Natural Discriminant Analysis Using Interactive Potts Models

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Abstract

Natural discriminant analysis based on interactive Potts models is developed in this work. A generative model composed of piece-wise multivariate gaussian distributions is used to characterize the input space, exploring the embedded clustering and mixing structures and developing proper internal representations of input parameters. The maximization of a log-likelihood function measuring the fitness of all input parameters to the generative model, and the minimization of a design cost summing up square errors between posterior outputs and desired outputs constitutes a mathematical framework for discriminant analysis. We apply a hybrid of the mean-field annealing and the gradient-descent methods to the optimization of this framework and obtain multiple sets of interactive dynamics, which realize coupled Potts models for discriminant analysis. The new learning process is a whole process of component analysis, clustering analysis, and labeling analysis. Its major improvement compared to the radial basis function and the support vector machine is described by using some artificial examples and a real-world application to breast cancer diagnosis.