

# Lab Assignment 3: Optimization for Machine Learning

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Write python codes of the following problems:

(i) Justify whether column vectors of A is linearly independent or not?

$$(a) A = \begin{bmatrix} 2 & 3 & 1 & -2 \\ 4 & 1 & 1 & -5 \\ 6 & -1 & 1 & -9 \\ 2 & 3 & 1 & R/10 \\ 9 & 8 & 1 & -11 \\ -3 & 11 & 1 & -13 \end{bmatrix}$$

(b) Given in A1

(c) Given in A2

(d) Given in A3

(ii) Solve the least square problems  $\min \frac{1}{2} \|Ax - b\|^2$  where

$$(a) A = \begin{bmatrix} 1 & r \\ 2 & r \\ 3 & r \end{bmatrix} \text{ and } b = (2, 3, 5)^T \text{ and } r \text{ is last digit of your roll no. Use } r = 1.5 \text{ if last digit of your roll no is 0.}$$

(b) Given in Ab1

(c) Given in Ab2

(d) Given in Ab3

**Solve the following QP**

(iii)

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

(iv)

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

(v)

$$\begin{aligned} \min \quad & \frac{1}{2} \|Ax - b\|^2 \\ \text{s.t.} \quad & \sum_i x_i \leq R \end{aligned}$$

where  $A, b$  are given in Ab1 and Ab2.