Elite-Driven SVMs: A Robust Framework for Classification

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Support Vector Machines (SVMs) are a cornerstone of classification methodology, where decision boundaries are shaped by support vectors determined via a chosen loss function. However, different loss functions yield different sets of support vectors, resulting in variable classification outcomes. This conventional dependence on a single loss function often obscures broader structural insights—particularly the presence of observations that consistently act as support vectors across multiple SVM configurations. These persistently influential points point to a new paradigm in classifier design.

We propose **Elite-Driven Support Vector Machines (EDSVM)**, a novel framework that enhances classification performance by identifying and amplifying the role of these elite observations. These elites are data points that recur as support vectors across a range of loss functions and decision boundaries. To harness their importance, we design new classification-calibrated loss functions that embed elite-weighted influence directly into the training process.

Through rigorous theoretical development and extensive empirical evaluation —spanning both synthetic and real-world datasets—we show that EDSVM outperforms classical SVMs in linear and nonlinear settings. This work advances the foundations of SVM methodology and offers practical tools for high-stakes, data-sensitive applications.