Systematic Classification Experiments

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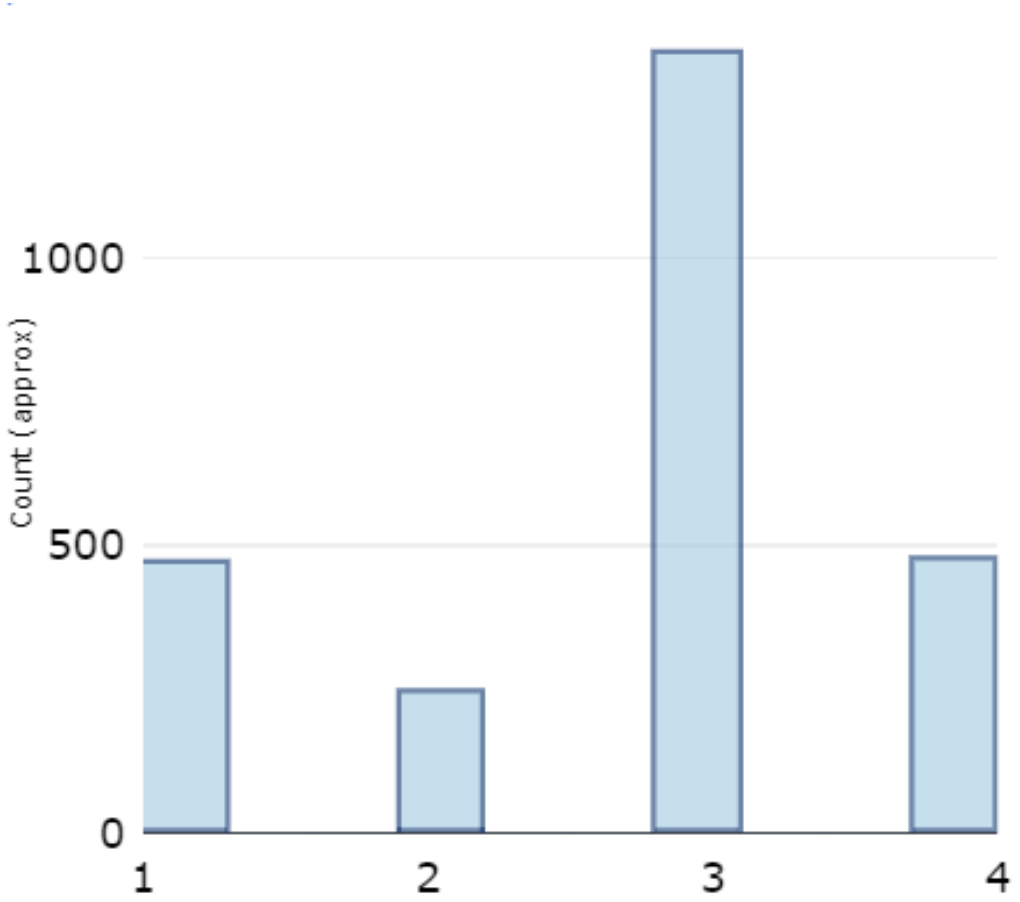
Outline

- Prediction of four emotion classes, with:
  - kNN
  - Boosted Tree
  - SVM
  - NN
- Prediciton of major/minor feature

