THU-70250403, Convex Optimization (Fall 2020) **Homework: 4**

Lagrange Functions and Dual Problems

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Problem 1

Please find the dual problem of the following primary problem (lasso problem)

$$\min_{\boldsymbol{x}} \ |A\boldsymbol{x} - \boldsymbol{b}|_2^2 + |\boldsymbol{x}|_1 \tag{1}$$

where $\boldsymbol{x} \in \mathbb{R}^n$, $\boldsymbol{b} \in \mathbb{R}^m$, $A \in \mathbb{R}^{m \times n}$, and $\text{rank}(A) = n$.

Problem 2

Please drive the corresponding dual problem of the following problem

$$\max_{\boldsymbol{x}} \quad \frac{1}{|\boldsymbol{c}^T\boldsymbol{x} - d|_2} \tag{2}$$

$$s.t. \quad |A\boldsymbol{x} - \boldsymbol{b}|_2 \leq \lambda \tag{3}$$

where $\boldsymbol{x}, \boldsymbol{c} \in \mathbb{R}^n$, $\boldsymbol{b} \in \mathbb{R}^m$, $d, \lambda \in \mathbb{R}$, $A \in \mathbb{R}^{m \times n}$, and $\text{rank}(A) = n$.

References