Recap

1. Your Intro → Your expectation
2. I gave my Introduction
3. I told my expectation
   a. Not to miss a class
   b. Interactive as possible
   c. Assignment / HW
   d. class setup
   e. Hackathon / Handson

Professional Growth

SOP

github profile ←

a. LinkedIn ✓ Kannan ↔ connect
b. Github – Sriram
c. Medium ✓ – Srinivasan – 1 article → MAANG
d. Leetcode / Hackerrank –
e. Analytics Vidhya – ✓ } Muni
f. Kaggle – ✓ }
g. Blogs – Github Blog →

ML	AI
Replace the expert with a s/m	Replace with common human activity with a s/m
House price Prediction	Seeing the picture and classify the objeet Dog/cat

Arthur Samuel → Father of Machine learning

Traditional rule Based → ML

Trends of Analytics

Discriptive → what happened!

Diagnostic → Why did it happened?

Predictive → what will happen?

Prescriptive → How can make it happen

Baby learning

Machine learning

Input + Program → Output

ML

Input + Output → Program

Types of Machine learning

1. Supervised → Dependant + Independant (Target) Data

- Regression ← Target → Continuous
- Classification ← Target → Discrete

2. UnSupervised → Independent
No Target

Clustering, Segmentation, Recommendation

3. Re-Informent

learns from mistake

Reward and Penality

Linear Regression

- Straight line
- Relationship b/w two points

Straight line that attempts to predict the relationship b/w the points

Find the Slope and Intercept
Provided the Error is Minimal

Linear Algebra

Gradient Descent

DL

Linear Algebra

X	Y
1	2
2	3
4	7
5	5
7	11

$$x + 2y = 5 \quad \text{***}$$
$$2x + y = 10 \quad x(-2)$$

$$x + 2y = 5$$
$$-4x - 2y = -20 \quad \checkmark$$

$$-3x = -15$$
$$x = 15/3 = 5$$

$$x + y + 3z = 5$$
$$2x + 2y + z = 10$$
$$x + y + 5z = 15$$

linear algebra

$$\begin{bmatrix} 1 & 1 & 3 \\ 2 & 2 & 1 \\ 1 & 1 & 5 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 10 \\ 15 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{\begin{bmatrix} 1 & 1 & 3 \\ 2 & 2 & 1 \\ 1 & 1 & 5 \end{bmatrix}} \begin{bmatrix} 5 \\ 10 \\ 15 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 & 1 & 3 \\ 2 & 2 & 1 \\ 1 & 1 & 5 \end{bmatrix}^{-1} \begin{bmatrix} 5 \\ 10 \\ 15 \end{bmatrix}$$

