

Regularized support vector machine

(Due on Nov.-15-2019)

Instruction: Each student needs to submit the source code file and a report by Latex. In the report file, you can summarize what you observe or difficulties you have. **You will be evaluated based on correctness of your algorithms, accuracy and efficiency of algorithms, performance on applications, and also the report.** Compress your files into a single .zip file, name it as “MATP6960_Assignment4_YourName”, and send it to `optimization.rpi@gmail.com`

1 Problem description

The ℓ_2 regularized logistic regression is formulated as

$$\underset{\mathbf{w}}{\text{minimize}} \quad \frac{1}{N} \sum_{i=1}^N \log(1 + \exp(-y_i \mathbf{x}_i^\top \mathbf{w})) + \frac{\mu}{2} \|\mathbf{w}\|^2, \quad (1)$$

where $\{(\mathbf{x}_i, y_i)\}_{i=1}^N$ are given training data with each $y_i \in \{+1, -1\}$. We take a $\mu > 0$ in this project in order to have linear convergence of various variance-reduced stochastic gradient methods.

2 Requirements

Include every item below in a single report and attach your code. Use the provided testfile to test your code.

1. Develop four solvers for (1) by the SVRG, SAG, SAGA, and SARAH. The input of the solver should include \mathbf{X} , \mathbf{y} , $\mu > 0$, and other parameters like the stopping tolerance. Here, the i -th row of \mathbf{X} contains i -th data point, and y_i contains the label.
2. Compare the four solvers on the provided `realsim` data set. Use the provided test file to conduct the comparison. Note that in the test file, the training data and testing data have been put together, because the purpose of this project is to compare the speed of the four methods in terms of epoch (or data pass) number. The “optimal”

objective is computed by the provided FISTA solver. You may need to run the FISTA solver to many epochs.

3. Tune the parameters of each solver. For each method, plot the difference of the objective value to the optimal value and report what you observe.