

CS419 Digital Image and Video Analysis Assignment 3

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1 Explanations

I first created the feature set below and extracted the information for all 700 training images.

```
features = ['area', 'perimeter', 'convexity', 'circularity', 'rectangularity', 'eccentricity',  
            'fourier_5', 'fourier_10', 'fourier_15', 'fourier_20', 'fourier_25',  
            'hist_5', 'hist_10', 'hist_15', 'hist_20', 'hist_25',  
            'hu_moments', 'zernike_moments', 'central_moments']
```

In order to test which features perform better and eliminate some of them based on that I created many subsets with 3 elements from this feature set. I tested the corresponding accuracies for these sets while also rotating through the distance metrics. The corresponding results for this first experiment is in Appendix 1.

The results showed me that eccentricity, and zernike moments don't do much for the classification task. So I removed them from the further experiments. I also analyzed the different versions of fourier and shape histograms from this data and decided that histogram with 10 bins and fourier with 10 coefficients performed the best.

In light of that I then modified the code to check every subset of 4 or more elements in the feature set below. I also did not want multiple moment descriptors to be picked as they are correlated within, so I discarded the subsets that had both the central moments and the hu moments.

```
features = ['area', 'perimeter', 'convexity', 'circularity', 'rectangularity',  
            'fourier_10', 'hist_10', 'hu_moments', 'central_moments']
```

I then started the code and let it run while I was at the tuesday lecture. After 5 hours of running I got the csv showing me the results for all possible 1048 combinations. I discarded some of the results and put the rest in Appendix 2.

In conclusion, according to my observations fourier descriptors with 10 coefficients and shape histograms with 10 bins performed the best. For the distance metrics mahalanobis was by far the superior one as it considers the correlation matrix while calculating the distances. Manhattan came in as the close second, euclidean was the third and chisquared was by far the worst as it didn't give a single decent result.

Correction: It has a single decent result when the subset is convexity, rectangularity, hist 10, hu moments. It is a mystery.

Other than that the best feature subsets are the following with 0.71 accuracy using the mahalanobis distance.

- area-convexity-circularity-rectangularity-hist_10-central_moments
- area-perimeter-convexity-circularity-rectangularity-hist_10
- perimeter-convexity-circularity-rectangularity-hist_10-central_moments
- area-perimeter-convexity-circularity-rectangularity-hist_10-hu_moments
- area-perimeter-convexity-circularity-rectangularity-hist_10-central_moments

As can be observed, area, convexity, circularity, rectangularity, 10 bin shape histograms, central and hu moments are the mainly common ones making them good descriptors for the image set.

2 Appendix

2.1 First Batch of Trials

Subset	Distance Metric	Accuracy
area-convexity-hist_10	mahalanobis	0.6428571428571429
area-hist_5-central_moments	mahalanobis	0.6357142857142857
area-rectangularity-hist_10	mahalanobis	0.6271428571428571
perimeter-convexity-hist_10	mahalanobis	0.6271428571428571
area-hist_10-central_moments	mahalanobis	0.6257142857142857
perimeter-rectangularity-hist_10	mahalanobis	0.6214285714285714
area-convexity-central_moments	mahalanobis	0.6185714285714285
perimeter-eccentricity-hist_10	mahalanobis	0.6142857142857143
area-convexity-hist_5	mahalanobis	0.6142857142857143
area-circularity-hist_10	mahalanobis	0.6114285714285714
area-eccentricity-hist_10	mahalanobis	0.61
area-rectangularity-hist_5	mahalanobis	0.61
area-perimeter-hist_10	mahalanobis	0.61
area-hist_10-hu_moments	mahalanobis	0.6085714285714285
perimeter-rectangularity-hist_5	mahalanobis	0.6085714285714285
perimeter-circularity-hist_5	mahalanobis	0.6057142857142858
perimeter-circularity-hist_10	mahalanobis	0.6042857142857143
area-eccentricity-hist_5	mahalanobis	0.6042857142857143
perimeter-convexity-hist_5	mahalanobis	0.6028571428571429
area-circularity-hist_5	mahalanobis	0.6014285714285714
area-convexity-hu_moments	mahalanobis	0.6014285714285714
perimeter-eccentricity-hist_5	mahalanobis	0.5942857142857143
perimeter-convexity-central_moments	mahalanobis	0.5942857142857143
area-circularity-central_moments	mahalanobis	0.5928571428571429
area-rectangularity-central_moments	mahalanobis	0.5914285714285714
area-hist_15-central_moments	mahalanobis	0.59
area-perimeter-hist_5	mahalanobis	0.59
area-perimeter-central_moments	mahalanobis	0.59
area-perimeter-fourier_15	manhattan	0.5885714285714285
area-fourier_25-hist_10	manhattan	0.5871428571428572
area-fourier_15-hist_25	manhattan	0.5871428571428572
area-rectangularity-fourier_15	manhattan	0.5871428571428572
area-eccentricity-fourier_25	manhattan	0.5871428571428572
area-circularity-fourier_25	manhattan	0.5871428571428572
area-circularity-fourier_15	manhattan	0.5871428571428572
area-fourier_15-hist_5	manhattan	0.5871428571428572
area-fourier_15-hist_10	manhattan	0.5871428571428572
area-fourier_15-hist_15	manhattan	0.5871428571428572
area-fourier_15-hist_20	manhattan	0.5871428571428572
area-fourier_25-zernike_moments	manhattan	0.5871428571428572
area-fourier_25-hist_5	manhattan	0.5871428571428572
area-fourier_15-zernike_moments	manhattan	0.5871428571428572
area-convexity-fourier_15	manhattan	0.5871428571428572
area-fourier_25-hu_moments	manhattan	0.5871428571428572
area-fourier_25-hist_25	manhattan	0.5871428571428572
area-convexity-fourier_25	manhattan	0.5871428571428572
area-fourier_25-hist_20	manhattan	0.5871428571428572
area-fourier_25-hist_15	manhattan	0.5871428571428572
area-eccentricity-fourier_15	manhattan	0.5871428571428572
area-rectangularity-fourier_25	manhattan	0.5871428571428572
area-fourier_15-hu_moments	manhattan	0.5871428571428572

area-perimeter-fourier_10	manhattan	0.5871428571428572
area-perimeter-fourier_20	manhattan	0.5871428571428572
area-perimeter-fourier_25	manhattan	0.5871428571428572
area-rectangularity-fourier_10	manhattan	0.5857142857142857
area-fourier_10-zernike_moments	manhattan	0.5857142857142857
area-fourier_10-hu_moments	manhattan	0.5857142857142857
area-fourier_10-hist_25	manhattan	0.5857142857142857
area-circularity-fourier_10	manhattan	0.5857142857142857
perimeter-circularity-central_moments	mahalanobis	0.5857142857142857
area-convexity-fourier_10	manhattan	0.5857142857142857
area-fourier_10-hist_20	manhattan	0.5857142857142857
area-fourier_10-hist_15	manhattan	0.5857142857142857
area-fourier_10-hist_10	manhattan	0.5857142857142857
area-fourier_10-hist_5	manhattan	0.5857142857142857
area-eccentricity-fourier_10	manhattan	0.5857142857142857
perimeter-eccentricity-central_moments	mahalanobis	0.5857142857142857
area-fourier_20-hist_5	manhattan	0.5842857142857143
area-fourier_20-zernike_moments	manhattan	0.5842857142857143
area-fourier_20-hu_moments	manhattan	0.5842857142857143
area-fourier_20-hist_25	manhattan	0.5842857142857143
area-fourier_20-hist_20	manhattan	0.5842857142857143
area-circularity-fourier_20	manhattan	0.5842857142857143
area-convexity-fourier_20	manhattan	0.5842857142857143
area-fourier_20-hist_15	manhattan	0.5842857142857143
area-fourier_20-hist_10	manhattan	0.5842857142857143
area-eccentricity-fourier_20	manhattan	0.5842857142857143
area-rectangularity-fourier_20	manhattan	0.5842857142857143
area-hist_5-hu_moments	mahalanobis	0.5742857142857143
area-convexity-hist_15	mahalanobis	0.5728571428571428
perimeter-rectangularity-central_moments	mahalanobis	0.5728571428571428
perimeter-convexity-hist_15	mahalanobis	0.57
area-perimeter-fourier_5	manhattan	0.57
area-fourier_5-hist_20	manhattan	0.5685714285714286
area-eccentricity-fourier_5	manhattan	0.5685714285714286
area-rectangularity-fourier_5	manhattan	0.5685714285714286
area-fourier_5-hist_5	manhattan	0.5685714285714286
area-fourier_5-hist_10	manhattan	0.5685714285714286
area-fourier_5-hist_15	manhattan	0.5685714285714286
perimeter-rectangularity-hist_15	mahalanobis	0.5685714285714286
area-fourier_5-hist_25	manhattan	0.5685714285714286
area-fourier_5-zernike_moments	manhattan	0.5685714285714286
area-convexity-fourier_5	manhattan	0.5685714285714286
area-circularity-fourier_5	manhattan	0.5685714285714286
area-fourier_5-hu_moments	manhattan	0.5685714285714286
perimeter-circularity-hu_moments	mahalanobis	0.5671428571428572
area-rectangularity-hist_15	mahalanobis	0.5671428571428572
area-rectangularity-hu_moments	mahalanobis	0.5657142857142857
area-convexity-eccentricity	mahalanobis	0.5657142857142857
perimeter-circularity-eccentricity	mahalanobis	0.5614285714285714
area-eccentricity-central_moments	mahalanobis	0.5614285714285714
area-fourier_20-hist_20	euclidean	0.56
area-fourier_20-hist_25	euclidean	0.56
area-fourier_20-hist_15	euclidean	0.56
area-fourier_20-hu_moments	euclidean	0.56
area-fourier_20-hist_10	euclidean	0.56
area-fourier_20-hist_5	euclidean	0.56