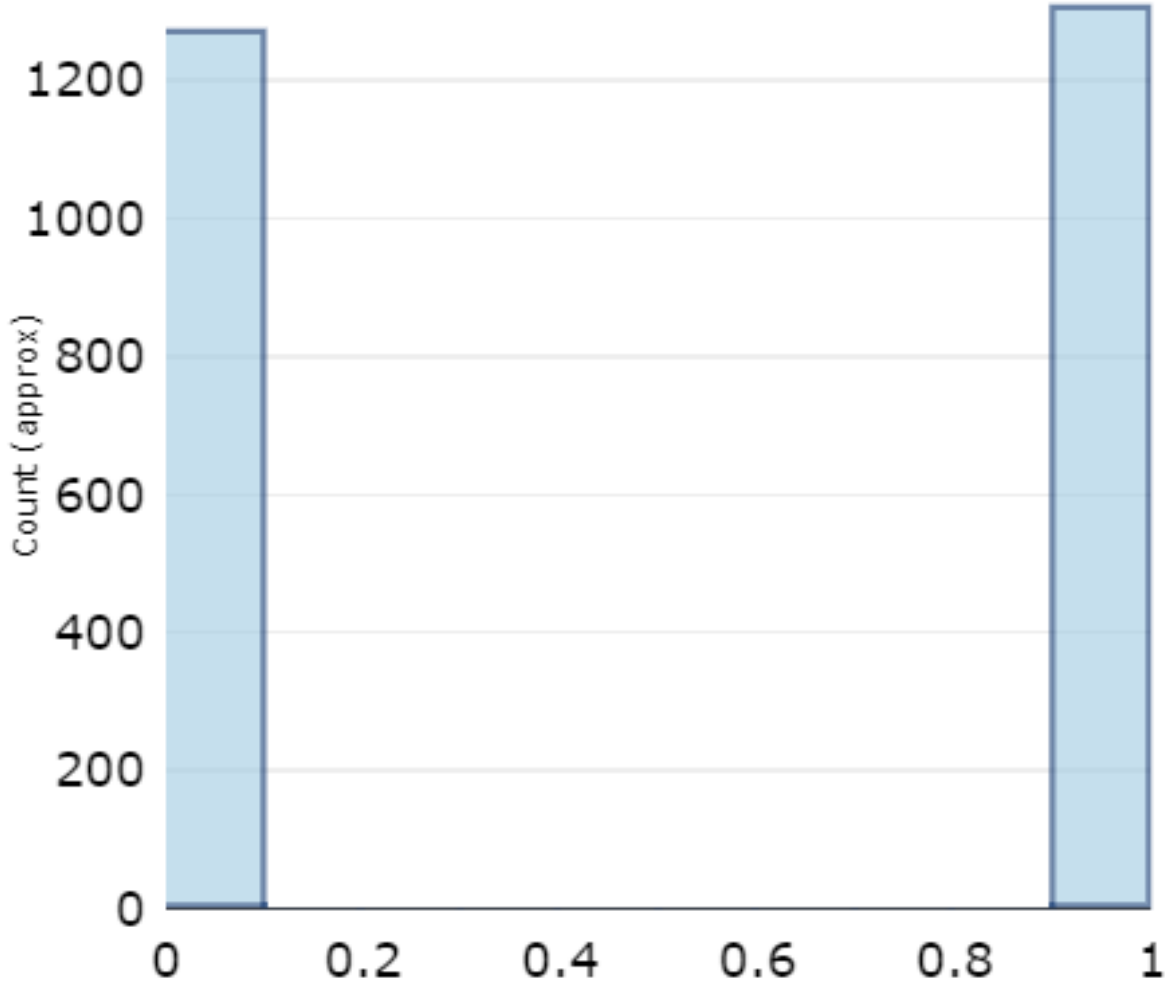
Underlying Data: Class Distribution

- Unbalanced Distribution
- Class 3 most dominant
- Class 2 least dominant



Underlying Data: Score Mode Distribution

- Score Mode (major/minor) feature is strongly balanced



Prediction on emotion classes: general info

- Models trained on quadrant labels
- Excluded features: score / id
  This was done, because they will not be provided in the later tasks
- Preprocessing / Normalization was done
  - To have better results with distance based classifiers (kNN, SVC)
  - To have better gradient descent with the NN
- We used 10-fold Cross Validation for each classifier
  - 10 was a good balance between training time and results
- We had some overfitting („high“ hyperparameters), which was avoided with 10-fold cross validation

kNN

- Dataset normalized with MinMax normalization
- 75/25 stratified train/test set split
- f1-score as metric
- Test set scored with best classifier

kNN: results

- 15 best classifiers
- Parameter p:
  - 1: manhatten distance
  - 2: euclidian distance
- Parameter weights:
  - Uniform: all points are weighted equally
  - Distance: closer points have higher influence
- Result: 75% accuracy

