

# A Cartesian Ensemble of Feature Subspace Classifiers for Music Categorization



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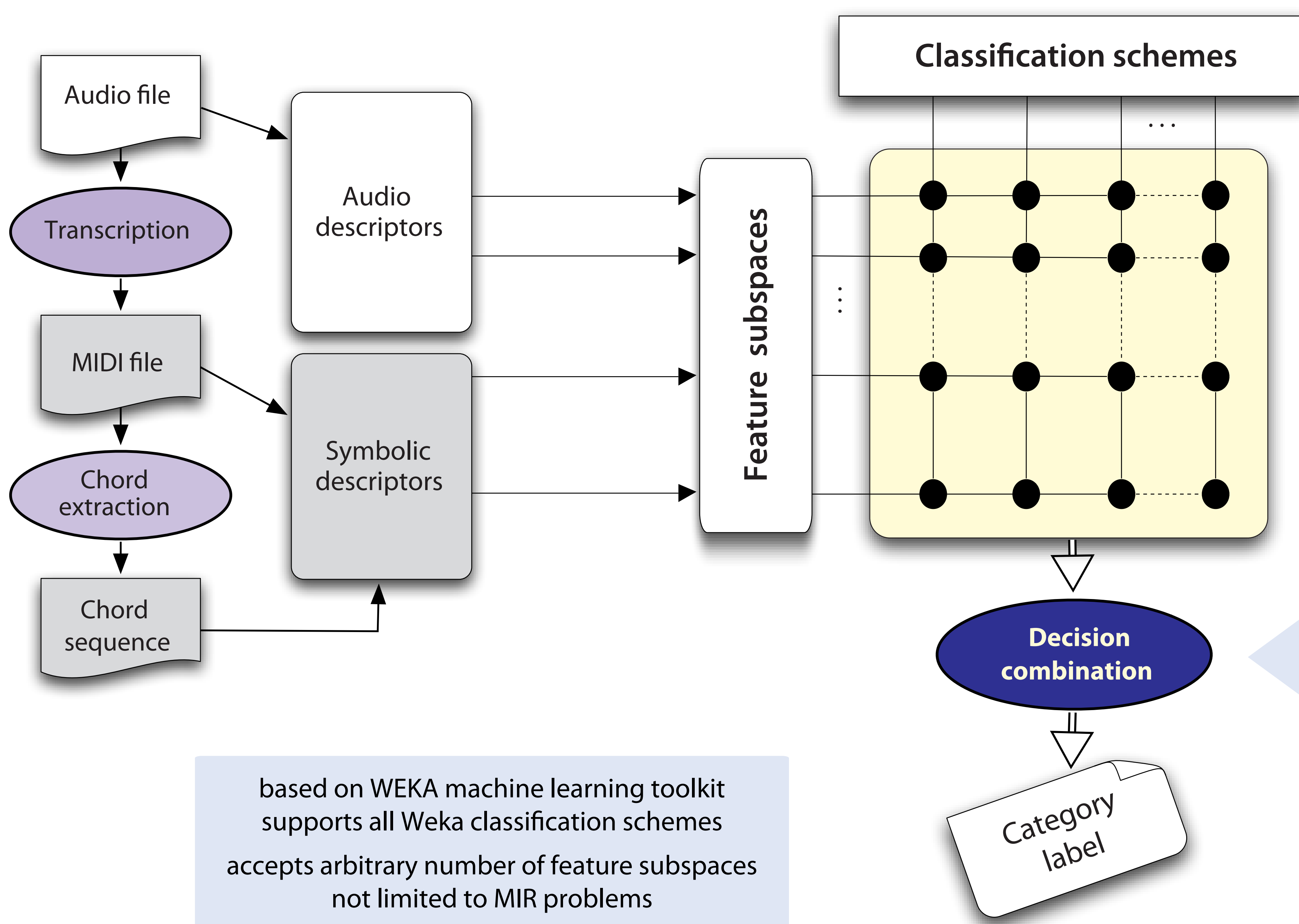
## Motivation and Goals

- Improvement of classification through combination of multiple sets of complementary information
- Create a generic ensemble classification framework
- Improve results on music genre classification

## Approach

- Combination of features from different subspaces  $D$  with a range of classification algorithms  $C$
- Creating a cartesian ensemble classification framework, which trains a matrix of classifier models ( $D \times C$ )

