562     0.730
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.742     0.223
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.702     0.238
Hümayun
                 0.481    0.030    0.591      0.481    0.531      0.496    0.826     0.433
Zirgüle
Weighted Avg.    0.698    0.593    ?          0.698    ?          ?        0.620     0.589

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 214   0   0   8 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   0   1 |   c = Hümayun
  14   0   0  13 |   d = Zirgüle
```

REMARKS ON TABLE 8a... The correct classification percentage for "LWL" is high (70 %) in comparison to the previous table, and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (13 members in bold), while even more are yet confounded with Hicaz (14). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA... And similarly, most Hümayun pieces are catalogued under Hicaz (48), while 1 is even confounded with Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (214) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Zirgüle (8), yet none to be in Uzzal or Hümayun! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 9a via AdaBoostM1 for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "AdaBoostM1" is a class for boosting a nominal class classifier using the Adaboost M1 method, where the batch size is chosen to be 325; it uses the DecisionStump classifier with the same batch size, that is a class for building and using a decision stump.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         226               69.5385 %
Incorrectly Classified Instances        99               30.4615 %
Kappa statistic                          0.148
Mean absolute error                      0.2447
Root mean squared error                  0.3507
Relative absolute error                 97.8153 %
Root relative squared error             99.4679 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.964     0.864     0.706      0.964    0.815      0.185    0.527     0.691
Hicaz
                 0.000     0.000     ?          0.000    ?          ?        0.492     0.081
Uzzal
                 0.000     0.000     ?          0.000    ?          ?        0.499     0.150
Hümayun
                 0.444     0.034     0.545      0.444    0.490      0.451    0.697     0.336
Zirgüle
Weighted Avg.    0.695     0.593     ?          0.695    ?          ?        0.534     0.529

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 214   0   0   8 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  47   0   0   2 |   c = Hümayun
  15   0   0  12 |   d = Zirgüle
```

REMARKS ON TABLE 9a... The correct classification percentage for "AdaBoostM1" is rather high, too (70 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (12 members in bold), while even more are yet confounded with Hicaz (15). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA... And similarly, most Hümayun pieces are rather catalogued under Hicaz (47), while 2 are even confounded with Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (214) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (8), yet none to be in Uzzal or Hümayun! A good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 10a via AttributeSelectedClassifier for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "AttributeSelectedClassifier", where the batch size is chosen to be 325, uses the J48 classifier with the same batch size, that is a class for generating a pruned or unpruned C4, and the "CfsSubsetEval", which evaluates the worth of a subset of attributes by considering the individual predictive ability of each feature along with the degree of redundancy between them, coupled with "BestFirst" that searches the space of attribute subsets by greedy hillclimbing augmented with a backtracking facility.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         223               68.6154 %
Incorrectly Classified Instances       102               31.3846 %
Kappa statistic                          0.2435
Mean absolute error                      0.2002
Root mean squared error                  0.3636
Relative absolute error                 80.0299 %
Root relative squared error            103.1487 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.892    0.689    0.736      0.892    0.807      0.250    0.573     0.692
Hicaz
                 0.148    0.027    0.333      0.148    0.205      0.178    0.659     0.184
Uzzal
                 0.163    0.065    0.308      0.163    0.213      0.129    0.623     0.220
Hümayun
                 0.481    0.017    0.722      0.481    0.578      0.561    0.795     0.451
Zirgüle
Weighted Avg.    0.686    0.484    0.637      0.686    0.648      0.251    0.606     0.558

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 198   7  13   4 |   a = Hicaz
  20   4   3   0 |   b = Uzzal
  39   1   8   1 |   c = Hümayun
  12   0   2  13 |   d = Zirgüle
```

REMARKS ON TABLE 10a... The percentage for "AttributeSelectedClassifier" in terms of correct classification is just as high as before (69 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (13 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (12) and even Hümayun (2); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (20), and some even with Hümayun (3), while only 4 are actually thought to be in Uzzal.

Moreover, most Hümayuns here are imagined to be in Hicaz (39) also, and only 8 to be actually in Hümayun, whereas WEKA thinks 1 to be in Uzzal and even 1 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (198) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (7), Hümayun (13) and Zirgüle (4).

Table 11a via Bagging for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "Bagging" is a class for bagging a classifier to reduce variance, where the batch size is chosen to be 325; it uses the RepTree (fast decision tree learner) classifier with the same batch size.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         228               70.1538 %
Incorrectly Classified Instances        97               29.8462 %
Kappa statistic                          0.2009
Mean absolute error                      0.2081
Root mean squared error                  0.3242
Relative absolute error                 83.1783 %
Root relative squared error             91.966  %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.941     0.816     0.713      0.941    0.812      0.197    0.668     0.784
Hicaz
                 0.000     0.003     0.000      0.000    0.000      -0.017   0.688     0.147
Uzzal
                 0.102     0.025     0.417      0.102    0.164      0.146    0.715     0.354
Hümayun
                 0.519     0.017     0.737      0.519    0.609      0.590    0.960     0.820
Zirgüle
Weighted Avg.    0.702     0.563     0.611      0.702    0.630      0.204    0.701     0.669

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 209   1   7   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  44   0   5   0 |   c = Hümayun
  13   0   0  14 |   d = Zirgüle
```

REMARKS ON TABLE 11a... The correct classification percentage for "Bagging" is appreciably high (70 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold), while some are confounded with Hicaz (13). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Yet, no Uzzal piece is conceived to fit under any category other than Hicaz (27), either!

While the majority of Hümayun pieces is again catalogued under Hicaz (44) instead of Hümayun (5), the fact that none are grouped under Uzzal or Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (209) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (1), Hümayun (7) and even Zirgüle (5).

Table 12a via ClassificationViaRegression for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "ClassificationViaRegression" is a class for doing classification using regression methods, where the batch size is chosen to be 325; it uses the M5P classifier, with the same batch size, that implements the M5' model tree algorithm.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         228               70.1538 %
Incorrectly Classified Instances        97               29.8462 %
Kappa statistic                          0.2639
Mean absolute error                      0.205
Root mean squared error                  0.3358
Relative absolute error                 81.9227 %
Root relative squared error             95.2625 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.910    0.709    0.735      0.910    0.813      0.259    0.644     0.770
Hicaz
                 0.037    0.023    0.125      0.037    0.057      0.024    0.741     0.177
Uzzal
                 0.102    0.047    0.278      0.102    0.149      0.086    0.671     0.259
Hümayun
                 0.741    0.013    0.833      0.741    0.784      0.768    0.942     0.772
Zirgüle
Weighted Avg.    0.702    0.494    0.623      0.702    0.648      0.256    0.681     0.644

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 202   7  10   3 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  43   0   5   1 |   c = Hümayun
   4   0   3  20 |   d = Zirgüle
```

REMARKS ON TABLE 12a... The percentage for "ClassificationViaRegression" in terms of correct classification is just as high as before (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (20 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (4) and even Hümayun (3); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Most Uzzals, however, are seemingly more conformal with Hicaz (26), while only 1 is actually thought to be in Uzzal!

Moreover, most Hümayuns here are imagined also to be in Hicaz (43), and only 5 to be actually in Hümayun, whereas WEKA even thinks 1 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (202) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (7), Hümayun (10) and even Zirgüle (3).

Table 13a via FilteredClassifier for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "FilteredClassifier", where the batch size is chosen to be 325, uses the J48 classifier with the same batch size, that is a class for generating a pruned or unpruned C4, coupled with "Discretize" filter, which is an instance filter that discretizes a range of numeric attributes in the dataset into nominal attributes.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         235               72.3077 %
Incorrectly Classified Instances        90               27.6923 %
Kappa statistic                          0.2246
Mean absolute error                      0.2087
Root mean squared error                  0.3351
Relative absolute error                 83.4208 %
Root relative squared error             95.0465 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.982    0.825    0.719      0.982    0.830      0.290    0.549     0.705
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.536     0.089
Uzzal
                 0.000    0.007    0.000      0.000    0.000      -0.033   0.503     0.149
Hümayun
                 0.630    0.010    0.850      0.630    0.723      0.712    0.773     0.602
Zirgüle
Weighted Avg.    0.723    0.566    ?          0.723    ?          ?        0.560     0.561

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 218   0   1   3 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
   9   0   1  17 |   d = Zirgüle
```

REMARKS ON TABLE 13a... The correct classification percentage for "FilteredClassifier" is the highest yet, BEING EXACTLY TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS (72 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (9) and 1 even in Hümayun; yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA... And similarly, all Hümayun pieces are catalogued under Hicaz (49)!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (218) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (1) and Zirgüle (3), yet none to be in Uzzal this time! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 14a via IterativeClassifierOptimizer for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "IterativeClassifierOptimizer" optimizes the number of iterations of the given iterative classifier using cross-validation or a percentage split evaluation, where the batch size is chosen to be 325; it uses the LogitBoost iterative classifier with the same batch size, which is a class for performing additive logistic regression that relies on DecisionStump, which is a classifier, with the same batch size, that is a class for performing additive logistic regression.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         229               70.4615 %
Incorrectly Classified Instances        96               29.5385 %
Kappa statistic                          0.2295
Mean absolute error                      0.2147
Root mean squared error                  0.3394
Relative absolute error                 85.8264 %
Root relative squared error             96.2621 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.932    0.786    0.719      0.932    0.812      0.214    0.591     0.746
Hicaz
                 0.037    0.010    0.250      0.037    0.065      0.068    0.690     0.221
Uzzal
                 0.082    0.018    0.444      0.082    0.138      0.139    0.621     0.254
Hümayun
                 0.630    0.023    0.708      0.630    0.667      0.640    0.911     0.689
Zirgüle
Weighted Avg.    0.705    0.543    0.638      0.705    0.636      0.226    0.631     0.623

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 207   3   5   7 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  45   0   4   0 |   c = Hümayun
  10   0   0  17 |   d = Zirgüle
```

REMARKS ON TABLE 14a... The percentage for "IterativeClassifierOptimizer" in terms of correct classification is almost as high as before (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold again). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz (10) but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but almost all Uzzals, except 1, are seemingly more conformal with Hicaz (26) according to WEKA!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (45), and only 4 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (207) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (3), Hümayun (5) and even Zirgüle (7).

Table 15a via LogitBoost for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "LogitBoost" is a class for performing additive logistic regression, where the batch size is chosen to be 325; it uses DecisionStump, which is a classifier, with the same batch size, that is a class for performing additive logistic regression.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         218               67.0769 %
Incorrectly Classified Instances       107               32.9231 %
Kappa statistic                          0.2237
Mean absolute error                      0.2025
Root mean squared error                  0.3514
Relative absolute error                 80.9518 %
Root relative squared error             99.6709 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.856    0.718    0.720      0.856    0.782      0.164    0.595     0.741
Hicaz
                 0.074    0.040    0.143      0.074    0.098      0.046    0.704     0.163
Uzzal
                 0.184    0.062    0.346      0.184    0.240      0.161    0.658     0.265
Hümayun
                 0.630    0.013    0.810      0.630    0.708      0.692    0.904     0.777
Zirgüle
Weighted Avg.    0.671    0.505    0.623      0.671    0.637      0.197    0.639     0.624

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 190  11  17   4 |   a = Hicaz
  25   2   0   0 |   b = Uzzal
  39   1   9   0 |   c = Hümayun
  10   0   0  17 |   d = Zirgüle
```

REMARKS ON TABLE 15a... The correct classification percentage for "LogitBoost" is appreciably high (67 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold again), while some are confounded with Hicaz (10). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but almost all Uzzals, except 2, are seemingly more conformal with Hicaz (25) according to the WEKA algorithm!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (39), and even 1 to be in Uzzal, and only 9 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (190) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (11) and Hümayun (17), while very few are confused as Zirgüle (4).

Table 16a via MultiClassClassifier for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: Implements a metaclassifier for handling multi-class datasets with 2-class classifiers, where the batch size is chosen to be 325; it relies on "Logistic", with the same batch size, that is a class for building and using a multinomial logistic regression model with a ridge estimator.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         181               55.6923 %
Incorrectly Classified Instances       144               44.3077 %
Kappa statistic                          0.1391
Mean absolute error                      0.2184
Root mean squared error                  0.4179
Relative absolute error                 87.3068 %
Root relative squared error            118.5488 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.685    0.563    0.724      0.685    0.704      0.118    0.596     0.734     Hicaz
                 0.185    0.094    0.152      0.185    0.167      0.083    0.627     0.143     Uzzal
                 0.286    0.203    0.200      0.286    0.235      0.072    0.650     0.230     Hümayun
                 0.370    0.007    0.833      0.370    0.513      0.532    0.934     0.638     Zirgüle
Weighted Avg.    0.557    0.424    0.606      0.557    0.573      0.143    0.635     0.601

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 152  24  44   2 |   a = Hicaz
  16   5   6   0 |   b = Uzzal
  32   3  14   0 |   c = Hümayun
  10   1   6  10 |   d = Zirgüle
```

REMARKS ON TABLE 16a... The correct classification percentage for "MultiClassClassifier" is rather low (merely 56 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (10 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (10), as well as in Hümayun (6) and even Uzzal (1).

Next, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (16) and Hümayun (6), instead of actually Uzzal (5). This algorithm does not appear to utilize the melodic contour features properly to distinguish particularly Uzzal.

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (32), and even 3 to be in Uzzal, while actual Hümayuns number 14. It is not realistic that Hümayun should easily be confounded with particularly Hicaz on such a substantial scale!

Finally, the bulk of Hicaz pieces (152) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (24) and Hümayun (44), while very few are confused as Zirgüle (2). Not only is the success rate at overall classification meager, but the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 17a via MultiClassClassifierUpdateable for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "MultiClassClassifierUpdateable" is a metaclassifier for handling multi-class datasets with 2-class classifiers, where the batch size is chosen to be 325; it uses the SGD classifier, with the same batch size, that implements stochastic gradient descent for learning various linear models (binary class SVM, binary class logistic regression, squared loss, Huber loss and epsilon-insensitive loss linear regression).

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         215               66.1538 %
Incorrectly Classified Instances       110               33.8462 %
Kappa statistic                          0.1691
Mean absolute error                      0.1766
Root mean squared error                  0.395
Relative absolute error                 70.5877 %
Root relative squared error            112.0494 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.878    0.767    0.712      0.878    0.786      0.142    0.590     0.729
Hicaz
                 0.037    0.040    0.077      0.037    0.050      -0.005   0.549     0.098
Uzzal
                 0.061    0.054    0.167      0.061    0.090      0.011    0.547     0.165
Hümayun
                 0.593    0.013    0.800      0.593    0.681      0.665    0.907     0.661
Zirgüle
Weighted Avg.    0.662    0.537    0.584      0.662    0.611      0.154    0.607     0.586

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 195  10  14   3 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  45   0   3   1 |   c = Hümayun
   8   2   1  16 |   d = Zirgüle
```

REMARKS ON TABLE 17a... The percentage for "MultiClassClassifierUpdateable" in terms of correct classification is higher than before (66 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (16 members in bold). However, there still turns out to be some uncertainty, where a part of them may instead be in Hicaz (8), Uzzal (2) and even Hümayun (1).

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Most Uzzals, however, are seemingly more conformal with Hicaz (26), while only 1 is actually thought to be in Uzzal!

Moreover, most Hümayuns are also imagined to be in Hicaz (45), and only 3 to be actually in Hümayun, whereas WEKA even thinks 1 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with polar opposites on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (195) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (10) and Hümayun (14), while very few are confused as Zirgüle (3).

Table 18a via RandomCommittee for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "RandomCommittee" is a class for building an ensemble of randomizable base classifiers, where the batch size is chosen to be 325; it uses RandomTree with the same batch size, which is a class for constructing a tree that considers K randomly chosen attributes at each node.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         234               72      %
Incorrectly Classified Instances        91               28      %
Kappa statistic                          0.2253
Mean absolute error                      0.2238
Root mean squared error                  0.3464
Relative absolute error                 89.4746 %
Root relative squared error             98.2707 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
                 0.973     0.816     0.720       0.973   0.828      0.275    0.542     0.693     Hicaz
                 0.000     0.000     ?           0.000   ?          ?        0.684     0.141     Uzzal
                 0.082     0.014     0.500       0.082   0.140      0.155    0.597     0.239     Hümayun
                 0.519     0.010     0.824       0.519   0.636      0.630    0.963     0.748     Zirgüle
Weighted Avg.    0.720     0.560     ?           0.720   ?          ?        0.597     0.583

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 216   0   4   2 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  44   0   4   1 |   c = Hümayun
  13   0   0  14 |   d = Zirgüle
```

REMARKS ON TABLE 18a... The correct classification percentage for "RandomCommittee" is even higher (72 %), IN LINE WITH TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS; and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (13). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, they are not conceived to fit under the category of Uzzal, either! Also, most Hümayuns here are once again imagined to be in Hicaz (44), and only 4 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (216) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (4) and even Zirgüle (2), but not at all in Uzzal! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 19a via RandomizableFilteredClassifier for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: It is a simple variant of the FilteredClassifier that instantiates the model with a randomizable filter (e.g., RandomProjection that reduces the dimensionality of the data by projecting it onto a lower dimensional subspace using a random matrix with columns of unit length), and IBk (K-nearest neighbours classifier) as the base classifier, where the batch size is chosen to be 325, and the "nearest neighbor search algorithm" (LinearNNSearch) is a class implementing the brute force search algorithm for nearest neighbour search, coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         197               60.6154 %
Incorrectly Classified Instances       128               39.3846 %
Kappa statistic                          0.155
Mean absolute error                      0.1993
Root mean squared error                  0.4408
Relative absolute error                 79.6731 %
Root relative squared error            125.038  %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.766     0.670     0.711      0.766    0.738      0.101    0.569     0.719
Hicaz
                 0.185     0.067     0.200      0.185    0.192      0.122    0.579     0.113
Uzzal
                 0.245     0.123     0.261      0.245    0.253      0.125    0.568     0.189
Hümayun
                 0.370     0.017     0.667      0.370    0.476      0.465    0.758     0.340
Zirgüle
Weighted Avg.    0.606     0.483     0.597      0.606    0.597      0.137    0.586     0.557

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 170  18  29   5 |   a = Hicaz
  21   5   1   0 |   b = Uzzal
  36   1  12   0 |   c = Hümayun
  12   1   4  10 |   d = Zirgüle
```

REMARKS ON TABLE 19a... The percentage for "RandomizableFilteredClassifier" in terms of correct classification is a bit lower (60 %) in comparison to the previous table, but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed significatively grouped under the Zirgüleli Hicaz label as one would expect (10 members in bold), while some are confounded with Hicaz (12), Uzzal (1) and even Hümayun (4).

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (36), and 1 even with Hümayun, instead of actually Uzzal (5).

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (21), and even 1 to be in Uzzal, and only 12 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with particularly Hicaz on such a substantial scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (170) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (18), Hümayun (29) and even Zirgüle (5).

Table 20a via RandomSubSpace for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "RandomSubSpace" method constructs a decision tree based classifier that maintains highest accuracy on training data and improves on generalization accuracy as it grows in complexity, where the batch size is chosen to be 325; it uses the RepTree (fast decision tree learner) classifier with the same batch size.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         235               72.3077 %
Incorrectly Classified Instances        90               27.6923 %
Kappa statistic                          0.1964
Mean absolute error                      0.2212
Root mean squared error                  0.3261
Relative absolute error                 88.4086 %
Root relative squared error             92.5051 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
                 0.995     0.864     0.713      0.995    0.831      0.291    0.660     0.774     Hicaz
                 0.000     0.000     ?          0.000    ?          ?        0.764     0.219     Uzzal
                 0.000     0.000     ?          0.000    ?          ?        0.664     0.249     Hümayun
                 0.519     0.003     0.933      0.519    0.667      0.678    0.945     0.815     Zirgüle
Weighted Avg.    0.723     0.591     ?          0.723    ?          ?        0.693     0.652

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 221   0   0   1 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  13   0   0  14 |   d = Zirgüle
```

REMARKS ON TABLE 20a... The percentage for "RandomSubSpace" in terms of correct classification is just as high as Table 13a, BEING EXACTLY THE PERCENTAGE OF TRT REPERTORY'S RECURRENT LABELS (72 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (13); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, just as are all the Hümayuns (49)!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (221) is indeed identified as Hicaz, but 1 is instead thought by WEKA to be in Zirgüle, yet none to be in Uzzal or Hümayun this time! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 21a via DecisionTable for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "DecisionTable" is a class for building and using a simple decision table majority classifier, where the batch size is chosen to be 325; it uses the BestFirst search, which searches the space of attribute subsets by greedy hillclimbing augmented with a backtracking facility.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         225               69.2308 %
Incorrectly Classified Instances       100               30.7692 %
Kappa statistic                          0.1254
Mean absolute error                      0.2343
Root mean squared error                  0.3433
Relative absolute error                 93.6617 %
Root relative squared error             97.3765 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.964     0.893     0.699      0.964    0.811      0.140    0.598     0.736
Hicaz
                 0.000     0.003     0.000      0.000    0.000      -0.017   0.548     0.101
Uzzal
                 0.000     0.004     0.000      0.000    0.000      -0.023   0.573     0.187
Hümayun
                 0.407     0.020     0.647      0.407    0.500      0.480    0.813     0.494
Zirgüle
Weighted Avg.    0.692     0.613     0.531      0.692    0.595      0.131    0.608     0.581

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 214   1   1   6 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  16   0   0  11 |   d = Zirgüle
```

REMARKS ON TABLE 21a... The correct classification percentage for "DecisionTable" is appreciably high as well (69 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (11 members in bold), while even more are yet confounded with Hicaz (16). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, just as are all the Hümayuns (49)!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (214) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (1), Hümayun (1) and even Zirgüle (6). A good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 22a via JRip for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "JRip" is a class that implements a propositional rule learner, Repeated Incremental Pruning to Produce Error Reduction (RIPPER), which was proposed by William W. Cohen as an optimized version of IREP, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         236               72.6154 %
Incorrectly Classified Instances        89               27.3846 %
Kappa statistic                          0.316
Mean absolute error                      0.1963
Root mean squared error                  0.3304
Relative absolute error                 78.4633 %
Root relative squared error             93.7281 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.928     0.699     0.741      0.928    0.824      0.303    0.617     0.739
Hicaz
                 0.111     0.013     0.429      0.111    0.176      0.186    0.627     0.146
Uzzal
                 0.143     0.033     0.438      0.143    0.215      0.182    0.603     0.209
Hümayun
                 0.741     0.013     0.833      0.741    0.784      0.768    0.868     0.738
Zirgüle
Weighted Avg.    0.726     0.485     0.677      0.726    0.675      0.314    0.637     0.610

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 206   4   8   4 |   a = Hicaz
  24   3   0   0 |   b = Uzzal
  42   0   7   0 |   c = Hümayun
   6   0   1  20 |   d = Zirgüle
```

REMARKS ON TABLE 22a... The correct classification percentage for "JRip" is the highest yet, EQUALLING THE PERCENTAGE OF TRT REPERTORY'S RECURRENT LABELS (73 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (20 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (6) and even Hümayun (1); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals, however, conform with Hicaz (24), while only 3 are actually thought to be in Uzzal!

Moreover, most Hümayuns here are imagined also to be in Hicaz (42), and only 7 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! On the other hand, the melodic contour features do seem to prevent misclassification of Uzzals as Hümayun or Zirgüle, and Hümayuns as Uzzal and Zirgüle.

Finally, the bulk of Hicaz pieces (206) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (4), Hümayun (8) and even Zirgüle (4). If the Uzzals and Hümayuns at large are incorrectly registered in the TRT repertory or by the experts, this algorithm might be the most promising one yet!

Table 23a via OneR for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "OneR" is a class for building and using a 1R classifier; in other words, uses the minimum-error attribute for prediction, discretizing numeric attributes; batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         227               69.8462 %
Incorrectly Classified Instances        98               30.1538 %
Kappa statistic                          0.1547
Mean absolute error                      0.1508
Root mean squared error                  0.3883
Relative absolute error                 60.2647 %
Root relative squared error            110.1443 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.964     0.864     0.706       0.964   0.815      0.185    0.550     0.705
Hicaz
                 0.000     0.000     ?           0.000   ?          ?        0.500     0.083
Uzzal
                 0.000     0.014     0.000       0.000   0.000      -0.047   0.493     0.151
Hümayun
                 0.481     0.017     0.722       0.481   0.578      0.561    0.732     0.391
Zirgüle
Weighted Avg.    0.698     0.594     ?           0.698   ?          ?        0.552     0.544

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 214   0   3   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  13   0   1  13 |   d = Zirgüle
```

REMARKS ON TABLE 23a... The correct classification percentage for "OneR" is appreciably high as well (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (13 members in bold), while just as much are yet confounded with Hicaz (13), with even 1 being in Hümayun. It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, just as are all the Hümayuns (49)!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (214) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (3) and even Zirgüle (5), but none in Uzzal. A good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 24a via PART for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "PART" is a class for generating a PART decision list, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         193               59.3846 %
Incorrectly Classified Instances       132               40.6154 %
Kappa statistic                          0.2121
Mean absolute error                      0.2057
Root mean squared error                  0.4335
Relative absolute error                 82.2336 %
Root relative squared error            122.9712 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.707    0.524    0.744      0.707    0.725      0.178    0.609     0.742
Hicaz
                 0.222    0.087    0.188      0.222    0.203      0.125    0.674     0.148
Uzzal
                 0.224    0.167    0.193      0.224    0.208      0.054    0.553     0.191
Hümayun
                 0.704    0.020    0.760      0.704    0.731      0.708    0.853     0.585
Zirgüle
Weighted Avg.    0.594    0.392    0.616      0.594    0.604      0.199    0.626     0.596

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 157  21  39   5 |   a = Hicaz
  18   6   3   0 |   b = Uzzal
  34   3  11   1 |   c = Hümayun
   2   2   4  19 |   d = Zirgüle
```

REMARKS ON TABLE 24a... The correct classification percentage for "PART" is a bit low (just 59 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (19 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (2), Uzzal (2) and even Hümayun (4). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (18) and Hümayun (3), instead of actually Uzzal (6). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is catalogued under Hicaz (34) instead of Hümayun (11), the fact that only very few are grouped under Uzzal (3) and only 1 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (157) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (21) and Hümayun (39), while a few are confused as Zirgüle (5). Not only is the success rate at overall classification meager, but the fact that Uzzals are somewhat misclassified by this algorithm is a bothersome aspect.

Table 25a via DecisionStump for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "DecisionStump" is a class for building and using a decision stump, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         226               69.5385 %
Incorrectly Classified Instances        99               30.4615 %
Kappa statistic                          0.148
Mean absolute error                      0.2305
Root mean squared error                  0.3473
Relative absolute error                 92.1213 %
Root relative squared error             98.5104 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.964     0.864     0.706      0.964    0.815      0.185    0.524     0.690
Hicaz
                 0.000     0.000     ?          0.000    ?          ?        0.500     0.081
Uzzal
                 0.000     0.000     ?          0.000    ?          ?        0.495     0.148
Hümayun
                 0.444     0.034     0.545      0.444    0.490      0.451    0.672     0.273
Zirgüle
Weighted Avg.    0.695     0.593     ?          0.695    ?          ?        0.530     0.523

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 214   0   0   8 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  47   0   0   2 |   c = Hümayun
  15   0   0  12 |   d = Zirgüle
```

REMARKS ON TABLE 25a... Results are identical to Table 9a. The correct classification percentage for "DecisionStump" is the same as with "AdaBoostM1" (70 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (12 members in bold), while even more are yet confounded with Hicaz (15). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, and similarly, most Hümayun pieces are catalogued under Hicaz (47), while 2 are even confounded with Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (214) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (8), yet none to be in Uzzal or Hümayun! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 26a via J48 for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "J48" is a class for generating a pruned or unpruned C4, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         212               65.2308 %
Incorrectly Classified Instances       113               34.7692 %
Kappa statistic                          0.2531
Mean absolute error                      0.1908
Root mean squared error                  0.392
Relative absolute error                 76.2765 %
Root relative squared error            111.2084 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.802    0.602    0.742      0.802    0.771      0.212    0.608     0.731
Hicaz
                 0.222    0.057    0.261      0.222    0.240      0.178    0.677     0.176
Uzzal
                 0.224    0.105    0.275      0.224    0.247      0.130    0.590     0.221
Hümayun
                 0.630    0.017    0.773      0.630    0.694      0.673    0.844     0.564
Zirgüle
Weighted Avg.    0.652    0.433    0.634      0.652    0.641      0.235    0.631     0.594

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 178  15  25   4 |   a = Hicaz
  19   6   2   0 |   b = Uzzal
  35   2  11   1 |   c = Hümayun
   8   0   2  17 |   d = Zirgüle
```

REMARKS ON TABLE 26a... The correct classification percentage for "J48" is lower (65 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (8) and Hümayun (2). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (19) and Hümayun (2), instead of actually Uzzal (6). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is catalogued under Hicaz (35) instead of Hümayun (11), the fact that only very few are grouped under Uzzal (2) and only 1 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (178) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (15) and Hümayun (25), while very few are confused as Zirgüle (4). Not only is the success rate at overall classification wanting, but the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 27a via LMT for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "LMT" is a classifier for building 'logistic model trees', which are classification trees with logistic regression functions at the leaves, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         229               70.4615 %
Incorrectly Classified Instances        96               29.5385 %
Kappa statistic                          0.1914
Mean absolute error                      0.214
Root mean squared error                  0.3314
Relative absolute error                 85.5352 %
Root relative squared error             94.0183 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.955     0.835     0.711      0.955    0.815      0.202    0.625     0.759
Hicaz
                 0.037     0.003     0.500      0.037    0.069      0.119    0.828     0.303
Uzzal
                 0.000     0.025     0.000      0.000    0.000      -0.063   0.670     0.224
Hümayun
                 0.593     0.007     0.889      0.593    0.711      0.707    0.902     0.687
Zirgüle
Weighted Avg.    0.705     0.575     0.601      0.705    0.622      0.197    0.672     0.635

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 212   1   7   2 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  11   0   0  16 |   d = Zirgüle
```

REMARKS ON TABLE 27a... Results are identical to Table 4a. The correct classification percentage for "LMT" is higher than before (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (16 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (11). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, no Hümayun piece is conceived to fit under any category other than Hicaz (49), either!

