

# Combining Mixtures of Classifiers

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## Abstract

In recent years, the explosion in computation and information technology allowed to dispose of vast amounts of data. Nowadays, the statistician's job is to make sense of it all, by extracting important patterns and trends with the aim of understanding what is inside the data. The new challenge of learning from data has been called "statistical learning" (Hastie et. al, 2001). In this framework, a lot of new tools have been introduced improving the performance of standard supervised methods.

We present a combined semiparametric approach to supervised statistical learning problems called Generalized Additive Multi-Mixture Model (GAM-MM, Conversano, 2002). This is a nonlinear regression tool capable to capture the complexity of the data. It has been defined as an additive combination of mixtures of different classifiers (both parametric and nonparametric) associated to each feature, that uses a backfitting-like algorithm for the estimation/prediction of the output of the response variable.

In this approach, Bagging (Breiman, 1996) and Boosting (Freund and Shapire, 1996) can be used to estimate the mixing parameters and to train the additive combination of mixtures of classifiers to reweighted versions of the training data.

We will show the effectiveness of GAM-MM in comparison to other alternatives.

## References

- Conversano C., (2002), "Bagged Mixtures of Classifiers using Model Scoring Criteria", *Journal of Pattern Analysis and Applications*, 5, 4, 351- 362.
- Breiman L. (1996), Bagging predictors. *Machine Learning*, **24**, 123-140.
- Freud, Y. and Shapire, R. E. (1996), Experiments with a new boosting algorithm. In: *Machine Learning: Proceedings of the XIII International Conference*, 148-156.
- Hastie, T., Tibshirani, R. and Friedman, J. H., (2001) *The Elements of Statistical Learning: Data Mining, Inference and Prediction*, Springer.