area-fourier_20-zernike_moments	euclidean	0.56
area-fourier_25-hu_moments	euclidean	0.56
area-fourier_25-hist_25	euclidean	0.56
area-rectangularity-fourier_25	euclidean	0.56
area-rectangularity-fourier_20	euclidean	0.56
area-eccentricity-fourier_20	euclidean	0.56
area-eccentricity-fourier_25	euclidean	0.56
area-circularity-hist_15	mahalanobis	0.56
area-fourier_25-zernike_moments	euclidean	0.56
area-circularity-fourier_25	euclidean	0.56
area-fourier_25-hist_5	euclidean	0.56
area-convexity-fourier_20	euclidean	0.56
area-convexity-fourier_25	euclidean	0.56
area-circularity-fourier_20	euclidean	0.56
area-fourier_25-hist_20	euclidean	0.56
area-perimeter-fourier_25	euclidean	0.56
area-fourier_25-hist_15	euclidean	0.56
area-fourier_25-hist_10	euclidean	0.56
area-perimeter-fourier_20	euclidean	0.56
area-fourier_15-hist_20	euclidean	0.5585714285714286
area-fourier_15-hist_5	euclidean	0.5585714285714286
area-rectangularity-fourier_15	euclidean	0.5585714285714286
area-fourier_15-hist_10	euclidean	0.5585714285714286
area-circularity-eccentricity	mahalanobis	0.5585714285714286
area-eccentricity-fourier_15	euclidean	0.5585714285714286
area-circularity-fourier_15	euclidean	0.5585714285714286
area-fourier_15-hist_15	euclidean	0.5585714285714286
area-fourier_15-hist_25	euclidean	0.5585714285714286
area-perimeter-fourier_15	euclidean	0.5585714285714286
area-fourier_15-hu_moments	euclidean	0.5585714285714286
area-convexity-fourier_15	euclidean	0.5585714285714286
area-fourier_15-zernike_moments	euclidean	0.5585714285714286
perimeter-eccentricity-hist_15	mahalanobis	0.5571428571428572
area-perimeter-hist_15	mahalanobis	0.5571428571428572
area-fourier_10-hist_25	euclidean	0.5557142857142857
area-convexity-fourier_10	euclidean	0.5557142857142857
area-fourier_10-hist_20	euclidean	0.5557142857142857
area-perimeter-fourier_10	euclidean	0.5557142857142857
area-fourier_10-hist_10	euclidean	0.5557142857142857
area-fourier_10-hist_5	euclidean	0.5557142857142857
area-fourier_10-zernike_moments	euclidean	0.5557142857142857
area-rectangularity-fourier_10	euclidean	0.5557142857142857
area-eccentricity-hist_15	mahalanobis	0.5557142857142857
area-fourier_10-hu_moments	euclidean	0.5557142857142857
area-fourier_10-hist_15	euclidean	0.5557142857142857
area-circularity-fourier_10	euclidean	0.5557142857142857
area-eccentricity-fourier_10	euclidean	0.5557142857142857
area-circularity-hu_moments	mahalanobis	0.5542857142857143
area-hist_15-hu_moments	mahalanobis	0.5542857142857143
perimeter-circularity-hist_15	mahalanobis	0.5542857142857143
area-fourier_5-zernike_moments	euclidean	0.5485714285714286
area-fourier_5-hist_5	euclidean	0.5485714285714286
area-fourier_5-hist_10	euclidean	0.5485714285714286
area-fourier_5-hist_15	euclidean	0.5485714285714286
area-circularity-fourier_5	euclidean	0.5485714285714286
area-fourier_5-hist_20	euclidean	0.5485714285714286

area-eccentricity-fourier_5	euclidean	0.5485714285714286
area-fourier_5-hist_25	euclidean	0.5485714285714286
area-fourier_5-hu_moments	euclidean	0.5485714285714286
area-rectangularity-fourier_5	euclidean	0.5485714285714286
area-convexity-fourier_5	euclidean	0.5485714285714286
area-perimeter-fourier_5	euclidean	0.5485714285714286
perimeter-circularity-fourier_10	manhattan	0.5471428571428572
perimeter-eccentricity-fourier_10	manhattan	0.5442857142857143
perimeter-rectangularity-fourier_10	manhattan	0.5442857142857143
perimeter-convexity-fourier_10	manhattan	0.5442857142857143
perimeter-circularity-fourier_15	manhattan	0.5385714285714286
perimeter-circularity-fourier_25	manhattan	0.5385714285714286
perimeter-rectangularity-fourier_25	manhattan	0.5385714285714286
perimeter-convexity-fourier_25	manhattan	0.5385714285714286
perimeter-eccentricity-fourier_15	manhattan	0.5385714285714286
perimeter-convexity-fourier_15	manhattan	0.5385714285714286
perimeter-rectangularity-fourier_15	manhattan	0.5385714285714286
perimeter-eccentricity-fourier_25	manhattan	0.5385714285714286
area-hist_20-central_moments	mahalanobis	0.5371428571428571
area-convexity-hist_20	mahalanobis	0.5371428571428571
area-perimeter-hu_moments	mahalanobis	0.5371428571428571
perimeter-circularity-fourier_20	manhattan	0.5357142857142857
perimeter-convexity-fourier_20	manhattan	0.5357142857142857
perimeter-eccentricity-fourier_20	manhattan	0.5357142857142857
perimeter-rectangularity-fourier_20	manhattan	0.5357142857142857
area-eccentricity-hu_moments	mahalanobis	0.5314285714285715
area-perimeter-eccentricity	mahalanobis	0.5228571428571429
area-perimeter-central_moments	manhattan	0.52
area-rectangularity-central_moments	manhattan	0.52
perimeter-eccentricity-central_moments	manhattan	0.52
perimeter-convexity-central_moments	manhattan	0.52
area-rectangularity-hist_20	mahalanobis	0.52
area-hist_15-central_moments	manhattan	0.52
area-fourier_25-central_moments	manhattan	0.52
area-fourier_10-central_moments	manhattan	0.52
area-circularity-central_moments	manhattan	0.52
area-eccentricity-central_moments	manhattan	0.52
area-hist_25-central_moments	manhattan	0.52
area-hist_20-central_moments	manhattan	0.52
perimeter-rectangularity-central_moments	manhattan	0.52
area-hist_10-central_moments	manhattan	0.52
area-fourier_5-central_moments	manhattan	0.52
perimeter-circularity-central_moments	manhattan	0.52
area-convexity-central_moments	manhattan	0.52
area-hist_5-central_moments	manhattan	0.52
area-fourier_15-central_moments	manhattan	0.52
area-fourier_20-central_moments	manhattan	0.52
perimeter-convexity-eccentricity	mahalanobis	0.5171428571428571
area-eccentricity-hist_20	mahalanobis	0.5157142857142857
perimeter-circularity-fourier_5	manhattan	0.5128571428571429
perimeter-convexity-hist_20	mahalanobis	0.5114285714285715
area-rectangularity-eccentricity	mahalanobis	0.5114285714285715
perimeter-fourier_5-hist_10	manhattan	0.51
perimeter-rectangularity-fourier_5	manhattan	0.51
perimeter-rectangularity-hist_20	mahalanobis	0.51
perimeter-fourier_5-hist_15	manhattan	0.51