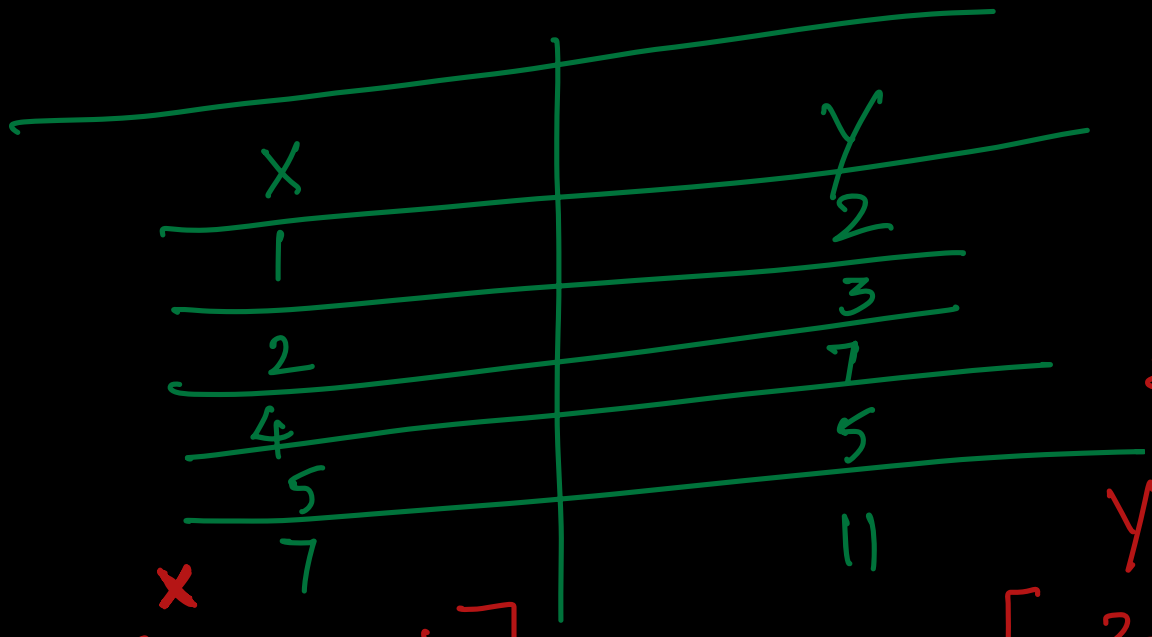
$$5x = 15$$

$$x = \frac{1}{5} \times 15 = 5^{-1} \times 15$$

$$\begin{bmatrix} 1 \\ 5 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 15 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1 \\ 5 \end{bmatrix}^{-1} \times \begin{bmatrix} 2 \\ 15 \end{bmatrix}$$

Variables

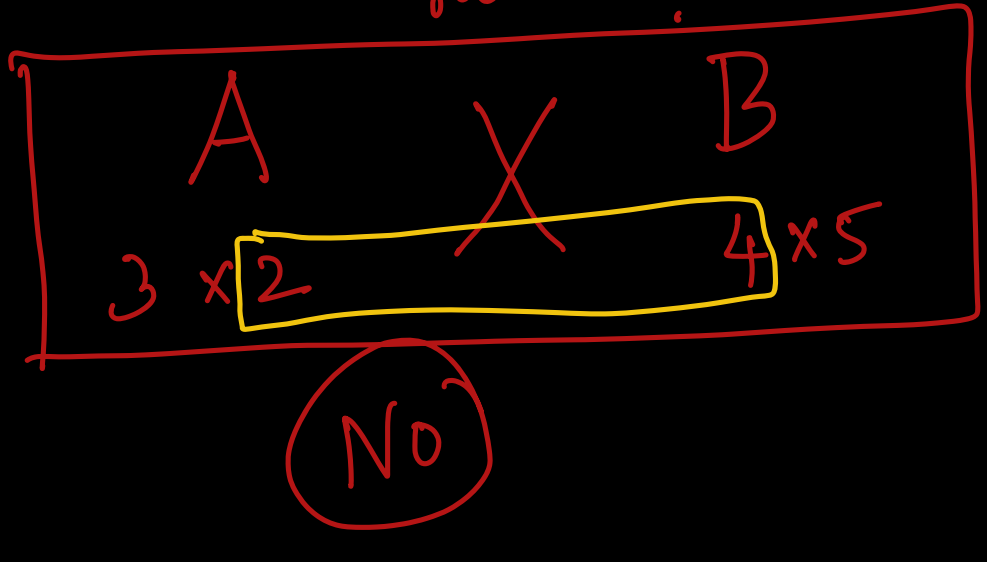


Slope Intercept

$$y = mx + b \cdot 1$$

$$\begin{bmatrix} 1 & 1 \\ 2 & 1 \\ 4 & 1 \\ 5 & 1 \\ 7 & 1 \end{bmatrix} \begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \\ 7 \\ 5 \\ 11 \end{bmatrix}$$

multiply 2 matrix rule ?



