# Homework (22)

1. Prove that the Lipschitz constant for the gradient of the logistic function

$$\frac{1}{s}\sum_{i=1}^{s}\log\left(1+\exp\left(-y_i(\bar{\mathbf{w}}^T\bar{\mathbf{x}}_i)\right)\right)$$

respect to $\bar{\mathbf{w}}$ is upper bounded by $L_{\bar{w}} \leq \frac{1}{4s}\|\bar{\mathbf{X}}\|_2^2$, where $\bar{\mathbf{X}} = (\bar{\mathbf{x}}_1, \bar{\mathbf{x}}_2, \cdots, \bar{\mathbf{x}}_s)$.

Then randomly generate samples and solve the minimization problem of the logistic function by gradient descent and Nesterov's accelerated gradient descent. Compare their convergence speed numerically. Hand in your code and report.

# Homework (22)

2. Use block coordinate descent to solve the low-rank matrix completion problem:

$$\min_{\mathbf{U},\mathbf{V},\mathbf{A}} \frac{1}{2}\|\mathbf{U}\mathbf{V}^T - \mathbf{A}\|_F^2, \quad s.t. \quad \mathcal{P}_\Omega(\mathbf{A}) = \mathcal{P}_\Omega(\mathbf{D}),$$

where $\mathcal{P}_\Omega(\cdot)$ is an operator that extracts entries of a matrix whose indices are in $\Omega$ and sets the remaining entries zeros.

Randomly generate $\mathbf{D} = \mathbf{U}_0\mathbf{V}_0^T$ and $\Omega$, where $\mathbf{U}_0 \in \mathbb{R}^{200\times 5}$, $\mathbf{V}_0 \in \mathbb{R}^{300\times 5}$ and $|\Omega| = 0.1 \times 200 \times 300$. Hand in your code and report showing your settings and the difference $\|\mathbf{A}^* - \mathbf{D}\|_2$ where $\mathbf{A}^*$ is the optimal solution.