ECE 595: Homework 1
Yi Qiao, Class ID 187
(Spring 2019)

Exercise 1

(a)

Refer to code in the back.

(b)

TODO: add a screenshot here

Exercise 2

(a)

$$\begin{bmatrix} \boldsymbol{\omega}^* \\ \omega_0^* \end{bmatrix} = \underset{\boldsymbol{\omega}, \omega_0}{argmin} \sum_{j=1}^{N} (\boldsymbol{\omega}^T \boldsymbol{x}_j + \omega_0 - y_j)^2$$

$$set\ \boldsymbol{\theta} = \begin{bmatrix} \boldsymbol{\omega}^* \\ \omega_0^* \end{bmatrix} \tag{1}$$

$$\boldsymbol{\theta}^* = \underset{\boldsymbol{\theta}}{argmin} \sum_{j=1}^{N} (\begin{bmatrix} \boldsymbol{x}_j^T & 1 \end{bmatrix} \boldsymbol{\theta} - y_j)^2$$

thus,

$$A = \begin{bmatrix} -\boldsymbol{x}_1- & 1 \\ -\boldsymbol{x}_2- & 1 \\ ... & ... \\ -\boldsymbol{x}_N- & 1 \end{bmatrix} \quad \boldsymbol{b} = \begin{bmatrix} y_1 \\ y_2 \\ ... \\ y_N \end{bmatrix}$$

(b)

by least square

$$\boldsymbol{A}^T \boldsymbol{A} \boldsymbol{\theta}^* = \boldsymbol{A}^T \boldsymbol{b}$$
$$\boldsymbol{\theta}^* = (\boldsymbol{A}^T \boldsymbol{A})^{-1} \boldsymbol{A}^T \boldsymbol{b} \tag{2}$$

if $A^T A$ is invertible, A needs to be full column rank (or $null(A) = 0$).

(c)

(d)