(5)	Contraint Bared Optimization - Single Constraint:
1 1	I thorough blood of the delivery of the
	Revenue function
-/1	1R(x, + x2, x3) = 50 17, + 40 10x2 + 30 1x3
	x ₁ : budget for spent on facebook Ads. x ₂ : budget spent on facebook Ads. x ₃ : budget spent on Linked In Ads.
	73: budget spent on Linked In Ads
	we want to maximize $R(x_1, x_2, x_3)$
	We want 40 musionize (11 1) 12,13)
	total budget constraint:
	$x_1 + x_2 + x_3 = 100,000.$
	Langrange function:
	$L(x_1, x_2, x_3, \lambda) = 50\sqrt{x_1} + 40\sqrt{x_2} + 30\sqrt{x_3}$
	+ A(100000 - x, -x2-x3)
	7/11 000 1, 12 3)
	The state of the s
A THINK	

Compute Gradients

$$\frac{\partial I}{\partial x_1} = \frac{50}{2\sqrt{x_1}} = 0$$

$$\Rightarrow (\lambda = 125)0000$$

$$\frac{\partial L}{\partial x_2} = \frac{40}{2\sqrt{x_2}} - \frac{1}{2\sqrt{x_2}} + \frac{1}{2\sqrt{x_2}} = \frac{1}{2\sqrt{x_2}}$$

$$0 \frac{\partial L}{\partial x_3} = \frac{30}{2\sqrt{x_3}} \frac{\partial}{\partial x_3} \frac{\partial x_3} \frac{\partial}{\partial x_3} \frac{\partial}{\partial x_3} \frac{\partial}{\partial x_3} \frac{\partial}{\partial x_3} \frac{\partial}{\partial x_3$$

$$\frac{000000 - 7, -72 - 73}{0000} = 0$$

$$\Rightarrow \gamma_{1} + \gamma_{2} + \gamma_{3} = 100000$$

Parameter Initialization

$$\begin{array}{c}
\alpha = 5000 \\
\alpha = 0.40001
\end{array}$$

: 15 x07 . E



for 72:

$$\frac{\partial L}{\partial \gamma_2}$$
 = 0.1095-1=6.8905 000001

11 50 1 1 1 11.

for ?3:

$$\frac{\partial L}{\partial x_3} = 0.0822 - 1 = -0.9178$$

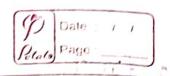
2,(1) = 3333333315000(-0.8631) = 29017.83

$$\alpha_2^{(1)} = 33333.33 + 3000(-0.8905)$$

= 28880.83

for 73:

$$\pi_3^{(1)} = 333333.33 + 5000(-0.9178) = 28744.33$$



after updating value $\gamma_1(1) + \gamma_2(1) + \gamma_3(1) = 29017.83 + 28880.83 + 28144.33$ = 86643.99

construit violation:

gz= (00000 -86643.99 = 13356.0)

 $3^{(1)} = 1 + 6 \times 13356.01$

~1+B3.56 = 134.56

Interpretation

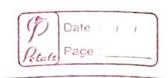
gradients for x, x, and x, are negative => decreasing their allocations

the total allocation dropped to about 86,649

. 231 410 - Jan 7. F - 120. 31 - 11 - 1

thus I gumped from 2 to about 12 3351

Horation 2 $\chi_1 = 29018.33$ i dilli - i - i - pilli calculate gradients 82 20 081 $9x_1 = 25$ $\sqrt{29018.33}$ $9x_{01} = 0.1467 - 2.33565 = -2.18895$ $9x_2 = \frac{20}{\sqrt{28880.82}} - 7 = 0.11765 - 2.33565$ = -2.2180. 15 - 11 = -2.24725 $\sqrt{28749.33}$ $97 = 100000 - (x_1^{(1)} + x_2^{(1)} + x_3^{(1)}) = 100000 - 86643.46$ = [3.356.5]



(B) Update thex values:

Ung dx = 5000:

 $x_1^{(2)} = 29018.33 + 5000 \times (-2.18895)$

= 18673,58 ilviling Halundon 1953

 $\chi_{2}^{(2)} = 17790.83$

 $\gamma_3^{(3)} = 17508.08$

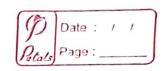
sum = 53372.49

Whates

 $\lambda^{(2)} = \lambda^{(1)} + 0.0001 \times 4627.51 = 6.9989$

thus

- Sum duopped more due to -ve value of gradients and 2 jumped to 6 9984, to



we see that for further steration the model do anot converge.

to mitigate this problem we can

- reduce Jeauning rate

- use constraint based of 19 mization.

9+ will not converge due to high Jeauning rate.