Moreover, most Uzzals here are imagined to be in Hicaz (26), and only 1 to be actually in Uzzal. It is not realistic that Uzzal and Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (212) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (1), Hümayun (7) and even Zirgüle (2). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 28a via RandomForest for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "RandomForest" is a class for constructing a forest of random trees, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         234               72      %
Incorrectly Classified Instances        91               28      %
Kappa statistic                          0.1821
Mean absolute error                      0.2184
Root mean squared error                  0.325
Relative absolute error                 87.2854 %
Root relative squared error             92.2002 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.995     0.874     0.711      0.995    0.829      0.279    0.646     0.766
Hicaz
                 0.000     0.000     ?          0.000    ?          ?        0.704     0.149
Uzzal
                 0.041     0.000     1.000      0.041    0.078      0.187    0.711     0.374
Hümayun
                 0.407     0.003     0.917      0.407    0.564      0.591    0.986     0.887
Zirgüle
Weighted Avg.    0.720     0.597     ?          0.720    ?          ?        0.689     0.666

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 221   0   0   1 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  47   0   2   0 |   c = Hümayun
  16   0   0  11 |   d = Zirgüle
```

REMARKS ON TABLE 28a... The correct classification percentage for "RandomForest" is just as high as Table 18a, BEING EXACTLY THE PERCENTAGE OF TRT REPERTORY'S RECURRENT LABELS (72 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (11 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (16); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA. Similarly, most Hümayun pieces are rather catalogued under Hicaz (47) and only 2 are identified as Hümayun!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (221) is indeed identified as Hicaz, but 1 is instead thought by WEKA to be in Zirgüle, yet none to be in Uzzal or Hümayun this time! An even better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 29a via RandomTree for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "RandomTree" is a class for constructing a tree that considers K randomly chosen attributes at each node, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         179               55.0769 %
Incorrectly Classified Instances       146               44.9231 %
Kappa statistic                          0.1399
Mean absolute error                      0.2246
Root mean squared error                  0.4739
Relative absolute error                 89.782  %
Root relative squared error            134.439  %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.671     0.573     0.716      0.671    0.693      0.095    0.549     0.705
Hicaz
                 0.259     0.094     0.200      0.259    0.226      0.147    0.583     0.113
Uzzal
                 0.184     0.152     0.176      0.184    0.180      0.031    0.516     0.155
Hümayun
                 0.519     0.057     0.452      0.519    0.483      0.434    0.731     0.274
Zirgüle
Weighted Avg.    0.551     0.427     0.570      0.551    0.559      0.118    0.562     0.537

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 149  25  37  11 |   a = Hicaz
  15   7   4   1 |   b = Uzzal
  34   1   9   5 |   c = Hümayun
  10   2   1  14 |   d = Zirgüle
```

REMARKS ON TABLE 29a... The correct classification percentage for "RandomTree" is not good (merely 55 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (10), Uzzal (2) and even Hümayun (1). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 5 Hümayun pieces as Zirgüle, too. Most Uzzals here, however, are instead imagined to be Hicaz (15) and Hümayun (4), instead of actually Uzzal (7). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is again catalogued under Hicaz (34) instead of Hümayun (9), the fact that only 1 is grouped under Uzzal and only 5 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (149) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (25) and Hümayun (37), while a handful are confused as Zirgüle (11). Not only is the success rate at overall classification meager, but the fact that Uzzals are somewhat misclassified by this algorithm is a bothersome aspect.

Table 30a via RepTree for allHicaz24-SORTED.csv that attempts a 10-fold cross-validation: "RepTree" is a fast decision tree learner, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         228               70.1538 %
Incorrectly Classified Instances        97               29.8462 %
Kappa statistic                          0.177
Mean absolute error                      0.2194
Root mean squared error                  0.3419
Relative absolute error                 87.7046 %
Root relative squared error             96.9792 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.959    0.845    0.710      0.959    0.816      0.200    0.585     0.729
Hicaz
                 0.000    0.003    0.000      0.000    0.000      -0.017   0.611     0.113
Uzzal
                 0.000    0.007    0.000      0.000    0.000      -0.033   0.633     0.215
Hümayun
                 0.556    0.023    0.682      0.556    0.612      0.585    0.742     0.526
Zirgüle
Weighted Avg.    0.702    0.580    0.542      0.702    0.608      0.179    0.607     0.583

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 213   1   1   7 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  11   0   1  15 |   d = Zirgüle
```

REMARKS ON TABLE 30a... The correct classification percentage for "RepTree" is much higher than the previous table (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (11), and even Hümayun (1). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Even so, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Yet, no Hümayun piece is conceived to fit under any category other than Hicaz (49), either!

Moreover, all Uzzals here are imagined to be in Hicaz (27). It is not realistic that Uzzal and Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (213) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (1), Hümayun (1) and even Zirgüle (7). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 31a via either Canopy (for clustering data using the canopy clustering algorithm, which requires just one pass over the data) OR Cobweb (that is a class implementing the Cobweb and Classit clustering algorithms) for allHicaz24-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0      325 (100%)


Class attribute: LABEL
Classes to Clusters:

   0  <-- assigned to cluster
 222 | Hicaz
  27 | Uzzal
  49 | Hümayun
  27 | Zirgüle

Cluster 0 <-- Hicaz

Incorrectly clustered instances :     103.0    31.6923 %
```

REMARKS ON TABLE 31a... While the percentage of incorrectly clustered instances for either "Canopy" OR "Cobweb" is appreciably low (32 %), one immediately notices that all the pieces of the dataset are straightly assigned to the Hicaz cluster!

The only thing worthwhile to remark about the clearly failed approaches at hand is the proportion of the pieces distributed under such a single category. Obviously, WEKA thinks that the majority of Hicaz pieces (222) is indeed befittingly labelled under the Hicaz cluster, whereas only 27 Uzzal, 49 Hümayun and 27 Zirgüle pieces are deemed to belong to the same category.

Aside from the deceptive success rate at overall classification, the fact that all the pieces are squashed under a single label with these algorithms is a troubling aspect.

Therefore, the aforesaid computational models do not appear to utilize the melodic contour features properly to distinguish the dataset in terms of pinpointing the correct makam categories for the batch of 325 'Hicaz family' pieces.

Table 32a via Simple EM (expectation maximisation) class for allHicaz24-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0      122 ( 38%)
1       49 ( 15%)
2      154 ( 47%)


Log likelihood: 2589.89681


Class attribute: LABEL
Classes to Clusters:

   0   1   2  <-- assigned to cluster
  84  26 112 | Hicaz
  20   1   6 | Uzzal
  11  10  28 | Hümayun
   7  12   8 | Zirgüle

Cluster 0 <-- Uzzal
Cluster 1 <-- Zirgüle
Cluster 2 <-- Hicaz

Incorrectly clustered instances :     181.0    55.6923 %
```

REMARKS ON TABLE 32a... The percentage of incorrectly clustered instances for "Simple EM (expectation maximization)" is rather high (56 %). Here, one may see that 26 Hicaz pieces, 1 Uzzal piece, 10 Hümayun pieces and 12 Zirgüle pieces are assigned to the Zirgüle (a.k.a. Hicaz-Zirgüle) cluster. The total number thought by WEKA to be Zirgüle is hence 49.

While such a low number may seem reasonable, Simple EM seems very much confused about differentiating especially individual Hümayuns from its kindred polar opposites, as there was no discovered Hümayun category to begin with!

In addition, 84 Hicaz pieces, 20 Uzzal pieces, 11 Hümayun pieces and 7 Zirgüle pieces were thought to be belonging to the Uzzal cluster (totalling 122 pieces). Individual Uzzals should not be possible to so easily confound with Hümayun!

Finally, 112 Hicaz pieces, 6 Uzzal pieces, 28 Hümayun pieces and 8 Zirgüle pieces were imagined by WEKA to belong to the Hicaz cluster (totalling 154 pieces). This seems more meaningful at a first glance, since individual Zirgüle pieces are indeed very diminutively attributed to the Hicaz cluster in comparison to individual Hümayun pieces. But so are individual Uzzal pieces! If individual Hümayuns are so easily identifiable with Hicaz instead, why not individual Uzzals, too?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in this clustering algorithm is a troubling aspect.

This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish individual Hümayuns from their polar opposites under the same 'Hicaz family'.

Table 33a via either FarthestFirst (for clustering data using the FarthestFirst algorithm) OR HierarchicalClusterer (which is a hierarchical clustering class) that uses "EuclideanDistance", implementing Euclidean distance (or similarity) function, for allHicaz24-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0      324 (100%)
1        1 (  0%)


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
 221   1 | Hicaz
  27   0 | Uzzal
  49   0 | Hümayun
  27   0 | Zirgüle

Cluster 0 <-- Hicaz
Cluster 1 <-- No class

Incorrectly clustered instances :     104.0    32      %
```

REMARKS ON TABLE 33a... While the percentage of incorrectly clustered instances for either "FarthestFirst" or "HierarchicalClusterer" is appreciably low (32 %), one immediately notices that the majority of pieces of the dataset is straightly assigned to the Hicaz cluster, and only 1 Hicaz is singled out as belonging to "no class"!

The only thing worthwhile to remark about these failed approaches is the proportion of the pieces distributed under such a single category. Obviously, WEKA thinks that, aside from the singled out 1 Hicaz piece of "no class", the majority of Hicaz pieces (221) is indeed befittingly labelled under the Hicaz cluster, whereas only 27 Uzzal, 49 Hümayun and 27 Zirgüle pieces are deemed to belong to the same category.

Aside from the deceptive success rate at overall classification, the fact that the majority of pieces is squashed under a single label with the given algorithms is a troubling aspect.

Therefore, neither FarthestFirst nor HierarchicalClusterer appear to utilize the melodic contour features properly to distinguish the dataset in terms of pinpointing the correct makam categories for the batch of 325 'Hicaz family' pieces.

Table 34a via either FilteredClusterer (which is a class for running an arbitrary clusterer on data that has been passed through an arbitrary filter) with "SimpleKMeans" (that clusters data using the k means algorithm) contingent upon "EuclideanDistance", implementing Euclidean distance (or similarity) function, coupled with AllFilter (an instance filter that passes all instances through unmodified), OR SimpleKMeans (for clustering data using the k means algorithm) that uses "EuclideanDistance", implementing Euclidean distance (or similarity) function, for allHicaz24-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0       143 ( 44%)
1       182 ( 56%)


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
  90 132 | Hicaz
   2  25 | Uzzal
  35  14 | Hümayun
  16  11 | Zirgüle

Cluster 0 <-- Hümayun
Cluster 1 <-- Hicaz

Incorrectly clustered instances :     158.0    48.6154 %
```

REMARKS ON TABLE 34a... The percentage of incorrectly clustered instances for either "FilteredClusterer" or "SimpleKMeans" is rather high (49 %). Here, one may see that 90 Hicaz pieces, 2 Uzzal pieces, 35 Hümayun pieces and 16 Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are problematically assigned to the Hümayun cluster. The total number thought by WEKA to be Hümayun is hence 143.

While the distribution of pieces under such a Hümayun clustering might seem reasonable, these algorithms appear to be very much confused about differentiating especially individual Uzzals from Hicaz, as there was no discovered Uzzal category to begin with!

In addition, 132 Hicaz pieces, 25 Uzzal pieces, 14 Hümayun pieces and 11 Zirgüle pieces were thought to belong to the Hicaz cluster (totalling 182 pieces). Individual Hümayuns should especially not be possible to so easily confuse with a Hicaz moniker!

While individual Zirgüle pieces are indeed very diminutively attributed to either the Hümayun cluster or the Hicaz cluster in comparison to the rest of the analyzed items, so are individual Uzzal pieces! If individual Hümayuns are so easily identifiable with the Hümayun cluster, why are individual Uzzals numbering rather few under the Hicaz cluster?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in these clustering algorithms is a troubling aspect.

Said algorithms therefore do not appear to utilize the melodic contour features properly to distinguish especially Uzzal from the other members of the 'Hicaz family'.

Table 35a via MakeDensityBasedClusterer (which is a class for wrapping a Clusterer to make it return a distribution and density) for allHicaz24-SORTED.csv, where a "classes to clusters" evaluation is attempted; it uses "SimpleKMeans" (that clusters data using the k means algorithm) contingent upon "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Model and evaluation on training set ===

Clustered Instances

0       151 ( 46%)
1       174 ( 54%)


Log likelihood: 2574.40125


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
  98 124 | Hicaz
   2  25 | Uzzal
  35  14 | Hümayun
  16  11 | Zirgüle

Cluster 0 <-- Hümayun
Cluster 1 <-- Hicaz

Incorrectly clustered instances :     166.0    51.0769 %
```

REMARKS ON TABLE 35a... The percentage of incorrectly clustered instances for "MakeDensityBasedClusterer" is rather high, too (51 %). Here, one may see that 98 Hicaz pieces, 2 Uzzal pieces, 35 Hümayun pieces and 16 Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are problematically assigned to the Hümayun cluster. The total number thought by WEKA to be Hümayun is hence 151.

While the distribution of pieces under such a Hümayun clustering might seem reasonable, this algorithm appears to be very much confused about differentiating especially individual Uzzals from Hicaz, as there was no discovered Uzzal category begin with!

In addition, 124 Hicaz pieces, 25 Uzzal pieces, 14 Hümayun pieces and 11 Zirgüle pieces were thought to belong to the Hicaz cluster (totalling 174 pieces). Individual Hümayuns should especially not be possible to so easily confuse with a Hicaz moniker!

While individual Zirgüle pieces are indeed very diminutively attributed to either the Hümayun cluster or the Hicaz cluster in comparison to the rest of the analyzed items, so are individual Uzzal pieces! If individual Hümayuns are so easily identifiable with the Hümayun cluster, why are individual Uzzals numbering so few under the Hicaz cluster?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in this clustering algorithm is a troubling aspect.

This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish especially Uzzal from the other members of the 'Hicaz family'.

Table 1b via BayesNet for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "BayesNet" is Bayes Network learning using various search algorithms and quality measures, where the batch size is chosen to be 325; it uses "SimpleEstimator" that is used for estimating the conditional probability tables of a Bayes network once the structure has been learned.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         212               65.2308 %
Incorrectly Classified Instances       113               34.7692 %
Kappa statistic                          0.1992
Mean absolute error                      0.2154
Root mean squared error                  0.3539
Relative absolute error                 86.0978 %
Root relative squared error            100.3803 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.833    0.709    0.717      0.833    0.771      0.143    0.593     0.723
Hicaz
                 0.037    0.027    0.111      0.037    0.056      0.017    0.586     0.108
Uzzal
                 0.102    0.094    0.161      0.102    0.125      0.010    0.604     0.195
Hümayun
                 0.778    0.020    0.778      0.778    0.778      0.758    0.986     0.868
Zirgüle
Weighted Avg.    0.652    0.502    0.588      0.652    0.615      0.164    0.627     0.605

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 185   8  25   4 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  42   0   5   2 |   c = Hümayun
   5   0   1  21 |   d = Zirgüle
```

REMARKS ON TABLE 1b... The correct classification percentage for "BayesNet" is mediocre (65 %), but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold), with only 5 thought to be in Hicaz and only 1 thought to be in Hümayun.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun; and only 2 Hümayun pieces are categorized under Zirgüle. Most Uzzals, save 1, however, are seemingly more conformal with Hicaz (26)!

While the majority of Hümayun pieces is catalogued under Hicaz (42) instead of Hümayun (5), the fact that none are grouped under Uzzal and only 2 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors, although visibly less successfully than in Table 1a.

Finally, the bulk of Hicaz pieces (185) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (8) and Hümayun (25), while very few are confused as Zirgüle (4).

Table 2b via Logistic for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "Logistic" is a class for building and using a multinomial logistic regression model with a ridge estimator, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         170               52.3077 %
Incorrectly Classified Instances       155               47.6923 %
Kappa statistic                          0.1582
Mean absolute error                      0.2382
Root mean squared error                  0.4855
Relative absolute error                 95.2027 %
Root relative squared error            137.7213 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.608     0.466     0.738      0.608     0.667      0.133     0.572     0.716
Hicaz
                 0.222     0.161     0.111      0.222     0.148      0.045     0.534     0.094
Uzzal
                 0.306     0.163     0.250      0.306     0.275      0.132     0.560     0.191
Hümayun
                 0.519     0.047     0.500      0.519     0.509      0.464     0.776     0.374
Zirgüle
Weighted Avg.    0.523     0.360     0.592      0.523     0.551      0.153     0.584     0.557

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 135  40  36  11 |   a = Hicaz
  13   6   7   1 |   b = Uzzal
  27   5  15   2 |   c = Hümayun
   8   3   2  14 |   d = Zirgüle
```

REMARKS ON TABLE 2b... The correct classification percentage for "Logistic" is rather low, too (merely 52 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (8), Uzzal (3) and even Hümayun (2). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Moreover, only 1 Uzzal piece is mistaken as Zirgüle, and only 2 Hümayun pieces are categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (13) and Hümayun (7) instead of actually Uzzal (6). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is again catalogued under Hicaz (27) instead of Hümayun (15), the fact that only a few are grouped under Uzzal (5) and only 2 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (135) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (40) and Hümayun (36), while some are confused as Zirgüle (11).

Table 3b via MultilayerPerceptron for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "MultilayerPerceptron" is a classifier that uses backpropagation to learn a multi-layer perceptron to classify instances, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         198               60.9231 %
Incorrectly Classified Instances       127               39.0769 %
Kappa statistic                          0.21
Mean absolute error                      0.2044
Root mean squared error                  0.4143
Relative absolute error                 81.6964 %
Root relative squared error            117.5329 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.734    0.592    0.728      0.734    0.731      0.143    0.591     0.721
Hicaz
                 0.111    0.047    0.176      0.111    0.136      0.079    0.630     0.141
Uzzal
                 0.245    0.109    0.286      0.245    0.264      0.145    0.640     0.252
Hümayun
                 0.741    0.074    0.476      0.741    0.580      0.549    0.923     0.620
Zirgüle
Weighted Avg.    0.609    0.431    0.594      0.609    0.599      0.172    0.629     0.594

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 163  12  30  17 |   a = Hicaz
  21   3   0   3 |   b = Uzzal
  33   2  12   2 |   c = Hümayun
   7   0   0  20 |   d = Zirgüle
```

REMARKS ON TABLE 3b... The correct classification percentage for "MultilayerPerceptron" is relatively higher (61 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (20 members in bold). However, there still turns out to be some uncertainty where some of them may instead be in Hicaz (7); yet it is still interesting that none are misidentified as Uzzal.

In addition, 3 Uzzal pieces are mistaken as Zirgüle; and 2 Hümayun pieces are categorized under Zirgüle, too. Most Uzzals here, however, are instead imagined to be Hicaz (21) instead of actually Uzzal (3). It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

While the majority of Hümayun pieces is again catalogued under Hicaz (33) instead of Hümayun (12), the fact that only 2 are grouped under Uzzal and only 2 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (163) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (12) and Hümayun (30), while a substantial portion is confused as Zirgüle (17).

Table 4b via SimpleLogistic for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "SimpleLogistic" is a classifier for building linear logistic regression models, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         224               68.9231 %
Incorrectly Classified Instances       101               31.0769 %
Kappa statistic                          0.2246
Mean absolute error                      0.2018
Root mean squared error                  0.3368
Relative absolute error                 80.6458 %
Root relative squared error             95.5468 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.901     0.757     0.719       0.901   0.800      0.190    0.628     0.748
Hicaz
                 0.000     0.027     0.000       0.000   0.000      -0.048   0.739     0.201
Uzzal
                 0.061     0.040     0.214       0.061   0.095      0.038    0.686     0.266
Hümayun
                 0.778     0.013     0.840       0.778   0.808      0.792    0.974     0.868
Zirgüle
Weighted Avg.    0.689     0.527     0.594       0.689   0.628      0.197    0.675     0.640

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 200   8  11   3 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  45   0   3   1 |   c = Hümayun
   6   0   0  21 |   d = Zirgüle
```

REMARKS ON TABLE 4b... The correct classification percentage for "SimpleLogistic" is even higher (69 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (6); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, none is conceived to fit under any category other than Hicaz (27), either! It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

On the other hand, 45 Hümayun pieces are evidently falsely categorized under Hicaz, and even 1 under Zirgüle, instead of actually Hümayun (3)! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun from its relatively distant neighbors Hicaz and Zirgüle.

Finally, the bulk of Hicaz pieces (200) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (8), Hümayun (11) and even Zirgüle (3). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 5b via SMO for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: Implements John Platt's "sequential minimal optimization" (SMO) algorithm for training a support vector classifier, where the batch size is chosen to be 325, and the training data is standardized; it uses "Logistic" with the same batch size, that is a class for building and using a multinomial logistic regression model with a ridge estimator, alongside the "polynomial kernel" K(x, y) = <x, y>^p or K(x, y) = (<x, y>+1)^p.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         209               64.3077 %
Incorrectly Classified Instances       116               35.6923 %
Kappa statistic                          0.2543
Mean absolute error                      0.2923
Root mean squared error                  0.3715
Relative absolute error                116.8396 %
Root relative squared error            105.3899 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.770    0.592    0.737      0.770    0.753      0.183    0.599     0.730
Hicaz
                 0.074    0.064    0.095      0.074    0.083      0.012    0.679     0.133
Uzzal
                 0.286    0.123    0.292      0.286    0.289      0.164    0.656     0.221
Hümayun
                 0.815    0.007    0.917      0.815    0.863      0.853    0.948     0.811
Zirgüle
Weighted Avg.    0.643    0.429    0.632      0.643    0.637      0.222    0.643     0.610

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 171  17  32   2 |   a = Hicaz
  23   2   2   0 |   b = Uzzal
  33   2  14   0 |   c = Hümayun
   5   0   0  22 |   d = Zirgüle
```

REMARKS ON TABLE 5b... The correct classification percentage for "Sequential Minimal Optimization" (SMO) by John Platt is a bit lower (64 %) in comparison to the table before, but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (22 members in bold), while a few are confounded with Hicaz (5); it is interesting that none are misidentified as Uzzal.

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (23), and some even with Hümayun (2), instead of actually Uzzal (2).

While the majority of Hümayun pieces is again catalogued under Hicaz (33) instead of Hümayun (14), the fact that only 2 are grouped under Uzzal and none under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (171) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (17) and Hümayun (32), while very few are confused as Zirgüle (2).

Table 6b via lBK for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "lazy.lbk" is K-nearest neighbours classifier, where the batch size is chosen to be 325, and the "nearest neighbor search algorithm" (LinearNNSearch) is a class implementing the brute force search algorithm for nearest neighbour search coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         193               59.3846 %
Incorrectly Classified Instances       132               40.6154 %
Kappa statistic                          0.1636
Mean absolute error                      0.2054
Root mean squared error                  0.4476
Relative absolute error                 82.0998 %
Root relative squared error            126.9764 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.743    0.612    0.724      0.743    0.733      0.134    0.574     0.721
Hicaz
                 0.037    0.084    0.038      0.037    0.038      -0.048   0.492     0.082
Uzzal
                 0.204    0.145    0.200      0.204    0.202      0.059    0.555     0.180
Hümayun
                 0.630    0.013    0.810      0.630    0.708      0.692    0.864     0.595
Zirgüle
Weighted Avg.    0.594    0.448    0.595      0.594    0.593      0.154    0.588     0.576

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 165  21  32   4 |   a = Hicaz
  22   1   4   0 |   b = Uzzal
  36   3  10   0 |   c = Hümayun
   5   1   4  17 |   d = Zirgüle
```

REMARKS ON TABLE 6b... The correct classification percentage for "lBk" is a bit less than the previous table (59 %), but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold), while a few are confounded with Hicaz (5), Uzzal (1) and even Hümayun (4). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Next, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (22) and Hümayun (4), instead of actually Uzzal (1). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is again catalogued under Hicaz (36) instead of Hümayun (10), the fact that only 3 are grouped under Uzzal and none under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (165) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (21), Hümayun (32) and even Zirgüle (4).

Table 7b via KStar for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "KStar" is an instance-based classifier (that is, the class of a test instance is based upon the class of those training instances similar to it) as determined by some similarity function, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         204               62.7692 %
Incorrectly Classified Instances       121               37.2308 %
Kappa statistic                          0.197
Mean absolute error                      0.1845
Root mean squared error                  0.4165
Relative absolute error                 73.7367 %
Root relative squared error            118.1532 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.784    0.641    0.725      0.784    0.753      0.151    0.601     0.732
Hicaz
                 0.074    0.064    0.095      0.074    0.083      0.012    0.629     0.122
Uzzal
                 0.286    0.127    0.286      0.286    0.286      0.159    0.695     0.326
Hümayun
                 0.519    0.003    0.933      0.519    0.667      0.678    0.946     0.827
Zirgüle
Weighted Avg.    0.628    0.462    0.624      0.628    0.620      0.185    0.646     0.628

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 174  18  29   1 |   a = Hicaz
  22   2   3   0 |   b = Uzzal
  34   1  14   0 |   c = Hümayun
  10   0   3  14 |   d = Zirgüle
```

REMARKS ON TABLE 7b... The correct classification percentage for "KStar" is higher this time compared to Table 7a (63 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (10) and even Hümayun (3). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Next, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun is misclassified as Uzzal. Most Uzzals here, however, are instead imagined to be Hicaz (22) and Hümayun (3), instead of actually Uzzal (2).

Also, while the majority of Hümayun pieces is again catalogued under Hicaz (34) instead of Hümayun (14), the fact that only 1 is grouped under Uzzal and none under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun.

Finally, the bulk of Hicaz pieces (174) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (18) and Hümayun (29), while just 1 is confused as Zirgüle (1). Despite the appreciable success rate at overall classification, the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 8b via LWL for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "Locally weighted learning" (LWL), where the batch size is chosen to be 325, uses the DecisionStump classifier with the same batch size, that is a class for building and using a decision stump, and the "nearest neighbor search algorithm" (LinearNNSearch), which is a class implementing the brute force search algorithm for nearest neighbour search, coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         224               68.9231 %
Incorrectly Classified Instances       101               31.0769 %
Kappa statistic                          0.1484
Mean absolute error                      0.2284
Root mean squared error                  0.3467
Relative absolute error                 91.3013 %
Root relative squared error             98.3361 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.955    0.845    0.709      0.955    0.814      0.189    0.588     0.718
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.674     0.186
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.637     0.234
Hümayun
                 0.444    0.047    0.462      0.444    0.453      0.404    0.803     0.417
Zirgüle
Weighted Avg.    0.689    0.581    ?          0.689    ?          ?        0.621     0.576

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 212   0   0  10 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  46   0   0   3 |   c = Hümayun
  15   0   0  12 |   d = Zirgüle
```

REMARKS ON TABLE 8b... The correct classification percentage for "LWL", in comparison to the previous table, is a bit higher (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (12 members in bold), while even more are yet confounded with Hicaz (15). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 3 Hümayun pieces are categorized under Zirgüle, too. The remaining Uzzals here, however, are instead imagined to be Hicaz (26) instead. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

Similarly, most Hümayun pieces are catalogued under Hicaz (46), while 3 are even confounded with Zirgüle!

Finally, the bulk of Hicaz pieces (212) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (10), yet none to be in Uzzal or Hümayun! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 9b via AdaBoostM1 for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "AdaBoostM1" is a class for boosting a nominal class classifier using the Adaboost M1 method, where the batch size is chosen to be 325; it uses the DecisionStump classifier with the same batch size, that is a class for building and using a decision stump.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         223               68.6154 %
Incorrectly Classified Instances       102               31.3846 %
Kappa statistic                          0.14
Mean absolute error                      0.3015
Root mean squared error                  0.3667
Relative absolute error                120.5046 %
Root relative squared error            104.015  %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.950     0.854     0.706      0.950     0.810      0.165    0.572     0.714
Hicaz
                 0.000     0.000     ?          0.000     ?          ?        0.420     0.070
Uzzal
                 0.000     0.000     ?          0.000     ?          ?        0.474     0.144
Hümayun
                 0.444     0.047     0.462      0.444     0.453      0.404    0.879     0.583
Zirgüle
Weighted Avg.    0.686     0.588     ?          0.686     ?          ?        0.570     0.564

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 211   0   0  11 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  47   0   0   2 |   c = Hümayun
  15   0   0  12 |   d = Zirgüle
```

REMARKS ON TABLE 9b... The correct classification percentage for "AdaBoostM1" is rather high, too (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (12 members in bold), while even more are yet confounded with Hicaz (15). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 2 Hümayun pieces are categorized under Zirgüle, too. The remaining Uzzals here, however, are instead imagined to be Hicaz (26) instead. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

Similarly, most Hümayun pieces are catalogued under Hicaz (47), while 2 are even confounded with Zirgüle!

Finally, the bulk of Hicaz pieces (211) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (11), yet none to be in Uzzal or Hümayun! A good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 10b via AttributeSelectedClassifier for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "AttributeSelectedClassifier", where the batch size is chosen to be 325, uses the J48 classifier with the same batch size, that is a class for generating a pruned or unpruned C4, and the "CfsSubsetEval", which evaluates the worth of a subset of attributes by considering the individual predictive ability of each feature along with the degree of redundancy between them, coupled with "BestFirst" that searches the space of attribute subsets by greedy hillclimbing augmented with a backtracking facility.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         233               71.6923 %
Incorrectly Classified Instances        92               28.3077 %
Kappa statistic                          0.2875
Mean absolute error                      0.2026
Root mean squared error                  0.344
Relative absolute error                 80.9938 %
Root relative squared error             97.5752 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.928    0.718    0.736      0.928    0.821      0.282    0.599     0.742
Hicaz
                 0.000    0.010    0.000      0.000    0.000      -0.029   0.609     0.112
Uzzal
                 0.102    0.029    0.385      0.102    0.161      0.133    0.527     0.178
Hümayun
                 0.815    0.023    0.759      0.815    0.786      0.766    0.845     0.679
Zirgüle
Weighted Avg.    0.717    0.498    0.624      0.717    0.650      0.274    0.609     0.599

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 206   2   8   6 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  42   1   5   1 |   c = Hümayun
   5   0   0  22 |   d = Zirgüle
```

REMARKS ON TABLE 10b... The percentage for "AttributeSelectedClassifier" in terms of correct classification is higher than before (72 %), BEING EXACTLY TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS, and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (22 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (5); yet it is still interesting that none are misidentified as Uzzal.

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, none of them are conceived to fit under any category other than Hicaz (27), either!