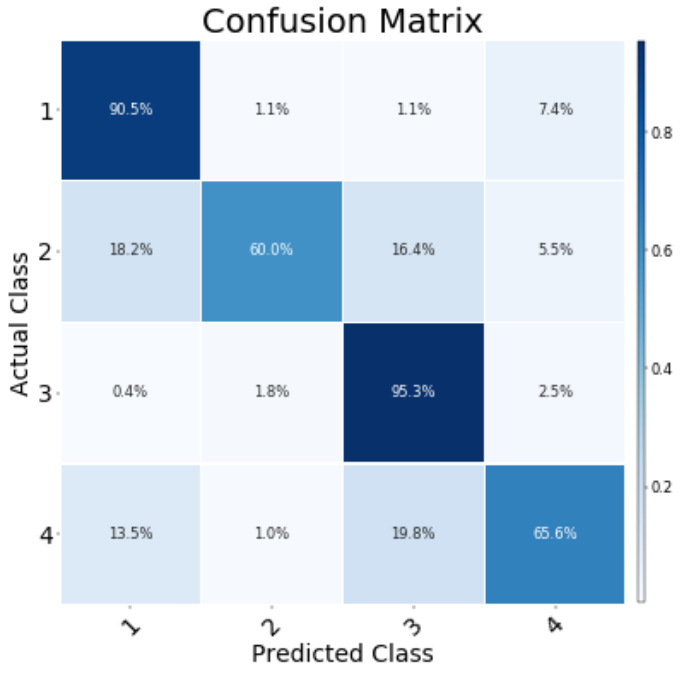
n	p	weights	mean_test_score
5	1	distance	0,7546
5	1	uniform	0,7490
10	1	distance	0,7449
5	2	distance	0,7403
10	2	distance	0,7367
10	1	uniform	0,7336
2	1	distance	0,7326
5	2	uniform	0,7321
10	2	uniform	0,7234
25	1	distance	0,7224
25	1	uniform	0,7137
25	2	distance	0,7122
2	1	uniform	0,7122
25	2	uniform	0,7071
50	1	distance	0,7030

Boosted Tree

- Used model class:
  - Lightgbm multiclass gradient boosted decision tree
- Dataset normalized with Zscore-normalization
- 75/25 stratified train/test set splitPermutation feature importance with accuracy as metric

Boosted Tree: results

- 15 best classifiers
- Result: 85% accuracy on test set (best model class, of the four tested)



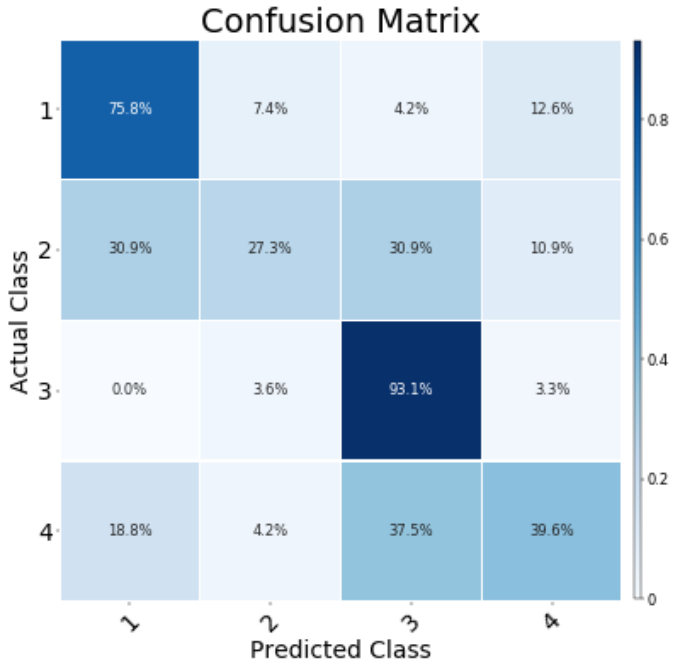
Learning rate	Minimum number of samples per leaf node	Number of trees constructed	Maximum number of leaves per tree	Mean test accuracy
0,1	10	500	32	0,800
0,05	1	500	32	0,799
0,05	10	500	32	0,799
0,2	50	500	32	0,799
0,2	50	500	128	0,799
0,05	50	500	128	0,799
0,05	50	500	32	0,799
0,025	10	500	32	0,797
0,1	1	500	32	0,797
0,2	50	500	8	0,796
0,4	1	100	32	0,796
0,1	50	500	128	0,795
0,1	10	500	128	0,795
0,1	50	500	32	0,795
0,4	10	500	8	0,794

SVM

- LinearSVC: one vs one mutliclass classifier
- Dataset normalized with MinMax-normalization
- Split 80/20 into stratified train/test setPermutation feature importance with accuracy as metric

SVM: results

- 15 best classifiers
- Result 73% on test set
  - Worse than kNN (75%) and Boosted Tree (85%)