perimeter-fourier_5-hist_20	manhattan	0.51
perimeter-eccentricity-fourier_5	manhattan	0.51
perimeter-fourier_5-hist_5	manhattan	0.51
perimeter-convexity-fourier_5	manhattan	0.51
perimeter-fourier_5-hist_25	manhattan	0.51
area-convexity-rectangularity	mahalanobis	0.5028571428571429
area-perimeter-hist_20	mahalanobis	0.5014285714285714
perimeter-circularity-hist_20	mahalanobis	0.49857142857142855
area-circularity-hist_20	mahalanobis	0.49857142857142855
perimeter-rectangularity-eccentricity	mahalanobis	0.49857142857142855
area-hist_25-central_moments	mahalanobis	0.49714285714285716
perimeter-rectangularity-hu_moments	mahalanobis	0.4957142857142857
perimeter-convexity-hu_moments	mahalanobis	0.4957142857142857
perimeter-eccentricity-hist_20	mahalanobis	0.4928571428571429
perimeter-circularity-fourier_10	euclidean	0.4928571428571429
perimeter-rectangularity-fourier_10	euclidean	0.4928571428571429
perimeter-convexity-fourier_10	euclidean	0.4928571428571429
perimeter-eccentricity-fourier_10	euclidean	0.4928571428571429
perimeter-eccentricity-hu_moments	mahalanobis	0.49142857142857144
area-hist_20-hu_moments	mahalanobis	0.49142857142857144
perimeter-rectangularity-fourier_25	euclidean	0.48857142857142855
perimeter-circularity-fourier_25	euclidean	0.48857142857142855
perimeter-eccentricity-fourier_15	euclidean	0.48857142857142855
perimeter-convexity-fourier_15	euclidean	0.48857142857142855
perimeter-circularity-fourier_15	euclidean	0.48857142857142855
perimeter-circularity-fourier_20	euclidean	0.48857142857142855
perimeter-eccentricity-fourier_25	euclidean	0.48857142857142855
perimeter-rectangularity-fourier_20	euclidean	0.48857142857142855
perimeter-rectangularity-fourier_15	euclidean	0.48857142857142855
perimeter-convexity-fourier_20	euclidean	0.48857142857142855
perimeter-convexity-fourier_25	euclidean	0.48857142857142855
perimeter-eccentricity-fourier_20	euclidean	0.48857142857142855
area-fourier_5-central_moments	euclidean	0.48428571428571426
area-perimeter-central_moments	euclidean	0.48428571428571426
area-convexity-central_moments	euclidean	0.48428571428571426
area-hist_25-central_moments	euclidean	0.48428571428571426
area-eccentricity-central_moments	euclidean	0.48428571428571426
area-circularity-central_moments	euclidean	0.48428571428571426
area-fourier_20-central_moments	euclidean	0.48428571428571426
perimeter-rectangularity-central_moments	euclidean	0.48428571428571426
perimeter-circularity-central_moments	euclidean	0.48428571428571426
perimeter-convexity-central_moments	euclidean	0.48428571428571426
area-rectangularity-central_moments	euclidean	0.48428571428571426
area-hist_20-central_moments	euclidean	0.48428571428571426
area-hist_5-central_moments	euclidean	0.48428571428571426
area-hist_10-central_moments	euclidean	0.48428571428571426
area-fourier_25-central_moments	euclidean	0.48428571428571426
area-fourier_10-central_moments	euclidean	0.48428571428571426
area-hist_15-central_moments	euclidean	0.48428571428571426
perimeter-eccentricity-central_moments	euclidean	0.48428571428571426
area-fourier_15-central_moments	euclidean	0.48428571428571426
perimeter-fourier_5-hist_15	euclidean	0.47714285714285715
perimeter-fourier_5-hist_10	euclidean	0.47714285714285715
perimeter-fourier_5-hist_20	euclidean	0.47714285714285715
perimeter-circularity-fourier_5	euclidean	0.47714285714285715
perimeter-eccentricity-fourier_5	euclidean	0.47714285714285715

perimeter-fourier_5-hist_25	euclidean	0.47714285714285715
perimeter-fourier_5-hist_5	euclidean	0.47714285714285715
perimeter-rectangularity-fourier_5	euclidean	0.47714285714285715
perimeter-convexity-fourier_5	euclidean	0.47714285714285715
area-eccentricity-hist_25	mahalanobis	0.4742857142857143
perimeter-convexity-circularity	mahalanobis	0.47
area-convexity-hist_25	mahalanobis	0.47
area-circularity-rectangularity	mahalanobis	0.4657142857142857
area-convexity-circularity	mahalanobis	0.4657142857142857
perimeter-convexity-hist_25	mahalanobis	0.4657142857142857
perimeter-rectangularity-hist_25	mahalanobis	0.4642857142857143
area-rectangularity-hist_25	mahalanobis	0.4642857142857143
perimeter-circularity-rectangularity	mahalanobis	0.46
perimeter-convexity-rectangularity	mahalanobis	0.46
area-perimeter-rectangularity	mahalanobis	0.4585714285714286
perimeter-eccentricity-hist_25	mahalanobis	0.45714285714285713
area-perimeter-convexity	mahalanobis	0.45571428571428574
area-perimeter-hist_25	mahalanobis	0.44142857142857145
area-hist_25-hu_moments	mahalanobis	0.43714285714285717
perimeter-circularity-hist_25	mahalanobis	0.4342857142857143
area-circularity-hist_25	mahalanobis	0.4257142857142857
perimeter-circularity-hist_15	chisquared	0.39
area-perimeter-hist_15	chisquared	0.38571428571428573
perimeter-circularity-hist_10	chisquared	0.3842857142857143
area-perimeter-hist_10	chisquared	0.38285714285714284
perimeter-circularity-hist_20	chisquared	0.37714285714285717
area-perimeter-hist_5	chisquared	0.3742857142857143
area-perimeter-hist_20	chisquared	0.37285714285714283
area-perimeter-hist_25	chisquared	0.37285714285714283
perimeter-circularity-hist_25	chisquared	0.36857142857142855
perimeter-circularity-hist_5	chisquared	0.36142857142857143
area-circularity-hist_15	chisquared	0.3485714285714286
area-circularity-hist_20	chisquared	0.34714285714285714
perimeter-circularity-eccentricity	chisquared	0.34714285714285714
area-circularity-hist_5	chisquared	0.3442857142857143
area-circularity-hist_10	chisquared	0.34285714285714286
perimeter-circularity-rectangularity	chisquared	0.3357142857142857
area-circularity-hist_25	chisquared	0.3342857142857143
perimeter-convexity-circularity	chisquared	0.3271428571428571
area-perimeter-eccentricity	chisquared	0.3271428571428571
area-perimeter-rectangularity	chisquared	0.32571428571428573
area-perimeter-convexity	chisquared	0.32285714285714284
area-perimeter-hu_moments	chisquared	0.32285714285714284
area-perimeter-circularity	mahalanobis	0.32285714285714284
perimeter-circularity-hu_moments	chisquared	0.32142857142857145
area-perimeter-circularity	chisquared	0.32
area-perimeter-zernike_moments	chisquared	0.31857142857142856
perimeter-circularity-zernike_moments	chisquared	0.3157142857142857
area-circularity-eccentricity	chisquared	0.3028571428571429
area-convexity-circularity	chisquared	0.30142857142857143
area-circularity-rectangularity	chisquared	0.30142857142857143
area-circularity-hu_moments	chisquared	0.30142857142857143
area-circularity-zernike_moments	chisquared	0.30142857142857143
area-perimeter-circularity	manhattan	0.2985714285714286
area-hist_15-zernike_moments	chisquared	0.29428571428571426
area-hist_25-zernike_moments	chisquared	0.29285714285714287