Moreover, most Hümayuns here are imagined to be in Hicaz (42) also, and only 5 to be actually in Hümayun, whereas WEKA thinks 1 to be in Uzzal and even 1 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (206) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (2), Hümayun (8) and Zirgüle (6). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 11b via Bagging for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "Bagging" is a class for bagging a classifier to reduce variance, where the batch size is chosen to be 325; it uses the RepTree (fast decision tree learner) classifier with the same batch size.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         236               72.6154 %
Incorrectly Classified Instances        89               27.3846 %
Kappa statistic                          0.262
Mean absolute error                      0.2098
Root mean squared error                  0.3239
Relative absolute error                 83.8412 %
Root relative squared error             91.8905 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.968    0.777    0.729      0.968    0.832      0.308    0.682     0.779
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.626     0.135
Uzzal
                 0.061    0.011    0.500      0.061    0.109      0.134    0.699     0.328
Hümayun
                 0.667    0.020    0.750      0.667    0.706      0.682    0.979     0.839
Zirgüle
Weighted Avg.    0.726    0.534    ?          0.726    ?          ?        0.704     0.663

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 215   0   3   4 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  44   0   3   2 |   c = Hümayun
   9   0   0  18 |   d = Zirgüle
```

REMARKS ON TABLE 11b... The correct classification percentage for "Bagging" is the highest yet (73 %), EQUALLING TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS, and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (9); yet it is still interesting that none are misidentified as Uzzal.

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, none of them are conceived to fit under any category other than Hicaz (27), either!

Moreover, most Hümayuns here are imagined to be in Hicaz (44) also, and only 3 to be actually in Hümayun, whereas WEKA even thinks 2 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (215) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (3) and Zirgüle (4), but none to be in Uzzal. An even better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 12b via ClassificationViaRegression for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "ClassificationViaRegression" is a class for doing classification using regression methods, where the batch size is chosen to be 325; it uses the M5P classifier, with the same batch size, that implements the M5' model tree algorithm.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         230               70.7692 %
Incorrectly Classified Instances        95               29.2308 %
Kappa statistic                          0.2672
Mean absolute error                      0.207
Root mean squared error                  0.3403
Relative absolute error                 82.7376 %
Root relative squared error             96.5266 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.919    0.718    0.734      0.919    0.816      0.265    0.610     0.753
Hicaz
                 0.037    0.007    0.333      0.037    0.067      0.088    0.645     0.149
Uzzal
                 0.163    0.054    0.348      0.163    0.222      0.152    0.625     0.271
Hümayun
                 0.630    0.013    0.810      0.630    0.708      0.692    0.964     0.763
Zirgüle
Weighted Avg.    0.708    0.501    0.649      0.708    0.655      0.269    0.645     0.631

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 204   2  14   2 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  39   0   8   2 |   c = Hümayun
   9   0   1  17 |   d = Zirgüle
```

REMARKS ON TABLE 12b... The percentage for "ClassificationViaRegression" in terms of correct classification is almost as high as before (71 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (9) and even Hümayun (1); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Most Uzzals, however, are seemingly more conformal with Hicaz (26), while only 1 is actually thought to be in Uzzal!

Moreover, most Hümayuns here are imagined also to be in Hicaz (39), and only 8 to be actually in Hümayun, whereas WEKA even thinks 2 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (204) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (2), Hümayun (14) and even Zirgüle (2).

Table 13b via FilteredClassifier for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "FilteredClassifier", where the batch size is chosen to be 325, uses the J48 classifier with the same batch size, that is a class for generating a pruned or unpruned C4, coupled with "Discretize" filter, which is an instance filter that discretizes a range of numeric attributes in the dataset into nominal attributes.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         238               73.2308 %
Incorrectly Classified Instances        87               26.7692 %
Kappa statistic                          0.2701
Mean absolute error                      0.2083
Root mean squared error                  0.3279
Relative absolute error                 83.2645 %
Root relative squared error             93.0046 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.977    0.786    0.728      0.977    0.835      0.322    0.567     0.705
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.515     0.091
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.523     0.153
Hümayun
                 0.778    0.020    0.778      0.778    0.778      0.758    0.862     0.731
Zirgüle
Weighted Avg.    0.732    0.539    ?          0.732    ?          ?        0.581     0.573

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 217   0   0   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   0   1 |   c = Hümayun
   6   0   0  21 |   d = Zirgüle
```

REMARKS ON TABLE 13b... The correct classification percentage for "FilteredClassifier" is very high, BEING IDENTICAL TO TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS (73 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (6); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA... And similarly, all Hümayun pieces, save the 1 assigned to Zirgüle, are catalogued under Hicaz (48)!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (217) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Zirgüle (5), yet none to be in Uzzal or Hümayun this time! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 14b via IterativeClassifierOptimizer for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "IterativeClassifierOptimizer" optimizes the number of iterations of the given iterative classifier using cross-validation or a percentage split evaluation, where the batch size is chosen to be 325; it uses the LogitBoost iterative classifier with the same batch size, which is a class for performing additive logistic regression that relies on DecisionStump, which is a classifier, with the same batch size, that is a class for performing additive logistic regression.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         230               70.7692 %
Incorrectly Classified Instances        95               29.2308 %
Kappa statistic                          0.2604
Mean absolute error                      0.2026
Root mean squared error                  0.3334
Relative absolute error                 80.9711 %
Root relative squared error             94.5819 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.923    0.738    0.730      0.923    0.815      0.252    0.656     0.757
Hicaz
                 0.037    0.020    0.143      0.037    0.059      0.032    0.652     0.176
Uzzal
                 0.122    0.029    0.429      0.122    0.190      0.165    0.682     0.304
Hümayun
                 0.667    0.017    0.783      0.667    0.720      0.699    0.938     0.722
Zirgüle
Weighted Avg.    0.708    0.511    0.640      0.708    0.650      0.258    0.683     0.637

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 205   6   7   4 |   a = Hicaz
  25   1   1   0 |   b = Uzzal
  42   0   6   1 |   c = Hümayun
   9   0   0  18 |   d = Zirgüle
```

REMARKS ON TABLE 14b... The percentage for "IterativeClassifierOptimizer" in terms of correct classification is almost as high as before (71 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (9); yet it is still interesting that none are misidentified as Uzzal.

Next, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun is misclassified as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (25), and 1 even with Hümayun, instead of actually Uzzal (1).

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (42), and only 6 to be actually in Hümayun, whereas WEKA even thinks 1 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (205) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (6), Hümayun (7) and even Zirgüle (4).

Table 15b via LogitBoost for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "LogitBoost" is a class for performing additive logistic regression, where the batch size is chosen to be 325; it uses DecisionStump, which is a classifier, with the same batch size, that is a class for performing additive logistic regression.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         227               69.8462 %
Incorrectly Classified Instances        98               30.1538 %
Kappa statistic                          0.2941
Mean absolute error                      0.1974
Root mean squared error                  0.3414
Relative absolute error                 78.9026 %
Root relative squared error             96.8331 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.878    0.650    0.744      0.878    0.806      0.268    0.631     0.740
Hicaz
                 0.185    0.023    0.417      0.185    0.256      0.237    0.682     0.192
Uzzal
                 0.204    0.069    0.345      0.204    0.256      0.170    0.682     0.276
Hümayun
                 0.630    0.017    0.773      0.630    0.694      0.673    0.958     0.767
Zirgüle
Weighted Avg.    0.698    0.458    0.659      0.698    0.668      0.284    0.670     0.627

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 195   6  17   4 |   a = Hicaz
  20   5   2   0 |   b = Uzzal
  37   1  10   1 |   c = Hümayun
  10   0   0  17 |   d = Zirgüle
```

REMARKS ON TABLE 15b... The correct classification percentage for "LogitBoost" is about the same as compared to the previous table (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (10); yet it is still interesting that none are misidentified as Uzzal.

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (20), and 2 even with Hümayun, instead of actually Uzzal (5).

While the majority of Hümayun pieces is catalogued under Hicaz (37) instead of Hümayun (10), the fact that only 1 is grouped under Uzzal and only 1 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (195) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (6) and Hümayun (17), while very few are confused as Zirgüle (4). A good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are somewhat misclassified by this algorithm.

Table 16b via MultiClassClassifier for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: Implements a metaclassifier for handling multi-class datasets with 2-class classifiers, where the batch size is chosen to be 325; it relies on "Logistic", with the same batch size, that is a class for building and using a multinomial logistic regression model with a ridge estimator.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         182               56      %
Incorrectly Classified Instances       143               44      %
Kappa statistic                          0.1895
Mean absolute error                      0.2133
Root mean squared error                  0.3998
Relative absolute error                 85.2708 %
Root relative squared error            113.3989 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.662    0.495    0.742      0.662    0.700      0.159    0.611     0.746
Hicaz
                 0.222    0.181    0.100      0.222    0.138      0.029    0.573     0.128
Uzzal
                 0.184    0.116    0.220      0.184    0.200      0.073    0.530     0.189
Hümayun
                 0.741    0.020    0.769      0.741    0.755      0.733    0.920     0.690
Zirgüle
Weighted Avg.    0.560    0.372    0.612      0.560    0.582      0.183    0.621     0.606

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 147  44  28   3 |   a = Hicaz
  17   6   3   1 |   b = Uzzal
  30   8   9   2 |   c = Hümayun
   4   2   1  20 |   d = Zirgüle
```

REMARKS ON TABLE 16b... The correct classification percentage for "MultiClassClassifier" is quite low (just 56 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (20 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (4), Uzzal (2) and even Hümayun (1).

Even so, only 1 Uzzal piece is mistaken as Zirgüle; and only 2 Hümayun pieces are categorized under Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (17), while 3 are identified as Hümayun, instead of actually Uzzal (6).

In addition, the majority of Hümayun pieces is catalogued under Hicaz (30) instead of Hümayun (9), while quite a few are grouped under Uzzal (8) and only 2 under Zirgüle.

Finally, the bulk of Hicaz pieces (147) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (44) and Hümayun (28), while very few are confused as Zirgüle (3). Not only is the success rate at overall classification meager, but the fact that Uzzals and Hümayuns are somewhat misclassified by this algorithm is a bothersome aspect.

Table 17b via MultiClassClassifierUpdateable for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "MultiClassClassifierUpdateable" is a metaclassifier for handling multi-class datasets with 2-class classifiers, where the batch size is chosen to be 325; it uses the SGD classifier, with the same batch size, that implements stochastic gradient descent for learning various linear models (binary class SVM, binary class logistic regression, squared loss, Huber loss and epsilon-insensitive loss linear regression).

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         224               68.9231 %
Incorrectly Classified Instances       101               31.0769 %
Kappa statistic                          0.2178
Mean absolute error                      0.1611
Root mean squared error                  0.3739
Relative absolute error                 64.4093 %
Root relative squared error            106.0516 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.914    0.748    0.725      0.914    0.809      0.225    0.645     0.759
Hicaz
                 0.037    0.034    0.091      0.037    0.053      0.005    0.536     0.094
Uzzal
                 0.061    0.036    0.231      0.061    0.097      0.046    0.605     0.203
Hümayun
                 0.630    0.013    0.810      0.630    0.708      0.692    0.946     0.731
Zirgüle
Weighted Avg.    0.689    0.520    0.605      0.689    0.630      0.218    0.655     0.618

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 203   6  10   3 |   a = Hicaz
  25   1   0   1 |   b = Uzzal
  45   1   3   0 |   c = Hümayun
   7   3   0  17 |   d = Zirgüle
```

REMARKS ON TABLE 17b... The percentage for "MultiClassClassifierUpdateable" in terms of correct classification is appreciably high (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold), while some are confounded with Hicaz (7) and Uzzal (3).

In addition, no Hümayun piece is mistaken, even as a low probability, as Zirgüle; while only 1 Uzzal is confused with Zirgüle and only 1 actually identified as Uzzal. Yet, almost all Uzzals, except these 2, are seemingly more conformal with Hicaz (25) according to the WEKA algorithm!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (45), and even 1 to be in Uzzal, and only 3 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (203) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (6) and Hümayun (10), while very few are confused as Zirgüle (3).

Table 18b via RandomCommittee for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RandomCommittee" is a class for building an ensemble of randomizable base classifiers, where the batch size is chosen to be 325; it uses RandomTree with the same batch size, which is a class for constructing a tree that considers K randomly chosen attributes at each node.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         235               72.3077 %
Incorrectly Classified Instances        90               27.6923 %
Kappa statistic                          0.2445
Mean absolute error                      0.2117
Root mean squared error                  0.3377
Relative absolute error                 84.6165 %
Root relative squared error             95.7828 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.968    0.796    0.724      0.968    0.829      0.286    0.610     0.743
Hicaz
                 0.037    0.000    1.000      0.037    0.071      0.185    0.593     0.118
Uzzal
                 0.082    0.022    0.400      0.082    0.136      0.124    0.655     0.244
Hümayun
                 0.556    0.007    0.882      0.556    0.682      0.680    0.923     0.716
Zirgüle
Weighted Avg.    0.723    0.548    0.711      0.723    0.649      0.286    0.641     0.614

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 215   0   5   2 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  45   0   4   0 |   c = Hümayun
  11   0   1  15 |   d = Zirgüle
```

REMARKS ON TABLE 18b... The correct classification percentage for "RandomCommittee" is even higher (72 %), BEING TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS; and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (11) and 1 even in Hümayun. It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but almost all Uzzals, except 1, are seemingly more conformal with Hicaz (26) according to WEKA!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (45), and only 4 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (215) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (5) and even Zirgüle (2), but not at all in Uzzal! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 19b via RandomizableFilteredClassifier for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: It is a simple variant of the FilteredClassifier that instantiates the model with a randomizable filter (e.g., RandomProjection that reduces the dimensionality of the data by projecting it onto a lower dimensional subspace using a random matrix with columns of unit length), and IBk (K-nearest neighbours classifier) as the base classifier, where the batch size is chosen to be 325, and the "nearest neighbor search algorithm" (LinearNNSearch) is a class implementing the brute force search algorithm for nearest neighbour search, coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         181               55.6923 %
Incorrectly Classified Instances       144               44.3077 %
Kappa statistic                          0.1071
Mean absolute error                      0.2236
Root mean squared error                  0.4675
Relative absolute error                 89.3796 %
Root relative squared error            132.6216 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.725     0.592     0.725      0.725    0.725      0.133    0.576     0.723
Hicaz
                 0.074     0.091     0.069      0.074    0.071      -0.016   0.513     0.085
Uzzal
                 0.265     0.141     0.250      0.265    0.257      0.121    0.563     0.184
Hümayun
                 0.185     0.057     0.227      0.185    0.204      0.141    0.619     0.143
Zirgüle
Weighted Avg.    0.557     0.438     0.558      0.557    0.557      0.119    0.573     0.541

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 161  18  33  10 |   a = Hicaz
  20   2   3   2 |   b = Uzzal
  26   5  13   5 |   c = Hümayun
  15   4   3   5 |   d = Zirgüle
```

REMARKS ON TABLE 19b... "RandomizableFilteredClassifier"s correct classification percentage is quite low (just 56 %). Even more than that, Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are not grouped under the Zirgüleli Hicaz label as one would expect (5 members in bold). Besides, there turns out to be some uncertainty where a significative part of them may instead be in Hicaz (15), Uzzal (4) and even Hümayun (3).

Furthermore, 2 Uzzal pieces are mistaken as Zirgüle; and 5 Hümayun pieces are categorized under Zirgüle, too. Most Uzzals, however, are seemingly more conformal with Hicaz (20), while 3 are identified as Hümayun, instead of actually Uzzal (2).

In addition, the majority of Hümayun pieces is catalogued under Hicaz (26) instead of Hümayun (13), while 5 are grouped under Uzzal (5) and even 5 under Zirgüle.

Finally, the bulk of Hicaz pieces (161) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (18) and Hümayun (33), while some are confused as Zirgüle (10). Not only is the success rate at overall classification meager, but the fact that Uzzals and Zirgüles are obviously misclassified by this algorithm is a bothersome aspect.

Table 20b via RandomSubSpace for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RandomSubSpace" method constructs a decision tree based classifier that maintains highest accuracy on training data and improves on generalization accuracy as it grows in complexity, where the batch size is chosen to be 325; it uses the RepTree (fast decision tree learner) classifier with the same batch size.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         239               73.5385 %
Incorrectly Classified Instances        86               26.4615 %
Kappa statistic                          0.2522
Mean absolute error                      0.2205
Root mean squared error                  0.3242
Relative absolute error                 88.1535 %
Root relative squared error             91.9524 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.995    0.816    0.725      0.995    0.839      0.348    0.641     0.778
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.620     0.146
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.661     0.315
Hümayun
                 0.667    0.007    0.900      0.667    0.766      0.758    0.969     0.852
Zirgüle
Weighted Avg.    0.735    0.558    ?          0.735    ?          ?        0.670     0.662

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 221   0   0   1 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   0   1 |   c = Hümayun
   9   0   0  18 |   d = Zirgüle
```

REMARKS ON TABLE 20b... The percentage for "RandomSubSpace" in terms of correct classification is the highest yet, BEING IDENTICAL TO THE PERCENTAGE OF TRT REPERTORY'S RECURRENT LABELS (74 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (9); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, just as are all the Hümayuns (48) except 1, which is imagined to be in Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (221) is indeed identified as Hicaz, but 1 is instead thought by WEKA to be in Zirgüle, yet none to be in Uzzal or Hümayun this time! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 21b via DecisionTable for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "DecisionTable" is a class for building and using a simple decision table majority classifier, where the batch size is chosen to be 325; it uses the BestFirst search, which searches the space of attribute subsets by greedy hillclimbing augmented with a backtracking facility.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         238               73.2308 %
Incorrectly Classified Instances        87               26.7692 %
Kappa statistic                          0.2701
Mean absolute error                      0.2208
Root mean squared error                  0.3296
Relative absolute error                 88.2562 %
Root relative squared error             93.4993 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.977    0.786    0.728      0.977    0.835      0.322    0.607     0.730
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.489     0.084
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.541     0.178
Hümayun
                 0.778    0.020    0.778      0.778    0.778      0.758    0.888     0.663
Zirgüle
Weighted Avg.    0.732    0.539    ?          0.732    ?          ?        0.611     0.588

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 217   0   0   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   0   1 |   c = Hümayun
   6   0   0  21 |   d = Zirgüle
```

REMARKS ON TABLE 21b... The correct classification percentage for "DecisionTable" is almost as high as well (73 %), BEING IDENTICAL TO TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS; and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold), while some are yet confounded with Hicaz (6). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, just as are all the Hümayuns (48) except 1, which is imagined to be in Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (217) is indeed identified as Hicaz, but 5 are instead thought by WEKA to be in Zirgüle, yet none to be in Uzzal or Hümayun this time! A very good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 22b via JRip for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "JRip" is a class that implements a propositional rule learner, Repeated Incremental Pruning to Produce Error Reduction (RIPPER), which was proposed by William W. Cohen as an optimized version of IREP, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         219               67.3846 %
Incorrectly Classified Instances       106               32.6154 %
Kappa statistic                          0.2084
Mean absolute error                      0.2143
Root mean squared error                  0.3485
Relative absolute error                 85.6611 %
Root relative squared error             98.8451 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.883    0.728    0.723      0.883    0.795      0.193    0.588     0.726
Hicaz
                 0.000    0.010    0.000      0.000    0.000      -0.029   0.503     0.083
Uzzal
                 0.061    0.069    0.136      0.061    0.085      -0.011   0.510     0.156
Hümayun
                 0.741    0.030    0.690      0.741    0.714      0.688    0.851     0.562
Zirgüle
Weighted Avg.    0.674    0.511    0.572      0.674    0.615      0.185    0.591     0.573

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 196   3  16   7 |   a = Hicaz
  24   0   3   0 |   b = Uzzal
  44   0   3   2 |   c = Hümayun
   7   0   0  20 |   d = Zirgüle
```

REMARKS ON TABLE 22b... The correct classification percentage for "JRip" is appreciable, but lacking in comparison to Table 22a (67 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (20 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (7); yet it is still interesting that none are misidentified as Uzzal.

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle. Yet, none of them are conceived to fit under any category other than Hicaz (24) and Hümayun (3), either!

Moreover, most Hümayuns here are imagined to be in Hicaz (44) also, and only 3 to be actually in Hümayun, whereas WEKA even thinks 2 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (196) is indeed identified as Hicaz, but a portion is instead thought by WEKA to be in Uzzal (3), Hümayun (16) and even Zirgüle (7). Not only is the success rate at overall classification wanting, but the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm is a bothersome aspect.

Table 23b via OneR for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "OneR" is a class for building and using a 1R classifier; in other words, uses the minimum-error attribute for prediction, discretizing numeric attributes; batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         227               69.8462 %
Incorrectly Classified Instances        98               30.1538 %
Kappa statistic                          0.1652
Mean absolute error                      0.1508
Root mean squared error                  0.3883
Relative absolute error                 60.2647 %
Root relative squared error            110.1443 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.964    0.845    0.711      0.964    0.818      0.212    0.560     0.710
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.500     0.083
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.500     0.151
Hümayun
                 0.481    0.037    0.542      0.481    0.510      0.469    0.722     0.304
Zirgüle
Weighted Avg.    0.698    0.580    ?          0.698    ?          ?        0.559     0.540

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 214   0   0   8 |   a = Hicaz
  24   0   0   3 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  14   0   0  13 |   d = Zirgüle
```

REMARKS ON TABLE 23b... The correct classification percentage for "OneR" is appreciably high as well (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (13 members in bold), while even more are yet confounded with Hicaz (14). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Hümayun piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) and even Zirgüle (3) according to WEKA, meanwhile all the Hümayuns (49) are identified as Hicaz!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (214) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Zirgüle (8), but none in Uzzal or Hümayun. A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 24b via PART for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "PART" is a class for generating a PART decision list, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         199               61.2308 %
Incorrectly Classified Instances       126               38.7692 %
Kappa statistic                          0.228
Mean absolute error                      0.2014
Root mean squared error                  0.43
Relative absolute error                 80.5093 %
Root relative squared error            121.9873 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.739    0.534    0.749      0.739    0.744      0.203    0.605     0.739
Hicaz
                 0.185    0.067    0.200      0.185    0.192      0.122    0.587     0.116
Uzzal
                 0.184    0.149    0.180      0.184    0.182      0.035    0.538     0.163
Hümayun
                 0.778    0.034    0.677      0.778    0.724      0.699    0.871     0.569
Zirgüle
Weighted Avg.    0.612    0.396    0.612      0.612    0.612      0.212    0.616     0.587

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 164  15  35   8 |   a = Hicaz
  17   5   5   0 |   b = Uzzal
  33   5   9   2 |   c = Hümayun
   5   0   1  21 |   d = Zirgüle
```

REMARKS ON TABLE 24b... The correct classification percentage for "PART" is a bit low (just 61 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (5) and Hümayun (1).

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 2 Hümayun pieces are categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (17) and Hümayun (5), instead of actually Uzzal (5). It is not realistic that Uzzal should easily be confounded with Hümayun!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (33), and even 5 to be in Uzzal, while actual Hümayuns number 9. It is not realistic that Hümayun should easily be confounded with Hicaz or Uzzal on such a substantial scale!

Finally, the bulk of Hicaz pieces (164) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (15) and Hümayun (35), while a few are confused as Zirgüle (8). Not only is the success rate at overall classification meager, but the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 25b via DecisionStump for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "DecisionStump" is a class for building and using a decision stump, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         223               68.6154 %
Incorrectly Classified Instances       102               31.3846 %
Kappa statistic                          0.14
Mean absolute error                      0.2315
Root mean squared error                  0.3502
Relative absolute error                 92.5482 %
Root relative squared error             99.3385 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.950     0.854     0.706      0.950     0.810      0.165     0.551     0.703
Hicaz
                 0.000     0.000     ?          0.000     ?          ?         0.527     0.091
Uzzal
                 0.000     0.000     ?          0.000     ?          ?         0.509     0.150
Hümayun
                 0.444     0.047     0.462      0.444     0.453      0.404     0.732     0.299
Zirgüle
Weighted Avg.    0.686     0.588     ?          0.686     ?          ?         0.557     0.535

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 211   0   0  11 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  47   0   0   2 |   c = Hümayun
  15   0   0  12 |   d = Zirgüle
```

REMARKS ON TABLE 25b... Results are identical to Table 9b. The correct classification percentage for "DecisionStump" is bit higher (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (12 members in bold), while even more are yet confounded with Hicaz (15). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 2 Hümayun pieces are categorized under Zirgüle, too. The remaining Uzzals here, however, are instead imagined to be Hicaz (26) instead. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

Similarly, most Hümayun pieces are catalogued under Hicaz (47), while 2 are even confounded with Zirgüle!

Finally, the bulk of Hicaz pieces (211) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (11), yet none to be in Uzzal or Hümayun! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 26b via J48 for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "J48" is a class for generating a pruned or unpruned C4, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         211               64.9231 %
Incorrectly Classified Instances       114               35.0769 %
Kappa statistic                          0.3075
Mean absolute error                      0.1941
Root mean squared error                  0.3946
Relative absolute error                 77.5733 %
Root relative squared error            111.9477 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.752    0.485    0.770      0.752    0.761      0.264    0.662     0.784
Hicaz
                 0.185    0.077    0.179      0.185    0.182      0.106    0.642     0.129
Uzzal
                 0.306    0.116    0.319      0.306    0.313      0.193    0.564     0.205
Hümayun
                 0.889    0.030    0.727      0.889    0.800      0.785    0.933     0.709
Zirgüle
Weighted Avg.    0.649    0.358    0.649      0.649    0.648      0.283    0.668     0.636

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 167  19  29   7 |   a = Hicaz
  19   5   2   1 |   b = Uzzal
  30   3  15   1 |   c = Hümayun
   1   1   1  24 |   d = Zirgüle
```

REMARKS ON TABLE 26b... The correct classification percentage for "J48" is a bit lower in comparison to the previous table (65 %). However, Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are almost entirely grouped under the Zirgüleli Hicaz label as one would expect (24 members in bold). But, there turns out to be some uncertainty where a few may instead be in Hicaz (1), Uzzal (1) and even Hümayun (1).

Furthermore, 1 Uzzal piece is mistaken as Zirgüle; and 1 Hümayun piece is categorized under Zirgüle, too. Most Uzzals, however, are seemingly more conformal with Hicaz (19), while 2 are identified as Hümayun, instead of actually Uzzal (5).

In addition, the majority of Hümayun pieces is catalogued under Hicaz (30) instead of Hümayun (15), while 3 are grouped under Uzzal and even 1 under Zirgüle.

Finally, the bulk of Hicaz pieces (167) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (19) and Hümayun (29), while some are confused as Zirgüle (7).

Though the success rate at overall classification is meager, the fact that Hümayuns and Zirgüles are visibly better recognized for the most part by this algorithm is a promising aspect of the computation.

Table 27b via LMT for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "LMT" is a classifier for building 'logistic model trees', which are classification trees with logistic regression functions at the leaves, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         224               68.9231 %
Incorrectly Classified Instances       101               31.0769 %
Kappa statistic                          0.2246
Mean absolute error                      0.2018
Root mean squared error                  0.3368
Relative absolute error                 80.6458 %
Root relative squared error             95.5468 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.901     0.757     0.719       0.901   0.800      0.190    0.628     0.748
Hicaz
                 0.000     0.027     0.000       0.000   0.000      -0.048   0.739     0.201
Uzzal
                 0.061     0.040     0.214       0.061   0.095      0.038    0.686     0.266
Hümayun
                 0.778     0.013     0.840       0.778   0.808      0.792    0.974     0.868
Zirgüle
Weighted Avg.    0.689     0.527     0.594       0.689   0.628      0.197    0.675     0.640

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 200   8  11   3 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  45   0   3   1 |   c = Hümayun
   6   0   0  21 |   d = Zirgüle
```

REMARKS ON TABLE 27b... Results are identical to Table 4b. The correct classification percentage for "LMT" is higher than before (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold), with only 6 thought to be in Hicaz. It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun; and only 1 Hümayun piece is categorized under Zirgüle. All Uzzals, however, are seemingly more conformal with Hicaz (27)!

Moreover, the majority of Hümayun pieces is catalogued under Hicaz (45) instead of Hümayun (3), while even 1 is grouped under Zirgüle.

Finally, the bulk of Hicaz pieces (200) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (8) and Hümayun (11), while very few are confused as Zirgüle (3). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 28b via RandomForest for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RandomForest" is a class for constructing a forest of random trees, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         238               73.2308 %
Incorrectly Classified Instances        87               26.7692 %
Kappa statistic                          0.2382
Mean absolute error                      0.2142
Root mean squared error                  0.3194
Relative absolute error                 85.6189 %
Root relative squared error             90.5962 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.995    0.825    0.722      0.995    0.837      0.338    0.670     0.775
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.768     0.182
Uzzal
                 0.041    0.004    0.667      0.041    0.077      0.139    0.757     0.432
Hümayun
                 0.556    0.003    0.938      0.556    0.698      0.704    0.970     0.883
Zirgüle
Weighted Avg.    0.732    0.565    ?          0.732    ?          ?        0.716     0.683

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 221   0   1   0 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  46   0   2   1 |   c = Hümayun
  12   0   0  15 |   d = Zirgüle
```

REMARKS ON TABLE 28b... The correct classification percentage for "RandomForest" is just as high as Table 21b, BEING IDENTICAL TO THE PERCENTAGE OF TRT REPERTORY'S RECURRENT LABELS (73 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (12); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA.

