Lab Assignment 3: Optimization for Machine Learning

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Write python codes of the following problems:

(1) Construct and solve the dual problems of the following problems. Then verify complementary slackness conditions.

(i)

$$\begin{aligned} \min z = 6x_1 - 3x_2 \\ 3x_1 - x_2 \geq 1 \\ 4x_1 - 3x_2 \geq 5 \\ x_1, x_2 \geq 0 \end{aligned}$$

(ii)

$$\begin{aligned} \min z = 3x_1 - x_2 \\ 2x_1 + x_2 \leq 6 \\ x_1 + x_2 \geq 1 \\ x_1, x_2 \geq 0 \end{aligned}$$

(iii)

$$\begin{aligned} \min Rx_1 - (R-1)x_2 \\ 3x_1 - 2x_2 \leq 1 \\ 2x_1 - 3x_2 \leq 6 \\ x_1, x_2 \geq 0 \end{aligned}$$

(iv)

$$\begin{aligned} \max \quad & (R+3)x_1 + (R+4)x_2 \\ & 3x_1 - x_2 \leq 12 \\ & 7x_1 + 11x_2 \leq 88 \\ & x_1, x_2 \geq 0 \end{aligned}$$

(2) Solve the following QP and verify complementary slackness condition.

(i)

$$\begin{aligned} \max 3x_1 - (x_1 - 1)^2 + 3x_2 - (x_2 - 2)^2 \\ 4x_1 + x_2 \leq 20 \\ 4x_1 + 4x_2 \leq 20 \\ x_1, x_2 \geq 0 \end{aligned}$$

(ii)

$$\begin{aligned} \min z = 1/2{x_1}^2 + x_2 \\ x_1 + 2x_2 \geq 15 \\ 2x_1 + 5x_2 \leq 100 \\ 3x_1 + 4x_2 \leq 80 \end{aligned}$$