

# Homework 5 for “Algorithms for Big-Data Analysis”

Acknowledgement:

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Note: Please write up your solutions independently. If you get significant help from others, write down the source of references. A formal mathematical proof for all your claims is required.

1. Given a  $n \times p$  matrix  $X$ . Derive the optimal solution for the following problem:

$$\min_{Z, V} \|X - ZV\|_F^2, \text{ s.t. } V^T V = I, Z^T \mathbf{1} = 0,$$

where  $Z$  is a  $n \times q$  matrix and  $V$  is a  $q \times p$  matrix.

2. Derive the dual optimization problem for

$$\begin{aligned} \min_{w, b, \xi} \quad & \frac{1}{2} \|w\|_2^2 + C_1 \sum_{i=1}^n \xi_i + C_2 \sum_{i=1}^n \xi_i^2 \\ \text{s.t.} \quad & y_i \cdot (x_i \cdot w + b) \geq 1 - \xi_i, \forall i = 1, \dots, n \\ & \xi_i \geq 0, \forall i = 1, \dots, n \end{aligned}$$

3. Exercise 10 (page 7-8) in the paper: “The \$25,000,000,000 Eigenvector: The Linear Algebra Behind Google”:  
<http://www.rose-hulman.edu/~bryan/googleFinalVersionFixed.pdf>