Approximating Solutions of Generalized Pinball Probabilistic Support Vector Machines using Neural Networks with Smoothing Techniques

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Abstract

We propose a neurodynamical neural network method for solving machine learning algorithms, specifically, the probabilistic Support Vector Machines (SVMs) involving different smoothing techniques of generalized pinball loss function. First, we employ seven different smoothing functions which approximate the non-smooth generalized pinball loss function associated with the probabilistic SVM problem. Next we propose a gradient neural network model to find real-time solutions of the probabilistic SVM with smooth objective function. We prove the relation between the optimal solutions of the smoothed problem and the equilibrium points of the proposed dynamical system. We then analyze existence and uniqueness properties of the introduced model followed by Lyapunov and asymptotic stability analysis. We next provide numerical experiments on synthetic and UCI benchmark to guarantee the effectiveness of the proposed model using the performance metrics: Accuracy, MCC, and F1-score. Finally, we compare the effectiveness of the proposed method with four benchmark methods.

Keywords: Generalized pinball loss; Global convergence; Neural networks; Probabilistic support vector machines; Smoothing functions; Stability.