Invited Talk Abstract

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A Neurodynamical Neural Network Approach for Solving Support Vector Machine Problems with Generalized Pinball Loss via Hyperbolic Tangent Smoothing

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Time	16:30–17:00
Session	Session 8
Venue	S102, Lecture Hall, Gong-Guan Campus, NTNU

Abstract

In this talk, we present a neurodynamical neural network approach for solving support vector machine (SVM) problems with generalized pinball loss functions by using a hyperbolic tangent smoothing technique. Since the generalized pinball loss function is nonsmooth, we first construct a smooth approximation through hyperbolic tangent smoothing. This allows us to reformulate the original nonsmooth SVM problem as a smooth optimization problem that can be handled within a continuous-time dynamical framework.

Based on the smoothed formulation, we propose a continuous-time neurodynamical neural network model whose trajectories provide continuous real-time solutions of the SVM problem. We prove that the set of optimal solutions of the hyperbolic tangent smoothed optimization problem coincides with the set of equilibrium points of the proposed dynamical system. In addition, we establish several important theoretical properties of the model, including the existence and uniqueness of solutions, global asymptotic stability, global convergence, and exponential stability.

To demonstrate the effectiveness of the proposed approach, we perform numerical experiments on both synthetic datasets and benchmark real-world datasets. The performance of the model is evaluated using accuracy, F1-score, and Matthews correlation coefficient (MCC). We also compare the proposed method with three existing benchmark models for SVM problems with pinball loss functions. Furthermore, Friedman test analysis followed by the Nemenyi post-hoc test is conducted to examine the statistical significance of the observed differences among the competing methods.

The results show that the proposed model achieves strong classification performance and compares favorably with the existing approaches. In particular, beyond competitive empirical performance, the proposed framework provides theoretical guarantees of global stability and convergence, making it an effective and reliable method for solving generalized pinball loss SVM problems.