Similarly, most Hümayun pieces are rather catalogued under Hicaz (46), while only 2 are identified as Hümayun and 1 even as Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (221) is indeed identified as Hicaz, but 1 is instead thought by WEKA to be in Hümayun, yet none to be in Uzzal or Zirgüle this time! A much better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 29b via RandomTree for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RandomTree" is a class for constructing a tree that considers K randomly chosen attributes at each node, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         199               61.2308 %
Incorrectly Classified Instances       126               38.7692 %
Kappa statistic                          0.2133
Mean absolute error                      0.1938
Root mean squared error                  0.4403
Relative absolute error                 77.4831 %
Root relative squared error            124.8919 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.752    0.563    0.742      0.752    0.747      0.191    0.595     0.728
Hicaz
                 0.333    0.077    0.281      0.333    0.305      0.237    0.628     0.149
Uzzal
                 0.204    0.116    0.238      0.204    0.220      0.094    0.544     0.169
Hümayun
                 0.481    0.044    0.500      0.481    0.491      0.445    0.719     0.284
Zirgüle
Weighted Avg.    0.612    0.412    0.608      0.612    0.610      0.201    0.600     0.558

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 167  19  29   7 |   a = Hicaz
  16   9   0   2 |   b = Uzzal
  35   0  10   4 |   c = Hümayun
   7   4   3  13 |   d = Zirgüle
```

REMARKS ON TABLE 29b... The correct classification percentage for "RandomTree" is mediocre (merely 61 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (13 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (7), Uzzal (4) and even Hümayun (3). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

In addition, 2 Uzzal pieces are mistaken as Zirgüle; and 4 Hümayun pieces as Zirgüle, too. Most Uzzals here, however, are instead imagined to be Hicaz (16) instead of actually Uzzal (9).

While the majority of Hümayun pieces is again catalogued under Hicaz (35) instead of Hümayun (10), the fact that none are grouped under Uzzal and only 4 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (167) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (19) and Hümayun (29), while a handful are confused as Zirgüle (7). Despite the meager success rate at overall classification, the fact that Uzzals and Hümayuns are more pronouncedly recognized by this algorithm is a positive aspect.

Table 30b via RepTree for allHicaz24OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RepTree" is a fast decision tree learner, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         227               69.8462 %
Incorrectly Classified Instances        98               30.1538 %
Kappa statistic                          0.1801
Mean absolute error                      0.2218
Root mean squared error                  0.3521
Relative absolute error                 88.6436 %
Root relative squared error             99.8694 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.955    0.825    0.714      0.955    0.817      0.215    0.521     0.692
Hicaz
                 0.000    0.003    0.000      0.000    0.000      -0.017   0.647     0.135
Uzzal
                 0.020    0.011    0.250      0.020    0.038      0.031    0.482     0.145
Hümayun
                 0.519    0.030    0.609      0.519    0.560      0.526    0.865     0.529
Zirgüle
Weighted Avg.    0.698    0.568    0.576      0.698    0.610      0.194    0.554     0.549

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 212   1   3   6 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  46   0   1   2 |   c = Hümayun
  13   0   0  14 |   d = Zirgüle
```

REMARKS ON TABLE 30b... The correct classification percentage for "RepTree" is appreciably higher than before (70 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold), while almost as much are yet confounded with Hicaz (13). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 2 Hümayun pieces are categorized under Zirgüle, too. The remaining Uzzals here, however, are instead imagined to be Hicaz (26) instead. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

Similarly, most Hümayun pieces are catalogued under Hicaz (47) instead of actually Hümayun (1), while 2 are even confounded with Zirgüle!

Finally, the bulk of Hicaz pieces (212) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (1), Hümayun (3) and even Zirgüle (6), A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 31b via either Canopy (for clustering data using the canopy clustering algorithm, which requires just one pass over the data) OR Cobweb (that is a class implementing the Cobweb and Classit clustering algorithms) for allHicaz24OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0      325 (100%)


Class attribute: LABEL
Classes to Clusters:

   0  <-- assigned to cluster
 222 | Hicaz
  27 | Uzzal
  49 | Hümayun
  27 | Zirgüle

Cluster 0 <-- Hicaz

Incorrectly clustered instances :     103.0    31.6923 %
```

REMARKS ON TABLE 31b... The output is the same as Table 31a. While the percentage of incorrectly clustered instances for either "Canopy" OR "Cobweb" is appreciably low (32 %), one immediately notices that all the pieces of the dataset are straightly assigned to the Hicaz cluster!

The only thing worthwhile to remark about the clearly failed approaches at hand is the proportion of the pieces distributed under such a single category. Obviously, WEKA thinks that the majority of Hicaz pieces (222) is indeed befittingly labelled under the Hicaz cluster, whereas only 27 Uzzal, 49 Hümayun and 27 Zirgüle pieces are deemed to belong to the same category.

Aside from the deceptive success rate at overall classification, the fact that all the pieces are squashed under a single label with these algorithms is a troubling aspect.

Therefore, the aforesaid computational models do not appear to utilize the melodic contour features properly to distinguish the dataset in terms of pinpointing the correct makam categories for the batch of 325 'Hicaz family' pieces.

Table 32b via Simple EM (expectation maximisation) class for allHicaz24OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0       41 ( 13%)
1       40 ( 12%)
2      244 ( 75%)


Log likelihood: 1684.93309


Class attribute: LABEL
Classes to Clusters:

   0   1   2  <-- assigned to cluster
  18  30 174 | Hicaz
   0   5  22 | Uzzal
  11   3  35 | Hümayun
  12   2  13 | Zirgüle

Cluster 0 <-- Zirgüle
Cluster 1 <-- Uzzal
Cluster 2 <-- Hicaz

Incorrectly clustered instances :     134.0    41.2308 %
```

REMARKS ON TABLE 32b... The percentage of incorrectly clustered instances for "Simple EM (expectation maximization)" is middling (41 %). Here, one may see that 18 Hicaz pieces, no Uzzal pieces, 11 Hümayun pieces and 12 Zirgüle pieces are assigned to the Zirgüle (a.k.a. Hicaz-Zirgüle) cluster. The total number thought by WEKA to be Zirgüle is hence 41.

While such a low number may seem reasonable, Simple EM seems very much confused about differentiating especially individual Hümayuns from its kindred polar opposites, as there was no discovered Hümayun category to begin with!

In addition, 30 Hicaz pieces, 5 Uzzal pieces, 3 Hümayun pieces and 3 Zirgüle pieces were thought to be belonging to the Uzzal cluster (totalling 40 pieces). Individual Uzzals should not be possible to so easily confound with Hümayun and Zirgüle!

Finally, 174 Hicaz pieces, 22 Uzzal pieces, 35 Hümayun pieces and 13 Zirgüle pieces were imagined by WEKA to belong to the Hicaz cluster (totalling 244 pieces). This seems more meaningful at a first glance, since individual Zirgüle pieces are indeed very diminutively attributed to the either the Zirgüle or Hicaz clusters akin to 0 individual Uzzal pieces for the Zirgüle cluster. Yet, if individual Hümayuns are so easily identifiable with Hicaz instead, why not more individual Uzzals, too?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in this clustering algorithm is a troubling aspect.

This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish the makams of the 'Hicaz family' from each other.

Table 33b via either FarthestFirst (for clustering data using the FarthestFirst algorithm) OR HierarchicalClusterer (which is a hierarchical clustering class) that uses "EuclideanDistance", implementing Euclidean distance (or similarity) function, for allHicaz24OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0      324 (100%)
1        1 (  0%)


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
 221   1 | Hicaz
  27   0 | Uzzal
  49   0 | Hümayun
  27   0 | Zirgüle

Cluster 0 <-- Hicaz
Cluster 1 <-- No class

Incorrectly clustered instances :     104.0    32      %
```

REMARKS ON TABLE 33b... The output is the same as Table 33a. While the percentage of incorrectly clustered instances for either "FarthestFirst" or "HierarchicalClusterer" is appreciably low (32 %), one immediately notices that the majority of pieces of the dataset is straightly assigned to the Hicaz cluster, and only 1 Hicaz is singled out as belonging to "no class"!

The only thing worthwhile to remark about these failed approaches is the proportion of the pieces distributed under such a single category. Obviously, WEKA thinks that, aside from the singled out 1 Hicaz piece of "no class", the majority of Hicaz pieces (221) is indeed befittingly labelled under the Hicaz cluster, whereas only 27 Uzzal, 49 Hümayun and 27 Zirgüle pieces are deemed to belong to the same category.

Aside from the deceptive success rate at overall classification, the fact that the majority of pieces is squashed under a single label with the given algorithms is a troubling aspect.

Therefore, neither FarthestFirst nor HierarchicalClusterer appear to utilize the melodic contour features properly to distinguish the dataset in terms of pinpointing the correct makam categories for the batch of 325 'Hicaz family' pieces.

Table 34b via either FilteredClusterer (which is a class for running an arbitrary clusterer on data that has been passed through an arbitrary filter) with "SimpleKMeans" (that clusters data using the k means algorithm) contingent upon "EuclideanDistance", implementing Euclidean distance (or similarity) function, coupled with AllFilter (an instance filter that passes all instances through unmodified), OR SimpleKMeans (for clustering data using the k means algorithm) that uses "EuclideanDistance", implementing Euclidean distance (or similarity) function, for allHicaz24OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0       153 ( 47%)
1       172 ( 53%)


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
  95 127 | Hicaz
   3  24 | Uzzal
  36  13 | Hümayun
  19   8 | Zirgüle

Cluster 0 <-- Hümayun
Cluster 1 <-- Hicaz

Incorrectly clustered instances :     162.0    49.8462 %
```

REMARKS ON TABLE 34b... The percentage of incorrectly clustered instances for either "FilteredClusterer" or "SimpleKMeans" is middling (50 %). Here, one may see that 95 Hicaz pieces, 3 Uzzal pieces, 36 Hümayun pieces and 19 Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are problematically assigned to the Hümayun cluster. The total number thought by WEKA to be Hümayun is hence 153.

While the distribution of pieces under such a Hümayun clustering might seem reasonable, these algorithms appear to be very much confused about differentiating especially individual Uzzals from Hicaz, as there was no discovered Uzzal category to begin with!

In addition, 127 Hicaz pieces, 24 Uzzal pieces, 13 Hümayun pieces and 8 Zirgüle pieces were thought to belong to the Hicaz cluster (totalling 172 pieces). Individual Hümayuns should especially not be possible to so easily confuse with a Hicaz moniker!

While individual Zirgüle pieces are indeed very diminutively attributed to either the Hümayun cluster or the Hicaz cluster in comparison to the rest of the analyzed items, so are individual Uzzal pieces! If individual Hümayuns are so easily identifiable with the Hümayun cluster, why are individual Uzzals numbering rather few under the Hicaz cluster?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in these clustering algorithms is a troubling aspect.

Said algorithms therefore do not appear to utilize the melodic contour features properly to distinguish especially Uzzal from the other members of the 'Hicaz family'.

Table 35b via MakeDensityBasedClusterer (which is a class for wrapping a Clusterer to make it return a distribution and density) for allHicaz24OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted; it uses "SimpleKMeans" (that clusters data using the k means algorithm) contingent upon "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Model and evaluation on training set ===

Clustered Instances

0       86 ( 26%)
1      239 ( 74%)


Log likelihood: 1659.66709


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
  49 173 | Hicaz
   1  26 | Uzzal
  20  29 | Hümayun
  16  11 | Zirgüle

Cluster 0 <-- Hümayun
Cluster 1 <-- Hicaz

Incorrectly clustered instances :     132.0    40.6154 %
```

REMARKS ON TABLE 35b... The percentage of incorrectly clustered instances for "MakeDensityBasedClusterer" is middling, too (41 %). Here, one may see that 49 Hicaz pieces, 1 Uzzal piece, 20 Hümayun pieces and 16 Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are problematically assigned to the Hümayun cluster. The total number thought by WEKA to be Hümayun is hence 86.

While the distribution of pieces under such a Hümayun clustering might seem reasonable, this algorithm appears to be very much confused about differentiating especially individual Uzzals from Hicaz, as there was no discovered Uzzal category begin with!

In addition, 173 Hicaz pieces, 26 Uzzal pieces, 29 Hümayun pieces and 11 Zirgüle pieces were thought to belong to the Hicaz cluster (totalling 239 pieces). Individual Hümayuns should especially not be possible to so easily confuse with a Hicaz moniker!

While individual Zirgüle pieces are indeed very diminutively attributed to either the Hümayun cluster or the Hicaz cluster in comparison to the rest of the analyzed items, so are individual Uzzal pieces! Moreover, if individual Hümayuns are so easily identifiable with the Hümayun cluster, why are there more individual Hümayuns under the Hicaz cluster?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in this clustering algorithm is a troubling aspect.

This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish especially Uzzal from the other members of the 'Hicaz family'.

Table 1c via BayesNet for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "BayesNet" is Bayes Network learning using various search algorithms and quality measures, where the batch size is chosen to be 325; it uses "SimpleEstimator" that is used for estimating the conditional probability tables of a Bayes network once the structure has been learned.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         186               57.2308 %
Incorrectly Classified Instances       139               42.7692 %
Kappa statistic                          0.2099
Mean absolute error                      0.2268
Root mean squared error                  0.3876
Relative absolute error                 90.6465 %
Root relative squared error            109.9574 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.649     0.505     0.735      0.649    0.689      0.137    0.617     0.757
Hicaz
                 0.148     0.111     0.108      0.148    0.125      0.033    0.661     0.122
Uzzal
                 0.327     0.181     0.242      0.327    0.278      0.129    0.646     0.215
Hümayun
                 0.815     0.013     0.846      0.815    0.830      0.815    0.986     0.908
Zirgüle
Weighted Avg.    0.572     0.382     0.618      0.572    0.592      0.183    0.656     0.635

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 144  28  47   3 |   a = Hicaz
  21   4   2   0 |   b = Uzzal
  28   4  16   1 |   c = Hümayun
   3   1   1  22 |   d = Zirgüle
```

REMARKS ON TABLE 1c... The correct classification percentage for "BayesNet" is rather low (57 %). However, Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are almost entirely grouped under the Zirgüleli Hicaz label as one would expect (22 members in bold). But, there turns out to be some uncertainty where a few may instead be in Hicaz (3), Uzzal (1) and even Hümayun (1).

Furthermore, 1 Hümayun piece is mistaken for Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (21), while 2 are identified as Hümayun, instead of actually Uzzal (4).

In addition, the majority of Hümayun pieces is catalogued under Hicaz (28) instead of Hümayun (16), while 4 are grouped under Uzzal and even 1 under Zirgüle.

Finally, the bulk of Hicaz pieces (144) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (28) and Hümayun (47), while a few are confused as Zirgüle (3).

Though the success rate at overall classification is meager, the fact that Hümayuns and Zirgüles are visibly better recognized for the most part by this algorithm is a promising aspect of the computation.

Table 2c via Logistic for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "Logistic" is a class for building and using a multinomial logistic regression model with a ridge estimator, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         168               51.6923 %
Incorrectly Classified Instances       157               48.3077 %
Kappa statistic                          0.1199
Mean absolute error                      0.2415
Root mean squared error                  0.4854
Relative absolute error                 96.5281 %
Root relative squared error            137.7004 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.649     0.456     0.754      0.649     0.697      0.182    0.640     0.775
Hicaz
                 0.259     0.131     0.152      0.259     0.192      0.102    0.619     0.119
Uzzal
                 0.286     0.217     0.189      0.286     0.228      0.058    0.633     0.223
Hümayun
                 0.111     0.037     0.214      0.111     0.146      0.101    0.679     0.217
Zirgüle
Weighted Avg.    0.517     0.358     0.574      0.517     0.539      0.150    0.641     0.591

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 144  26  43   9 |   a = Hicaz
  13   7   7   0 |   b = Uzzal
  25   8  14   2 |   c = Hümayun
   9   5  10   3 |   d = Zirgüle
```

REMARKS ON TABLE 2c... The correct classification percentage for "Logistic" is meager, too (merely 52 %). Even more than that, it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are not significatively grouped under the Zirgüleli Hicaz label as one would expect (3 members in bold), and there still turns out to be some uncertainty where some of them may instead be in Hicaz (9), Uzzal (5) and even Hümayun (10). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 2 Hümayun pieces are categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (13) and Hümayun (7) instead of actually Uzzal (7). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is again catalogued under Hicaz (25) instead of Hümayun (14), the fact that only a few are grouped under Uzzal (8) and only 2 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (144) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (26) and Hümayun (43), while a few are confused as Zirgüle (9).

Table 3c via MultilayerPerceptron for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "MultilayerPerceptron" is a classifier that uses backpropagation to learn a multi-layer perceptron to classify instances, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         196               60.3077 %
Incorrectly Classified Instances       129               39.6923 %
Kappa statistic                          0.1639
Mean absolute error                      0.2005
Root mean squared error                  0.4303
Relative absolute error                 80.142  %
Root relative squared error            122.0672 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.752     0.660     0.711      0.752     0.731      0.096    0.571     0.712
Hicaz
                 0.037     0.034     0.091      0.037     0.053      0.005    0.616     0.158
Uzzal
                 0.204     0.109     0.250      0.204     0.225      0.104    0.619     0.274
Hümayun
                 0.667     0.070     0.462      0.667     0.545      0.506    0.902     0.517
Zirgüle
Weighted Avg.    0.603     0.476     0.569      0.603     0.583      0.124    0.610     0.584

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 167  10  28  17 |   a = Hicaz
  24   1   2   0 |   b = Uzzal
  35   0  10   4 |   c = Hümayun
   9   0   0  18 |   d = Zirgüle
```

REMARKS ON TABLE 3c... The correct classification percentage for "MultilayerPerceptron" is relatively higher (60 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold). However, there still turns out to be some uncertainty where part of them may instead be in Hicaz (9). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 4 Hümayun pieces are categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (24) and Hümayun (2) instead of actually Uzzal (1). It is not realistic that Uzzal should easily be confounded with Hümayun!

Moreover, the majority of Hümayun pieces is catalogued under Hicaz (35) instead of Hümayun (10), while even 4 are grouped under Zirgüle.

Finally, the bulk of Hicaz pieces (167) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (10) and Hümayun (28), while a substantial portion is confused as Zirgüle (17). A better success rate at overall classification is compounded by the fact that Uzzals are obviously misclassified by this algorithm.

Table 4c via SimpleLogistic for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "SimpleLogistic" is a classifier for building linear logistic regression models, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         224               68.9231 %
Incorrectly Classified Instances       101               31.0769 %
Kappa statistic                          0.1662
Mean absolute error                      0.2085
Root mean squared error                  0.3359
Relative absolute error                 83.3278 %
Root relative squared error             95.2877 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.937     0.835     0.707      0.937    0.806      0.162    0.608     0.750
Hicaz
                 0.000     0.010     0.000      0.000    0.000      -0.029   0.745     0.197
Uzzal
                 0.000     0.025     0.000      0.000    0.000      -0.063   0.639     0.202
Hümayun
                 0.593     0.017     0.762      0.593    0.667      0.646    0.957     0.820
Zirgüle
Weighted Avg.    0.689     0.576     0.547      0.689    0.606      0.152    0.653     0.627

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 208   3   6   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  10   0   1  16 |   d = Zirgüle
```

REMARKS ON TABLE 4c... The correct classification percentage for "SimpleLogistic" is even higher (69 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (16 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (10) and even Hümayun (1). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, no Hümayun piece is conceived to fit under any category other than Hicaz (49), either!

In addition, all Uzzals here are imagined to be in Hicaz (27). It is not realistic that Uzzal and Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (208) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (3), Hümayun (6) and even Zirgüle (5). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 5c via SMO for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: Implements John Platt's "sequential minimal optimization" (SMO) algorithm for training a support vector classifier, where the batch size is chosen to be 325, and the training data is standardized; it uses "Logistic" with the same batch size, that is a class for building and using a multinomial logistic regression model with a ridge estimator, alongside the "polynomial kernel" K(x, y) = <x, y>^p or K(x, y) = (<x, y>+1)^p.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         195               60      %
Incorrectly Classified Instances       130               40      %
Kappa statistic                          0.1899
Mean absolute error                      0.2967
Root mean squared error                  0.3776
Relative absolute error                118.582  %
Root relative squared error            107.1052 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
                 0.721     0.612     0.717      0.721     0.719      0.109     0.586     0.724     Hicaz
                 0.185     0.064     0.208      0.185     0.196      0.128     0.659     0.135     Uzzal
                 0.224     0.159     0.200      0.224     0.212      0.062     0.636     0.199     Hümayun
                 0.704     0.013     0.826      0.704     0.760      0.743     0.925     0.692     Zirgüle
Weighted Avg.    0.600     0.448     0.606      0.600     0.603      0.156     0.628     0.593

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 160  19  39   4 |   a = Hicaz
  18   5   4   0 |   b = Uzzal
  38   0  11   0 |   c = Hümayun
   7   0   1  19 |   d = Zirgüle
```

REMARKS ON TABLE 5c... The correct classification percentage for "Sequential Minimal Optimization" (SMO) by John Platt is a bit lower (60 %) in comparison to the table before, but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (19 members in bold), while a few are confounded with Hicaz (7) and 1 even with Hümayun; yet it is interesting that none are misidentified as Uzzal.

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (18), and some even with Hümayun (4), instead of actually Uzzal (5).

While the majority of Hümayun pieces is again catalogued under Hicaz (38) instead of Hümayun (11), the fact that none are grouped under Uzzal or Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (160) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (19) and Hümayun (39), while very few are confused as Zirgüle (4).

Table 6c via lBK for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "lazy.lbk" is K-nearest neighbours classifier, where the batch size is chosen to be 325, and the "nearest neighbor search algorithm" (LinearNNSearch) is a class implementing the brute force search algorithm for nearest neighbour search coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         205               63.0769 %
Incorrectly Classified Instances       120               36.9231 %
Kappa statistic                          0.1972
Mean absolute error                      0.1872
Root mean squared error                  0.4268
Relative absolute error                 74.8202 %
Root relative squared error            121.0685 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
                 0.788     0.650     0.723       0.788   0.754      0.147    0.574     0.721     Hicaz
                 0.148     0.034     0.286       0.148   0.195      0.156    0.541     0.115     Uzzal
                 0.224     0.138     0.224       0.224   0.224      0.087    0.561     0.179     Hümayun
                 0.556     0.017     0.750       0.556   0.638      0.619    0.808     0.509     Zirgüle
Weighted Avg.    0.631     0.469     0.614       0.631   0.618      0.178    0.589     0.572

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 175  10  32   5 |   a = Hicaz
  20   4   3   0 |   b = Uzzal
  38   0  11   0 |   c = Hümayun
   9   0   3  15 |   d = Zirgüle
```

REMARKS ON TABLE 6c... The correct classification percentage for "lBk" is similar when compared to the previous table (63 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold). However, there still turns out to be some uncertainty where part of them may instead be in Hicaz (9) and Hümayun (3). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

Even so, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (20) and Hümayun (3) instead of actually Uzzal (4). It is not realistic that Uzzal should easily be confounded with Hümayun!

Moreover, the majority of Hümayun pieces is catalogued under Hicaz (38) instead of Hümayun (11). Be that as it may, it is clear that many Hümayuns are identified successfully.

Finally, the bulk of Hicaz pieces (175) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (10) and Hümayun (32), while a few are confused as Zirgüle (5). Not only is the success rate at overall classification meager, but the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 7c via KStar for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "KStar" is an instance-based classifier (that is, the class of a test instance is based upon the class of those training instances similar to it) as determined by some similarity function, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances           1               0.3077 %
Incorrectly Classified Instances         2               0.6154 %
Kappa statistic                          0.1429
Mean absolute error                      0.3291
Root mean squared error                  0.5689
Relative absolute error              10261.1631 %
Root relative squared error           1256.643  %
UnClassified Instances                 322              99.0769 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
                 0.000     0.500     0.000       0.000   0.000      -0.500   0.503     0.684     Hicaz
                 ?         0.333     0.000       ?       ?          ?        0.503     0.084     Uzzal
                 0.000     0.000     ?           0.000   ?          ?        0.504     0.152     Hümayun
                 1.000     0.000     1.000       1.000   1.000      1.000    0.510     0.085     Zirgüle
Weighted Avg.    0.333     0.167     ?           0.333   ?          ?        0.505     0.307

=== Confusion Matrix ===

 a b c d   <-- classified as
 0 1 0 0 | a = Hicaz
 0 0 0 0 | b = Uzzal
 1 0 0 0 | c = Hümayun
 0 0 0 1 | d = Zirgüle
```

REMARKS ON TABLE 7c... The correct classification percentage for "KStar" shows that the output is a clear failure. It is due to the fact that, compared to Tables 7b and 7c, the algorithm discarded almost all of the dataset pertaining, this time, to the 53-tone Equal Temperament (Holderian comma) resolution, where not even an octave normalization procedure was applied.

Therefore, it is meaningless to pay any further attention to this particular result.

Table 8c via LWL for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "Locally weighted learning" (LWL), where the batch size is chosen to be 325, uses the DecisionStump classifier with the same batch size, that is a class for building and using a decision stump, and the "nearest neighbor search algorithm" (LinearNNSearch), which is a class implementing the brute force search algorithm for nearest neighbour search, coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         231               71.0769 %
Incorrectly Classified Instances        94               28.9231 %
Kappa statistic                          0.1993
Mean absolute error                      0.2241
Root mean squared error                  0.3407
Relative absolute error                 89.5888 %
Root relative squared error             96.6572 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.973    0.825    0.718      0.973    0.826      0.263    0.570     0.714
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.713     0.172
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.619     0.200
Hümayun
                 0.556    0.030    0.625      0.556    0.588      0.554    0.799     0.469
Zirgüle
Weighted Avg.    0.711    0.566    ?          0.711    ?          ?        0.608     0.571

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 216   0   0   6 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  46   0   0   3 |   c = Hümayun
  12   0   0  15 |   d = Zirgüle
```

REMARKS ON TABLE 8c... The correct classification percentage for "LWL" is rather high (71 %) in comparison to the previous tables, and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold), while some are yet confounded with Hicaz (12). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA... And similarly, most Hümayun pieces are catalogued under Hicaz (46), while 3 are even confounded with Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (216) is indeed identified as Hicaz, yet none are thought to be in Uzzal, Hümayun or Zirgüle! A much better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 9c via AdaBoostM1 for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "AdaBoostM1" is a class for boosting a nominal class classifier using the Adaboost M1 method, where the batch size is chosen to be 325; it uses the DecisionStump classifier with the same batch size, that is a class for building and using a decision stump.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         231               71.0769 %
Incorrectly Classified Instances        94               28.9231 %
Kappa statistic                          0.1869
Mean absolute error                      0.2918
Root mean squared error                  0.3612
Relative absolute error                116.645  %
Root relative squared error            102.4502 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.977     0.845     0.714      0.977    0.825      0.251    0.564     0.704
Hicaz
                 0.000     0.000     ?          0.000    ?          ?        0.445     0.073
Uzzal
                 0.000     0.000     ?          0.000    ?          ?        0.487     0.161
Hümayun
                 0.519     0.023     0.667      0.519    0.583      0.556    0.788     0.625
Zirgüle
Weighted Avg.    0.711     0.579     ?          0.711    ?          ?        0.561     0.563

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 217   0   0   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  47   0   0   2 |   c = Hümayun
  13   0   0  14 |   d = Zirgüle
```

REMARKS ON TABLE 9c... The correct classification percentage for "AdaBoostM1" is rather high, too (71 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold), while almost just as much are yet confounded with Hicaz (13). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA... And similarly, most Hümayun pieces are rather catalogued under Hicaz (47), while 2 are even confounded with Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (217) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (5), yet none to be in Uzzal or Hümayun! A very good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 10c via AttributeSelectedClassifier for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "AttributeSelectedClassifier", where the batch size is chosen to be 325, uses the J48 classifier with the same batch size, that is a class for generating a pruned or unpruned C4, and the "CfsSubsetEval", which evaluates the worth of a subset of attributes by considering the individual predictive ability of each feature along with the degree of redundancy between them, coupled with "BestFirst" that searches the space of attribute subsets by greedy hillclimbing augmented with a backtracking facility.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         213               65.5385 %
Incorrectly Classified Instances       112               34.4615 %
Kappa statistic                          0.1569
Mean absolute error                      0.2169
Root mean squared error                  0.3804
Relative absolute error                 86.6994 %
Root relative squared error            107.9027 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.878    0.757    0.714      0.878    0.788      0.154    0.561     0.712
Hicaz
                 0.037    0.034    0.091      0.037    0.053      0.005    0.631     0.120
Uzzal
                 0.041    0.065    0.100      0.041    0.058      -0.036   0.567     0.171
Hümayun
                 0.556    0.020    0.714      0.556    0.625      0.601    0.757     0.462
Zirgüle
Weighted Avg.    0.655    0.532    0.570      0.655    0.603      0.150    0.584     0.561

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 195   8  14   5 |   a = Hicaz
  24   1   2   0 |   b = Uzzal
  44   2   2   1 |   c = Hümayun
  10   0   2  15 |   d = Zirgüle
```

REMARKS ON TABLE 10c... The percentage for "AttributeSelectedClassifier" in terms of correct classification is a bit lower (66 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (10) and even Hümayun (2); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (24), and some even with Hümayun (2), while only 1 is actually thought to be in Uzzal.

Moreover, most Hümayuns here are imagined to be in Hicaz (44) also, and only 2 to be actually in Hümayun, whereas WEKA thinks 2 to be in Uzzal and even 1 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on a similar scale!

Finally, the bulk of Hicaz pieces (195) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (8), Hümayun (14) and Zirgüle (5).

Table 11c via Bagging for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "Bagging" is a class for bagging a classifier to reduce variance, where the batch size is chosen to be 325; it uses the RepTree (fast decision tree learner) classifier with the same batch size.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         231               71.0769 %
Incorrectly Classified Instances        94               28.9231 %
Kappa statistic                          0.2402
Mean absolute error                      0.2088
Root mean squared error                  0.3264
Relative absolute error                 83.4737 %
Root relative squared error             92.5784 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
                 0.941     0.777     0.723       0.941   0.818      0.244    0.657     0.781     Hicaz
                 0.000     0.000     ?           0.000   ?          ?        0.625     0.114     Uzzal
                 0.082     0.033     0.308       0.082   0.129      0.090    0.715     0.320     Hümayun
                 0.667     0.017     0.783       0.667   0.720      0.699    0.978     0.833     Zirgüle
Weighted Avg.    0.711     0.537     ?           0.711   ?          ?        0.690     0.661

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 209   0   9   4 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  45   0   4   0 |   c = Hümayun
   9   0   0  18 |   d = Zirgüle
```

REMARKS ON TABLE 11c... The correct classification percentage for "Bagging" is appreciably high (71 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold), while some are confounded with Hicaz (9). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Hümayun piece is mistaken, even as a low probability, as Zirgüle. Yet, no Uzzal piece, except the 1 thought to be under Zirgüle, is conceived to fit under any category other than Hicaz (26), either!

While the majority of Hümayun pieces is again catalogued under Hicaz (45) instead of Hümayun (4), the fact that none are grouped under Uzzal or Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (209) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (9) and Zirgüle (4), but none to be in Uzzal! It is not understandable why the algorithm is so lenient towards Hümayun but not towards Uzzal.