area-perimeter-hist_25	manhattan	0.2914285714285714
perimeter-circularity-rectangularity	manhattan	0.2914285714285714
area-perimeter-rectangularity	manhattan	0.2914285714285714
area-perimeter-hist_15	manhattan	0.2914285714285714
area-hist_20-zernike_moments	chisquared	0.2914285714285714
area-perimeter-hu_moments	manhattan	0.2914285714285714
area-perimeter-eccentricity	manhattan	0.2914285714285714
perimeter-circularity-eccentricity	manhattan	0.2914285714285714
area-perimeter-convexity	manhattan	0.2914285714285714
area-perimeter-hist_5	manhattan	0.2914285714285714
area-perimeter-hist_20	manhattan	0.2914285714285714
area-perimeter-zernike_moments	manhattan	0.2914285714285714
perimeter-circularity-zernike_moments	manhattan	0.2914285714285714
area-perimeter-hist_10	manhattan	0.2914285714285714
perimeter-eccentricity-hist_15	chisquared	0.2914285714285714
perimeter-circularity-hist_5	manhattan	0.2885714285714286
perimeter-circularity-hist_10	manhattan	0.2885714285714286
perimeter-convexity-circularity	manhattan	0.2885714285714286
perimeter-circularity-hist_15	manhattan	0.2885714285714286
perimeter-circularity-hist_20	manhattan	0.2885714285714286
perimeter-circularity-hist_25	manhattan	0.2885714285714286
perimeter-eccentricity-hist_10	chisquared	0.28714285714285714
perimeter-circularity-hu_moments	manhattan	0.28714285714285714
perimeter-eccentricity-hist_20	chisquared	0.2842857142857143
area-hist_10-zernike_moments	chisquared	0.28285714285714286
perimeter-eccentricity-hist_5	chisquared	0.28285714285714286
area-rectangularity-hist_15	chisquared	0.2814285714285714
area-perimeter-hist_25	euclidean	0.28
perimeter-convexity-circularity	euclidean	0.28
area-perimeter-zernike_moments	euclidean	0.28
perimeter-convexity-hist_15	chisquared	0.28
area-perimeter-hu_moments	euclidean	0.28
perimeter-circularity-eccentricity	euclidean	0.28
perimeter-circularity-rectangularity	euclidean	0.28
area-perimeter-convexity	euclidean	0.28
area-perimeter-hist_20	euclidean	0.28
area-perimeter-eccentricity	euclidean	0.28
perimeter-circularity-zernike_moments	euclidean	0.28
area-perimeter-hist_5	euclidean	0.28
perimeter-circularity-hu_moments	euclidean	0.28
perimeter-circularity-hist_25	euclidean	0.28
area-perimeter-hist_10	euclidean	0.28
perimeter-circularity-hist_5	euclidean	0.28
perimeter-circularity-hist_20	euclidean	0.28
area-eccentricity-hist_15	chisquared	0.28
perimeter-circularity-hist_15	euclidean	0.28
area-perimeter-rectangularity	euclidean	0.28
perimeter-circularity-hist_10	euclidean	0.28
area-perimeter-circularity	euclidean	0.28
area-perimeter-hist_15	euclidean	0.28
area-convexity-hist_15	chisquared	0.2785714285714286
perimeter-convexity-hist_10	chisquared	0.2785714285714286
area-eccentricity-hist_25	chisquared	0.2785714285714286
area-eccentricity-hist_20	chisquared	0.2785714285714286
perimeter-convexity-eccentricity	chisquared	0.2785714285714286
perimeter-rectangularity-eccentricity	chisquared	0.2785714285714286

perimeter-rectangularity-hist_10	chisquared	0.27714285714285714
perimeter-convexity-hist_20	chisquared	0.2757142857142857
area-convexity-hist_25	chisquared	0.2757142857142857
perimeter-rectangularity-hist_20	chisquared	0.2757142857142857
area-hist_5-zernike_moments	chisquared	0.2742857142857143
area-rectangularity-hist_20	chisquared	0.27285714285714285
area-convexity-hist_20	chisquared	0.27285714285714285
perimeter-rectangularity-hist_15	chisquared	0.27285714285714285
area-hist_15-hu_moments	chisquared	0.27285714285714285
area-eccentricity-hist_10	chisquared	0.27285714285714285
area-rectangularity-hist_25	chisquared	0.2714285714285714
perimeter-convexity-hist_5	chisquared	0.2714285714285714
perimeter-eccentricity-hist_25	chisquared	0.2714285714285714
area-hist_25-hu_moments	chisquared	0.26857142857142857
perimeter-rectangularity-hist_5	chisquared	0.2671428571428571
perimeter-convexity-hist_25	chisquared	0.26571428571428574
area-hist_20-hu_moments	chisquared	0.26571428571428574
area-rectangularity-hist_10	chisquared	0.2642857142857143
area-convexity-hist_10	chisquared	0.2642857142857143
perimeter-rectangularity-hist_25	chisquared	0.2642857142857143
area-eccentricity-hist_5	chisquared	0.2571428571428571
area-hist_10-hu_moments	chisquared	0.2557142857142857
perimeter-convexity-rectangularity	chisquared	0.25
area-rectangularity-hist_5	chisquared	0.24714285714285714
area-convexity-hist_5	chisquared	0.24714285714285714
area-hist_5-hu_moments	chisquared	0.23857142857142857
perimeter-eccentricity-hu_moments	chisquared	0.22857142857142856
area-hist_15-zernike_moments	mahalanobis	0.22714285714285715
perimeter-rectangularity-hu_moments	chisquared	0.22714285714285715
perimeter-convexity-hu_moments	chisquared	0.22428571428571428
area-rectangularity-eccentricity	chisquared	0.22428571428571428
area-convexity-eccentricity	chisquared	0.22142857142857142
area-hist_10-zernike_moments	mahalanobis	0.22
area-convexity-zernike_moments	chisquared	0.22
area-rectangularity-zernike_moments	chisquared	0.21857142857142858
area-eccentricity-zernike_moments	chisquared	0.21857142857142858
area-convexity-circularity	manhattan	0.21428571428571427
area-circularity-eccentricity	manhattan	0.21428571428571427
area-circularity-hist_5	manhattan	0.21428571428571427
area-circularity-hu_moments	manhattan	0.21428571428571427
area-circularity-hist_10	manhattan	0.21428571428571427
area-circularity-rectangularity	manhattan	0.21428571428571427
area-circularity-hist_15	manhattan	0.21428571428571427
area-circularity-hist_20	manhattan	0.21428571428571427
area-circularity-hist_25	manhattan	0.21428571428571427
area-circularity-zernike_moments	manhattan	0.21428571428571427
area-convexity-rectangularity	chisquared	0.21285714285714286
area-eccentricity-hu_moments	chisquared	0.21285714285714286
area-hist_25-zernike_moments	mahalanobis	0.21
area-hist_20-zernike_moments	mahalanobis	0.2057142857142857
area-convexity-hu_moments	chisquared	0.2042857142857143
perimeter-eccentricity-zernike_moments	chisquared	0.2042857142857143
area-circularity-eccentricity	euclidean	0.20285714285714285
area-circularity-hist_5	euclidean	0.20285714285714285
area-circularity-hist_10	euclidean	0.20285714285714285
area-circularity-hu_moments	euclidean	0.20285714285714285

area-circularity-hist_25	euclidean	0.20285714285714285
area-circularity-zernike_moments	euclidean	0.20285714285714285
area-circularity-hist_20	euclidean	0.20285714285714285
area-circularity-rectangularity	euclidean	0.20285714285714285
area-circularity-hist_15	euclidean	0.20285714285714285
area-convexity-circularity	euclidean	0.20285714285714285
area-rectangularity-hu_moments	chisquared	0.1957142857142857
perimeter-rectangularity-zernike_moments	chisquared	0.19142857142857142
area-hist_5-zernike_moments	mahalanobis	0.19142857142857142
area-hist_25-zernike_moments	manhattan	0.18428571428571427
area-hist_10-hu_moments	euclidean	0.18428571428571427
area-convexity-eccentricity	euclidean	0.18428571428571427
area-hist_10-zernike_moments	euclidean	0.18428571428571427
area-hist_10-zernike_moments	manhattan	0.18428571428571427
area-rectangularity-hist_15	manhattan	0.18428571428571427
area-hist_25-zernike_moments	euclidean	0.18428571428571427
area-hist_20-hu_moments	euclidean	0.18428571428571427
area-hist_15-hu_moments	euclidean	0.18428571428571427
area-hist_15-hu_moments	manhattan	0.18428571428571427
area-convexity-rectangularity	manhattan	0.18428571428571427
area-hist_25-hu_moments	manhattan	0.18428571428571427
area-hist_15-zernike_moments	euclidean	0.18428571428571427
area-hist_15-zernike_moments	manhattan	0.18428571428571427
area-hist_25-hu_moments	euclidean	0.18428571428571427
area-hist_20-zernike_moments	manhattan	0.18428571428571427
area-convexity-rectangularity	euclidean	0.18428571428571427
area-hist_20-zernike_moments	euclidean	0.18428571428571427
area-hist_10-hu_moments	manhattan	0.18428571428571427
area-rectangularity-hist_15	euclidean	0.18428571428571427
area-hist_20-hu_moments	manhattan	0.18428571428571427
area-eccentricity-hist_15	euclidean	0.18428571428571427
area-rectangularity-hist_10	euclidean	0.18428571428571427
area-rectangularity-zernike_moments	euclidean	0.18428571428571427
area-convexity-hist_25	manhattan	0.18428571428571427
area-convexity-hist_5	euclidean	0.18428571428571427
area-convexity-hist_5	manhattan	0.18428571428571427
area-convexity-eccentricity	manhattan	0.18428571428571427
area-convexity-hist_10	euclidean	0.18428571428571427
area-rectangularity-zernike_moments	manhattan	0.18428571428571427
area-eccentricity-hist_5	manhattan	0.18428571428571427
area-eccentricity-hist_5	euclidean	0.18428571428571427
area-convexity-hist_10	manhattan	0.18428571428571427
area-rectangularity-hist_5	manhattan	0.18428571428571427
area-convexity-hist_15	euclidean	0.18428571428571427
area-convexity-hist_15	manhattan	0.18428571428571427
area-convexity-zernike_moments	manhattan	0.18428571428571427
area-convexity-hist_20	euclidean	0.18428571428571427
area-convexity-hist_20	manhattan	0.18428571428571427
area-convexity-zernike_moments	euclidean	0.18428571428571427
area-convexity-hu_moments	manhattan	0.18428571428571427
area-convexity-hist_25	euclidean	0.18428571428571427
area-rectangularity-hist_5	euclidean	0.18428571428571427
area-eccentricity-hist_10	manhattan	0.18428571428571427
area-eccentricity-hist_10	euclidean	0.18428571428571427
area-eccentricity-hist_15	manhattan	0.18428571428571427
area-eccentricity-hist_20	manhattan	0.18428571428571427