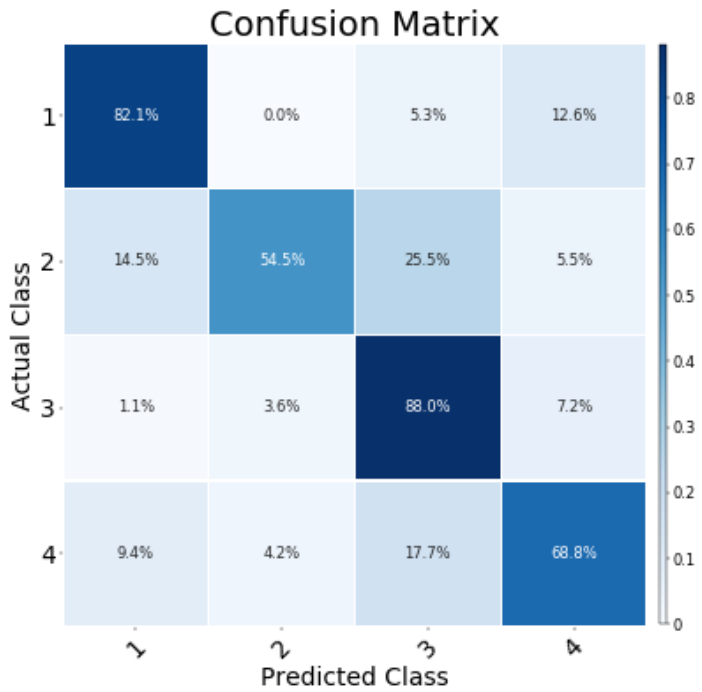
Lambda	Number of iterations	mean test accuracy
1	1000	0,740
1	100	0,735
0,1	100	0,727
0,1	1000	0,720
1	10	0,698
0,1	10	0,697
10	1000	0,689
10	100	0,686
10	10	0,677
1	1	0,604
0,1	1	0,602
10	1	0,599
100	1	0,529
100	10	0,529
100	100	0,529

Neural Network

- Fully connected NN with 3 hidden layers (each 100 neurons)
- Dataset normalized with MinMax-normalization
- Split 80/20 into stratified train/test setPermutation feature importance with accuracy as metric

Neural Network: results

- Best 15 classifiers
- Result: 80% on test set
- Confusion Matrix more equally distributed



Learning rate	Number of learning iterations	mean test accuracy
0,01	320	0,762
0,1	160	0,754
0,01	640	0,754
0,01	2560	0,754
0,1	640	0,754
0,1	1280	0,754
0,1	2560	0,754
0,1	320	0,753
0,01	1280	0,752
0,001	1280	0,752
0,001	2560	0,750
0,01	160	0,747
0,001	640	0,727
0,001	320	0,698
0,001	160	0,665

Feature importances

- All features that had an importance of at least 3% in any of the last three classifiers

Feature	Boosted Tree	SVM	NN
essentia_onset_rate	13,40%	14,55%	15,51%
midlevel_features_melody	2,30%	9,20%	7,66%
librosa_bpm	5,75%	0,96%	2,87%
midlevel_features_articulation	1,92%	2,68%	5,56%
midlevel_features_rhythm_complexity	3,07%	4,60%	1,92%
midlevel_features_dissonance	0,19%	1,34%	4,21%
librosa_spectral_bandwidth_mean	1,72%	3,45%	1,72%
midlevel_features_minorness	2,30%	3,26%	1,34%

