EE457 INTRODUCTION TO OPTIMIZATION

HOMEWORK 4 REPORT

Introduction

This homework is basically constituted by two parts. In the first part, performances of several iterative algorithms for minimizing the Rosenbrock function were evaluated. Then, for the given dataset, a curve and a line were fitted.

Analysis

Problem 1

Firstly, the conjugate direction algorithm was implemented and the search is done on the conjugate paths. The function given is nonquadratic so use of Q was expensive. Also, the solution was not necessarily reached in n steps. In modified algorithm, we computed the optimal alpha in every iteration as in the steepest descent algorithm. This reduced the speed of the algorithm.

Secondly, we applied the Quasi-Newton algorithm with 3 different correction formulas for updating H(k+1). All formulas have the same form H(k+1) = H(k) + U(k). Comparing the results, The DFP algorithm performed better than the rank-1 correction formula. However, the best performance was obtained with BFGS algorithm.

Problem 2

In this problem, two randomized search algorithms were employed. There was no need for gradients and we quickly obtained satisfactory solution.

Firstly, in naïve approach, the algorithm had the descent property. However, results showed that it get stuck in the local minimum for a short range of neighboorhood. When the range is expanded, the algorithm resulted in a close vicinity of global minimum.

Then, by adding a probability term I was expecting to obtain better results since it can climb out of local minimum. However, I obtained very likely results of the first approach. It may due to that the alpha is not big enough to jump from the local minimum.

Problem 3

In this problem, the RLS algorithm performed unsatisfactory results compared to the LS solution. The algorithm was double-checked and found to be correct but the cost function resulted hugely compared with that obtained by the LS solution method. One probable cause of the error might be that RLS required much more data to approximate the trend. LS Solution, however, reduced the cost almost to zero.

Problem 4

In the first part, we used Gauss – Newton method to approximate the data with a sine curve. The algorithm was employed for various initial points and some of them did not function well. The cause of this error is that for certain initial points, J' * J wasn't invertible and it caused an unsatisfactory approximation.

Secondly, when we used Levenberg algorithm, we applied a small multiple of identity and this made J' * J invertible. Thus, for the initial points where Gauss – Newton failed, we were achieved a very satisfactory approximation.

Conclusion

The exercises were helpful to teach and practice various methods of optimization as well as line and curve fitting.