area-hist_5-zernike_moments	manhattan	0.18428571428571427
area-hist_5-zernike_moments	euclidean	0.18428571428571427
area-rectangularity-eccentricity	euclidean	0.18428571428571427
area-hist_5-hu_moments	manhattan	0.18428571428571427
area-hist_5-hu_moments	euclidean	0.18428571428571427
area-rectangularity-hist_20	euclidean	0.18428571428571427
area-eccentricity-hist_25	euclidean	0.18428571428571427
area-eccentricity-hist_25	manhattan	0.18428571428571427
area-rectangularity-hu_moments	manhattan	0.18428571428571427
area-rectangularity-hist_20	manhattan	0.18428571428571427
area-rectangularity-hist_10	manhattan	0.18428571428571427
area-convexity-hu_moments	euclidean	0.18428571428571427
area-eccentricity-hu_moments	euclidean	0.18428571428571427
area-eccentricity-zernike_moments	euclidean	0.18428571428571427
area-rectangularity-hu_moments	euclidean	0.18428571428571427
area-rectangularity-eccentricity	manhattan	0.18428571428571427
area-eccentricity-zernike_moments	manhattan	0.18428571428571427
area-rectangularity-hist_25	manhattan	0.18428571428571427
area-eccentricity-hist_20	euclidean	0.18428571428571427
area-rectangularity-hist_25	euclidean	0.18428571428571427
area-eccentricity-hu_moments	manhattan	0.18428571428571427
perimeter-convexity-zernike_moments	chisquared	0.18285714285714286
perimeter-eccentricity-zernike_moments	manhattan	0.16285714285714287
perimeter-convexity-rectangularity	manhattan	0.16142857142857142
perimeter-convexity-eccentricity	manhattan	0.16142857142857142
perimeter-rectangularity-zernike_moments	manhattan	0.16
perimeter-rectangularity-eccentricity	manhattan	0.16
perimeter-convexity-zernike_moments	manhattan	0.15857142857142856
perimeter-eccentricity-hist_15	manhattan	0.15571428571428572
perimeter-eccentricity-hist_5	manhattan	0.15571428571428572
perimeter-eccentricity-hist_20	manhattan	0.15571428571428572
perimeter-eccentricity-hist_25	manhattan	0.15571428571428572
perimeter-eccentricity-hist_10	manhattan	0.15571428571428572
perimeter-eccentricity-hu_moments	manhattan	0.15571428571428572
perimeter-rectangularity-hist_5	manhattan	0.15428571428571428
perimeter-rectangularity-hist_10	manhattan	0.15428571428571428
perimeter-rectangularity-hist_25	manhattan	0.15428571428571428
perimeter-convexity-hu_moments	manhattan	0.15428571428571428
perimeter-convexity-hist_25	manhattan	0.15428571428571428
perimeter-convexity-hist_20	manhattan	0.15428571428571428
perimeter-convexity-hist_15	manhattan	0.15428571428571428
perimeter-convexity-hist_10	manhattan	0.15428571428571428
perimeter-convexity-hist_5	manhattan	0.15428571428571428
perimeter-rectangularity-hist_15	manhattan	0.15428571428571428
perimeter-rectangularity-hist_20	manhattan	0.15428571428571428
perimeter-rectangularity-hu_moments	manhattan	0.15285714285714286
perimeter-convexity-eccentricity	euclidean	0.15
perimeter-eccentricity-zernike_moments	euclidean	0.15
perimeter-rectangularity-hist_10	euclidean	0.14857142857142858
perimeter-rectangularity-hist_5	euclidean	0.14857142857142858
perimeter-rectangularity-hist_15	euclidean	0.14857142857142858
perimeter-rectangularity-zernike_moments	euclidean	0.14857142857142858
perimeter-rectangularity-hu_moments	euclidean	0.14857142857142858
perimeter-rectangularity-eccentricity	euclidean	0.14857142857142858
perimeter-rectangularity-hist_25	euclidean	0.14857142857142858
perimeter-rectangularity-hist_20	euclidean	0.14857142857142858

perimeter-convexity-rectangularity	euclidean	0.14857142857142858
perimeter-convexity-hist_25	euclidean	0.14714285714285713
perimeter-eccentricity-hist_10	euclidean	0.14714285714285713
perimeter-convexity-hu_moments	euclidean	0.14714285714285713
perimeter-eccentricity-hist_15	euclidean	0.14714285714285713
perimeter-convexity-zernike_moments	euclidean	0.14714285714285713
perimeter-eccentricity-hist_5	euclidean	0.14714285714285713
perimeter-convexity-hist_20	euclidean	0.14714285714285713
perimeter-eccentricity-hu_moments	euclidean	0.14714285714285713
perimeter-eccentricity-hist_20	euclidean	0.14714285714285713
perimeter-convexity-hist_5	euclidean	0.14714285714285713
perimeter-convexity-hist_15	euclidean	0.14714285714285713
perimeter-eccentricity-hist_25	euclidean	0.14714285714285713
perimeter-convexity-hist_10	euclidean	0.14714285714285713
perimeter-eccentricity-zernike_moments	mahalanobis	0.1357142857142857
perimeter-rectangularity-zernike_moments	mahalanobis	0.13142857142857142
area-eccentricity-zernike_moments	mahalanobis	0.13142857142857142
perimeter-convexity-zernike_moments	mahalanobis	0.13
area-rectangularity-zernike_moments	mahalanobis	0.12428571428571429
area-convexity-zernike_moments	mahalanobis	0.12428571428571429
perimeter-eccentricity-fourier_10	mahalanobis	0.11714285714285715
area-fourier_5-central_moments	mahalanobis	0.11571428571428571
area-perimeter-zernike_moments	mahalanobis	0.11428571428571428
perimeter-circularity-zernike_moments	mahalanobis	0.11428571428571428
area-circularity-zernike_moments	mahalanobis	0.11428571428571428
area-eccentricity-fourier_10	mahalanobis	0.10857142857142857
area-convexity-fourier_10	mahalanobis	0.10571428571428572
area-eccentricity-fourier_5	mahalanobis	0.10142857142857142
perimeter-eccentricity-fourier_5	mahalanobis	0.1
area-fourier_10-central_moments	mahalanobis	0.09857142857142857
area-perimeter-fourier_10	mahalanobis	0.09857142857142857
perimeter-convexity-fourier_10	mahalanobis	0.09285714285714286
area-convexity-fourier_5	mahalanobis	0.09285714285714286
perimeter-rectangularity-fourier_10	mahalanobis	0.09142857142857143
perimeter-circularity-fourier_10	mahalanobis	0.09
perimeter-circularity-fourier_20	mahalanobis	0.08857142857142856
perimeter-eccentricity-fourier_15	mahalanobis	0.08857142857142856
perimeter-convexity-fourier_5	mahalanobis	0.08714285714285715
area-fourier_10-hu_moments	mahalanobis	0.08714285714285715
area-perimeter-fourier_5	mahalanobis	0.08571428571428572
area-rectangularity-fourier_10	mahalanobis	0.08428571428571428
area-circularity-fourier_5	mahalanobis	0.08428571428571428
perimeter-circularity-fourier_5	mahalanobis	0.08285714285714285
area-fourier_20-central_moments	mahalanobis	0.08285714285714285
area-circularity-fourier_10	mahalanobis	0.08
area-fourier_5-hu_moments	mahalanobis	0.07857142857142857
area-rectangularity-fourier_5	mahalanobis	0.07857142857142857
area-circularity-fourier_15	mahalanobis	0.07714285714285714
perimeter-eccentricity-fourier_20	mahalanobis	0.07714285714285714
area-fourier_10-hist_5	mahalanobis	0.07428571428571429
perimeter-rectangularity-fourier_5	mahalanobis	0.07428571428571429
area-fourier_5-hist_5	mahalanobis	0.07285714285714286
perimeter-convexity-fourier_20	mahalanobis	0.07142857142857142
area-fourier_10-hist_15	mahalanobis	0.07
perimeter-fourier_5-hist_5	mahalanobis	0.07
area-perimeter-fourier_15	mahalanobis	0.07

