

# 5361 Statistical Computing Project Proposal

So far in this course we have covered many of the optimization method, I'm especially interested in investigating several gradient based optimization methods, i.e. naïve gradient descent, conjugate gradient descent and coordinate descent.

## 1. Comparing different optimization methods

I will apply optimizing methods for different classic statistical problems, i.e., linear regression, logistic regression, SVM, to see how they perform differently. Gradient based method doesn't use the information of Hessian matrix, and I'm wondering how re-scale the parameter space would change the performance, since there's a theorem to guarantee the affine transformation will not change the performance of Newton's method. I will try to create pathological functions to test the "break point" of each optimization algorithm.

## 2. Gradient descent for quasi-convex case

For instance, gradient descent is usually applied when optimization objective is convex, but for quasi-convex case, not many literatures are found. Thus, applying the naïve gradient descent may perform badly, another direction for me is to analyze the performance of gradient descent when function is quasi-convex, and how to choose step size cleverly.

## 3. Non-convex problem

I'm not familiar with neural nets and matrix completion, but after checking the literature, they all related to non-convexity to some extent, so I will explore what is the status-of-the-art to deal with the issue of non-convexity, i.e. stochastic gradient descent, momentum, and how non-convexity can be relaxed to convex problem.

## 4. MM algorithm and direct optimization methods

If time possible, I will compare the MM algorithm and direct methods, on their convergence rate and precision.