Lab Assignment 1: Optimization for Machine Learning

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Write python codes to solve the following LPP:

(1)

$$\begin{aligned} \max z = 5x_1 + 7x_2 & \\ s.\,t. \quad x_1 + x_2 &\leq 4 \\ 3x_1 + 8x_2 &\leq 24 \\ 10x_1 + 7x_2 &\leq 35 \\ x_1, x_2 &\geq 0 \end{aligned}$$

(2)

$$\begin{aligned} \min z = -x_1 + 2x_2 & \\ s.\,t. \quad -x_1 + 3x_2 &\leq 10 \\ x_1 + x_2 &\leq 6 \\ x_1 - x_2 &\leq 2 \\ x_1, x_2 &\geq 0 \end{aligned}$$

(3)

$$\begin{aligned} \max z = 4x_1 + 3x_2 & \\ s.\,t. \quad x_1 + x_2 &\leq 50 \\ x_1 + 2x_2 &\leq 80 \\ 2x_1 + x_{@} &\geq 20 \\ x_1, x_2 &\geq 0 \end{aligned}$$

(4)

$$\begin{aligned} \max z = x_1 + x_2 & \\ s.\,t. \quad -2x_1 + x_2 &\leq 1 \\ x_1 - x_2 &\leq 1 \\ x_1, x_2 &\geq 0 \end{aligned}$$

(5) An airline offers coach and first-class tickets. For the airline to be profitable, it must sell a minimum of 25 first-class tickets and a minimum of 40 coach tickets. The company makes a profit of $225 for each coach ticket and $200 for each first-class ticket. At most, the plane has a capacity of 150 travellers. How many of each ticket should be sold in order to maximize profits? Construct an LPP and solve using python code.

(6) A person requires at least 10, 12, and 12 units of chemicals for A, B and C respectively for his garden. A liquid product contains 5,2, and 1 units of A, B, and C per jar. A dry product contains 1, 2, and 4 units of A, B, and C per carton. The liquid product sells for Rs 30 per jar and the dry product sells Rs 20 per cartoon. Construct an LPP to minimize the total cost of Jars and cartoons to meet the requirements and solve it by python code.

(7) A small firm specializes in making five types of spare automobile parts. Each part is first cast from iron in the casting shop and then sent to the finishing shop where holes are drilled, surfaces are turned, and edges are ground. The required worker-hours (per 100 units) for each of the parts of the two shops are shown below:

$Part:$	1	2	3	4	5
$Casting:$	2	1	3	3	1
$Finishing:$	3	2	2	1	1

The profits from the parts are $ 30, $ 20, $ 40, $ 25, and $ 10 (per 100 units), respectively.
The capacities of the casting and finishing shops over the next month are 700 and 1000 worker-hours, respectively. Formulate the problem of determining the quantities of each spare part to be made during the month so as to maximize profit and solve it using python codes.

Sample code for linear regression

```
import numpy as np
import pandas as pd
import cvxopt as cp
c=np.array([[-5.0],[-7.0]])
A=np.array([[1,1],[3,8],[10,7]])
b=np.array([[4],[24],[35]])
sol =cp.solvers.lp(cp.matrix(c,tc='d'), cp.matrix(A,tc='d'),cp.matrix(b,tc='d'))
print(sol['x'],sol['primal objective'])
```