area-perimeter-fourier_20	mahalanobis	0.06857142857142857
area-fourier_15-central_moments	mahalanobis	0.06857142857142857
perimeter-circularity-fourier_15	mahalanobis	0.06857142857142857
area-fourier_10-hist_25	mahalanobis	0.06714285714285714
area-fourier_10-hist_20	mahalanobis	0.06714285714285714
area-fourier_10-hist_10	mahalanobis	0.06571428571428571
perimeter-circularity-fourier_25	mahalanobis	0.06571428571428571
perimeter-convexity-fourier_15	mahalanobis	0.06428571428571428
perimeter-eccentricity-fourier_25	mahalanobis	0.06428571428571428
perimeter-rectangularity-fourier_20	mahalanobis	0.06428571428571428
area-convexity-fourier_20	mahalanobis	0.06285714285714286
area-fourier_5-hist_10	mahalanobis	0.06285714285714286
area-fourier_15-hist_25	mahalanobis	0.06285714285714286
area-eccentricity-fourier_20	mahalanobis	0.06142857142857143
area-rectangularity-fourier_25	mahalanobis	0.06142857142857143
area-fourier_25-central_moments	mahalanobis	0.06142857142857143
area-fourier_25-hu_moments	mahalanobis	0.06142857142857143
area-circularity-fourier_20	mahalanobis	0.06
area-fourier_20-hu_moments	mahalanobis	0.06
area-eccentricity-fourier_15	mahalanobis	0.06
area-perimeter-fourier_25	mahalanobis	0.05857142857142857
area-fourier_5-hist_20	mahalanobis	0.05857142857142857
area-fourier_15-zernike_moments	mahalanobis	0.05857142857142857
perimeter-rectangularity-fourier_15	mahalanobis	0.05857142857142857
area-fourier_5-zernike_moments	mahalanobis	0.05714285714285714
area-circularity-fourier_25	mahalanobis	0.05714285714285714
area-fourier_15-hist_20	mahalanobis	0.05714285714285714
area-fourier_5-hist_25	mahalanobis	0.05714285714285714
area-fourier_20-hist_5	mahalanobis	0.055714285714285716
area-fourier_20-hist_25	mahalanobis	0.055714285714285716
area-fourier_25-hist_25	mahalanobis	0.055714285714285716
area-fourier_15-hist_10	mahalanobis	0.054285714285714284
area-fourier_10-zernike_moments	mahalanobis	0.054285714285714284
perimeter-fourier_5-hist_10	mahalanobis	0.05285714285714286
area-convexity-fourier_15	mahalanobis	0.05285714285714286
area-fourier_5-hist_15	mahalanobis	0.05285714285714286
area-fourier_20-hist_20	mahalanobis	0.05142857142857143
area-fourier_15-hu_moments	mahalanobis	0.05142857142857143
area-fourier_20-zernike_moments	mahalanobis	0.05142857142857143
area-fourier_15-hist_15	mahalanobis	0.05142857142857143
area-rectangularity-fourier_15	mahalanobis	0.05142857142857143
area-fourier_25-hist_5	mahalanobis	0.05
perimeter-convexity-fourier_25	mahalanobis	0.05
area-convexity-fourier_25	mahalanobis	0.05
perimeter-fourier_5-hist_20	mahalanobis	0.05
area-fourier_20-hist_10	mahalanobis	0.047142857142857146
area-fourier_15-hist_5	mahalanobis	0.047142857142857146
area-fourier_25-hist_10	mahalanobis	0.047142857142857146
perimeter-fourier_5-hist_15	mahalanobis	0.047142857142857146
area-fourier_25-hist_15	mahalanobis	0.045714285714285714
area-eccentricity-fourier_25	mahalanobis	0.04428571428571428
perimeter-rectangularity-fourier_25	mahalanobis	0.04428571428571428
area-fourier_20-hist_15	mahalanobis	0.04428571428571428
area-rectangularity-fourier_20	mahalanobis	0.04428571428571428
area-fourier_25-zernike_moments	mahalanobis	0.04285714285714286
area-fourier_25-hist_20	mahalanobis	0.041428571428571426

perimeter-eccentricity-central_moments	chisquared	0.022857142857142857
area-rectangularity-central_moments	chisquared	0.022857142857142857
perimeter-rectangularity-central_moments	chisquared	0.022857142857142857
area-hist_5-central_moments	chisquared	0.022857142857142857
perimeter-convexity-central_moments	chisquared	0.022857142857142857
area-hist_20-central_moments	chisquared	0.022857142857142857
area-fourier_5-central_moments	chisquared	0.022857142857142857
area-hist_10-central_moments	chisquared	0.022857142857142857
area-fourier_15-central_moments	chisquared	0.022857142857142857
area-fourier_20-central_moments	chisquared	0.022857142857142857
perimeter-circularity-central_moments	chisquared	0.022857142857142857
area-eccentricity-central_moments	chisquared	0.022857142857142857
area-hist_25-central_moments	chisquared	0.022857142857142857
area-circularity-central_moments	chisquared	0.022857142857142857
area-fourier_10-central_moments	chisquared	0.022857142857142857
area-hist_15-central_moments	chisquared	0.022857142857142857
area-perimeter-central_moments	chisquared	0.022857142857142857
area-fourier_25-central_moments	chisquared	0.022857142857142857
area-convexity-central_moments	chisquared	0.022857142857142857
area-fourier_5-zernike_moments	chisquared	0.02
perimeter-fourier_5-hist_15	chisquared	0.015714285714285715
area-fourier_5-hist_15	chisquared	0.015714285714285715
area-fourier_5-hist_20	chisquared	0.015714285714285715
perimeter-fourier_5-hist_10	chisquared	0.015714285714285715
area-fourier_5-hist_10	chisquared	0.015714285714285715
perimeter-fourier_5-hist_20	chisquared	0.015714285714285715
area-eccentricity-fourier_5	chisquared	0.014285714285714285
area-circularity-fourier_5	chisquared	0.014285714285714285
perimeter-convexity-fourier_5	chisquared	0.014285714285714285
perimeter-circularity-fourier_5	chisquared	0.014285714285714285
area-rectangularity-fourier_5	chisquared	0.014285714285714285
perimeter-eccentricity-fourier_5	chisquared	0.014285714285714285
perimeter-fourier_5-hist_5	chisquared	0.014285714285714285
perimeter-rectangularity-fourier_5	chisquared	0.014285714285714285
area-convexity-fourier_5	chisquared	0.014285714285714285
area-fourier_5-hist_5	chisquared	0.014285714285714285
area-fourier_5-hu_moments	chisquared	0.014285714285714285
area-fourier_5-hist_25	chisquared	0.014285714285714285
area-perimeter-fourier_5	chisquared	0.014285714285714285
area-fourier_20-zernike_moments	chisquared	0.012857142857142857
area-fourier_10-zernike_moments	chisquared	0.011428571428571429
area-fourier_15-zernike_moments	chisquared	0.011428571428571429
area-fourier_25-zernike_moments	chisquared	0.011428571428571429
area-fourier_20-hu_moments	chisquared	0.007142857142857143
area-convexity-fourier_20	chisquared	0.007142857142857143
area-perimeter-fourier_20	chisquared	0.007142857142857143
area-fourier_20-hist_5	chisquared	0.007142857142857143
area-rectangularity-fourier_20	chisquared	0.007142857142857143
area-fourier_20-hist_20	chisquared	0.007142857142857143
area-fourier_20-hist_10	chisquared	0.007142857142857143
area-eccentricity-fourier_20	chisquared	0.007142857142857143
area-fourier_20-hist_15	chisquared	0.007142857142857143
area-circularity-fourier_20	chisquared	0.007142857142857143
area-fourier_20-hist_25	chisquared	0.007142857142857143
area-fourier_15-hu_moments	chisquared	0.005714285714285714
area-rectangularity-fourier_25	chisquared	0.005714285714285714

