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Logistic regression methods with truncated newton method

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Abstract

Considering two-class classification, this paper aims to perform further study on the success of Truncated Newton method in Truncated Regularized Kernel Logistic Regression (TR-KLR) and Iterative Re-weighted Least Square (TR-IRLS) on solving the numerical problem of KLR and RLR. The study was conducted by developing the Newton version of TR-KLR and TR-IRLS algorithm respectively. They are general classifiers which are termed respectively as proposed Newton TR-KLR (NTR-KLR) and proposed NTR Regularized Logistic Regression (NTR-LR). Instead of using IRLS procedure as used by TR-KLR and TR-IRLS, the proposed algorithms implement Newton-Raphson method as the outer algorithm of Truncated Newton for KLR and RLR respectively. Since, for KLR and RLR, IRLS is equivalent to Newton-Raphson method, both proposed algorithms can be expected to perform as well as TR-KLR and TR-IRLS. Moreover, both proposed algorithms are mathematically simpler, because they do not need to restate the Newton-Raphson method as the IRLS procedure before such as in TR-KLR and TR-IRLS. Hence, they simply can be applied as further explanation to the effectiveness of Truncated Newton method in TR-KLR and TR-IRLS respectively. Numerical experiment with *Image Segmentation* data set has demonstrated that proposed NTR-KLR performs effectively when exist the singularity and the training time problem in using Newton-Raphson method for KLR (KLR-NR). While proposed NTR-LR has performed better training time than RLR with Newton-Raphson (RLR-NR) method on *Letter Image* data set. Moreover, both proposed algorithms have showed consistency with the convergence theory and have promising results, i.e. accurate and stable classification, on image data sets respectively.

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