Table 12c via ClassificationViaRegression for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "ClassificationViaRegression" is a class for doing classification using regression methods, where the batch size is chosen to be 325; it uses the M5P classifier, with the same batch size, that implements the M5' model tree algorithm.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         222               68.3077 %
Incorrectly Classified Instances       103               31.6923 %
Kappa statistic                          0.1706
Mean absolute error                      0.21
Root mean squared error                  0.3401
Relative absolute error                 83.9373 %
Root relative squared error             96.4839 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.923     0.806     0.712       0.923   0.804      0.172    0.641     0.759
Hicaz
                 0.000     0.013     0.000       0.000   0.000      -0.034   0.651     0.145
Uzzal
                 0.061     0.043     0.200       0.061   0.094      0.030    0.647     0.236
Hümayun
                 0.519     0.013     0.778       0.519   0.622      0.609    0.945     0.745
Zirgüle
Weighted Avg.    0.683     0.559     0.581       0.683   0.615      0.170    0.668     0.628

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 205   2  11   4 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  44   2   3   0 |   c = Hümayun
  12   0   1  14 |   d = Zirgüle
```

REMARKS ON TABLE 12c... The percentage for "ClassificationViaRegression" in terms of correct classification is similar to before (68 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold). However, there still turns out to be some uncertainty, where a part of them may instead be in Hicaz (12) and even Hümayun (1); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle or Hümayun. All Uzzals, however, are seemingly more conformal with Hicaz (27)!

Moreover, most Hümayuns here are imagined also to be in Hicaz (44), and only 3 to be actually in Hümayun, whereas WEKA even thinks 2 to be in Uzzal. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (205) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (2), Hümayun (11) and even Zirgüle (4).

Table 13c via FilteredClassifier for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "FilteredClassifier", where the batch size is chosen to be 325, uses the J48 classifier with the same batch size, that is a class for generating a pruned or unpruned C4, coupled with "Discretize" filter, which is an instance filter that discretizes a range of numeric attributes in the dataset into nominal attributes.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         236               72.6154 %
Incorrectly Classified Instances        89               27.3846 %
Kappa statistic                          0.2297
Mean absolute error                      0.2101
Root mean squared error                  0.3342
Relative absolute error                 83.9699 %
Root relative squared error             94.7923 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.986    0.825    0.720      0.986    0.833      0.305    0.538     0.689
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.534     0.088
Uzzal
                 0.000    0.004    0.000      0.000    0.000      -0.023   0.521     0.157
Hümayun
                 0.630    0.010    0.850      0.630    0.723      0.712    0.750     0.610
Zirgüle
Weighted Avg.    0.726    0.565    ?          0.726    ?          ?        0.552     0.552

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 219   0   1   2 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   0   1 |   c = Hümayun
  10   0   0  17 |   d = Zirgüle
```

REMARKS ON TABLE 13c... The correct classification percentage for "FilteredClassifier" is quite high, EQUALLING TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS (73 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (10); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA... And similarly, all Hümayun pieces, except the 1 under Zirgüle, are catalogued under Hicaz (48)!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (219) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (1) and Zirgüle (2), yet none to be in Uzzal this time! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 14c via IterativeClassifierOptimizer for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "IterativeClassifierOptimizer" optimizes the number of iterations of the given iterative classifier using cross-validation or a percentage split evaluation, where the batch size is chosen to be 325; it uses the LogitBoost iterative classifier with the same batch size, which is a class for performing additive logistic regression that relies on DecisionStump, which is a classifier, with the same batch size, that is a class for performing additive logistic regression.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         229               70.4615 %
Incorrectly Classified Instances        96               29.5385 %
Kappa statistic                          0.2339
Mean absolute error                      0.2138
Root mean squared error                  0.3417
Relative absolute error                 85.4578 %
Root relative squared error             96.9312 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.937    0.757    0.727      0.937    0.819      0.257    0.583     0.749
Hicaz
                 0.037    0.007    0.333      0.037    0.067      0.088    0.682     0.163
Uzzal
                 0.102    0.040    0.313      0.102    0.154      0.103    0.652     0.229
Hümayun
                 0.556    0.017    0.750      0.556    0.638      0.619    0.897     0.659
Zirgüle
Weighted Avg.    0.705    0.525    0.634      0.705    0.641      0.250    0.628     0.615

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 208   2   8   4 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  43   0   5   1 |   c = Hümayun
   9   0   3  15 |   d = Zirgüle
```

REMARKS ON TABLE 14c... The percentage for "IterativeClassifierOptimizer" in terms of correct classification is almost as high as before and the same as Table 14a (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (9) and Hümayun (3); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but almost all Uzzals, except 1, are seemingly more conformal with Hicaz (26) according to WEKA!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (43), and only 5 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (208) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (2), Hümayun (8) and even Zirgüle (4).

Table 15c via LogitBoost for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "LogitBoost" is a class for performing additive logistic regression, where the batch size is chosen to be 325; it uses DecisionStump, which is a classifier, with the same batch size, that is a class for performing additive logistic regression.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         231               71.0769 %
Incorrectly Classified Instances        94               28.9231 %
Kappa statistic                          0.3043
Mean absolute error                      0.1938
Root mean squared error                  0.3442
Relative absolute error                 77.4786 %
Root relative squared error             97.6333 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.901     0.670     0.743      0.901    0.815      0.285    0.621     0.748
Hicaz
                 0.111     0.030     0.250      0.111    0.154      0.118    0.649     0.155
Uzzal
                 0.204     0.043     0.455      0.204    0.282      0.229    0.688     0.319
Hümayun
                 0.667     0.013     0.818      0.667    0.735      0.718    0.870     0.711
Zirgüle
Weighted Avg.    0.711     0.468     0.665      0.711    0.673      0.298    0.654     0.631

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 200   7  11   4 |   a = Hicaz
  24   3   0   0 |   b = Uzzal
  37   2  10   0 |   c = Hümayun
   8   0   1  18 |   d = Zirgüle
```

REMARKS ON TABLE 15c... The correct classification percentage for "LogitBoost" is appreciably high (71 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold), while some are confounded with Hicaz (8) and 1 even with Hümayun. It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but almost all Uzzals, except 3, are seemingly more conformal with Hicaz (25) according to the WEKA algorithm!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (37), and even 2 to be in Uzzal, and only 10 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a substantial scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (200) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (7) and Hümayun (11), while very few are confused as Zirgüle (4).

Table 16c via MultiClassClassifier for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: Implements a metaclassifier for handling multi-class datasets with 2-class classifiers, where the batch size is chosen to be 325; it relies on "Logistic", with the same batch size, that is a class for building and using a multinomial logistic regression model with a ridge estimator.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         186               57.2308 %
Incorrectly Classified Instances       139               42.7692 %
Kappa statistic                          0.1385
Mean absolute error                      0.2308
Root mean squared error                  0.4394
Relative absolute error                 92.235  %
Root relative squared error            124.656  %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.730    0.573    0.733      0.730    0.731      0.157    0.660     0.810
Hicaz
                 0.185    0.087    0.161      0.185    0.172      0.092    0.657     0.164
Uzzal
                 0.204    0.181    0.167      0.204    0.183      0.021    0.626     0.197
Hümayun
                 0.333    0.013    0.692      0.333    0.450      0.451    0.923     0.591
Zirgüle
Weighted Avg.    0.572    0.427    0.597      0.572    0.579      0.155    0.676     0.646

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 162  18  39   3 |   a = Hicaz
  16   5   6   0 |   b = Uzzal
  32   6  10   1 |   c = Hümayun
  11   2   5   9 |   d = Zirgüle
```

REMARKS ON TABLE 16c... The correct classification percentage for "MultiClassClassifier" is rather low (merely 57 %). Even more than that, it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are not significatively grouped under the Zirgüleli Hicaz label as one would expect (9 members in bold), and there still turns out to be some uncertainty where some of them may instead be in Hicaz (11), Uzzal (2) and even Hümayun (5). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (16) and Hümayun (6) instead of actually Uzzal (5). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is again catalogued under Hicaz (32) instead of Hümayun (10), the fact that only a few are grouped under Uzzal (6) and only 1 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (162) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (18), Hümayun (39) and even Zirgüle (3).

Table 17c via MultiClassClassifierUpdateable for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "MultiClassClassifierUpdateable" is a metaclassifier for handling multi-class datasets with 2-class classifiers, where the batch size is chosen to be 325; it uses the SGD classifier, with the same batch size, that implements stochastic gradient descent for learning various linear models (binary class SVM, binary class logistic regression, squared loss, Huber loss and epsilon-insensitive loss linear regression).

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         225               69.2308 %
Incorrectly Classified Instances       100               30.7692 %
Kappa statistic                          0.2178
Mean absolute error                      0.1663
Root mean squared error                  0.3748
Relative absolute error                 66.4783 %
Root relative squared error            106.3188 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.914    0.767    0.720      0.914    0.806      0.202    0.623     0.747
Hicaz
                 0.074    0.030    0.182      0.074    0.105      0.067    0.619     0.124
Uzzal
                 0.122    0.029    0.429      0.122    0.190      0.165    0.576     0.204
Hümayun
                 0.519    0.013    0.778      0.519    0.622      0.609    0.924     0.665
Zirgüle
Weighted Avg.    0.692    0.532    0.636      0.692    0.639      0.219    0.641     0.607

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 203   7   8   4 |   a = Hicaz
  25   2   0   0 |   b = Uzzal
  43   0   6   0 |   c = Hümayun
  11   2   0  14 |   d = Zirgüle
```

REMARKS ON TABLE 17c... The percentage for "MultiClassClassifierUpdateable" in terms of correct classification is higher than before (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold). However, there still turns out to be some uncertainty, where a part of them may instead be in Hicaz (11) and Uzzal (2).

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (25), while only 2 are actually thought to be in Uzzal!

Moreover, most Hümayuns are also imagined to be in Hicaz (43), and only 6 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a substantial scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (203) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (7) and Hümayun (8), while very few are confused as Zirgüle (4).

Table 18c via RandomCommittee for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "RandomCommittee" is a class for building an ensemble of randomizable base classifiers, where the batch size is chosen to be 325; it uses RandomTree with the same batch size, which is a class for constructing a tree that considers K randomly chosen attributes at each node.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         233               71.6923 %
Incorrectly Classified Instances        92               28.3077 %
Kappa statistic                          0.1995
Mean absolute error                      0.2134
Root mean squared error                  0.3411
Relative absolute error                 85.2929 %
Root relative squared error             96.76   %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.977    0.845    0.714      0.977    0.825      0.251    0.595     0.732
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.607     0.105
Uzzal
                 0.102    0.018    0.500      0.102    0.169      0.174    0.611     0.255
Hümayun
                 0.407    0.000    1.000      0.407    0.579      0.622    0.954     0.767
Zirgüle
Weighted Avg.    0.717    0.580    ?          0.717    ?          ?        0.628     0.611

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 217   0   5   0 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  44   0   5   0 |   c = Hümayun
  16   0   0  11 |   d = Zirgüle
```

REMARKS ON TABLE 18c... The correct classification percentage for "RandomCommittee" is even higher, the same as Table 10c (72 %), BEING IN LINE WITH TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS; and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (11 members in bold). However, there still turns out to be some uncertainty, where even more may instead be in Hicaz (16). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, they are not conceived to fit under the category of Uzzal, either! Also, most Hümayuns here are once again imagined to be in Hicaz (44), and only 5 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a subtantial scale!

Finally, the bulk of Hicaz pieces (217) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (5), but not at all in Uzzal or Zirgüle! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 19c via RandomizableFilteredClassifier for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: It is a simple variant of the FilteredClassifier that instantiates the model with a randomizable filter (e.g., RandomProjection that reduces the dimensionality of the data by projecting it onto a lower dimensional subspace using a random matrix with columns of unit length), and IBk (K-nearest neighbours classifier) as the base classifier, where the batch size is chosen to be 325, and the "nearest neighbor search algorithm" (LinearNNSearch) is a class implementing the brute force search algorithm for nearest neighbour search, coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         182               56      %
Incorrectly Classified Instances       143               44      %
Kappa statistic                          0.1003
Mean absolute error                      0.2221
Root mean squared error                  0.4659
Relative absolute error                 88.773  %
Root relative squared error            132.1604 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.707     0.670     0.695      0.707     0.701      0.038    0.529     0.699
Hicaz
                 0.074     0.077     0.080      0.074     0.077      -0.003   0.520     0.086
Uzzal
                 0.204     0.149     0.196      0.204     0.200      0.055    0.558     0.184
Hümayun
                 0.481     0.034     0.565      0.481     0.520      0.482    0.756     0.312
Zirgüle
Weighted Avg.    0.560     0.489     0.558      0.560     0.559      0.074    0.551     0.538

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 157  19  36  10 |   a = Hicaz
  22   2   3   0 |   b = Uzzal
  36   3  10   0 |   c = Hümayun
  11   1   2  13 |   d = Zirgüle
```

REMARKS ON TABLE 19c... The percentage for "RandomizableFilteredClassifier" in terms of correct classification is much lower (56 %) in comparison to the previous table, but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed significatively grouped under the Zirgüleli Hicaz label as one would expect (13 members in bold), while some are confounded with Hicaz (11), Uzzal (1) and even Hümayun (2).

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (22), and 3 even with Hümayun, instead of actually Uzzal (2).

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (36), and even 3 to be in Uzzal, and only 10 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with particularly Hicaz on such a substantial scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (157) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (19), Hümayun (36) and even Zirgüle (10).

Table 20c via RandomSubSpace for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "RandomSubSpace" method constructs a decision tree based classifier that maintains highest accuracy on training data and improves on generalization accuracy as it grows in complexity, where the batch size is chosen to be 325; it uses the RepTree (fast decision tree learner) classifier with the same batch size.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         232               71.3846 %
Incorrectly Classified Instances        93               28.6154 %
Kappa statistic                          0.1955
Mean absolute error                      0.2192
Root mean squared error                  0.3254
Relative absolute error                 87.6049 %
Root relative squared error             92.2992 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
                 0.977     0.845     0.714      0.977    0.825      0.251    0.677     0.799     Hicaz
                 0.000     0.000     ?          0.000    ?          ?        0.625     0.132     Uzzal
                 0.000     0.000     ?          0.000    ?          ?        0.701     0.319     Hümayun
                 0.556     0.020     0.714      0.556    0.625      0.601    0.967     0.803     Zirgüle
Weighted Avg.    0.714     0.579     ?          0.714    ?          ?        0.701     0.671

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 217   0   0   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   0   1 |   c = Hümayun
  12   0   0  15 |   d = Zirgüle
```

REMARKS ON TABLE 20c... The percentage for "RandomSubSpace" in terms of correct classification is almost as high as Table 18c, EQUALLING THE PERCENTAGE OF TRT REPERTORY'S RECURRENT LABELS (72 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (12); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, just as are all the Hümayuns (48) save the 1 that is identified as Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (217) is indeed identified as Hicaz, but 5 are instead thought by WEKA to be in Zirgüle, yet none to be in Uzzal or Hümayun this time! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 21c via DecisionTable for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "DecisionTable" is a class for building and using a simple decision table majority classifier, where the batch size is chosen to be 325; it uses the BestFirst search, which searches the space of attribute subsets by greedy hillclimbing augmented with a backtracking facility.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         229               70.4615 %
Incorrectly Classified Instances        96               29.5385 %
Kappa statistic                          0.1982
Mean absolute error                      0.2305
Root mean squared error                  0.3385
Relative absolute error                 92.122  %
Root relative squared error             96.0082 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.955     0.825     0.714      0.955     0.817      0.215    0.553     0.706
Hicaz
                 0.000     0.003     0.000      0.000     0.000      -0.017   0.534     0.092
Uzzal
                 0.000     0.004     0.000      0.000     0.000      -0.023   0.553     0.169
Hümayun
                 0.630     0.030     0.654      0.630     0.642      0.610    0.849     0.660
Zirgüle
Weighted Avg.    0.705     0.567     0.542      0.705     0.611      0.193    0.576     0.570

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 212   1   1   8 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  10   0   0  17 |   d = Zirgüle
```

REMARKS ON TABLE 21c... The correct classification percentage for "DecisionTable" is appreciably high as well (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold), while some are yet confounded with Hicaz (10). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, only 1 Uzzal piece is mistaken as Zirgüle; but all remaining Uzzals are seemingly more conformal with Hicaz (26) according to WEKA, just as are all the Hümayuns (49)!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (212) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (1), Hümayun (1) and even Zirgüle (8). A good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 22c via JRip for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "JRip" is a class that implements a propositional rule learner, Repeated Incremental Pruning to Produce Error Reduction (RIPPER), which was proposed by William W. Cohen as an optimized version of IREP, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         226               69.5385 %
Incorrectly Classified Instances        99               30.4615 %
Kappa statistic                          0.2333
Mean absolute error                      0.2049
Root mean squared error                  0.3428
Relative absolute error                 81.8947 %
Root relative squared error             97.232  %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.914     0.748     0.725      0.914     0.809      0.225    0.590     0.721
Hicaz
                 0.000     0.007     0.000      0.000     0.000      -0.024   0.527     0.087
Uzzal
                 0.061     0.036     0.231      0.061     0.097      0.046    0.566     0.191
Hümayun
                 0.741     0.034     0.667      0.741     0.702      0.674    0.872     0.623
Zirgüle
Weighted Avg.    0.695     0.519     0.585      0.695     0.625      0.214    0.604     0.580

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 203   2   9   8 |   a = Hicaz
  25   0   1   1 |   b = Uzzal
  45   0   3   1 |   c = Hümayun
   7   0   0  20 |   d = Zirgüle
```

REMARKS ON TABLE 22c... The correct classification percentage for "JRip" is the quite high, too (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (20 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (7); yet it is still interesting that none are misidentified as Uzzal.

In addition, only 1 Uzzal and 1 Hümayun piece is mistaken as Zirgüle. The remaining Uzzals, however, conform with Hicaz (25), with only 1 actually thought to be in Uzzal!

Moreover, most Hümayuns here are imagined also to be in Hicaz (45), and only 3 to be actually in Hümayun, with 1 even assigned to Zirgüle as stated. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (203) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (2), Hümayun (9) and even Zirgüle (8). A good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 23c via OneR for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "OneR" is a class for building and using a 1R classifier; in other words, uses the minimum-error attribute for prediction, discretizing numeric attributes; batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         229               70.4615 %
Incorrectly Classified Instances        96               29.5385 %
Kappa statistic                          0.1846
Mean absolute error                      0.1477
Root mean squared error                  0.3843
Relative absolute error                 59.0348 %
Root relative squared error            109.0146 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.964     0.835     0.713      0.964     0.820      0.225    0.565     0.712
Hicaz
                 0.000     0.000     ?          0.000     ?          ?        0.500     0.083
Uzzal
                 0.000     0.014     0.000      0.000     0.000      -0.047   0.493     0.151
Hümayun
                 0.556     0.020     0.714      0.556     0.625      0.601    0.768     0.434
Zirgüle
Weighted Avg.    0.705     0.574     ?          0.705     ?          ?        0.565     0.552

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 214   0   3   5 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  11   0   1  15 |   d = Zirgüle
```

REMARKS ON TABLE 23c... The correct classification percentage for "OneR" is appreciably high as well (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold), while some are yet confounded with Hicaz (11), with even 1 being in Hümayun. It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, only 1 Uzzal piece is mistaken as Zirgüle; but all remaining Uzzals are seemingly more conformal with Hicaz (26) according to WEKA, just as are all the Hümayuns (49)!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (214) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (3) and even Zirgüle (5), but none in Uzzal. A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 24c via PART for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "PART" is a class for generating a PART decision list, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         198               60.9231 %
Incorrectly Classified Instances       127               39.0769 %
Kappa statistic                          0.2165
Mean absolute error                      0.2039
Root mean squared error                  0.429
Relative absolute error                 81.5012 %
Root relative squared error            121.697  %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.734    0.563    0.738      0.734    0.736      0.171    0.566     0.717
Hicaz
                 0.074    0.084    0.074      0.074    0.074      -0.010   0.541     0.091
Uzzal
                 0.265    0.130    0.265      0.265    0.265      0.135    0.584     0.190
Hümayun
                 0.741    0.027    0.714      0.741    0.727      0.702    0.852     0.527
Zirgüle
Weighted Avg.    0.609    0.414    0.609      0.609    0.609      0.194    0.590     0.570

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 163  22  31   6 |   a = Hicaz
  23   2   2   0 |   b = Uzzal
  31   3  13   2 |   c = Hümayun
   4   0   3  20 |   d = Zirgüle
```

REMARKS ON TABLE 24c... The correct classification percentage for "PART" is a bit low (just 61 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (20 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (4) and Hümayun (3). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 2 Hümayun pieces are categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (23) and Hümayun (2), instead of actually Uzzal (2). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is catalogued under Hicaz (31) instead of Hümayun (13), the fact that only very few are grouped under Uzzal (3) and only 2 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (163) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (22) and Hümayun (31), while a few are confused as Zirgüle (6). Not only is the success rate at overall classification meager, but the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 25c via DecisionStump for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "DecisionStump" is a class for building and using a decision stump, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         231               71.0769 %
Incorrectly Classified Instances        94               28.9231 %
Kappa statistic                          0.1869
Mean absolute error                      0.2248
Root mean squared error                  0.3408
Relative absolute error                 89.8599 %
Root relative squared error             96.6648 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.977     0.845     0.714       0.977   0.825      0.251    0.557     0.704
Hicaz
                 0.000     0.000     ?           0.000   ?          ?        0.522     0.084
Uzzal
                 0.000     0.000     ?           0.000   ?          ?        0.496     0.149
Hümayun
                 0.519     0.023     0.667       0.519   0.583      0.556    0.718     0.359
Zirgüle
Weighted Avg.    0.711     0.579     ?           0.711   ?          ?        0.558     0.540

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 217   0   0   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  47   0   0   2 |   c = Hümayun
  13   0   0  14 |   d = Zirgüle
```

REMARKS ON TABLE 25c... Results are identical to Table 9c. The correct classification percentage for "DecisionStump" is the same as with "LWL" (71 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold), while almost as much are yet confounded with Hicaz (13). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, and similarly, most Hümayun pieces are catalogued under Hicaz (47), while 2 are even confounded with Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (217) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (5), yet none to be in Uzzal or Hümayun! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 26c via J48 for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "J48" is a class for generating a pruned or unpruned C4, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         201               61.8462 %
Incorrectly Classified Instances       124               38.1538 %
Kappa statistic                          0.2083
Mean absolute error                      0.2107
Root mean squared error                  0.4103
Relative absolute error                 84.2212 %
Root relative squared error            116.3913 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.770    0.583    0.740      0.770    0.755      0.193    0.600     0.736
Hicaz
                 0.111    0.091    0.100      0.111    0.105      0.020    0.623     0.123
Uzzal
                 0.184    0.116    0.220      0.184    0.200      0.073    0.599     0.209
Hümayun
                 0.667    0.017    0.783      0.667    0.720      0.699    0.832     0.542
Zirgüle
Weighted Avg.    0.618    0.424    0.612      0.618    0.614      0.202    0.621     0.590

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 171  23  24   4 |   a = Hicaz
  19   3   5   0 |   b = Uzzal
  35   4   9   1 |   c = Hümayun
   6   0   3  18 |   d = Zirgüle
```

REMARKS ON TABLE 26c... The correct classification percentage for "J48" is lower (62 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (6) and Hümayun (3). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (19) and Hümayun (5), instead of actually Uzzal (3). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is catalogued under Hicaz (35) instead of Hümayun (9), the fact that only very few are grouped under Uzzal (4) and only 1 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (171) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (23) and Hümayun (24), while very few are confused as Zirgüle (4). Not only is the success rate at overall classification wanting, but the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 27c via LMT for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "LMT" is a classifier for building 'logistic model trees', which are classification trees with logistic regression functions at the leaves, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         224               68.9231 %
Incorrectly Classified Instances       101               31.0769 %
Kappa statistic                          0.181
Mean absolute error                      0.2052
Root mean squared error                  0.338
Relative absolute error                 82.041  %
Root relative squared error             95.8819 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.928     0.816     0.710       0.928   0.805      0.169    0.610     0.756
Hicaz
                 0.000     0.010     0.000       0.000   0.000      -0.029   0.726     0.183
Uzzal
                 0.020     0.033     0.100       0.020   0.034      -0.025   0.651     0.218
Hümayun
                 0.630     0.017     0.773       0.630   0.694      0.673    0.961     0.818
Zirgüle
Weighted Avg.    0.689     0.564     0.564       0.689   0.612      0.165    0.655     0.632

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 206   3   8   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   1   0 |   c = Hümayun
   9   0   1  17 |   d = Zirgüle
```

REMARKS ON TABLE 27c... Results are almost identical to Table 4c. The percentage for "LMT" in terms of correct classification is higher than before (69 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (9), with even 1 being in Hümayun. It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, and similarly, most Hümayun pieces are catalogued under Hicaz (47), while only 1 is recognized to be Hümayun!

It is not realistic that Uzzal and Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (206) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (3), Hümayun (8) and even Zirgüle (5). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 28c via RandomForest for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "RandomForest" is a class for constructing a forest of random trees, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         235               72.3077 %
Incorrectly Classified Instances        90               27.6923 %
Kappa statistic                          0.1945
Mean absolute error                      0.221
Root mean squared error                  0.3266
Relative absolute error                 88.3246 %
Root relative squared error             92.6355 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.995     0.864     0.713      0.995    0.831      0.291    0.635     0.752
Hicaz
                 0.000     0.000     ?          0.000    ?          ?        0.730     0.165
Uzzal
                 0.061     0.004     0.750      0.061    0.113      0.187    0.702     0.346
Hümayun
                 0.407     0.000     1.000      0.407    0.579      0.622    0.976     0.886
Zirgüle
Weighted Avg.    0.723     0.591     ?          0.723    ?          ?        0.681     0.653

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 221   0   1   0 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  46   0   3   0 |   c = Hümayun
  16   0   0  11 |   d = Zirgüle
```

REMARKS ON TABLE 28c... The correct classification percentage for "RandomForest" is even higher, BEING EXACTLY THE PERCENTAGE OF TRT REPERTORY'S RECURRENT LABELS (72 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (11 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (16); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA. Similarly, most Hümayun pieces are rather catalogued under Hicaz (47) and only 3 are identified as Hümayun!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (221) is indeed identified as Hicaz, but 1 is instead thought by WEKA to be in Hümayun, yet none to be in Uzzal or Zirgüle this time! An better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 29c via RandomTree for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "RandomTree" is a class for constructing a tree that considers K randomly chosen attributes at each node, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         183               56.3077 %
Incorrectly Classified Instances       142               43.6923 %
Kappa statistic                          0.1013
Mean absolute error                      0.2185
Root mean squared error                  0.4674
Relative absolute error                 87.3222 %
Root relative squared error            132.5846 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.716     0.660     0.700      0.716     0.708      0.057    0.528     0.696
Hicaz
                 0.074     0.074     0.083      0.074     0.078      0.000    0.500     0.083
Uzzal
                 0.245     0.159     0.214      0.245     0.229      0.081    0.543     0.166
Hümayun
                 0.370     0.027     0.556      0.370     0.444      0.415    0.672     0.258
Zirgüle
Weighted Avg.    0.563     0.483     0.564      0.563     0.562      0.085    0.540     0.529

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 159  20  38   5 |   a = Hicaz
  22   2   2   1 |   b = Uzzal
  33   2  12   2 |   c = Hümayun
  13   0   4  10 |   d = Zirgüle
```

REMARKS ON TABLE 29c... The correct classification percentage for "RandomTree" is not good (merely 56 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (10 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (13) and Hümayun (4). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 2 Hümayun pieces as Zirgüle, too. Most Uzzals here, however, are instead imagined to be Hicaz (22) and Hümayun (2), instead of actually Uzzal (2). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is again catalogued under Hicaz (33) instead of Hümayun (12), the fact that only 2 are grouped under Uzzal and only 1 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (159) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (20) and Hümayun (38), while a handful are confused as Zirgüle (5). Not only is the success rate at overall classification meager, but the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 30c via RepTree for allHicaz53-SORTED.csv that attempts a 10-fold cross-validation: "RepTree" is a fast decision tree learner, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         230               70.7692 %
Incorrectly Classified Instances        95               29.2308 %
Kappa statistic                          0.2242
Mean absolute error                      0.2157
Root mean squared error                  0.3427
Relative absolute error                 86.2244 %
Root relative squared error             97.2193 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.946    0.796    0.719      0.946    0.817      0.231    0.602     0.736
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.564     0.095
Uzzal
                 0.020    0.014    0.200      0.020    0.037      0.017    0.575     0.182
Hümayun
                 0.704    0.030    0.679      0.704    0.691      0.662    0.831     0.602
Zirgüle
Weighted Avg.    0.708    0.549    ?          0.708    ?          ?        0.614     0.588

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 210   0   4   8 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  47   0   1   1 |   c = Hümayun
   8   0   0  19 |   d = Zirgüle
```

REMARKS ON TABLE 30c... The correct classification percentage for "RepTree" is much higher than the previous table (71 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (19 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (8); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (47), and only 1 to be actually in Hümayun, with 1 even assigned to Zirgüle as stated. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (210) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (4) and even Zirgüle (8), but none to be in Uzzal. A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 31c via either Canopy (for clustering data using the canopy clustering algorithm, which requires just one pass over the data) OR Cobweb (that is a class implementing the Cobweb and Classit clustering algorithms) for allHicaz53-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0      325 (100%)


Class attribute: LABEL
Classes to Clusters:

   0  <-- assigned to cluster
 222 | Hicaz
  27 | Uzzal
  49 | Hümayun
  27 | Zirgüle

Cluster 0 <-- Hicaz

Incorrectly clustered instances :     103.0    31.6923 %
```

REMARKS ON TABLE 31c... The output is the same as Table 31a and Table 31b. While the percentage of incorrectly clustered instances for either "Canopy" OR "Cobweb" is appreciably low (32 %), one immediately notices that all the pieces of the dataset are straightly assigned to the Hicaz cluster!

The only thing worthwhile to remark about the clearly failed approaches at hand is the proportion of the pieces distributed under such a single category. Obviously, WEKA thinks that the majority of Hicaz pieces (222) is indeed befittingly labelled under the Hicaz cluster, whereas only 27 Uzzal, 49 Hümayun and 27 Zirgüle pieces are deemed to belong to the same category.

Aside from the deceptive success rate at overall classification, the fact that all the pieces are squashed under a single label with these algorithms is a troubling aspect.

Therefore, the aforesaid computational models do not appear to utilize the melodic contour features properly to distinguish the dataset in terms of pinpointing the correct makam categories for the batch of 325 'Hicaz family' pieces.