area-perimeter-fourier_25	chisquared	0.005714285714285714
area-fourier_25-hist_5	chisquared	0.005714285714285714
area-perimeter-fourier_15	chisquared	0.005714285714285714
area-fourier_25-hist_25	chisquared	0.005714285714285714
area-rectangularity-fourier_15	chisquared	0.005714285714285714
area-fourier_15-hist_25	chisquared	0.005714285714285714
area-eccentricity-fourier_25	chisquared	0.005714285714285714
area-convexity-fourier_15	chisquared	0.005714285714285714
area-fourier_25-hist_20	chisquared	0.005714285714285714
area-fourier_25-hu_moments	chisquared	0.005714285714285714
area-convexity-fourier_25	chisquared	0.005714285714285714
area-circularity-fourier_25	chisquared	0.005714285714285714
area-fourier_25-hist_15	chisquared	0.005714285714285714
area-fourier_25-hist_10	chisquared	0.005714285714285714
area-fourier_15-hist_5	chisquared	0.005714285714285714
area-fourier_15-hist_10	chisquared	0.005714285714285714
area-fourier_15-hist_15	chisquared	0.005714285714285714
area-circularity-fourier_15	chisquared	0.005714285714285714
area-fourier_15-hist_20	chisquared	0.005714285714285714
area-eccentricity-fourier_15	chisquared	0.005714285714285714
area-convexity-fourier_10	chisquared	0.004285714285714286
perimeter-rectangularity-fourier_25	chisquared	0.004285714285714286
perimeter-convexity-fourier_10	chisquared	0.004285714285714286
area-fourier_10-hu_moments	chisquared	0.004285714285714286
perimeter-rectangularity-fourier_20	chisquared	0.004285714285714286
perimeter-rectangularity-fourier_15	chisquared	0.004285714285714286
perimeter-rectangularity-fourier_10	chisquared	0.004285714285714286
area-perimeter-fourier_10	chisquared	0.004285714285714286
area-fourier_10-hist_5	chisquared	0.004285714285714286
area-fourier_10-hist_15	chisquared	0.004285714285714286
area-fourier_10-hist_20	chisquared	0.004285714285714286
area-fourier_10-hist_25	chisquared	0.004285714285714286
perimeter-circularity-fourier_25	chisquared	0.004285714285714286
perimeter-circularity-fourier_20	chisquared	0.004285714285714286
perimeter-circularity-fourier_15	chisquared	0.004285714285714286
perimeter-convexity-fourier_15	chisquared	0.004285714285714286
perimeter-circularity-fourier_10	chisquared	0.004285714285714286
perimeter-eccentricity-fourier_10	chisquared	0.004285714285714286
area-circularity-fourier_10	chisquared	0.004285714285714286
perimeter-eccentricity-fourier_15	chisquared	0.004285714285714286
perimeter-eccentricity-fourier_20	chisquared	0.004285714285714286
area-rectangularity-fourier_10	chisquared	0.004285714285714286
perimeter-eccentricity-fourier_25	chisquared	0.004285714285714286
area-eccentricity-fourier_10	chisquared	0.004285714285714286
perimeter-convexity-fourier_25	chisquared	0.004285714285714286
perimeter-convexity-fourier_20	chisquared	0.004285714285714286
area-fourier_10-hist_10	chisquared	0.004285714285714286

2.2 Final Results

Subset	Distance Metric	Accuracy
area-convexity-circularity-rectangularity-hist_10-central_moments	mahalanobis	0.71
area-perimeter-convexity-circularity-rectangularity-hist_10	mahalanobis	0.71
perimeter-convexity-circularity-rectangularity-hist_10-central_moments	mahalanobis	0.71
area-perimeter-convexity-circularity-rectangularity-hist_10-hu_moments	mahalanobis	0.71

area-perimeter-convexity-circularity-rectangularity-hist_10-central_moments	mahalanobis	0.7085714285714285
area-convexity-circularity-rectangularity-hist_10-hu_moments	mahalanobis	0.7014285714285714
area-convexity-circularity-rectangularity-hist_10	mahalanobis	0.7
convexity-circularity-rectangularity-hist_10-hu_moments	mahalanobis	0.6971428571428572
area-perimeter-convexity-rectangularity-hist_10-hu_moments	mahalanobis	0.6971428571428572
perimeter-convexity-circularity-rectangularity-hist_10-hu_moments	mahalanobis	0.6928571428571428
convexity-circularity-rectangularity-hist_10-central_moments	mahalanobis	0.6928571428571428
area-convexity-circularity-hist_10-central_moments	mahalanobis	0.6928571428571428
area-perimeter-convexity-rectangularity-hist_10-central_moments	mahalanobis	0.6914285714285714
area-perimeter-convexity-circularity-hist_10-central_moments	mahalanobis	0.6914285714285714
perimeter-convexity-circularity-hist_10-central_moments	mahalanobis	0.6871428571428572
area-perimeter-convexity-rectangularity-hist_10	mahalanobis	0.6871428571428572
perimeter-convexity-circularity-rectangularity-hist_10	mahalanobis	0.6857142857142857
area-perimeter-convexity-circularity-rectangularity-central_moments	mahalanobis	0.6857142857142857
perimeter-convexity-rectangularity-hist_10-central_moments	mahalanobis	0.6857142857142857
area-convexity-rectangularity-hist_10-central_moments	mahalanobis	0.6857142857142857
area-perimeter-convexity-circularity-hist_10-hu_moments	mahalanobis	0.6828571428571428
perimeter-circularity-rectangularity-hist_10-central_moments	mahalanobis	0.6828571428571428
area-convexity-hist_10-central_moments	mahalanobis	0.6814285714285714
area-perimeter-circularity-rectangularity-hist_10-central_moments	mahalanobis	0.6814285714285714
area-perimeter-circularity-rectangularity-hist_10-hu_moments	mahalanobis	0.6814285714285714
area-perimeter-convexity-hist_10-central_moments	mahalanobis	0.68
perimeter-convexity-circularity-rectangularity-central_moments	mahalanobis	0.68
perimeter-convexity-rectangularity-hist_10-hu_moments	mahalanobis	0.6785714285714286
convexity-circularity-rectangularity-hist_10	mahalanobis	0.6785714285714286
area-convexity-rectangularity-hist_10-hu_moments	mahalanobis	0.6785714285714286
area-convexity-circularity-hist_10-hu_moments	mahalanobis	0.6771428571428572
area-circularity-rectangularity-hist_10-central_moments	mahalanobis	0.6742857142857143
area-perimeter-convexity-circularity-hist_10	mahalanobis	0.6728571428571428
area-perimeter-convexity-hist_10-hu_moments	mahalanobis	0.6728571428571428
circularity-rectangularity-hist_10-central_moments	mahalanobis	0.6728571428571428
convexity-circularity-hist_10-central_moments	mahalanobis	0.6714285714285714
perimeter-convexity-circularity-hist_10-hu_moments	mahalanobis	0.6714285714285714
perimeter-rectangularity-hist_10-central_moments	mahalanobis	0.6714285714285714
perimeter-circularity-rectangularity-hist_10-hu_moments	mahalanobis	0.6714285714285714
area-convexity-circularity-hist_10	mahalanobis	0.67
perimeter-convexity-hist_10-central_moments	mahalanobis	0.67
area-convexity-circularity-rectangularity-central_moments	mahalanobis	0.67
area-convexity-rectangularity-hist_10	mahalanobis	0.67
convexity-circularity-hist_10-hu_moments	mahalanobis	0.67
area-perimeter-convexity-circularity-rectangularity-hu_moments	mahalanobis	0.67
perimeter-convexity-circularity-rectangularity-hu_moments	mahalanobis	0.6685714285714286
convexity-rectangularity-hist_10-hu_moments	chisquared	0.6685714285714286
area-perimeter-rectangularity-hist_10-central_moments	mahalanobis	0.6685714285714286
convexity-rectangularity-hist_10-central_moments	mahalanobis	0.6685714285714286
area-circularity-rectangularity-hist_10-hu_moments	mahalanobis	0.6671428571428571
perimeter-convexity-circularity-hist_10	mahalanobis	0.6657142857142857
area-circularity-rectangularity-hist_10	mahalanobis	0.6657142857142857
area-perimeter-convexity-rectangularity-central_moments	mahalanobis	0.6657142857142857
perimeter-convexity-rectangularity-hist_10	mahalanobis	0.6657142857142857
convexity-rectangularity-hist_10-hu_moments	mahalanobis	0.6657142857142857
area-perimeter-rectangularity-hist_10-hu_moments	mahalanobis	0.6642857142857143
area-perimeter-circularity-rectangularity-hist_10	mahalanobis	0.6642857142857143
area-perimeter-circularity-hist_10-central_moments	mahalanobis	0.6628571428571428
area-rectangularity-hist_10-central_moments	mahalanobis	0.6628571428571428
area-convexity-hist_10-hu_moments	mahalanobis	0.6614285714285715