## Cartesian Ensemble Framework



### Combination Rules

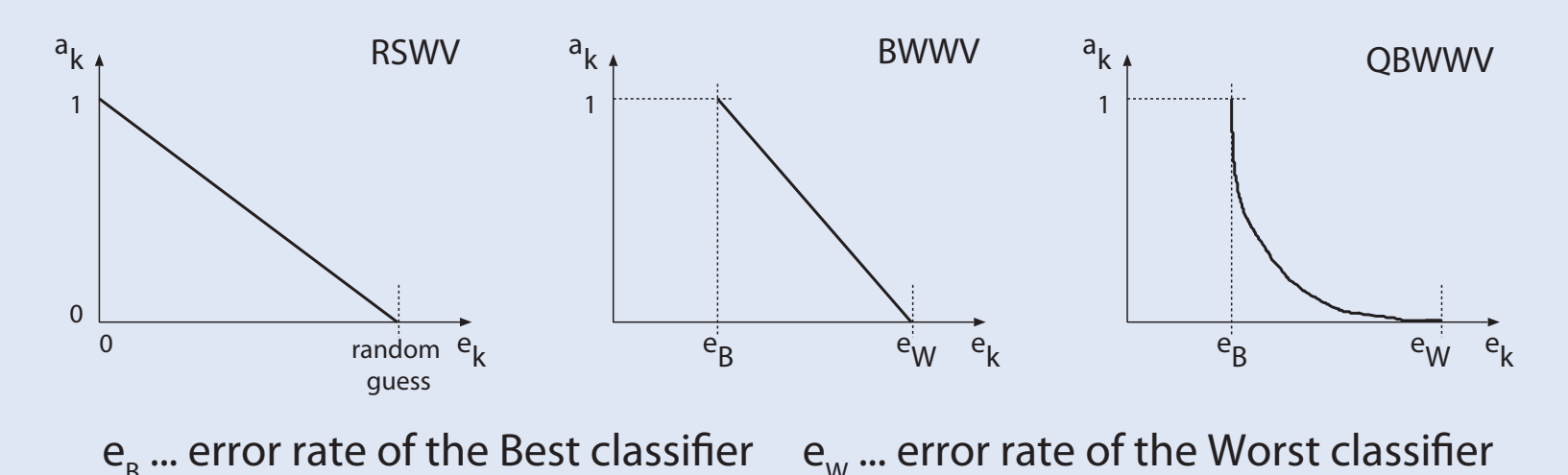
#### Unweighted (Weka rules)

- MAJ Majority vote rule
- AVG Average of Probabilities
- MAX Maximum Probability
- MED Median Probability

#### Weighted

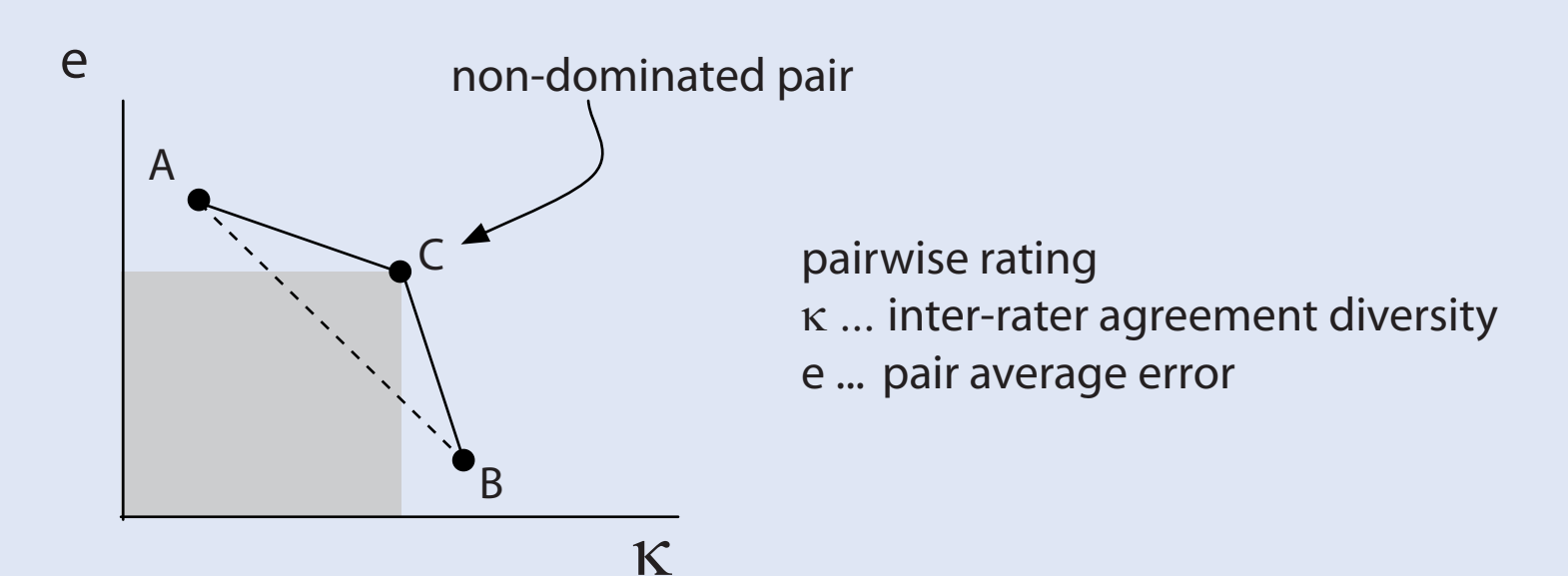
(weights based on internal cross-val. of the models)

