

Lab assignment 9

Optimization in ML (CSL4010)

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1. Find a KKT point of the following problems:

$$\begin{aligned} \max \quad & x_1 + x_2 + x_3 + x_4 \\ (x_1 - x_2)^2 + (x_3 + 2x_4)^4 & \leq 5 \\ x_1 + 2x_2 + 3x_3 + 4x_4 & \leq 6 \\ x_i & \geq 0 \end{aligned}$$

2. Using 1, 2, 3, 4, 5, 6, 7 degree polynomial fitting curve such that $\sum_{i=0}^m \alpha_i \leq r$ find the price of a house with R -thousand square feet where R is the last digit of your roll no. If last digit of your roll no is 0, choose $R = 1.5$.

3. Construct and Solve the dual of the following LPP. Show that duality gap is 0.

$$\begin{aligned} \min \quad & 3x_1 - 4x_2 \\ x_1 + 3x_2 & \leq 12 \\ 2x_1 - x_2 & \leq 20 \\ x_1 - 4x_2 & \geq 5 \\ x_1 & \geq 0, \quad x_2 \text{ is unrestricted in sign} \end{aligned}$$

(dual constraint of unrestricted variable is equality)

4.

$$\min (R+3)x_1 + (R+41)x_2$$

$$3x_1 - x_2 \leq 12$$

$$7x_1 + 11x_2 \leq 88$$

$$x_1, x_2 \geq 0$$

5.

$$\min Rx_1 - (R-1)x_2$$

$$3x_1 - 2x_2 \leq 1$$

$$3x_1 - 2x_2 \leq 6$$

$$x_1, x_2 \geq 0$$

6.

$$\max z = x_1 + x_2 + x_3$$

$$3x_1 + 2x_2 + x_3 \leq 3$$

$$2x_1 + x_2 + 2x_3 \leq 2$$

$$x_1, x_2, x_3 \geq 0$$

7.

$$\max z = (R+2)x_1 + (R+3)x_2$$

$$s. \ t. \ 2x_1 + x_2 \leq 1000$$

$$x_1 + x_2 \leq 600$$

$$2x_1 + 4x_2 \leq 2000$$

$$x_1, x_2 \geq 0$$

8.

$$\min \quad 2x_1 + 3x_2 + 10x_3$$

$$x_1 + 2x_3 = 0$$

$$x_2 + x_3 = 1$$

$$x_1, x_2, x_3 \geq 0$$

dual variable of equality constrained is unrestricted in sign.

9.

$$\min \quad 3x_1 - 4x_2$$

$$x_1 + 3x_2 \leq 12$$

$$2x_1 - x_2 \leq 20$$

$$x_1 - 4x_2 \geq 5$$

$$x_1 \geq 0, \quad x_2 \text{ is unrestricted in sign}$$

10.

$$\max \quad Rx_1 + (R+3)x_2$$

$$s. t. \quad 3x_1 + x_2 \geq 3$$

$$x_1 + 4x_2 \geq 4$$

$$x_1 + x_2 \leq 5$$

$$x_1, x_2 \geq 0$$

11.

$$\min \quad Rx_1 + (2R+1)x_2$$

$$2x_1 + x_2 \leq 4$$

$$3x_1 + 4x_2 \geq 24$$

$$2x_1 - 3x_2 \geq 6$$

$$x_1, x_2 \geq 0$$

12.

$$\min (R+3)x_1 + x_2$$

$$x_1 + 2x_2 \leq 3$$

$$4x_1 + 3x_2 \geq 6$$

$$3x_1 + x_2 = 3$$

$$x_1, x_2 \geq 0$$

13.

$$\min -3x_1 + x_2$$

$$x_1 + 2x_2 = 0$$

$$2x_1 - 2x_2 = 9$$

$$x_1, x_2 \geq 0$$

(R is last 2 digits of your roll no)