A Robust Optimization Model for Nonlinear Support Vector Machine

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Abstract. In this paper we present a novel optimization approach for Support Vector Machine (SVM), with the aim of separating two sets of points by means of a nonlinear decision boundary. Our approach extends the linear predictor proposed in [2] to a nonlinear classifier by including a kernel function in the model. However, when data points are real-world observations, they may be plagued by uncertainty due to measurement errors. Along with a deterministic model in which data is assumed to be perfectly known, we formulate a robust optimization model where the uncertainty set around each data point is bounded by a ℓ_p-norm. This approach generalizes the technique proposed in [1] to a general class of uncertainty sets and by including a nonlinear classifier. Finally, we show that the deterministic model and its robust counterpart reduce both to linear models with advantages in terms of efficiency compared to other approaches in the literature. Preliminary numerical results show the efficiency of the proposed approach.

Keywords: Machine Learning; Nonlinear Support Vector Machine; Robust Optimization

References

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