Optimization Methods for Computer Vision Applications (CS6777)

Software Assignment 1
August 10, 2019

1 Assignment Part 1

1.1 Problem Statement

- Given a random (non-singular) matrix A and a random vector X s.t. $X \in \mathbb{R}^N$, the following equation holds good

$$AX = B \tag{1}$$

- Construct A' from A by:
  1. eliminating **OR** concatenating few rows.
  2. perturbing diagonal elements of A by a small random gaussian noise ϵ_i with different variance (σ^2).
- Now, form B' as

$$B' = A'X \tag{2}$$

- Solve the following optimization problem (appending zeros when required)

$$\hat{X} = \min_X ||AX - B'||_F \tag{3}$$

- Use the following optimization algorithms (as allotted in Table 1.2).
  1. Adaptive Gradient Descent
  2. Co-ordinate Descent
  3. Conjugate Gradient
  4. Quasi Newton
  5. Gauss Newton

  Equation 3 gives the optimum value of X ($\hat{X}$) which minimizes $||AX - B'||_F$, where $|| \cdot ||_F$ denotes the Frobenius norm.

- Plot $||X - \hat{X}||_2$ vs %-of rows removed or added (or increasing σ^2 as applicable) for different optimization algorithms (in a single plot), where $||\cdot||_2$) denotes the ℓ_2 norm.
- Perform 5-fold study of this optimization problem.
- Repeat this experiment for N=10, 50 and 100.

1.2 Algorithm Allotment

Name	**Algorithm 1**	**Algorithm 2**
Sadbhavana Babar	Gauss Newton	Co-ordinate Descent
Sonam Gupta	Quasi-Newton	Conjugate Gradient
Kitty Varghese	Adaptive Gradient Descent	Quasi-Newton

1.3 Instructions

There is no restriction on the usage of any programming language. Usage of library functions (if available) are allowed.

2 Assignment Part 2

Given a matrix A, find an algorithm to make the matrix A singular by altering the elements (not size). Please note the following:

1. Avoid trivial solutions, such as $A - A$.
2. Extra credit for 2 or 3 different types of algorithms.