Safe Screening - Old and New

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Abstract. This report provides a comprehensive review of the development of safe screening techniques during the last 15 years.

1. Introduction

Safe screening is a technique to reduce the dimension of optimization problem, so that one can solve the reduced problem faster.

In the following, we mentioned some of the landmark in this field.

Safe screening was first introduced in around 2010 by El Ghaoui et. al. [1]. They introduced the method for sparse machine learning problems including lasso, sparse logistic regression and sparse SVM. The common characteristic of these problems is that they are L1 norm regularization convex optimization problem, here L1 norm encourage the sparsity. Although the proposed methods aim to reduce the dimension of the problems, it is referred to as *Feature Elimination* due to the machine learning context.

Another landmark appearred when Ogawa et. al. [2] introduced the *Sample Elimination* for sparse (soft) Support Vector Machine (SVM) for discarding the non-support vector in SVM models. In the language of optimization, this is equivalent to a dimensionality reduction for the dual problem of SVM.

Furthermore, Shibagaki et. al. [3] proposes the safe screening techniques for simultaneous sample and feature elimination for sparse SVM.

2. Lasso - Feature Elimination

[4]

3. SVM - Sample Elimination

[4]

4. Possible Research Directions

4.1. Variational denoising

[4]

4.2. Sparse Machine Learning Models

[4]

4.3. Sparse Optimal Transport

[4]

Bibliography

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[4] F. Bach, "Optimization with Sparsity-Inducing Penalties," *Foundations and Trends® in Machine Learning*, vol. 4, no. 1, pp. 1–106, 2011.