Research on the Lp-SVM data classification problem for non-linearly separable data

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Abstract: This study investigates the application of Lp-norm Support Vector Machines (Lp-SVM) for the classification of nonlinearly separable data. Traditional SVM models, which typically employ the L2-norm, are effective for linearly separable problems but often exhibit limitations in feature selection and robustness when handling complex, overlapping data distributions. This research formulates and analyzes the Lp-SVM framework, where the parameter p ($0 < p \leq 2$) governs the sparsity and geometric properties of the separating hyperplane. We examine the theoretical foundations of the Lp-norm regularization, focusing on its ability to induce sparsity and enhance model interpretability in high-dimensional spaces. Through a series of experiments on benchmark datasets characterized by nonlinear separability, the performance of Lp-SVM is evaluated against standard L2-SVM and kernel-based methods. The results demonstrate that by tuning the p parameter, Lp-SVM can achieve superior classification accuracy and improved margin characteristics for nonlinearly separable data, offering a flexible and effective alternative to traditional approaches without the computational overhead of kernel transformations.

Keywords: Lp-SVM, data classification, non-linearly separable data, classification problem