# Review of Homework-1 (Group-2)

Group 1

## 1 problem1

### 1.1

To prove equivalence, both necessity and sufficiently should be proved. In the solution, only the necessity is proved.

### 1.2

Same as the previous one.

### 1.3

The answer seems correct and clear.

### 1.4

The answer is correct and comprehensive.

### 1.5

Interesting and clear proof.

### 1.6

The solution should be correct.

## 2 problem2

### 2.1

Interesting and clear proof.

### 2.2

The answer seems correct.

### 2.3

We are a bit confused that the authors have already got the inequality result of (1) and (2) in problem 1.2.b:

$$f(x_2) \geq f(x_1) + \bigtriangledown f(x_1)^T(x_2 - x_1) + \frac{1}{2L} \left\| \bigtriangledown f(x_2) - \bigtriangledown f(x_1) \right\|_2^2 \tag{1}$$

$$f(x_1) \geq f(x_2) + \bigtriangledown f(x_2)^T(x_1 - x_2) + \frac{1}{2L} \left\| \bigtriangledown f(x_1) - \bigtriangledown f(x_2) \right\|_2^2 \tag{2}$$

But the authors prove these inequality again by using another method different from their previous answer.

## 3 problem3

The authors give definition of different convergence rate without giving examples. There is a bit ambiguous in the inequality (31).

## 4 problem4

### 4.1 a

The answer seems to be correct.

### 4.2 b

The answer seems to be correct.

### 4.3 c

The matrix to compute Newton step should be like:

$$\begin{bmatrix} \bigtriangledown^2 f(\mathbf{x}) & \mathbf{A}^T \\ \mathbf{A} & 0 \end{bmatrix} \begin{bmatrix} \Delta \mathbf{x}_{nt} \\ w \end{bmatrix} = \begin{bmatrix} - \bigtriangledown f(\mathbf{x}) \\ 0 \end{bmatrix} \tag{3}$$

instead of

$$\begin{bmatrix} \bigtriangledown^2 f(\mathbf{x})^2 & \mathbf{A}^T \\ \mathbf{A} & 0 \end{bmatrix} \begin{bmatrix} \Delta \mathbf{x}_{nt} \\ w \end{bmatrix} = \begin{bmatrix} - \bigtriangledown f(\mathbf{x}) \\ 0 \end{bmatrix} \tag{4}$$

And the authors also claim that it is computational infeasible to compute the inverse of $\begin{bmatrix} \bigtriangledown^2 f(\mathbf{x}) & \mathbf{A}^T \\ \mathbf{A} & 0 \end{bmatrix}$. But I would argue since the Hessian matrix $\bigtriangledown^2 f(\mathbf{x})$ is diagonal matrix, we may still be able to compute the inverse of $\begin{bmatrix} \bigtriangledown^2 f(\mathbf{x}) & \mathbf{A}^T \\ \mathbf{A} & 0 \end{bmatrix}$

### 4.4 d

I believe the convexity of $r(x)$ should be discussed.

# 5 problem5

The same as our solution.