circularity-rectangularity-hist_10-hu_moments	mahalanobis	0.66
area-convexity-circularity-rectangularity-hu_moments	mahalanobis	0.66
perimeter-circularity-hist_10-central_moments	mahalanobis	0.6585714285714286
perimeter-circularity-rectangularity-hist_10	mahalanobis	0.6585714285714286
area-convexity-rectangularity-central_moments	mahalanobis	0.6571428571428571
area-perimeter-rectangularity-hist_10	mahalanobis	0.6571428571428571
area-perimeter-convexity-hist_10	mahalanobis	0.6557142857142857
area-perimeter-convexity-rectangularity-hu_moments	mahalanobis	0.6557142857142857
perimeter-convexity-hist_10-hu_moments	mahalanobis	0.6542857142857142
area-circularity-hist_10-central_moments	mahalanobis	0.6542857142857142
area-perimeter-hist_10-central_moments	mahalanobis	0.6485714285714286
perimeter-convexity-rectangularity-central_moments	mahalanobis	0.6442857142857142
perimeter-rectangularity-hist_10-hu_moments	mahalanobis	0.6442857142857142
perimeter-convexity-circularity-central_moments	mahalanobis	0.64
area-perimeter-convexity-circularity-central_moments	mahalanobis	0.64
area-perimeter-circularity-hist_10-hu_moments	mahalanobis	0.6385714285714286
area-rectangularity-hist_10-hu_moments	mahalanobis	0.6385714285714286
area-convexity-rectangularity-hu_moments	mahalanobis	0.6342857142857142
area-circularity-hist_10-hu_moments	mahalanobis	0.6314285714285715
area-convexity-circularity-central_moments	mahalanobis	0.63
perimeter-circularity-hist_10-hu_moments	mahalanobis	0.6257142857142857
convexity-circularity-rectangularity-central_moments	mahalanobis	0.6242857142857143
area-perimeter-hist_10-hu_moments	mahalanobis	0.6242857142857143
area-perimeter-convexity-central_moments	mahalanobis	0.6228571428571429
area-perimeter-circularity-hist_10	mahalanobis	0.6185714285714285
area-perimeter-rectangularity-central_moments	mahalanobis	0.6185714285714285
area-circularity-rectangularity-hu_moments	mahalanobis	0.6142857142857143
area-convexity-circularity-hu_moments	mahalanobis	0.6142857142857143
perimeter-circularity-rectangularity-central_moments	mahalanobis	0.6142857142857143
perimeter-convexity-circularity-hu_moments	mahalanobis	0.6128571428571429
area-perimeter-circularity-rectangularity-central_moments	mahalanobis	0.6114285714285714
area-circularity-rectangularity-central_moments	mahalanobis	0.6114285714285714
perimeter-circularity-rectangularity-hu_moments	mahalanobis	0.61
area-perimeter-convexity-circularity-hu_moments	mahalanobis	0.6014285714285714
area-perimeter-circularity-rectangularity-hu_moments	mahalanobis	0.6014285714285714
area-perimeter-convexity-hu_moments	mahalanobis	0.5971428571428572
area-perimeter-rectangularity-hu_moments	mahalanobis	0.5914285714285714
perimeter-convexity-rectangularity-hu_moments	mahalanobis	0.5885714285714285
area-perimeter-convexity-circularity-rectangularity-fourier_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-circularity-rectangularity-fourier_10	manhattan	0.5871428571428572
area-perimeter-convexity-circularity-fourier_10-hist_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-convexity-fourier_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-convexity-circularity-fourier_10	manhattan	0.5871428571428572
area-perimeter-fourier_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-convexity-fourier_10-hist_10	manhattan	0.5871428571428572
area-perimeter-convexity-circularity-rectangularity-fourier_10	manhattan	0.5871428571428572
area-perimeter-convexity-circularity-rectangularity-fourier_10-hist_10	manhattan	0.5871428571428572
area-perimeter-convexity-circularity-rectangularity-fourier_10-hist_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-convexity-circularity-fourier_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-convexity-rectangularity-fourier_10-hist_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-circularity-rectangularity-fourier_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-circularity-rectangularity-fourier_10-hist_10	manhattan	0.5871428571428572
area-perimeter-circularity-fourier_10-hist_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-convexity-fourier_10-hist_10-hu_moments	manhattan	0.5871428571428572
area-perimeter-rectangularity-fourier_10-hist_10	manhattan	0.5871428571428572
area-perimeter-circularity-fourier_10	manhattan	0.5871428571428572

area-perimeter-rectangularity-fourier_10-hist_10-central_moments	euclidean	0.4842857142857142
perimeter-circularity-rectangularity-fourier_10-central_moments	euclidean	0.4842857142857142
area-perimeter-fourier_10-central_moments	euclidean	0.4842857142857142
area-perimeter-convexity-fourier_10-central_moments	euclidean	0.4842857142857142
area-perimeter-circularity-rectangularity-central_moments	euclidean	0.4842857142857142
area-circularity-fourier_10-central_moments	euclidean	0.4842857142857142
area-perimeter-circularity-rectangularity-fourier_10-hist_10-central_moments	euclidean	0.4842857142857142
area-perimeter-fourier_10-hist_10-central_moments	euclidean	0.4842857142857142
area-perimeter-hist_10-central_moments	euclidean	0.4842857142857142
area-perimeter-rectangularity-hist_10-central_moments	euclidean	0.4842857142857142
area-perimeter-circularity-fourier_10-central_moments	euclidean	0.4842857142857142
area-perimeter-convexity-circularity	mahalanobis	0.4785714285714286
area-perimeter-circularity-rectangularity	mahalanobis	0.4757142857142857
convexity-rectangularity-hist_10-hu_moments	manhattan	0.3957142857142857
convexity-circularity-rectangularity-hist_10-hu_moments	chisquared	0.3871428571428571
convexity-circularity-rectangularity-hist_10	chisquared	0.3857142857142857
circularity-rectangularity-hist_10-hu_moments	chisquared	0.3657142857142857
convexity-circularity-hist_10-hu_moments	chisquared	0.3557142857142857
perimeter-circularity-rectangularity-hist_10	chisquared	0.3414285714285714
perimeter-circularity-rectangularity-hist_10-hu_moments	chisquared	0.3414285714285714
perimeter-convexity-circularity-rectangularity-hist_10	chisquared	0.34
perimeter-convexity-circularity-rectangularity-hist_10-hu_moments	chisquared	0.34
perimeter-convexity-circularity-rectangularity	chisquared	0.3371428571428571
perimeter-convexity-circularity-rectangularity-hu_moments	chisquared	0.3371428571428571
perimeter-convexity-circularity-hist_10	chisquared	0.3342857142857143
perimeter-circularity-rectangularity-hu_moments	chisquared	0.3342857142857143
perimeter-convexity-circularity-hist_10-hu_moments	chisquared	0.3342857142857143
convexity-rectangularity-hist_10-hu_moments	euclidean	0.3314285714285714
perimeter-convexity-circularity-hu_moments	chisquared	0.33
area-perimeter-circularity-rectangularity	chisquared	0.3271428571428571
area-perimeter-circularity-rectangularity-hist_10-hu_moments	chisquared	0.3271428571428571
area-perimeter-convexity-circularity-rectangularity	chisquared	0.3271428571428571
area-perimeter-circularity-rectangularity-hist_10	chisquared	0.3271428571428571
area-perimeter-convexity-circularity-rectangularity-hist_10-hu_moments	chisquared	0.3271428571428571