Table 32c via Simple EM (expectation maximisation) class for allHicaz53-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0       154 ( 47%)
1       170 ( 52%)
2         1 (  0%)


Log likelihood: 6614.25684


Class attribute: LABEL
Classes to Clusters:

   0   1   2  <-- assigned to cluster
 107 114   1 | Hicaz
  24   3   0 | Uzzal
  13  36   0 | Hümayun
  10  17   0 | Zirgüle

Cluster 0 <-- Hicaz
Cluster 1 <-- Hümayun
Cluster 2 <-- No class

Incorrectly clustered instances :     182.0    56      %
```

REMARKS ON TABLE 32c... The percentage of incorrectly clustered instances for "Simple EM (expectation maximization)" is rather high (56 %). Here, one may see that 107 Hicaz pieces, 24 Uzzal pieces, 13 Hümayun pieces and 10 Zirgüle pieces are assigned to the Hicaz cluster. The total number thought by WEKA to be Hicaz is hence 154.

Simple EM further seems very much confused about differentiating especially individual Zirgüles from its kindred polar opposites, as there was no discovered Zirgüle category to begin with!

In addition, 114 Hicaz pieces, 3 Uzzal pieces, 36 Hümayun pieces and 17 Zirgüle pieces were strangely thought to be belonging to the Hümayun cluster (totalling 170 pieces). Individual Uzzals, however, were possible to be differentiated from the Hümayun category for the most part in this regard.

Finally, 1 Hicaz piece, 0 Uzzal pieces, 0 Hümayun pieces and 0 Zirgüle pieces were imagined by WEKA to belong to the "no class" cluster (totalling 1 piece only). This seems quite meaningless at a first glance, since such a category serves no purpose other than separating the 1 designated Hicaz file from the rest of the dataset.

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in this clustering algorithm is a troubling aspect.

This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish especially individual Hicaz members from their polar opposites under the same 'Hicaz family'.

Table 33c via either FarthestFirst (for clustering data using the FarthestFirst algorithm) OR HierarchicalClusterer (which is a hierarchical clustering class) that uses "EuclideanDistance", implementing Euclidean distance (or similarity) function, for allHicaz53-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0      324 (100%)
1        1 (  0%)


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
 221   1 | Hicaz
  27   0 | Uzzal
  49   0 | Hümayun
  27   0 | Zirgüle

Cluster 0 <-- Hicaz
Cluster 1 <-- No class

Incorrectly clustered instances :     104.0    32      %
```

REMARKS ON TABLE 33c... The output is the same as Table 33a and Table 33b. While the percentage of incorrectly clustered instances for either "FarthestFirst" or "HierarchicalClusterer" is appreciably low (32 %), one immediately notices that the majority of pieces of the dataset is straightly assigned to the Hicaz cluster, and only 1 Hicaz is singled out as belonging to "no class"!

The only thing worthwhile to remark about these failed approaches is the proportion of the pieces distributed under such a single category. Obviously, WEKA thinks that, aside from the singled out 1 Hicaz piece of "no class", the majority of Hicaz pieces (221) is indeed befittingly labelled under the Hicaz cluster, whereas only 27 Uzzal, 49 Hümayun and 27 Zirgüle pieces are deemed to belong to the same category.

Aside from the deceptive success rate at overall classification, the fact that the majority of pieces is squashed under a single label with the given algorithms is a troubling aspect.

Therefore, neither FarthestFirst nor HierarchicalClusterer appear to utilize the melodic contour features properly to distinguish the dataset in terms of pinpointing the correct makam categories for the batch of 325 'Hicaz family' pieces.

Table 34c via either FilteredClusterer (which is a class for running an arbitrary clusterer on data that has been passed through an arbitrary filter) with "SimpleKMeans" (that clusters data using the k means algorithm) contingent upon "EuclideanDistance", implementing Euclidean distance (or similarity) function, coupled with AllFilter (an instance filter that passes all instances through unmodified), OR SimpleKMeans (for clustering data using the k means algorithm) that uses "EuclideanDistance", implementing Euclidean distance (or similarity) function, for allHicaz53-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0       148 ( 46%)
1       177 ( 54%)


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
  93 129 | Hicaz
   3  24 | Uzzal
  35  14 | Hümayun
  17  10 | Zirgüle

Cluster 0 <-- Hümayun
Cluster 1 <-- Hicaz

Incorrectly clustered instances :     161.0    49.5385 %
```

REMARKS ON TABLE 34c... The percentage of incorrectly clustered instances for either "FilteredClusterer" or "SimpleKMeans" is rather high (50 %). Here, one may see that 93 Hicaz pieces, 3 Uzzal pieces, 35 Hümayun pieces and 17 Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are problematically assigned to the Hümayun cluster. The total number thought by WEKA to be Hümayun is hence 148.

While the distribution of pieces under such a Hümayun clustering might seem reasonable, these algorithms appear to be very much confused about differentiating especially individual Uzzals from Hicaz, as there was no discovered Uzzal category to begin with!

In addition, 129 Hicaz pieces, 24 Uzzal pieces, 14 Hümayun pieces and 10 Zirgüle pieces were thought to belong to the Hicaz cluster (totalling 177 pieces). Individual Hümayuns should especially not be possible to so easily confuse with a Hicaz moniker!

While individual Zirgüle pieces are indeed very diminutively attributed to either the Hümayun cluster or the Hicaz cluster in comparison to the rest of the analyzed items, so are individual Uzzal pieces! If individual Hümayuns are so easily identifiable with the Hümayun cluster, why are individual Uzzals numbering rather few under the Hicaz cluster?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in these clustering algorithms is a troubling aspect.

Said algorithms therefore do not appear to utilize the melodic contour features properly to distinguish especially Uzzal from the other members of the 'Hicaz family'.

Table 35c via MakeDensityBasedClusterer (which is a class for wrapping a Clusterer to make it return a distribution and density) for allHicaz53-SORTED.csv, where a "classes to clusters" evaluation is attempted; it uses "SimpleKMeans" (that clusters data using the k means algorithm) contingent upon "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Model and evaluation on training set ===

Clustered Instances

0      128 ( 39%)
1      197 ( 61%)


Log likelihood: 6583.0207


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
  85 137 | Hicaz
   2  25 | Uzzal
  26  23 | Hümayun
  15  12 | Zirgüle

Cluster 0 <-- Hümayun
Cluster 1 <-- Hicaz

Incorrectly clustered instances :     162.0    49.8462 %
```

REMARKS ON TABLE 35c... The percentage of incorrectly clustered instances for "MakeDensityBasedClusterer" is rather high, too (50 %). Here, one may see that 85 Hicaz pieces, 2 Uzzal pieces, 26 Hümayun pieces and 15 Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are problematically assigned to the Hümayun cluster. The total number thought by WEKA to be Hümayun is hence 128.

While the distribution of pieces under such a Hümayun clustering might seem reasonable, this algorithm appears to be very much confused about differentiating especially individual Uzzals from Hicaz, as there was no discovered Uzzal category begin with!

In addition, 137 Hicaz pieces, 25 Uzzal pieces, 23 Hümayun pieces and 12 Zirgüle pieces were thought to belong to the Hicaz cluster (totalling 197 pieces). Individual Hümayuns should especially not be possible to so easily confuse with a Hicaz moniker!

While individual Zirgüle pieces are indeed very diminutively attributed to either the Hümayun cluster or the Hicaz cluster in comparison to the rest of the analyzed items, so are individual Uzzal pieces! If individual Hümayuns are so easily identifiable with the Hümayun cluster, why are individual Uzzals numbering so few under the Hicaz cluster?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in this clustering algorithm is a troubling aspect.

This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish especially Uzzal from the other members of the 'Hicaz family'.

Table 1d via BayesNet for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "BayesNet" is Bayes Network learning using various search algorithms and quality measures, where the batch size is chosen to be 325; it uses "SimpleEstimator" that is used for estimating the conditional probability tables of a Bayes network once the structure has been learned.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         212               65.2308 %
Incorrectly Classified Instances       113               34.7692 %
Kappa statistic                          0.1992
Mean absolute error                      0.2156
Root mean squared error                  0.354
Relative absolute error                 86.1939 %
Root relative squared error            100.4289 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.833    0.709    0.717      0.833    0.771      0.143    0.593     0.725
Hicaz
                 0.037    0.027    0.111      0.037    0.056      0.017    0.586     0.108
Uzzal
                 0.102    0.094    0.161      0.102    0.125      0.010    0.603     0.196
Hümayun
                 0.778    0.020    0.778      0.778    0.778      0.758    0.986     0.873
Zirgüle
Weighted Avg.    0.652    0.502    0.588      0.652    0.615      0.164    0.626     0.607

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 185   8  25   4 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  42   0   5   2 |   c = Hümayun
   5   0   1  21 |   d = Zirgüle
```

REMARKS ON TABLE 1d... The output is the same as Table 1b. The correct classification percentage for "BayesNet" is mediocre (65 %), but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold), with only 5 thought to be in Hicaz and only 1 thought to be in Hümayun.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun; and only 2 Hümayun pieces are categorized under Zirgüle. Most Uzzals, save 1, however, are seemingly more conformal with Hicaz (26)!

While the majority of Hümayun pieces is catalogued under Hicaz (42) instead of Hümayun (5), the fact that none are grouped under Uzzal and only 2 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors, although visibly less successfully than in Table 1a.

Finally, the bulk of Hicaz pieces (185) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (8) and Hümayun (25), while very few are confused as Zirgüle (4).

Table 2d via Logistic for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "Logistic" is a class for building and using a multinomial logistic regression model with a ridge estimator, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         171               52.6154 %
Incorrectly Classified Instances       154               47.3846 %
Kappa statistic                          0.1612
Mean absolute error                      0.2378
Root mean squared error                  0.4852
Relative absolute error                 95.0529 %
Root relative squared error            137.6385 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.613    0.466    0.739      0.613    0.670      0.138    0.574     0.716
Hicaz
                 0.222    0.161    0.111      0.222    0.148      0.045    0.543     0.094
Uzzal
                 0.306    0.159    0.254      0.306    0.278      0.136    0.560     0.193
Hümayun
                 0.519    0.047    0.500      0.519    0.509      0.464    0.769     0.343
Zirgüle
Weighted Avg.    0.526    0.360    0.594      0.526    0.554      0.157    0.586     0.554

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 136  40  35  11 |   a = Hicaz
  13   6   7   1 |   b = Uzzal
  27   5  15   2 |   c = Hümayun
   8   3   2  14 |   d = Zirgüle
```

REMARKS ON TABLE 2d... The output is almost the same as Table 2b. The correct classification percentage for "Logistic" is rather low, too (merely 53 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (8), Uzzal (3) and even Hümayun (2). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Moreover, only 1 Uzzal piece is mistaken as Zirgüle, and only 2 Hümayun pieces are categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (13) and Hümayun (7) instead of actually Uzzal (6). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is again catalogued under Hicaz (27) instead of Hümayun (15), the fact that only a few are grouped under Uzzal (5) and only 2 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (136) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (40) and Hümayun (35), while some are confused as Zirgüle (11).

Table 3d via MultilayerPerceptron for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "MultilayerPerceptron" is a classifier that uses backpropagation to learn a multi-layer perceptron to classify instances, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         203               62.4615 %
Incorrectly Classified Instances       122               37.5385 %
Kappa statistic                          0.2171
Mean absolute error                      0.1969
Root mean squared error                  0.3994
Relative absolute error                 78.7018 %
Root relative squared error            113.2978 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.766    0.602    0.733      0.766    0.749      0.169    0.616     0.750
Hicaz
                 0.074    0.037    0.154      0.074    0.100      0.052    0.630     0.125
Uzzal
                 0.224    0.120    0.250      0.224    0.237      0.110    0.644     0.278
Hümayun
                 0.741    0.054    0.556      0.741    0.635      0.604    0.946     0.688
Zirgüle
Weighted Avg.    0.625    0.437    0.597      0.625    0.608      0.186    0.649     0.622

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 170   8  32  12 |   a = Hicaz
  23   2   1   1 |   b = Uzzal
  33   2  11   3 |   c = Hümayun
   6   1   0  20 |   d = Zirgüle
```

REMARKS ON TABLE 3d... The correct classification percentage for "MultilayerPerceptron" is relatively higher (62 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (20 members in bold). However, there still turns out to be some uncertainty where some of them may instead be in Hicaz (6) and Uzzal (1).

In addition, 3 Uzzal pieces are mistaken as Zirgüle; and 1 Hümayun piece is categorized under Zirgüle, too. Most Uzzals here, however, are instead imagined to be Hicaz (23) instead of actually Uzzal (2), with even 1 assigned to Hümayun. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

While the majority of Hümayun pieces is again catalogued under Hicaz (33) instead of Hümayun (11), the fact that only 2 are grouped under Uzzal and only 3 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (170) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (8) and Hümayun (32), while a substantial portion is confused as Zirgüle (12).

Table 4d via SimpleLogistic for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "SimpleLogistic" is a classifier for building linear logistic regression models, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         223               68.6154 %
Incorrectly Classified Instances       102               31.3846 %
Kappa statistic                          0.2225
Mean absolute error                      0.2013
Root mean squared error                  0.3363
Relative absolute error                 80.4527 %
Root relative squared error             95.3871 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.892     0.757     0.717       0.892   0.795      0.175    0.633     0.756
Hicaz
                 0.000     0.027     0.000       0.000   0.000      -0.048   0.743     0.190
Uzzal
                 0.082     0.051     0.222       0.082   0.119      0.048    0.701     0.277
Hümayun
                 0.778     0.007     0.913       0.778   0.840      0.830    0.972     0.871
Zirgüle
Weighted Avg.    0.686     0.528     0.599       0.686   0.631      0.192    0.680     0.646

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 198   8  14   2 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  45   0   4   0 |   c = Hümayun
   6   0   0  21 |   d = Zirgüle
```

REMARKS ON TABLE 4d... The correct classification percentage for "SimpleLogistic" is even higher (69 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (6); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, none is conceived to fit under any category other than Hicaz (27), either! It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

On the other hand, 45 Hümayun pieces are evidently falsely categorized under Hicaz instead of actually Hümayun (4)!

This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun from its relatively distant neighbors Hicaz and Zirgüle.

Finally, the bulk of Hicaz pieces (198) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (8), Hümayun (14) and even Zirgüle (3). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 5d via SMO for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: Implements John Platt's "sequential minimal optimization" (SMO) algorithm for training a support vector classifier, where the batch size is chosen to be 325, and the training data is standardized; it uses "Logistic" with the same batch size, that is a class for building and using a multinomial logistic regression model with a ridge estimator, alongside the "polynomial kernel" K(x, y) = <x, y>^p or K(x, y) = (<x, y>+1)^p.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         206               63.3846 %
Incorrectly Classified Instances       119               36.6154 %
Kappa statistic                          0.2431
Mean absolute error                      0.2933
Root mean squared error                  0.3728
Relative absolute error                117.2496 %
Root relative squared error            105.7482 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.757    0.592    0.734      0.757    0.745      0.168    0.595     0.728
Hicaz
                 0.074    0.067    0.091      0.074    0.082      0.008    0.677     0.132
Uzzal
                 0.286    0.130    0.280      0.286    0.283      0.154    0.652     0.217
Hümayun
                 0.815    0.007    0.917      0.815    0.863      0.853    0.949     0.813
Zirgüle
Weighted Avg.    0.634    0.430    0.627      0.634    0.630      0.209    0.640     0.609

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 168  18  34   2 |   a = Hicaz
  23   2   2   0 |   b = Uzzal
  33   2  14   0 |   c = Hümayun
   5   0   0  22 |   d = Zirgüle
```

REMARKS ON TABLE 5d... The output is almost the same as Table 5b. The correct classification percentage for "Sequential Minimal Optimization" (SMO) by John Platt is a bit lower (64 %) in comparison to the table before, but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (22 members in bold), while a few are confounded with Hicaz (5); it is interesting that none are misidentified as Uzzal.

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (23), and some even with Hümayun (2), instead of actually Uzzal (2).

While the majority of Hümayun pieces is again catalogued under Hicaz (33) instead of Hümayun (14), the fact that only 2 are grouped under Uzzal and none under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (168) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (18) and Hümayun (34), while very few are confused as Zirgüle (2).

Table 6d via lBK for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "lazy.lbk" is K-nearest neighbours classifier, where the batch size is chosen to be 325, and the "nearest neighbor search algorithm" (LinearNNSearch) is a class implementing the brute force search algorithm for nearest neighbour search coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         193               59.3846 %
Incorrectly Classified Instances       132               40.6154 %
Kappa statistic                          0.1636
Mean absolute error                      0.2054
Root mean squared error                  0.4476
Relative absolute error                 82.0998 %
Root relative squared error            126.9764 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.743    0.612    0.724      0.743    0.733      0.134    0.574     0.721
Hicaz
                 0.037    0.084    0.038      0.037    0.038      -0.048   0.492     0.082
Uzzal
                 0.204    0.145    0.200      0.204    0.202      0.059    0.555     0.180
Hümayun
                 0.630    0.013    0.810      0.630    0.708      0.692    0.864     0.595
Zirgüle
Weighted Avg.    0.594    0.448    0.595      0.594    0.593      0.154    0.588     0.576

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 165  21  32   4 |   a = Hicaz
  22   1   4   0 |   b = Uzzal
  36   3  10   0 |   c = Hümayun
   5   1   4  17 |   d = Zirgüle
```

REMARKS ON TABLE 6d... The output is the same as Table 6b. The correct classification percentage for "lBk" is a bit less than the previous table (59 %), but it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold), while a few are confounded with Hicaz (5), Uzzal (1) and even Hümayun (4). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Next, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (22) and Hümayun (4), instead of actually Uzzal (1). It is not realistic that Uzzal should easily be confounded with Hümayun!

While the majority of Hümayun pieces is again catalogued under Hicaz (36) instead of Hümayun (10), the fact that only 3 are grouped under Uzzal and none under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (165) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (21), Hümayun (32) and even Zirgüle (4).

Table 7d via KStar for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "KStar" is an instance-based classifier (that is, the class of a test instance is based upon the class of those training instances similar to it) as determined by some similarity function, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         204               62.7692 %
Incorrectly Classified Instances       121               37.2308 %
Kappa statistic                          0.197
Mean absolute error                      0.1841
Root mean squared error                  0.4158
Relative absolute error                 73.596  %
Root relative squared error            117.9458 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.784     0.641     0.725      0.784     0.753      0.151    0.601     0.733
Hicaz
                 0.074     0.064     0.095      0.074     0.083      0.012    0.629     0.122
Uzzal
                 0.286     0.127     0.286      0.286     0.286      0.159    0.695     0.326
Hümayun
                 0.519     0.003     0.933      0.519     0.667      0.678    0.946     0.827
Zirgüle
Weighted Avg.    0.628     0.462     0.624      0.628     0.620      0.185    0.646     0.629

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 174  18  29   1 |   a = Hicaz
  22   2   3   0 |   b = Uzzal
  34   1  14   0 |   c = Hümayun
  10   0   3  14 |   d = Zirgüle
```

REMARKS ON TABLE 7d... The output is the same as Table 7b. The correct classification percentage for "KStar" is higher this time compared to Table 7a (63 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (10) and even Hümayun (3). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

Next, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun is misclassified as Uzzal. Most Uzzals here, however, are instead imagined to be Hicaz (22) and Hümayun (3), instead of actually Uzzal (2).

Also, while the majority of Hümayun pieces is again catalogued under Hicaz (34) instead of Hümayun (14), the fact that only 1 is grouped under Uzzal and none under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun.

Finally, the bulk of Hicaz pieces (174) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (18) and Hümayun (29), while just 1 is confused as Zirgüle (1).

Table 8d via LWL for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "Locally weighted learning" (LWL), where the batch size is chosen to be 325, uses the DecisionStump classifier with the same batch size, that is a class for building and using a decision stump, and the "nearest neighbor search algorithm" (LinearNNSearch), which is a class implementing the brute force search algorithm for nearest neighbour search, coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         223               68.6154 %
Incorrectly Classified Instances       102               31.3846 %
Kappa statistic                          0.1356
Mean absolute error                      0.23
Root mean squared error                  0.3484
Relative absolute error                 91.9436 %
Root relative squared error             98.8257 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.955    0.854    0.707      0.955    0.812      0.176    0.577     0.715
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.678     0.191
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.632     0.231
Hümayun
                 0.407    0.047    0.440      0.407    0.423      0.373    0.789     0.377
Zirgüle
Weighted Avg.    0.686    0.588    ?          0.686    ?          ?        0.611     0.570

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 212   0   0  10 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  46   0   0   3 |   c = Hümayun
  16   0   0  11 |   d = Zirgüle
```

REMARKS ON TABLE 8d... The output is almost the same as Table 8b. The correct classification percentage for "LWL" is a bit higher as well (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (11 members in bold), while even more are yet confounded with Hicaz (16). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 3 Hümayun pieces are categorized under Zirgüle, too. The remaining Uzzals here, however, are instead imagined to be Hicaz (26) instead. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

Similarly, the remaining Hümayun pieces are catalogued under Hicaz (46)! It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (212) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (10), yet none to be in Uzzal or Hümayun! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 9d via AdaBoostM1 for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "AdaBoostM1" is a class for boosting a nominal class classifier using the Adaboost M1 method, where the batch size is chosen to be 325; it uses the DecisionStump classifier with the same batch size, that is a class for building and using a decision stump.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         223               68.6154 %
Incorrectly Classified Instances       102               31.3846 %
Kappa statistic                          0.14
Mean absolute error                      0.3015
Root mean squared error                  0.3667
Relative absolute error                120.5046 %
Root relative squared error            104.015  %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.950     0.854     0.706      0.950     0.810      0.165    0.572     0.714
Hicaz
                 0.000     0.000     ?          0.000     ?          ?        0.420     0.070
Uzzal
                 0.000     0.000     ?          0.000     ?          ?        0.474     0.144
Hümayun
                 0.444     0.047     0.462      0.444     0.453      0.404    0.879     0.583
Zirgüle
Weighted Avg.    0.686     0.588     ?          0.686     ?          ?        0.570     0.564

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 211   0   0  11 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  47   0   0   2 |   c = Hümayun
  15   0   0  12 |   d = Zirgüle
```

REMARKS ON TABLE 9d... Results are identical to Table 9b and Table 25b. The correct classification percentage for "AdaBoostM1" is rather high, too (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (12 members in bold), while even more are yet confounded with Hicaz (15). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 2 Hümayun pieces are categorized under Zirgüle, too. The remaining Uzzals here, however, are instead imagined to be Hicaz (26) instead. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

Similarly, most Hümayun pieces are catalogued under Hicaz (47), while 2 are even confounded with Zirgüle!

Finally, the bulk of Hicaz pieces (211) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (11), yet none to be in Uzzal or Hümayun! A good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 10d via AttributeSelectedClassifier for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "AttributeSelectedClassifier", where the batch size is chosen to be 325, uses the J48 classifier with the same batch size, that is a class for generating a pruned or unpruned C4, and the "CfsSubsetEval", which evaluates the worth of a subset of attributes by considering the individual predictive ability of each feature along with the degree of redundancy between them, coupled with "BestFirst" that searches the space of attribute subsets by greedy hillclimbing augmented with a backtracking facility.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         228               70.1538 %
Incorrectly Classified Instances        97               29.8462 %
Kappa statistic                          0.2576
Mean absolute error                      0.2101
Root mean squared error                  0.3524
Relative absolute error                 83.985  %
Root relative squared error             99.9531 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.910    0.728    0.729      0.910    0.810      0.238    0.579     0.730
Hicaz
                 0.000    0.007    0.000      0.000    0.000      -0.024   0.661     0.140
Uzzal
                 0.082    0.047    0.235      0.082    0.121      0.055    0.512     0.156
Hümayun
                 0.815    0.023    0.759      0.815    0.786      0.766    0.843     0.679
Zirgüle
Weighted Avg.    0.702    0.507    0.597      0.702    0.637      0.233    0.598     0.590

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 202   2  12   6 |   a = Hicaz
  26   0   1   0 |   b = Uzzal
  44   0   4   1 |   c = Hümayun
   5   0   0  22 |   d = Zirgüle
```

REMARKS ON TABLE 10d... The percentage for "AttributeSelectedClassifier" in terms of correct classification is just as high as before (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (22 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (5); yet it is still interesting that none are misidentified as Uzzal.

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle. Yet, none of them, except the 1 assigned to Hümayun, are conceived to fit under any category other than Hicaz (26), either!

Moreover, most Hümayuns here are imagined to be in Hicaz (44) also, and only 4 to be actually in Hümayun, whereas WEKA even thinks 1 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (202) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (2), Hümayun (12) and Zirgüle (6).

Table 11d via Bagging for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "Bagging" is a class for bagging a classifier to reduce variance, where the batch size is chosen to be 325; it uses the RepTree (fast decision tree learner) classifier with the same batch size.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         237               72.9231 %
Incorrectly Classified Instances        88               27.0769 %
Kappa statistic                          0.2666
Mean absolute error                      0.2096
Root mean squared error                  0.3237
Relative absolute error                 83.8    %
Root relative squared error             91.8167 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.973    0.777    0.730      0.973    0.834      0.320    0.682     0.779
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.628     0.135
Uzzal
                 0.061    0.011    0.500      0.061    0.109      0.134    0.700     0.329
Hümayun
                 0.667    0.017    0.783      0.667    0.720      0.699    0.979     0.842
Zirgüle
Weighted Avg.    0.729    0.534    ?          0.729    ?          ?        0.705     0.663

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 216   0   3   3 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  44   0   3   2 |   c = Hümayun
   9   0   0  18 |   d = Zirgüle
```

REMARKS ON TABLE 11d... The output is almost the same as Table 11b. The correct classification percentage for "Bagging" is good (73 %), EQUALLING TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS, and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (9); yet it is still interesting that none are misidentified as Uzzal.

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Yet, none of them are conceived to fit under any category other than Hicaz (27), either!

Moreover, most Hümayuns here are imagined to be in Hicaz (44) also, and only 3 to be actually in Hümayun, whereas WEKA even thinks 2 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (216) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (3) and Zirgüle (3), but none to be in Uzzal. An even better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 12d via ClassificationViaRegression for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "ClassificationViaRegression" is a class for doing classification using regression methods, where the batch size is chosen to be 325; it uses the M5P classifier, with the same batch size, that implements the M5' model tree algorithm.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         230               70.7692 %
Incorrectly Classified Instances        95               29.2308 %
Kappa statistic                          0.2672
Mean absolute error                      0.207
Root mean squared error                  0.3403
Relative absolute error                 82.7509 %
Root relative squared error             96.5268 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.919    0.718    0.734      0.919    0.816      0.265    0.610     0.752
Hicaz
                 0.037    0.007    0.333      0.037    0.067      0.088    0.645     0.149
Uzzal
                 0.163    0.054    0.348      0.163    0.222      0.152    0.625     0.271
Hümayun
                 0.630    0.013    0.810      0.630    0.708      0.692    0.964     0.751
Zirgüle
Weighted Avg.    0.708    0.501    0.649      0.708    0.655      0.269    0.645     0.629

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 204   2  14   2 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  39   0   8   2 |   c = Hümayun
   9   0   1  17 |   d = Zirgüle
```

REMARKS ON TABLE 12d... The output is the same as Table 12b. The correct classification percentage for "ClassificationViaRegression" is almost as high as before (71 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (9) and even Hümayun (1); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun. Most Uzzals, however, are seemingly more conformal with Hicaz (26), while only 1 is actually thought to be in Uzzal!

Moreover, most Hümayuns here are imagined also to be in Hicaz (39), and only 8 to be actually in Hümayun, whereas WEKA even thinks 2 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (204) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (2), Hümayun (14) and even Zirgüle (2).

Table 13d via FilteredClassifier for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "FilteredClassifier", where the batch size is chosen to be 325, uses the J48 classifier with the same batch size, that is a class for generating a pruned or unpruned C4, coupled with "Discretize" filter, which is an instance filter that discretizes a range of numeric attributes in the dataset into nominal attributes.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         238               73.2308 %
Incorrectly Classified Instances        87               26.7692 %
Kappa statistic                          0.2701
Mean absolute error                      0.2083
Root mean squared error                  0.3279
Relative absolute error                 83.2645 %
Root relative squared error             93.0046 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.977    0.786    0.728      0.977    0.835      0.322    0.567     0.705
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.515     0.091
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.523     0.153
Hümayun
                 0.778    0.020    0.778      0.778    0.778      0.758    0.862     0.731
Zirgüle
Weighted Avg.    0.732    0.539    ?          0.732    ?          ?        0.581     0.573

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 217   0   0   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   0   1 |   c = Hümayun
   6   0   0  21 |   d = Zirgüle
```

REMARKS ON TABLE 13d... The output is the same as Table 13b. The correct classification percentage for "FilteredClassifier" is very high, BEING IDENTICAL TO TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS (73 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (6); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA... And similarly, all Hümayun pieces, save the 1 assigned to Zirgüle, are catalogued under Hicaz (48)!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (217) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Zirgüle (5), yet none to be in Uzzal or Hümayun this time! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 14d via IterativeClassifierOptimizer for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "IterativeClassifierOptimizer" optimizes the number of iterations of the given iterative classifier using cross-validation or a percentage split evaluation, where the batch size is chosen to be 325; it uses the LogitBoost iterative classifier with the same batch size, which is a class for performing additive logistic regression that relies on DecisionStump, which is a classifier, with the same batch size, that is a class for performing additive logistic regression.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         233               71.6923 %
Incorrectly Classified Instances        92               28.3077 %
Kappa statistic                          0.2933
Mean absolute error                      0.2028
Root mean squared error                  0.3341
Relative absolute error                 81.043  %
Root relative squared error             94.7831 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.923    0.709    0.737      0.923    0.820      0.284    0.648     0.760
Hicaz
                 0.074    0.020    0.250      0.074    0.114      0.096    0.658     0.166
Uzzal
                 0.143    0.029    0.467      0.143    0.219      0.194    0.673     0.295
Hümayun
                 0.704    0.017    0.792      0.704    0.745      0.725    0.946     0.732
Zirgüle
Weighted Avg.    0.717    0.492    0.661      0.717    0.664      0.291    0.677     0.638

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 205   6   7   4 |   a = Hicaz
  24   2   1   0 |   b = Uzzal
  41   0   7   1 |   c = Hümayun
   8   0   0  19 |   d = Zirgüle
```

REMARKS ON TABLE 14d... The output is almost the same as Table 14b. The correct classification percentage for "IterativeClassifierOptimizer" is almost as high as before, EQUALLING TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS (72 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (19 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (8); yet it is still interesting that none are misidentified as Uzzal.

Next, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun is misclassified as Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (24), and 1 even with Hümayun, instead of actually Uzzal (2).

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (41), and only 7 to be actually in Hümayun, whereas WEKA even thinks 1 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (205) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (6), Hümayun (7) and even Zirgüle (4).