- SWV Simple Weighted Vote
- RSWV Rescaled Simple Weighted Vote
- BWWV Best-Worst Weighted Vote
- QBWWV Quadratic Best-Worst Weighted Vote
- WMV Weighted Majority Vote



### Pareto-optimal Selection

selecting the best subset of models



## Evaluation

### Feature Subspaces

#### Audio Features

- SSD Statistical Spectrum Descriptor
- TSSD Temporal SSD
- RP Rhythm Pattern
- RH Rhythm Histogram
- TRH Temporal RH
- MVD Modulation Freq. Var. Descriptor

#### Symbolic Features

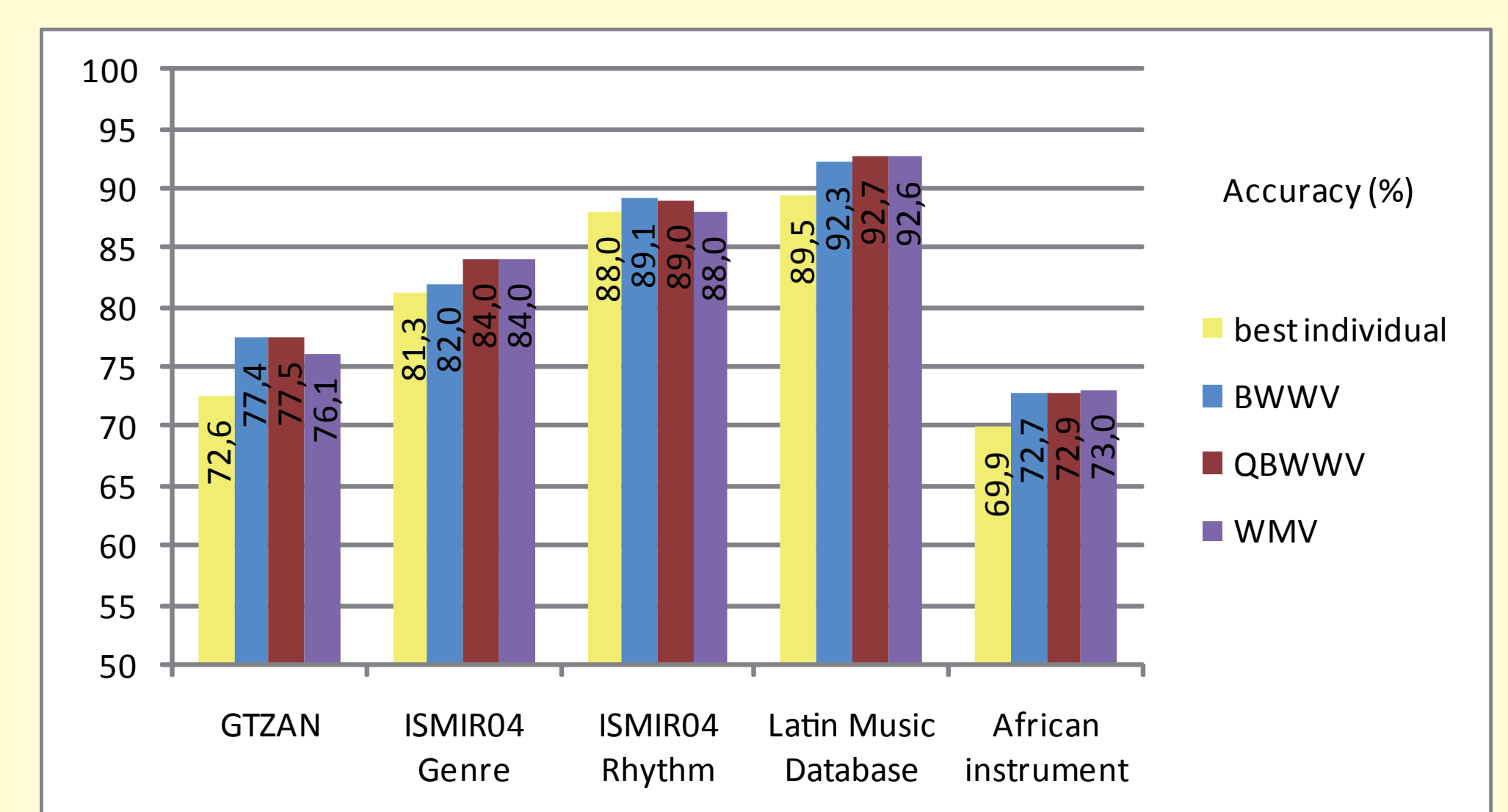
61 features (note pitches, note durations, IOIs, pitch intervals, non-diatonic notes, syncopations, chord sequences, ...)

### Classification Schemes

- Naïve Bayes
- 1-Nearest Neighbor (Euclidean)
- 3-Nearest Neighbor (Manhattan)
- Ripper rule learner
- J48 Decision tree
- Reduced-Error Pruning Tree
- Random Forest
- SVM linear
- SVM quadratic
- SVM with Puk kernel

10-fold cross-validation

### Results



Baseline: best individual classification result among all subspaces and classification schemes