Homework 1

Deadline: 5th June, 2019

Wednesday 29$^{\text{th}}$ May, 2019

1. Judge whether the following functions are convex or not, all of them are 1-dimension functions $f : \mathbb{R} \mapsto \mathbb{R}$:

   - $f(x) = \frac{1}{1+e^{-x}}$.
   - $f(x) = \max\{0, 1 - x\}$.

2. In the linear regression model now we assume in the dataset $D = \{(x_1, y_1), \cdots, (x_N, y_N)\}$, each sample (x_i, y_i) is associated with a weight $r_i > 0$, so now the loss function becomes

$$J(w) = \frac{1}{2} \sum_{n=1}^{N} r_n (y_n - w^T x_n)^2. \tag{1}$$

   Find an expression w^* that minimize this loss function.

3. Consider the Question 2. Instead of using the expression of w^* directly, now we want to use the Gradient Descent method. Write a pseudocode at the t-th iteration, assume the stepsize is η. For example, in the linear regression problem we discussed in the class, we can write the pseudocode as

$$w_{t+1} = w_t - \eta \sum_{n=1}^{N} (x_n w_t^T - y_n) x_n. \tag{2}$$