Assignment 3

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Optimization

***Abstract*—This document contains the solution to find the maximum value of given function, subject to given constraints by linear programming.**

Download all python codes from

https://github.com/rubeenaafreen20/EE5600AI−ML/tree/master/Assignment3/Code

Download latex-tikz codes from

https://github.com/rubeenaafreen20/EE5600AI−ML/tree/master/Assignment3

1 Problem

Solve:

$$\max_{\{x\}} Z = \begin{pmatrix} 4 & 1 \end{pmatrix} \mathbf{x} \tag{1.0.1}$$

$$s.t \quad \begin{pmatrix} 1 & 1 \\ 3 & 1 \end{pmatrix} \leq \begin{pmatrix} 50 \\ 90 \end{pmatrix} \tag{1.0.2}$$

$$\mathbf{x} \geq 0 \tag{1.0.3}$$

2 Solution

The given problem can be expressed as:

$$\max_{\{x\}} \mathbf{c}^T \mathbf{x} \tag{2.0.1}$$

$$s.t \quad \mathbf{A}\mathbf{x} = \mathbf{b} \tag{2.0.2}$$

$$\mathbf{x} \geq 0 \tag{2.0.3}$$

$$\tag{2.0.4}$$

where

$$\mathbf{c} = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \tag{2.0.5}$$

$$\mathbf{A} = \begin{pmatrix} 1 & 1 \\ 3 & 1 \end{pmatrix} \tag{2.0.6}$$

$$\mathbf{b} = \begin{pmatrix} 50 \\ 90 \end{pmatrix} \tag{2.0.7}$$

In Fig:1, we observe that the feasible solution lies in the region OCPD. So, we now use Corner Point Method to determine the maximum value of Z.

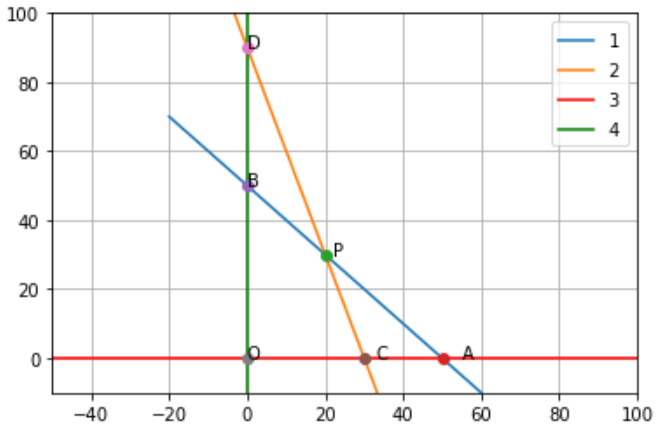

Fig. 1: Plot obtained from python code

Corner Point	$Z = \mathbf{c}^T\mathbf{x}$	Value of Z
$\begin{pmatrix} 0 \\ 0 \end{pmatrix}$	$\begin{pmatrix} 4 & 1 \end{pmatrix}\begin{pmatrix} 0 \\ 0 \end{pmatrix}$	0
$\begin{pmatrix} 30 \\ 0 \end{pmatrix}$	$\begin{pmatrix} 4 & 1 \end{pmatrix}\begin{pmatrix} 30 \\ 0 \end{pmatrix}$	120
$\begin{pmatrix} 20 \\ 30 \end{pmatrix}$	$\begin{pmatrix} 4 & 1 \end{pmatrix}\begin{pmatrix} 20 \\ 30 \end{pmatrix}$	110
$\begin{pmatrix} 0 \\ 50 \end{pmatrix}$	$\begin{pmatrix} 4 & 1 \end{pmatrix}\begin{pmatrix} 0 \\ 50 \end{pmatrix}$	50

TABLE 1: Computing values of Z at different points of the polygon

Table 1 gives value of Z at the points O,C,P and D. From table 1, it is clear that the maximum value of Z is 120 at point C=$\begin{pmatrix} 30 \\ 0 \end{pmatrix}$

3 Output

Output obtained from python code on the console is attached below:

```
 Maximization-Problem:
MAXIMIZE
4.0*X_1 + 1.0*X_2 + 0.0
SUBJECT TO
_C1: X_1 + X_2 <= 50

_C2: X_1 >= 0

_C3: 3 X_1 + 3 X_2 <= 90

_C4: X_2 >= 0

VARIABLES
0 <= X_1 Integer
0 <= X_2 Integer

Optimal
X_1 = 30.0
X_2 = 0.0
Printing the final solution:

X_ 1 = 30.0
X_ 2 = 0.0
Maximum value of Z= 120.0
```

Fig. 2: Output of python code