Table 15d via LogitBoost for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "LogitBoost" is a class for performing additive logistic regression, where the batch size is chosen to be 325; it uses DecisionStump, which is a classifier, with the same batch size, that is a class for performing additive logistic regression.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         227               69.8462 %
Incorrectly Classified Instances        98               30.1538 %
Kappa statistic                          0.2941
Mean absolute error                      0.198
Root mean squared error                  0.342
Relative absolute error                 79.1441 %
Root relative squared error             97.0229 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.878    0.650    0.744      0.878    0.806      0.268    0.628     0.738
Hicaz
                 0.185    0.023    0.417      0.185    0.256      0.237    0.685     0.194
Uzzal
                 0.204    0.069    0.345      0.204    0.256      0.170    0.676     0.271
Hümayun
                 0.630    0.017    0.773      0.630    0.694      0.673    0.957     0.766
Zirgüle
Weighted Avg.    0.698    0.458    0.659      0.698    0.668      0.284    0.668     0.624

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 195   6  17   4 |   a = Hicaz
  20   5   2   0 |   b = Uzzal
  37   1  10   1 |   c = Hümayun
  10   0   0  17 |   d = Zirgüle
```

REMARKS ON TABLE 15d... The output is the same as Table 15b. The correct classification percentage for "LogitBoost" is about the same as compared to the previous table (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (10); yet it is still interesting that none are misidentified as Uzzal.

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle. Most Uzzals, however, are seemingly more conformal with Hicaz (20), and 2 even with Hümayun, instead of actually Uzzal (5).

While the majority of Hümayun pieces is catalogued under Hicaz (37) instead of Hümayun (10), the fact that only 1 is grouped under Uzzal and only 1 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (195) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (6) and Hümayun (17), while very few are confused as Zirgüle (4).

Table 16d via MultiClassClassifier for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: Implements a metaclassifier for handling multi-class datasets with 2-class classifiers, where the batch size is chosen to be 325; it relies on "Logistic", with the same batch size, that is a class for building and using a multinomial logistic regression model with a ridge estimator.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         179               55.0769 %
Incorrectly Classified Instances       146               44.9231 %
Kappa statistic                          0.1746
Mean absolute error                      0.2164
Root mean squared error                  0.4051
Relative absolute error                 86.4828 %
Root relative squared error            114.9188 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.653    0.505    0.736      0.653    0.692      0.141    0.591     0.723
Hicaz
                 0.222    0.185    0.098      0.222    0.136      0.027    0.554     0.112
Uzzal
                 0.204    0.120    0.233      0.204    0.217      0.089    0.538     0.197
Hümayun
                 0.667    0.020    0.750      0.667    0.706      0.682    0.890     0.690
Zirgüle
Weighted Avg.    0.551    0.380    0.608      0.551    0.576      0.169    0.605     0.590

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 145  44  29   4 |   a = Hicaz
  17   6   3   1 |   b = Uzzal
  31   7  10   1 |   c = Hümayun
   4   4   1  18 |   d = Zirgüle
```

REMARKS ON TABLE 16d... The output is almost the same as Table 16b. The correct classification percentage for "MultiClassClassifier" is quite low (just 55 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (4), Uzzal (4) and even Hümayun (1).

Even so, only 1 Uzzal piece is mistaken as Zirgüle; and only 1 Hümayun piece is categorized under Zirgüle, too. Most Uzzals, however, are seemingly more conformal with Hicaz (17), while 3 are identified as Hümayun, instead of actually Uzzal (6).

In addition, the majority of Hümayun pieces is catalogued under Hicaz (31) instead of Hümayun (10), while quite a few are grouped under Uzzal 78) and only 1 under Zirgüle.

Finally, the bulk of Hicaz pieces (145) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (44) and Hümayun (29), while very few are confused as Zirgüle (4). Not only is the success rate at overall classification meager, but the fact that Uzzals and Hümayuns are somewhat misclassified by this algorithm is a bothersome aspect.

Table 17d via MultiClassClassifierUpdateable for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "MultiClassClassifierUpdateable" is a metaclassifier for handling multi-class datasets with 2-class classifiers, where the batch size is chosen to be 325; it uses the SGD classifier, with the same batch size, that implements stochastic gradient descent for learning various linear models (binary class SVM, binary class logistic regression, squared loss, Huber loss and epsilon-insensitive loss linear regression).

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         224               68.9231 %
Incorrectly Classified Instances       101               31.0769 %
Kappa statistic                          0.2178
Mean absolute error                      0.1614
Root mean squared error                  0.3753
Relative absolute error                 64.516  %
Root relative squared error            106.4463 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.914    0.748    0.725      0.914    0.809      0.225    0.642     0.758
Hicaz
                 0.037    0.034    0.091      0.037    0.053      0.005    0.538     0.095
Uzzal
                 0.061    0.036    0.231      0.061    0.097      0.046    0.595     0.195
Hümayun
                 0.630    0.013    0.810      0.630    0.708      0.692    0.946     0.732
Zirgüle
Weighted Avg.    0.689    0.520    0.605      0.689    0.630      0.218    0.652     0.616

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 203   6  10   3 |   a = Hicaz
  25   1   0   1 |   b = Uzzal
  45   1   3   0 |   c = Hümayun
   7   3   0  17 |   d = Zirgüle
```

REMARKS ON TABLE 17d... The output is the same as Table 17b. The correct classification percentage for "MultiClassClassifierUpdateable" is appreciably high (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (17 members in bold), while some are confounded with Hicaz (7) and Uzzal (3).

In addition, no Hümayun piece is mistaken, even as a low probability, as Zirgüle; while only 1 Uzzal is confused with Zirgüle and only 1 actually identified as Uzzal. Yet, almost all Uzzals, except these 2, are seemingly more conformal with Hicaz (25) according to the WEKA algorithm!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (45), and even 1 to be in Uzzal, and only 3 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale! This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish Hümayun or Uzzal.

Finally, the bulk of Hicaz pieces (203) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (6) and Hümayun (10), while very few are confused as Zirgüle (3).

Table 18d via RandomCommittee for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RandomCommittee" is a class for building an ensemble of randomizable base classifiers, where the batch size is chosen to be 325; it uses RandomTree with the same batch size, which is a class for constructing a tree that considers K randomly chosen attributes at each node.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         239               73.5385 %
Incorrectly Classified Instances        86               26.4615 %
Kappa statistic                          0.2752
Mean absolute error                      0.2095
Root mean squared error                  0.3341
Relative absolute error                 83.7556 %
Root relative squared error             94.7628 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.977    0.786    0.728      0.977    0.835      0.322    0.619     0.743
Hicaz
                 0.037    0.000    1.000      0.037    0.071      0.185    0.613     0.152
Uzzal
                 0.102    0.011    0.625      0.102    0.175      0.211    0.668     0.277
Hümayun
                 0.593    0.007    0.889      0.593    0.711      0.707    0.925     0.728
Zirgüle
Weighted Avg.    0.735    0.539    0.749      0.735    0.662      0.326    0.651     0.622

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 217   0   3   2 |   a = Hicaz
  26   1   0   0 |   b = Uzzal
  44   0   5   0 |   c = Hümayun
  11   0   0  16 |   d = Zirgüle
```

REMARKS ON TABLE 18d... The correct classification percentage for "RandomCommittee" is even higher (75 %), BEING TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS; and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (16 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (11). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal or Hümayun piece is mistaken, even as a low probability, as Zirgüle; but almost all Uzzals, except 1, are seemingly more conformal with Hicaz (26) according to WEKA!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (44), and only 5 to be actually in Hümayun. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (217) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Hümayun (3) and even Zirgüle (2), but not at all in Uzzal! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 19d via RandomizableFilteredClassifier for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: It is a simple variant of the FilteredClassifier that instantiates the model with a randomizable filter (e.g., RandomProjection that reduces the dimensionality of the data by projecting it onto a lower dimensional subspace using a random matrix with columns of unit length), and IBk (K-nearest neighbours classifier) as the base classifier, where the batch size is chosen to be 325, and the "nearest neighbor search algorithm" (LinearNNSearch) is a class implementing the brute force search algorithm for nearest neighbour search, coupled with "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         181               55.6923 %
Incorrectly Classified Instances       144               44.3077 %
Kappa statistic                          0.1071
Mean absolute error                      0.2236
Root mean squared error                  0.4675
Relative absolute error                 89.3796 %
Root relative squared error            132.6216 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.725     0.592     0.725      0.725     0.725      0.133     0.576     0.723
Hicaz
                 0.074     0.091     0.069      0.074     0.071      -0.016    0.513     0.085
Uzzal
                 0.265     0.141     0.250      0.265     0.257      0.121     0.563     0.184
Hümayun
                 0.185     0.057     0.227      0.185     0.204      0.141     0.619     0.143
Zirgüle
Weighted Avg.    0.557     0.438     0.558      0.557     0.557      0.119     0.573     0.541

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 161  18  33  10 |   a = Hicaz
  20   2   3   2 |   b = Uzzal
  26   5  13   5 |   c = Hümayun
  15   4   3   5 |   d = Zirgüle
```

REMARKS ON TABLE 19d... The output is the same as Table 19b. The correct classification percentage for "RandomizableFilteredClassifier" is quite low (just 56 %). Even more than that, Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are not grouped under the Zirgüleli Hicaz label as one would expect (5 members in bold). Besides, there turns out to be some uncertainty where a significative part of them may instead be in Hicaz (15), Uzzal (4) and even Hümayun (3).

Furthermore, 2 Uzzal pieces are mistaken as Zirgüle; and 5 Hümayun pieces are categorized under Zirgüle, too. Most Uzzals, however, are seemingly more conformal with Hicaz (20), while 3 are identified as Hümayun, instead of actually Uzzal (2).

In addition, the majority of Hümayun pieces is catalogued under Hicaz (26) instead of Hümayun (13), while 5 are grouped under Uzzal (5) and even 5 under Zirgüle.

Finally, the bulk of Hicaz pieces (161) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (18) and Hümayun (33), while some are confused as Zirgüle (10). Not only is the success rate at overall classification meager, but the fact that Uzzals and Zirgüles are obviously misclassified by this algorithm is a bothersome aspect.

Table 20d via RandomSubSpace for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RandomSubSpace" method constructs a decision tree based classifier that maintains highest accuracy on training data and improves on generalization accuracy as it grows in complexity, where the batch size is chosen to be 325; it uses the RepTree (fast decision tree learner) classifier with the same batch size.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         239               73.5385 %
Incorrectly Classified Instances        86               26.4615 %
Kappa statistic                          0.2522
Mean absolute error                      0.2212
Root mean squared error                  0.3245
Relative absolute error                 88.3992 %
Root relative squared error             92.0394 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.995    0.816    0.725      0.995    0.839      0.348    0.642     0.771
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.630     0.131
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.663     0.313
Hümayun
                 0.667    0.007    0.900      0.667    0.766      0.758    0.966     0.841
Zirgüle
Weighted Avg.    0.735    0.558    ?          0.735    ?          ?        0.671     0.655

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 221   0   0   1 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   0   1 |   c = Hümayun
   9   0   0  18 |   d = Zirgüle
```

REMARKS ON TABLE 20d... The output is the same as Table 20b. The percentage for "RandomSubSpace" in terms of correct classification is the highest yet, BEING IDENTICAL TO THE PERCENTAGE OF TRT REPERTORY'S RECURRENT LABELS (74 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (18 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (9); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, just as are all the Hümayuns (48) except 1, which is imagined to be in Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (221) is indeed identified as Hicaz, but 1 is instead thought by WEKA to be in Zirgüle, yet none to be in Uzzal or Hümayun this time! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 21d via DecisionTable for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "DecisionTable" is a class for building and using a simple decision table majority classifier, where the batch size is chosen to be 325; it uses the BestFirst search, which searches the space of attribute subsets by greedy hillclimbing augmented with a backtracking facility.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         238               73.2308 %
Incorrectly Classified Instances        87               26.7692 %
Kappa statistic                          0.2701
Mean absolute error                      0.2208
Root mean squared error                  0.3296
Relative absolute error                 88.2562 %
Root relative squared error             93.4993 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.977    0.786    0.728      0.977    0.835      0.322    0.607     0.730
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.489     0.084
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.541     0.178
Hümayun
                 0.778    0.020    0.778      0.778    0.778      0.758    0.888     0.663
Zirgüle
Weighted Avg.    0.732    0.539    ?          0.732    ?          ?        0.611     0.588

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 217   0   0   5 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  48   0   0   1 |   c = Hümayun
   6   0   0  21 |   d = Zirgüle
```

REMARKS ON TABLE 21d... The output is the same as Table 21b. The correct classification percentage for "DecisionTable" is almost as high as well (73 %), BEING IDENTICAL TO TRT REPERTORY'S PERCENTAGE OF RECURRENT LABELS; and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold), while some are yet confounded with Hicaz (6). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA, just as are all the Hümayuns (48) except 1, which is imagined to be in Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (217) is indeed identified as Hicaz, but 5 are instead thought by WEKA to be in Zirgüle, yet none to be in Uzzal or Hümayun this time! A very good success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 22d via JRip for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "JRip" is a class that implements a propositional rule learner, Repeated Incremental Pruning to Produce Error Reduction (RIPPER), which was proposed by William W. Cohen as an optimized version of IREP, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         220               67.6923 %
Incorrectly Classified Instances       105               32.3077 %
Kappa statistic                          0.2316
Mean absolute error                      0.2119
Root mean squared error                  0.3468
Relative absolute error                 84.7105 %
Root relative squared error             98.3705 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.874    0.699    0.729      0.874    0.795      0.211    0.605     0.734
Hicaz
                 0.000    0.010    0.000      0.000    0.000      -0.029   0.510     0.083
Uzzal
                 0.102    0.076    0.192      0.102    0.133      0.034    0.533     0.172
Hümayun
                 0.778    0.030    0.700      0.778    0.737      0.713    0.871     0.576
Zirgüle
Weighted Avg.    0.677    0.492    0.585      0.677    0.624      0.206    0.609     0.582

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 194   3  18   7 |   a = Hicaz
  24   0   3   0 |   b = Uzzal
  42   0   5   2 |   c = Hümayun
   6   0   0  21 |   d = Zirgüle
```

REMARKS ON TABLE 22d... The output is almost the same as Table 22b. The correct classification percentage for "JRip" is appreciable, but lacking in comparison to Table 22a and Table 22c (67 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold again). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (6); yet it is still interesting that none are misidentified as Uzzal.

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle. Yet, none of them are conceived to fit under any category other than Hicaz (24) and Hümayun (3), either!

Moreover, most Hümayuns here are imagined to be in Hicaz (42) also, and only 5 to be actually in Hümayun, whereas WEKA even thinks 2 to be in Zirgüle. It is not realistic that Hümayun should easily be confounded with Hicaz on such a large scale!

Finally, the bulk of Hicaz pieces (194) is indeed identified as Hicaz, but a portion is instead thought by WEKA to be in Uzzal (3), Hümayun (18) and even Zirgüle (7). Not only is the success rate at overall classification wanting, but the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm is a bothersome aspect.

Table 23d via OneR for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "OneR" is a class for building and using a 1R classifier; in other words, uses the minimum-error attribute for prediction, discretizing numeric attributes; batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         227               69.8462 %
Incorrectly Classified Instances        98               30.1538 %
Kappa statistic                          0.1652
Mean absolute error                      0.1508
Root mean squared error                  0.3883
Relative absolute error                 60.2647 %
Root relative squared error            110.1443 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.964    0.845    0.711      0.964    0.818      0.212    0.560     0.710
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.500     0.083
Uzzal
                 0.000    0.000    ?          0.000    ?          ?        0.500     0.151
Hümayun
                 0.481    0.037    0.542      0.481    0.510      0.469    0.722     0.304
Zirgüle
Weighted Avg.    0.698    0.580    ?          0.698    ?          ?        0.559     0.540

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 214   0   0   8 |   a = Hicaz
  24   0   0   3 |   b = Uzzal
  49   0   0   0 |   c = Hümayun
  14   0   0  13 |   d = Zirgüle
```

REMARKS ON TABLE 23d... The output is the same as Table 23b. The correct classification percentage for "OneR" is appreciably high as well (70 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (13 members in bold), while even more are yet confounded with Hicaz (14). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Hümayun piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) and even Zirgüle (3) according to WEKA, meanwhile all the Hümayuns (49) are identified as Hicaz!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (214) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Zirgüle (8), but none in Uzzal or Hümayun. A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 24d via PART for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "PART" is a class for generating a PART decision list, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         198               60.9231 %
Incorrectly Classified Instances       127               39.0769 %
Kappa statistic                          0.2219
Mean absolute error                      0.2031
Root mean squared error                  0.4316
Relative absolute error                 81.1963 %
Root relative squared error            122.4326 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.734     0.544     0.744      0.734    0.739      0.189    0.596     0.733
Hicaz
                 0.185     0.067     0.200      0.185    0.192      0.122    0.577     0.114
Uzzal
                 0.184     0.149     0.180      0.184    0.182      0.035    0.543     0.168
Hümayun
                 0.778     0.034     0.677      0.778    0.724      0.699    0.871     0.569
Zirgüle
Weighted Avg.    0.609     0.402     0.608      0.609    0.608      0.203    0.609     0.583

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 163  15  36   8 |   a = Hicaz
  18   5   4   0 |   b = Uzzal
  33   5   9   2 |   c = Hümayun
   5   0   1  21 |   d = Zirgüle
```

REMARKS ON TABLE 24d... The output is almost the same as Table 24b. The correct classification percentage for "PART" is a bit low (just 61 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold). However, there still turns out to be some uncertainty, where a diminutive part of them may instead be in Hicaz (5) and Hümayun (1).

Even so, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; and only 2 Hümayun pieces are categorized under Zirgüle. Most Uzzals here, however, are instead imagined to be Hicaz (18) and Hümayun (4), instead of actually Uzzal (5). It is not realistic that Uzzal should easily be confounded with Hümayun!

Moreover, most Hümayuns here are similarly imagined to be in Hicaz (33), and even 5 to be in Uzzal, while actual Hümayuns number 9. It is not realistic that Hümayun should easily be confounded with Hicaz or Uzzal on such a substantial scale!

Finally, the bulk of Hicaz pieces (163) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (15) and Hümayun (36), while a few are confused as Zirgüle (8). Not only is the success rate at overall classification meager, but the fact that Uzzals are obviously misclassified by this algorithm is a bothersome aspect.

Table 25d via DecisionStump for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "DecisionStump" is a class for building and using a decision stump, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         223               68.6154 %
Incorrectly Classified Instances       102               31.3846 %
Kappa statistic                          0.14
Mean absolute error                      0.2315
Root mean squared error                  0.3502
Relative absolute error                 92.5482 %
Root relative squared error             99.3385 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.950     0.854     0.706       0.950   0.810      0.165    0.551     0.703
Hicaz
                 0.000     0.000     ?           0.000   ?          ?        0.527     0.091
Uzzal
                 0.000     0.000     ?           0.000   ?          ?        0.509     0.150
Hümayun
                 0.444     0.047     0.462       0.444   0.453      0.404    0.732     0.299
Zirgüle
Weighted Avg.    0.686     0.588     ?           0.686   ?          ?        0.557     0.535

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 211   0   0  11 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  47   0   0   2 |   c = Hümayun
  15   0   0  12 |   d = Zirgüle
```

REMARKS ON TABLE 25d... Results are identical to Table 9b, Table 25b and Table 9d. The correct classification percentage for "DecisionStump" is bit higher (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are significatively grouped under the Zirgüleli Hicaz label as one would expect (12 members in bold), while even more are yet confounded with Hicaz (15). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 2 Hümayun pieces are categorized under Zirgüle, too. The remaining Uzzals here, however, are instead imagined to be Hicaz (26) instead. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

Similarly, most Hümayun pieces are catalogued under Hicaz (47), while 2 are even confounded with Zirgüle!

Finally, the bulk of Hicaz pieces (211) is indeed identified as Hicaz again, but some are instead thought by WEKA to be in Zirgüle (11), yet none to be in Uzzal or Hümayun! A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 26d via J48 for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "J48" is a class for generating a pruned or unpruned C4, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         211               64.9231 %
Incorrectly Classified Instances       114               35.0769 %
Kappa statistic                          0.3075
Mean absolute error                      0.1941
Root mean squared error                  0.3946
Relative absolute error                 77.5733 %
Root relative squared error            111.9477 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.752     0.485     0.770      0.752    0.761      0.264    0.662     0.784
Hicaz
                 0.185     0.077     0.179      0.185    0.182      0.106    0.642     0.129
Uzzal
                 0.306     0.116     0.319      0.306    0.313      0.193    0.564     0.205
Hümayun
                 0.889     0.030     0.727      0.889    0.800      0.785    0.933     0.709
Zirgüle
Weighted Avg.    0.649     0.358     0.649      0.649    0.648      0.283    0.668     0.636

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 167  19  29   7 |   a = Hicaz
  19   5   2   1 |   b = Uzzal
  30   3  15   1 |   c = Hümayun
   1   1   1  24 |   d = Zirgüle
```

REMARKS ON TABLE 26d... The output is the same as Table 26b. The correct classification percentage for "J48" is a bit lower in comparison to the previous table (65 %). However, Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are almost entirely grouped under the Zirgüleli Hicaz label as one would expect (24 members in bold). But, there turns out to be some uncertainty where a few may instead be in Hicaz (1), Uzzal (1) and even Hümayun (1).

Furthermore, 1 Uzzal piece is mistaken as Zirgüle; and 1 Hümayun piece is categorized under Zirgüle, too. Most Uzzals, however, are seemingly more conformal with Hicaz (19), while 2 are identified as Hümayun, instead of actually Uzzal (5).

In addition, the majority of Hümayun pieces is catalogued under Hicaz (30) instead of Hümayun (15), while 3 are grouped under Uzzal and even 1 under Zirgüle.

Finally, the bulk of Hicaz pieces (167) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (19) and Hümayun (29), while some are confused as Zirgüle (7).

Though the success rate at overall classification is meager, the fact that Hümayuns and Zirgüles are visibly better recognized for the most part by this algorithm is a promising aspect of the computation.

Table 27d via LMT for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "LMT" is a classifier for building 'logistic model trees', which are classification trees with logistic regression functions at the leaves, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         224               68.9231 %
Incorrectly Classified Instances       101               31.0769 %
Kappa statistic                          0.2246
Mean absolute error                      0.2018
Root mean squared error                  0.3368
Relative absolute error                 80.6458 %
Root relative squared error             95.5468 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area
Class
                 0.901     0.757     0.719       0.901   0.800      0.190    0.628     0.748
Hicaz
                 0.000     0.027     0.000       0.000   0.000      -0.048   0.739     0.201
Uzzal
                 0.061     0.040     0.214       0.061   0.095      0.038    0.686     0.266
Hümayun
                 0.778     0.013     0.840       0.778   0.808      0.792    0.974     0.868
Zirgüle
Weighted Avg.    0.689     0.527     0.594       0.689   0.628      0.197    0.675     0.640

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 200   8  11   3 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  45   0   3   1 |   c = Hümayun
   6   0   0  21 |   d = Zirgüle
```

REMARKS ON TABLE 27d... Results are identical to Table 4b and Table 27b. The correct classification percentage for "LMT" is higher than before (69 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are indeed mostly grouped under the Zirgüleli Hicaz label as one would expect (21 members in bold), with only 6 thought to be in Hicaz. It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle or Hümayun; and only 1 Hümayun piece is categorized under Zirgüle. All Uzzals, however, are seemingly more conformal with Hicaz (27)!

Moreover, the majority of Hümayun pieces is catalogued under Hicaz (45) instead of Hümayun (3), while even 1 is grouped under Zirgüle.

Finally, the bulk of Hicaz pieces (200) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (8) and Hümayun (11), while very few are confused as Zirgüle (3). A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 28d via RandomForest for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RandomForest" is a class for constructing a forest of random trees, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         238               73.2308 %
Incorrectly Classified Instances        87               26.7692 %
Kappa statistic                          0.2382
Mean absolute error                      0.2147
Root mean squared error                  0.3198
Relative absolute error                 85.8218 %
Root relative squared error             90.7162 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.995    0.825    0.722      0.995    0.837      0.338    0.663     0.768
Hicaz
                 0.000    0.000    ?          0.000    ?          ?        0.759     0.170
Uzzal
                 0.041    0.004    0.667      0.041    0.077      0.139    0.753     0.433
Hümayun
                 0.556    0.003    0.938      0.556    0.698      0.704    0.969     0.874
Zirgüle
Weighted Avg.    0.732    0.565    ?          0.732    ?          ?        0.710     0.676

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 221   0   1   0 |   a = Hicaz
  27   0   0   0 |   b = Uzzal
  46   0   2   1 |   c = Hümayun
  12   0   0  15 |   d = Zirgüle
```

REMARKS ON TABLE 28d... The output is the same as Table 28b. "RandomForest"s correct classification percentage is just as high as Table 21d, BEING THE PERCENTAGE OF TRT REPERTORY'S RECURRENT LABELS (73 %), and it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (15 members in bold). However, there still turns out to be some uncertainty, where some of them may instead be in Hicaz (12); yet it is still interesting that none are misidentified as Uzzal.

In addition, no Uzzal piece is mistaken, even as a low probability, as Zirgüle; but all Uzzals are seemingly more conformal with Hicaz (27) according to WEKA.

Similarly, most Hümayun pieces are rather catalogued under Hicaz (46), while only 2 are identified as Hümayun and 1 even as Zirgüle!

This reveals that the melodic contour features are not successful here in distinguishing Uzzal and Hümayun.

Finally, the bulk of Hicaz pieces (221) is indeed identified as Hicaz, but 1 is instead thought by WEKA to be in Hümayun, yet none to be in Uzzal or Zirgüle this time! A much better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 29d via RandomTree for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RandomTree" is a class for constructing a tree that considers K randomly chosen attributes at each node, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         199               61.2308 %
Incorrectly Classified Instances       126               38.7692 %
Kappa statistic                          0.2133
Mean absolute error                      0.1938
Root mean squared error                  0.4403
Relative absolute error                 77.4831 %
Root relative squared error            124.8919 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.752    0.563    0.742      0.752    0.747      0.191    0.595     0.728
Hicaz
                 0.333    0.077    0.281      0.333    0.305      0.237    0.628     0.149
Uzzal
                 0.204    0.116    0.238      0.204    0.220      0.094    0.544     0.169
Hümayun
                 0.481    0.044    0.500      0.481    0.491      0.445    0.719     0.284
Zirgüle
Weighted Avg.    0.612    0.412    0.608      0.612    0.610      0.201    0.600     0.558

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 167  19  29   7 |   a = Hicaz
  16   9   0   2 |   b = Uzzal
  35   0  10   4 |   c = Hümayun
   7   4   3  13 |   d = Zirgüle
```

REMARKS ON TABLE 29d... The output is the same as Table 29b. RandomTree"s correct classification percentage is mediocre (merely 61 %), but it is once more seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (13 members in bold). However, there still turns out to be some uncertainty, where part of them may instead be in Hicaz (7), Uzzal (4) and even Hümayun (3). Zirgüle should particularly not be possible to misidentify as Hümayun, given that their musical scale characteristics visibly differ!

In addition, 2 Uzzal pieces are mistaken as Zirgüle; and 4 Hümayun pieces as Zirgüle, too. Most Uzzals here, however, are instead imagined to be Hicaz (16) instead of actually Uzzal (9).

While the majority of Hümayun pieces is again catalogued under Hicaz (35) instead of Hümayun (10), the fact that none are grouped under Uzzal and only 4 under Zirgüle reveals that the melodic contour features are working to a certain extent to distinguish Hümayun from its relatively distant neighbors.

Finally, the bulk of Hicaz pieces (167) is indeed identified as Hicaz, but some are instead thought by WEKA to be in Uzzal (19) and Hümayun (29), while a handful are confused as Zirgüle (7). Despite the meager success rate at overall classification, the fact that Uzzals and Hümayuns are more pronouncedly recognized by this algorithm is a positive aspect.

Table 30d via RepTree for allHicaz53OctRed-SORTED.csv that attempts a 10-fold cross-validation: "RepTree" is a fast decision tree learner, where the batch size is chosen to be 325.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         227               69.8462 %
Incorrectly Classified Instances        98               30.1538 %
Kappa statistic                          0.1801
Mean absolute error                      0.2218
Root mean squared error                  0.3521
Relative absolute error                 88.6436 %
Root relative squared error             99.8694 %
Total Number of Instances              325

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area
Class
                 0.955    0.825    0.714      0.955    0.817      0.215    0.521     0.692
Hicaz
                 0.000    0.003    0.000      0.000    0.000      -0.017   0.647     0.135
Uzzal
                 0.020    0.011    0.250      0.020    0.038      0.031    0.482     0.145
Hümayun
                 0.519    0.030    0.609      0.519    0.560      0.526    0.865     0.529
Zirgüle
Weighted Avg.    0.698    0.568    0.576      0.698    0.610      0.194    0.554     0.549

=== Confusion Matrix ===

   a   b   c   d   <-- classified as
 212   1   3   6 |   a = Hicaz
  26   0   0   1 |   b = Uzzal
  46   0   1   2 |   c = Hümayun
  13   0   0  14 |   d = Zirgüle
```

REMARKS ON TABLE 30d... The output is the same as Table 30b. The correct classification percentage for "RepTree" is appreciably higher than before (70 %), and it is seen that Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are mostly grouped under the Zirgüleli Hicaz label as one would expect (14 members in bold), while almost as much are yet confounded with Hicaz (13). It is surprising that WEKA thinks some Zirgüle pieces are close to Hicaz but none to Uzzal, where the latter two makams (Hicaz and Uzzal) rely on the same theoretical musical scale!

In addition, 1 Uzzal piece is mistaken as Zirgüle; and 2 Hümayun pieces are categorized under Zirgüle, too. The remaining Uzzals here, however, are instead imagined to be Hicaz (26) instead. It is not realistic that Uzzal should easily be confounded with Hicaz on such a large scale!

Similarly, most Hümayun pieces are catalogued under Hicaz (47) instead of actually Hümayun (1), while 2 are even confounded with Zirgüle!

Finally, the bulk of Hicaz pieces (212) is indeed identified as Hicaz, but a miniscule portion is instead thought by WEKA to be in Uzzal (1), Hümayun (3) and even Zirgüle (6), A better success rate at overall classification is compounded by the fact that Uzzals and Hümayuns are obviously misclassified by this algorithm.

