Today is the last day of class

- We will go over 4.7 (No Homework on 4.7)

& start working on the final Exam practice set
(80 problems on the practice set)
78 T/F problems

- Final Exam (40 problems
38 T/F)

4.7 [Optimization]

[Machine learning
Deep learning]

Example

1. Distribution of a National Vaccine

Minimize cost
minimize duration

2. Testing for COVID-19

* Gradient Descent (Machine learning)

given a function

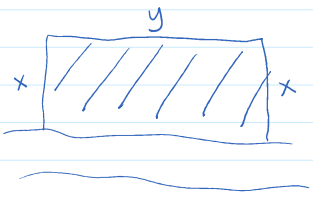
Example $A(x) = 2400x - 2x^2$ (objective function)

find x value that minimizes A(x)

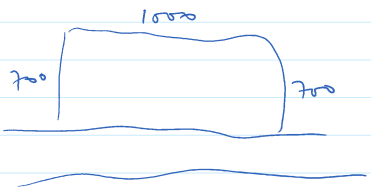
- Stochastic gradient descent
- LBFGS
- Levenberg-Marquardt

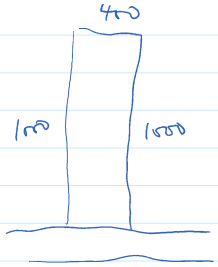
Toy problem

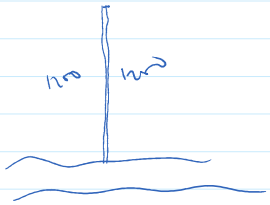
A farmer has 2400 ft of fencing and wants to fence off a rectangular field that borders a straight river. He needs no fence along the river. What are the dimension of the field that has the largest area?



trial and Error







$A = L \cdot B$
$= 1000 \cdot 700$
$= 700{,}000\ ft^2$

$A = L \cdot B$
$= 400 \cdot 1000$
$= 400{,}000\ ft^2$

(Area) $A = xy$ — (1)

$2400 = 2x + y$

We can re-write (1) as follow Set $y = 2400 - 2x$

$A(x) = x(2400 - 2x)$

$A(x) = 2400x - 2x^2$ $0 \le x \le 1200$

(find the optimal x that gives the maximum Area)

($f(x) = 2400x - 2x^2$ $0 \le x \le 1200$, what does this function attain a local max)

find the critical numbers (c is critical number if $f'(c) = 0$ or DNE)

$\frac{d}{dx}(A(x)) = \frac{d}{dx}(2400x - 2x^2)$

$= 2400 - 4x = 0$

$\frac{2400}{4} = \frac{4x}{4}$

$x = 600$ (critical number)

closed interval method

$A(x) = 2400x - 2x^2$

$A(0) = 0$

$A(1200) = 0$

$A(600) = 720{,}000\ ft^2$

$A = L \cdot B$
$= 600 \cdot 1200$
$= 720{,}000\ ft^2$