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Generalization bounds for multiclass classifiers

Classification methods based on statistical learning theory are mostly concerned with binary (two-class) classifiers. It is sometimes argued that multi-class (more than two classes) problems can be reduced to binary ones through sequential dichotomization. The drawbacks of such approaches are obvious. We seek here simultaneous solutions (classifier determinations) to a multiple classification problem with real loss function on classification error cases, reflecting the possibly variable gravity of misdiagnoses and/or a decision not to classify an object. We demonstrate a general *reduction principle* and show in particular that asymmetry in the loss function is necessary and sufficient for the multi-class problem not to be reducible to a bi-class one. We then propose two generalization bounds specifically designed for the multi-class setting. These bounds are numerical, and are tight by construction.