Table 31d via either Canopy (for clustering data using the canopy clustering algorithm, which requires just one pass over the data) OR Cobweb (that is a class implementing the Cobweb and Classit clustering algorithms) for allHicaz53OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0      325 (100%)


Class attribute: LABEL
Classes to Clusters:

   0  <-- assigned to cluster
 222 | Hicaz
  27 | Uzzal
  49 | Hümayun
  27 | Zirgüle

Cluster 0 <-- Hicaz

Incorrectly clustered instances :     103.0    31.6923 %
```

REMARKS ON TABLE 31d... The output is the same as Table 31a, Table 31b and Table 31c. While the percentage of incorrectly clustered instances for either "Canopy" OR "Cobweb" is appreciably low (32 %), one immediately notices that all the pieces of the dataset are straightly assigned to the Hicaz cluster!

The only thing worthwhile to remark about the clearly failed approaches at hand is the proportion of the pieces distributed under such a single category. Obviously, WEKA thinks that the majority of Hicaz pieces (222) is indeed befittingly labelled under the Hicaz cluster, whereas only 27 Uzzal, 49 Hümayun and 27 Zirgüle pieces are deemed to belong to the same category.

Aside from the deceptive success rate at overall classification, the fact that all the pieces are squashed under a single label with these algorithms is a troubling aspect.

Therefore, the aforesaid computational models do not appear to utilize the melodic contour features properly to distinguish the dataset in terms of pinpointing the correct makam categories for the batch of 325 'Hicaz family' pieces.

Table 32d via Simple EM (expectation maximisation) class for allHicaz53OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0       41 ( 13%)
1       40 ( 12%)
2      244 ( 75%)


Log likelihood: 1640.7558


Class attribute: LABEL
Classes to Clusters:

   0   1   2  <-- assigned to cluster
  18  30 174 | Hicaz
   0   5  22 | Uzzal
  11   3  35 | Hümayun
  12   2  13 | Zirgüle

Cluster 0 <-- Zirgüle
Cluster 1 <-- Uzzal
Cluster 2 <-- Hicaz

Incorrectly clustered instances :     134.0    41.2308 %
```

REMARKS ON TABLE 32d... The output is the same as Table 32b. The percentage of incorrectly clustered instances for "Simple EM (expectation maximization)" is middling (41 %). Here, one may see that 18 Hicaz pieces, no Uzzal pieces, 11 Hümayun pieces and 12 Zirgüle pieces are assigned to the Zirgüle (a.k.a. Hicaz-Zirgüle) cluster. The total number thought by WEKA to be Zirgüle is hence 41.

While such a low number may seem reasonable, Simple EM seems very much confused about differentiating especially individual Hümayuns from its kindred polar opposites, as there was no discovered Hümayun category to begin with! In addition, 30 Hicaz pieces, 5 Uzzal pieces, 3 Hümayun pieces and 3 Zirgüle pieces were thought to be belonging to the Uzzal cluster (totalling 40 pieces). Individual Uzzals should not be possible to so easily confound with Hümayun and Zirgüle!

Finally, 174 Hicaz pieces, 22 Uzzal pieces, 35 Hümayun pieces and 13 Zirgüle pieces were imagined by WEKA to belong to the Hicaz cluster (totalling 244 pieces). This seems more meaningful at a first glance, since individual Zirgüle pieces are indeed very diminutively attributed to the either the Zirgüle or Hicaz clusters akin to 0 individual Uzzal pieces for the Zirgüle cluster. Yet, if individual Hümayuns are so easily identifiable with Hicaz instead, why not more individual Uzzals, too?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in this clustering algorithm is a troubling aspect.

This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish the makams of the 'Hicaz family' from each other.

Table 33d via either FarthestFirst (for clustering data using the FarthestFirst algorithm) OR HierarchicalClusterer (which is a hierarchical clustering class) that uses "EuclideanDistance", implementing Euclidean distance (or similarity) function, for allHicaz53OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0      324 (100%)
1        1 (  0%)


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
 221   1 | Hicaz
  27   0 | Uzzal
  49   0 | Hümayun
  27   0 | Zirgüle

Cluster 0 <-- Hicaz
Cluster 1 <-- No class

Incorrectly clustered instances :     104.0    32      %
```

REMARKS ON TABLE 33d... The output is the same as Table 33a, Table 33b and Table 33c. While the percentage of incorrectly clustered instances for either "FarthestFirst" or "HierarchicalClusterer" is appreciably low (32 %), one immediately notices that the majority of pieces of the dataset is straightly assigned to the Hicaz cluster, and only 1 Hicaz is singled out as belonging to "no class"!

The only thing worthwhile to remark about these failed approaches is the proportion of the pieces distributed under such a single category. Obviously, WEKA thinks that, aside from the singled out 1 Hicaz piece of "no class", the majority of Hicaz pieces (221) is indeed befittingly labelled under the Hicaz cluster, whereas only 27 Uzzal, 49 Hümayun and 27 Zirgüle pieces are deemed to belong to the same category.

Aside from the deceptive success rate at overall classification, the fact that the majority of pieces is squashed under a single label with the given algorithms is a troubling aspect.

Therefore, neither FarthestFirst nor HierarchicalClusterer appear to utilize the melodic contour features properly to distinguish the dataset in terms of pinpointing the correct makam categories for the batch of 325 'Hicaz family' pieces.

Table 34d via either FilteredClusterer (which is a class for running an arbitrary clusterer on data that has been passed through an arbitrary filter) with "SimpleKMeans" (that clusters data using the k means algorithm) contingent upon "EuclideanDistance", implementing Euclidean distance (or similarity) function, coupled with AllFilter (an instance filter that passes all instances through unmodified), OR SimpleKMeans (for clustering data using the k means algorithm) that uses "EuclideanDistance", implementing Euclidean distance (or similarity) function, for allHicaz53OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted.

```
=== Model and evaluation on training set ===

Clustered Instances

0       129 ( 40%)
1       196 ( 60%)


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
  80 142 | Hicaz
   3  24 | Uzzal
  33  16 | Hümayun
  13  14 | Zirgüle

Cluster 0 <-- Hümayun
Cluster 1 <-- Hicaz

Incorrectly clustered instances :     150.0    46.1538 %
```

REMARKS ON TABLE 34d... The percentage of incorrectly clustered instances for either "FilteredClusterer" or "SimpleKMeans" is middling (46 %). Here, one may see that 80 Hicaz pieces, 3 Uzzal pieces, 33 Hümayun pieces and 13 Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are problematically assigned to the Hümayun cluster. The total number thought by WEKA to be Hümayun is hence 129.

While the distribution of pieces under such a Hümayun clustering might seem reasonable, these algorithms appear to be very much confused about differentiating especially individual Uzzals from Hicaz, as there was no discovered Uzzal category to begin with!

In addition, 142 Hicaz pieces, 24 Uzzal pieces, 16 Hümayun pieces and 14 Zirgüle pieces were thought to belong to the Hicaz cluster (totalling 196 pieces). Individual Hümayuns should especially not be possible to so easily confuse with a Hicaz moniker!

While individual Zirgüle pieces are indeed very diminutively attributed to either the Hümayun cluster or the Hicaz cluster in comparison to the rest of the analyzed items, so are individual Uzzal pieces! If individual Hümayuns are so easily identifiable with the Hümayun cluster, why are individual Uzzals numbering rather few under the Hicaz cluster?

Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in these clustering algorithms is a troubling aspect.

Said algorithms therefore do not appear to utilize the melodic contour features properly to distinguish especially Uzzal from the other members of the 'Hicaz family'.

Table 35d via MakeDensityBasedClusterer (which is a class for wrapping a Clusterer to make it return a distribution and density) for allHicaz53OctRed-SORTED.csv, where a "classes to clusters" evaluation is attempted; it uses "SimpleKMeans" (that clusters data using the k means algorithm) contingent upon "EuclideanDistance", implementing Euclidean distance (or similarity) function.

```
=== Model and evaluation on training set ===

Clustered Instances

0       63 ( 19%)
1      262 ( 81%)


Log likelihood: 1618.70614


Class attribute: LABEL
Classes to Clusters:

   0   1  <-- assigned to cluster
  40 182 | Hicaz
   0  27 | Uzzal
  14  35 | Hümayun
   9  18 | Zirgüle

Cluster 0 <-- Hümayun
Cluster 1 <-- Hicaz

Incorrectly clustered instances :     129.0    39.6923 %
```

REMARKS ON TABLE 35d... The percentage of incorrectly clustered instances for "MakeDensityBasedClusterer" is middling, too (40 %). Here, one may see that 40 Hicaz pieces, 0 Uzzal pieces, 14 Hümayun pieces and 9 Zirgüle (a.k.a. Hicaz-Zirgüle) pieces are problematically assigned to the Hümayun cluster. The total number thought by WEKA to be Hümayun is hence 63.

While the distribution of pieces under such a Hümayun clustering might seem reasonable, this algorithm appears to be very much confused about differentiating especially individual Uzzals from Hicaz, as there was no discovered Uzzal category begin with!

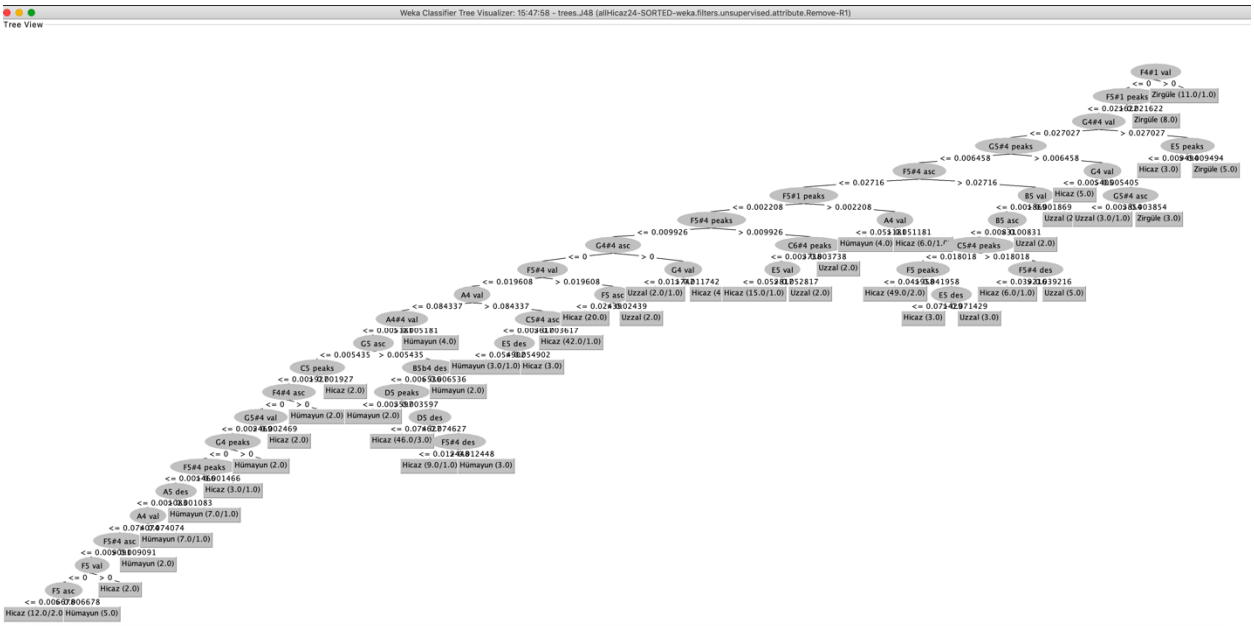
In addition, 182 Hicaz pieces, 27 Uzzal pieces, 35 Hümayun pieces and 18 Zirgüle pieces were thought to belong to the Hicaz cluster (totalling 262 pieces). Individual Hümayuns should especially not be possible to so easily confuse with a Hicaz moniker!

While individual Zirgüle pieces are indeed very diminutively attributed to either the Hümayun cluster or the Hicaz cluster in comparison to the rest of the analyzed items, so are individual Uzzal pieces! Moreover, if individual Hümayuns are so easily identifiable with the Hümayun cluster, why are there more individual Hümayuns under the Hicaz cluster?

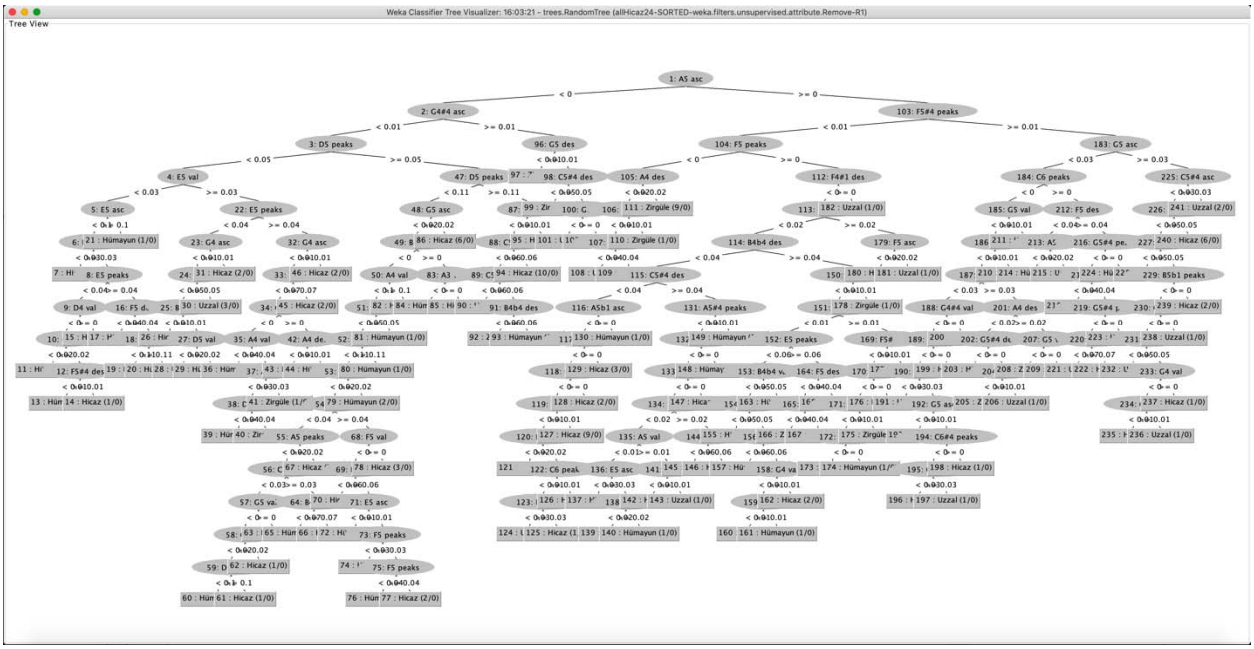
Not only is the success rate at overall classification questionable, but the fact that so much uncertainty exists in this clustering algorithm is a troubling aspect.

This algorithm therefore does not appear to utilize the melodic contour features properly to distinguish especially Uzzal from the other members of the 'Hicaz family'.

Graphic 1: Screenshot of the J48 algorithm's tree branching analysis from the melodic contour features of allHicaz24-SORTED.csv



Graphic 2: Screenshot of the RandomTree algorithm's tree branching analysis from the melodic contour features of allHicaz24-SORTED.csv



OUR FINAL REMARKS ON THE ANALYSIS OF THE DATASET ARE AS FOLLOWS...

The separately analyzed 4 comma seperated values (.csv) master files did not result in fundamentally different outputs for any given algorithm. They only seem to have made a minute difference in most cases (slightly scrambling a previous panorama), and a barely significative difference in makam distributions with respect to clustering.

JRip classifier's distribution is rather appreciable for especially allHicaz24-SORTED.csv, with a 73 % correct classification success rate. It appears to more successfully pinpoint Uzzals and Hümayuns while attributing a huge chunk of Hicaz to the Hicaz category and many Zirgüles to the Zirgüle category. However, octave-reducing the standard Arel-Ezgi-Uzdilek scheme or picking 53-tET versions of the relevant master comma seperated values files adversely affected the panorama presented by JRip.

Many algorithms with a similar concordance were anyway found to be IN LINE WITH THE PERCENTAGE OF RECURRENTLY LABELLED ENTRIES OF THE TRT REPERTORY.

An additional observation is this... Most of the time, a higher classification success rate comes at the cost of confusing Uzzals and Hümayuns with other categories (*viz.*, Hicaz class or Zirgüle class). Also, a lower success rate may generally hint at how many Uzzals and Hümayuns come to indeed correctly belong to their designated categories.

Clusterers are, in the end, cryptic and enigmatic. Compared to the regular classifiers, we have reservations about taking them as a serious basis for the meaningful categorization of the 325 'Hicaz family' pieces.

It must also be mentioned that ancillary attempts by M. K. Karaosmanoğlu, who later excused himself from this project, to filter out only those "limma to augmented second intervals" from out of the 'trigram melodic contour extraction' procedure in order to search for ways to improve the classification success rate, did not offer tangible benefits.

V. An inconclusive wrap-up: 'Hicaz family' members could in fact be hybrid makams

Recurrently labelled pieces of the 'Hicaz family' across the TRT repertory (as made available under Notam.exe by the TRT employee Aytaç Ergen) were seen to be **73 percent** of the whole batch by a very generous screening approach, where the first co-author included under, for example, the Hicaz makam denomination such ambiguous labels as "Hicaz (Uzzal)" and "Garip Hicaz", too.

It was then seen that certain heuristically deployed Machine Learning algorithms under WEKA also yielded **73 percent** correct classification rates, justifying the suspicion that 'Hicaz family' makams might actually be hybridized for the most part (*viz.*, a Hicaz piece is perhaps almost never 100 percent in the theoretical idiom of Hicaz, but can be said to be, for instance, 75 percent in CORE Hicaz and 25 percent in CORE Uzzal).

On the other hand, our 6 anonymized experts remarkably displayed even more corporeal disagreement about what is Hicaz, what is Uzzal, what is Hümayun, *etc*...

Links to the relevant tables detailing makam labellings by hand for the batch of 325 'Hicaz family' pieces from the TRT repertory (that even to this day remains in relative disarray) and which demonstrate the aforementioned experts' lack of congruence overall were shared above.

Faced with the dilemma that

i) contemporaneous experts widely disagree,
ii) the TRT repertory is ridden with questionable labelling,
iii) our computational models evince no greater success rate than about 75 percent in auto-classifications,

the authors of this report are led to believe that certain makams are, in actuality, structurally ingrained with snippets (or rather "AROMAS") of other makams. That is why we are inclined to assert that any given piece of the 'Hicaz family' denomination might in fact more correctly be in, say, "75 percent CORE Hicaz, 25 percent CORE Uzzal", for example.

This is also how we wish to interpret the ambiguous labels of the TRT repertory, as well as the variegated expert responses, where one chances upon such monikers as 'Hicaz (Uzzal)' and 'Hicaz (Hümayun)'.

Further thoughts to train WEKA's Machine Learning tools based on a "regression model" where one omits the final step of choosing the best outcome could possibly vindicate this insight.

To summarize... The obtained results seem, at least on the surface, to be somewhat convoluted. We have mediocre agreement among our experts. We also did not deeply question how the experiments were conducted. What specific instructions were the experts given, if any? How did they listen to the pieces? What external information did they have access to? How were the pieces selected for inclusion in the dataset? What criteria did the experts use to determine *Hicaz-ness*? These are all quandaries that must be further investigated to try to understand why modern opinions diverged so greatly as compared to the older, and seemingly more reliable, TRT repertory labellings.

Be that as it may, perhaps less faith should be placed in the abilities of contemporaneous executants and theorists, who are likely to be affected by modern adverse influences, in opposition to advanced Machine Learning tools that seem to yield more promising outcomes in line with the older TRT repertory tags.

Notice, in addition, that we also exercised a couple of different automatic clustering methods under WEKA that nonetheless performed somewhat poorly. So let’s say our experts have opinions on various Hicaz grouping of makams, and our algorithms have opinions on the same makams. Who is right? How can we know where the "correct" answer is? It would seem that we cannot. So one might ask a question like: "What aspects of the music (whether sheet, recording, midi file, or whatever) are being used by the experts and by the algorithms?"

One possible frame to hack at the problem is from the lens of music perception. It may be likely that one sub-group of experts/algorithms focuses on "listening" to one aspect of the music, while another sub-group focuses their attention on another aspect. One might also think that such an observation can be generalized to other contexts, or that it may tell us something about how (different) people listen (differently).

VI. Recommendations for future researchers

Aside from the respectable performance of some WEKA categorization runs whose congruence is in line with the older TRT labellings, when faced with the failure to balance "the awkward picture generated by human tagging efforts" with heuristic Machine Learning auto-classifications in a confident manner, the final panorama seems to suggest that the best algorithms at our disposal are not very different in their behavior from the experts: They appear to classify the same pieces of the 'Hicaz family' with conflicting labels in the end; so Machine Learning appears to promote no better consensus than does tagging by human hands in general, and one eventually comes back to the "who is right?" question...

Basically, we reached a point where a denomination like "Hicaz (in the theoretical sense)" could, in fact, be too simple. In reality, "Hicaz" could be a collection of related makam designations. One may take this and see if one can devise a test. In the case where all 6 consulted experts agree, one can say that the makam is unequivocally in Hicaz; maybe "core" or "central" Hicaz. But when they disagree, a histogram from the 6 responses can be constructed.

Following the suggestion as to "66 percent in CORE Hicaz (*Yüzde 66 Hicaz AROMALI*), 33 percent in CORE Uzzal (*Yüzde 33 Uzzal AROMALI*)", one might imagine that 4 of the experts said Hicaz and 2 said Uzzal… then one could imagine that the "ground truth" answer for this piece should be a vector 2/3 Hicaz and 1/3 Uzzal. One could hence train the network (beyond a simple classifier) to identify the hybridization percentage of each makam type.

In fact, this is the way that many classifiers work: They calculate all the probabilities and then choose the largest. So one would really just be removing the final classification step — basically turning things into a regression model.

So — *if* one can get significantly closer to the experts using such an algorithm, this would be a kind of "proof" that the original classification idea is too simple, and that the family of makams is indeed characterized by multiple CORE members in some kind of proportion.

The problem then becomes this: "By what criteria should the classification be made?" and "what therefore is the ground truth?"... To put it in other words, "How do we know that one of the experts might be correct in all things, and that the others are wanting, including the automated methods?"

Obviously the authors and participants of this study did not get anywhere concrete despite their best efforts. So, we underline that the obtained findings are inconclusive at this stage, and that there might be many factors at play, indicating how the task at hand is rather difficult to solve.

It should nevertheless be remarked that the desire to prioritize contemporaneous experts as arbitrators for the establishment of "ground truth" seems to diminish in favor of computational approaches that promise better yields in line with the older TRT repertory labellings.

This could hint at even more issues to take into account regarding the possible adverse nature of reformist or modern influences on traditional music-making endeavors in Türkiye.

VII. Acknowledgements

We graciously thank Assoc. Prof. Dr. Mustafa Kemal Karaosmanoğlu (retired from YTÜ) and our anonymized experts F., Z., L., B., N. and M. stimulated by him, who spent valuable time trying to categorize the 325 'Hicaz family' pieces that have been analyzed in this contribution. We recognize that it was no easy task, and the diverging views on this matter evoke more questions that should motivate other researchers to investigate further. We also extend our gratitude to Prof. Dr. Sıddık Binboğa Yarman and his colleagues for showing interest in advancing the study at hand by the suggestion to utilize their novel "Sympes" encoding-decoding technology, even if it bore no fruit, and even though it is primarily meant for audio/video signal processing.

VIII. References

Yarman et al., 2020, "*An Investigation of the Role of Diatonic Functions in the Seyir Phenomenon of Turkish Makam Music: Case of 'Hicaz Family'*", DYUMM conference proceedings, 292-340: http://www.ozanyarman.com/files/DrOz_perde-seyirV14-ENSON.pdf

NOTAM.EXE is a Windows program privately made available by the TRT Employee Aytaç Ergen. He had personally scanned thousands of pages and made the whole TRT repertory available as a single digital archive thanks to basic programming help from his colleagues.

Mus2okur from DataSoft, as spearheaded by M. K. Karaosmanoğlu, is the preliminary stepping stone and inspiration for SymbTR. Link to it is: http://www.data-soft.com.tr/mus2okur.html

SymbTR is the open-source continuation of Mus2okur. It is a machine-readable database of Turkish Classical and Folk music pieces. The website, as maintained by M. K. Karaosmanoğlu and his colleagues, is accessible here: https://github.com/MTG/SymbTr

WEKA is the abbreviation for "University of *Waikato*, New Zealand, *Environment* for *Knowledge Analysis*". It can be downloaded from here: https://sourceforge.net/projects/weka

Wolfram Mathematica is a powerhouse for diverse mathematical operations. It can be downloaded from this link: https://www.wolfram.com/mathematica

IX. Appendix A: Completing the number of 'Hicaz family' pieces to 325

The following final entries to the batch of 325 'Hicaz family' pieces were faithfully re-transcribed by the first co-author via Datasoft's *Mus2* score editor in the face of the lack of updates to the SymbTR database of late by Assoc. Prof. Dr. M. K. Karaosmanoğlu:

Tende Cânım	hicaz_zirgule--tevsihilahi--evsat_4--tende_canim--calakzade_mustafa_efendi
Hicaz Seyir from İslam Ansiklopedisi	hicaz--seyir--duyek--1--ismail_hakki_ozkan
Hicaz-Zirgüle Sazsemâîsi	hicaz_zirgule--sazsemaisi--aksaksemai--1--ferit_sidal
Hicaz-Hümâyûn Seyir from İslam Ansiklopedisi	hicaz_humayun--seyir--duyek--1--ismail_hakki_ozkan
Hicaz-Zirgüle Seyir from İslam Ansiklopedisi	hicaz_zirgule--seyir--duyek--1--ismail_hakki_ozkan
Hicaz-Uzzâl Seyir from İslam Ansiklopedisi	hicaz_uzzal--seyir--duyek--1--ismail_hakki_ozkan
Guruba Yaklaşan Ömür	hicaz_zirgule--sarki--duyek--guruba_yaklasan--alaeddin_yavasca
Hiç Bulunmaz Akrânı	hicaz_zirgule--ilahi--sofyan--hic_bulunmaz--husnu_sarier
Ödemiş Bağlarında	hicaz_zirgule--zeybek--agiraksak--odemis_baglarinda--neveser_kokdes
Ey Sevgilim	hicaz_zirgule--sarki--aksak--ey_sevgilim--erdinc_celikkol
Âşıklarının Haline Ey	hicaz_humayun--agirsemai--aksaksemai--asiklarinin_haline--haci_faik_bey
Âlemde Ey	hicaz_zirgule--sarki--aksak--alemde_ey--haci_faik_bey
İçimdeki Aşkın	hicaz_zirgule--sarki--duyek--icimdeki_askin--muzaffer_ilkar
Bakışların Kıvılcım	hicaz_zirgule--sarki--nimsofyan--bakislarin_kivilcim--alaeddin_yavasca
Kûşe-i Nisyana	hicaz_uzzal--sarki--devrihindi--kuse-i_nisyana--aleko_bacanos
Hicaz-Zirgüle Sazsemâîsi	hicaz_zirgule--sazsemaisi--aksaksemai----nayi_osman_dede
Eyâ Âlemlerin Şahı	hicaz_uzzal--ilahi--sofyan--eya_alemlerin--dede_efendi
Hicaz-Uzzâl Peşrev	hicaz_uzzal--pesrev--duyek--1--kanuni_mehmed_bey
Zevk-i Sevda Duymadın	hicaz_uzzal--sarki--agiraksak--zevk-i_sevda--leyla_saz
Evimizin Direğisin	hicaz_zirgule--sarki--semai--evimizin_diregisin--danyal_manti
Bahçelerde Mor Meni	hicaz--turku--nimsofyan--bahcelerde_mor--istanbul

X. Appendix B: Excel MACRO code by ChatGPT for normalizing row sum values to 1

The Microsoft EXCEL Macro code below was written by ChatGPT-4o upon request, which enormously facilitated the correct normalization of each row of the 4 main spreadsheets that contained the melodic contour information for every single piece of the dataset made up of 325 'Hicaz family' pieces:

```
Sub NormalizeRows()
    Dim ws As Worksheet
    Dim rng As Range
    Dim cell As Range
    Dim rowSum As Double
    Dim i As Long, j As Long
    Dim firstRow As Long, lastRow As Long
    Dim firstCol As Long, lastCol As Long
```

```
    ' Set the worksheet you want to normalize
    Set ws = ThisWorkbook.Sheets("Sheet") ' Change "Sheet" to your sheet name

    ' Define the range of rows and columns to normalize AFTER DELETING THE FIRST
EMPTY ROW DUE TO CONVERSION FROM APPLE NUMBERS AND TEMPORARILY
DELETING THE LAST COLUMN OF LABELS
    ' Change these values to your specific range
    firstRow = 2
    lastRow = ws.Cells(ws.Rows.Count, 1).End(xlUp).Row
    firstCol = 2
    lastCol = ws.Cells(1, ws.Columns.Count).End(xlToLeft).Column

    ' Loop through each row in the specified range
    For i = firstRow To lastRow
        ' Calculate the sum of the row
        rowSum = 0
        For j = firstCol To lastCol
            rowSum = rowSum + ws.Cells(i, j).Value
        Next j

        ' Normalize each cell in the row if the row sum is not zero
        If rowSum <> 0 Then
            For j = firstCol To lastCol
                ws.Cells(i, j).Value = ws.Cells(i, j).Value / rowSum
            Next j
        End If
    Next i

    MsgBox "Normalization complete!", vbInformation
End Sub
```

XI. Appendix C: List of LINKS to downloadables mentioned in this report

Machine Learning computations shared herein depended on the available traditional Turkish music symbolic representation data in SymbTR format. With respect to the 325 'Hicaz family' items used in this study, the pertinent SymbTR files are downloadable FROM THIS LINK.

The Mathematica code written by the second co-author that extracts novel melodic contour features from the SymbTR files and creates the 4 master comma seperated values files is given IN THIS LINK.

The 4 master comma seperated values files produced, as such, by the said code for use in WEKA can be downloaded FROM HERE. Bear in mind that each row of every file had to be normalized to 1 using the previously mentioned EXCEL Macro code by ChatGPT.

In addition, the first co-author labored extensively to make a sensible categorization of all the existing transcriptions of the 325 'Hicaz family' pieces in the extant TRT repertory. Thankfully, this was facilitated through the NOTAM.EXE program by Aytaç Ergen. Makam tags across several different scores for each piece hence resulted in a spreadsheet that can be dowloaded HERE.

A similar file displaying only the recurrently labelled entries can be downloaded FROM THIS LINK. The recurrent instances are **73 percent** of the whole collection, which is in line with some of the computational musicology findings yielding similar classification success rates.

Finally, the spreadsheet painstakingly organized by M. K. Karaosmanoğlu that lays out human tagging efforts by 6 anonymized experts (F., Z., L., B., N. and M., who spent valuable time trying to categorize the 325 'Hicaz family' pieces) is downloadable HERE. The overall consensus among all or almost all participants in terms of tagging a piece as the same makam was at the level of **20 percent**.