Ann Inst Stat Math (2009) 61:331–353
DOI 10.1007/s10463-007-0143-3

Nonlinear logistic discrimination via regularized radial basis functions for classifying high-dimensional data

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Received: 8 August 2005 / Revised: 16 April 2007 / Published online: 10 August 2007

Abstract A flexible nonparametric method is proposed for classifying high-dimensional data with a complex structure. The proposed method can be regarded as an extended version of linear logistic discriminant procedures, in which the linear predictor is replaced by a radial-basis-expansion predictor. Radial basis functions with a hyperparameter are used to take the information on covariates and class labels into account; this was nearly impossible within the previously proposed hybrid learning framework. The penalized maximum likelihood estimation procedure is employed to obtain stable parameter estimates. A crucial issue in the model-construction process is the choice of a suitable model from candidates. This issue is examined from information-theoretic and Bayesian viewpoints and we employed Ando et al. (*Japanese Journal of Applied Statistics*, *31*, 123–139, 2002)'s model evaluation criteria. The proposed method is available not only for the high-dimensional data but also for the variable selection problem. Real data analysis and Monte Carlo experiments show that our proposed method performs well in classifying future observations in practical situations. The simulation results also show that the use of the hyperparameter in the basis functions improves the prediction performance.

Keywords Bayes approach · Information criteria · Maximum penalized likelihood method · Radial basis functions