Score mode predictions: Random Forest

- For all predictions: 80/20 - train / test split

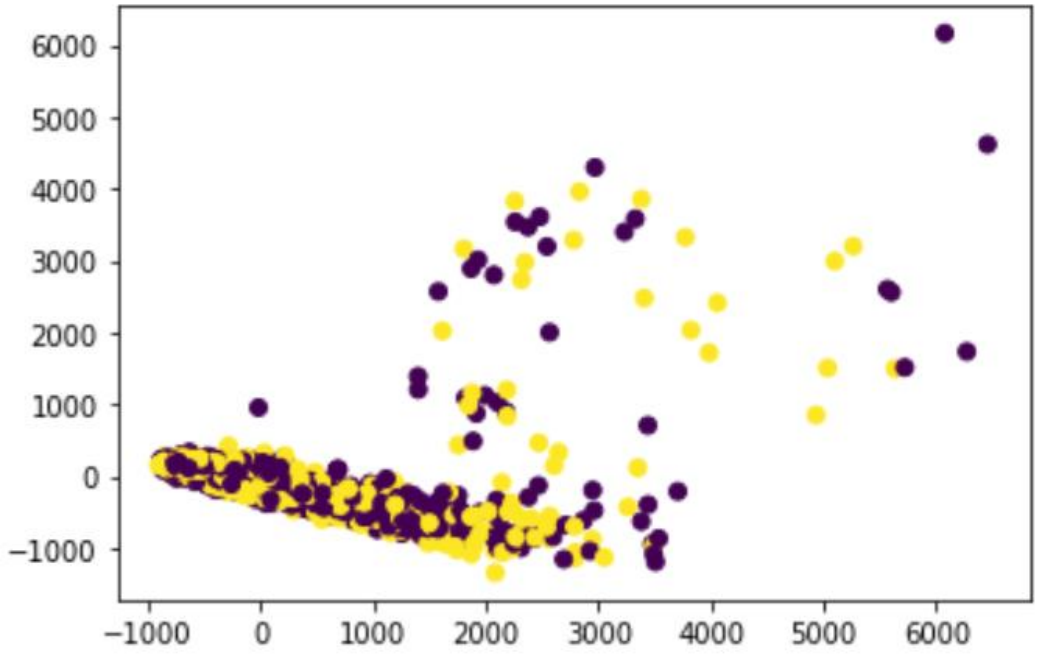
- Random Forest
  - Accuracy: 53,64%
  - After dropping some unnecessary features: 55,94%
  - After GridSearchCV: 55,94%

Naive Bayes / SVM

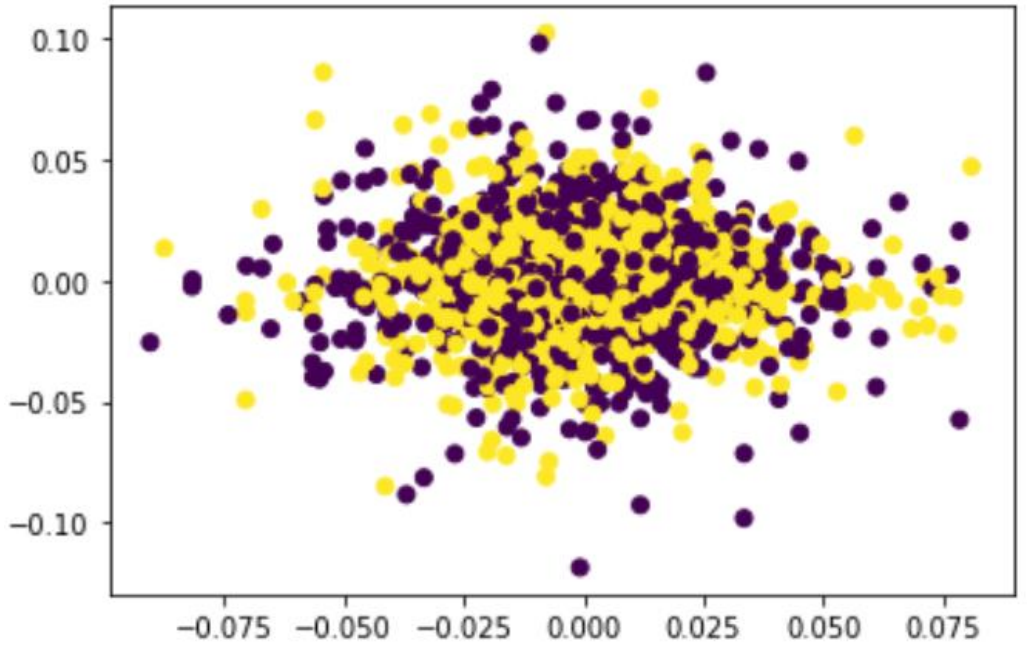
- Gaussian NB
  - Result: 49,8%
- Bernoulli NB
  - Result: 52,87%
- SVM
  - Poly: 43,9%
  - RBF: 45,6%
  - Sigmoid: 45,8%

PCA / ICA

PCA



ICA



No significant separation visible

Conclusion for our mode prediction

- Results are really bad
- Could be the case due to the much overlapping distribution of major and minor samples

Distribution of score mode