$5x = 10$

multiply $\times 2$

$10x = 20$

$$A \quad X \quad B$$

$$\begin{bmatrix} 1 & 1 \\ 2 & 1 \\ 4 & 1 \\ 5 & 1 \\ 7 & 1 \end{bmatrix} \begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \\ 7 \\ 5 \\ 11 \end{bmatrix}$$

If I multiply both side with a matrix will the equation remains same

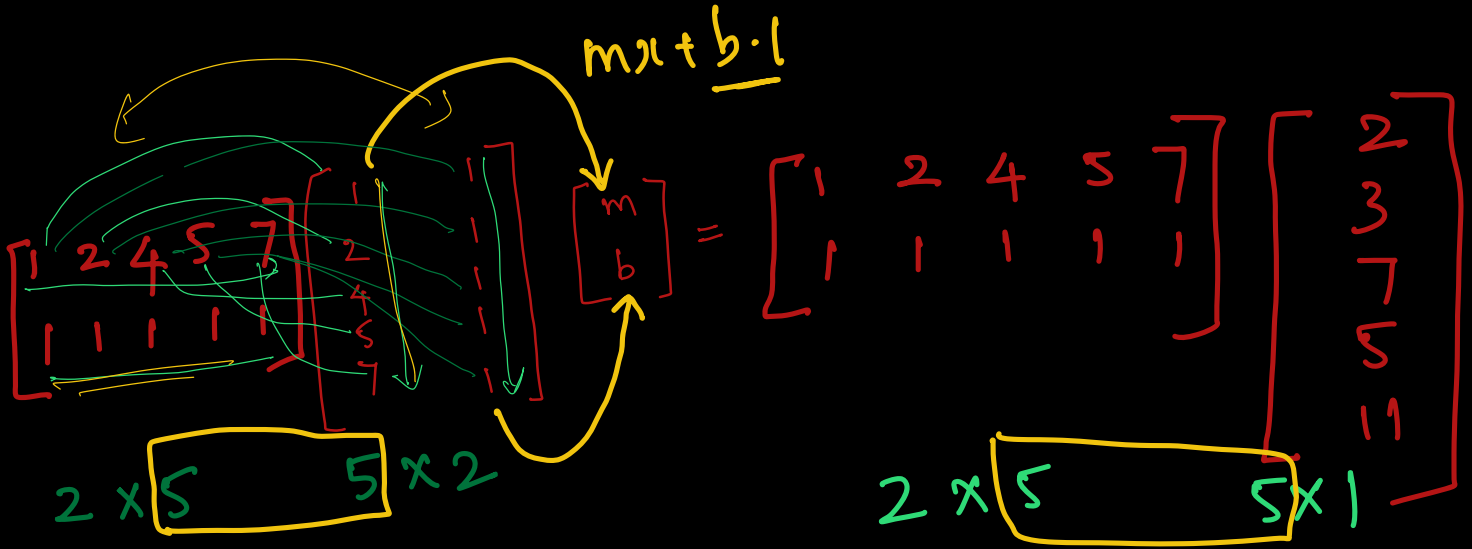
if I multiply

$$Ax = B$$

$$A^T A x = A^T B$$

$$C \qquad C^T$$

$$\begin{bmatrix} 1 & 2 \\ 1 & 5 \end{bmatrix} \quad \begin{bmatrix} 1 & 1 \\ 2 & 5 \end{bmatrix}$$



Remember from past birth

$$\begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix} \begin{bmatrix} 1 \\ 5 \end{bmatrix} = \begin{bmatrix} 1\times1 + 2\times5 \\ 1\times1 + 3\times5 \end{bmatrix} = \begin{bmatrix} 1+10 \\ 1+15 \end{bmatrix} = \begin{bmatrix} 11 \\ 16 \end{bmatrix}$$

$$1 + 4 + 16 + 25 + 49$$

$$\begin{bmatrix} 1\times1 + 2\times2 + 4\times4 + 5\times5 + 7\times7 \\ \hline 1\times1 + 1\times2 + 1\times4 \times1\times5 + 1\times7 \end{bmatrix}$$

$$1 + 2 + 4 + 5 + 7$$

$$1\times1 + 2\times1 + 4\times1 + 5\times1 + 7\times1$$

$$1\times1 + 1\times1 + 1\times1 + 1\times1 + 1\times7$$

$$\begin{bmatrix} 95 & 19 \\ 19 & 5 \end{bmatrix} \begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 138 \\ 28 \end{bmatrix}$$

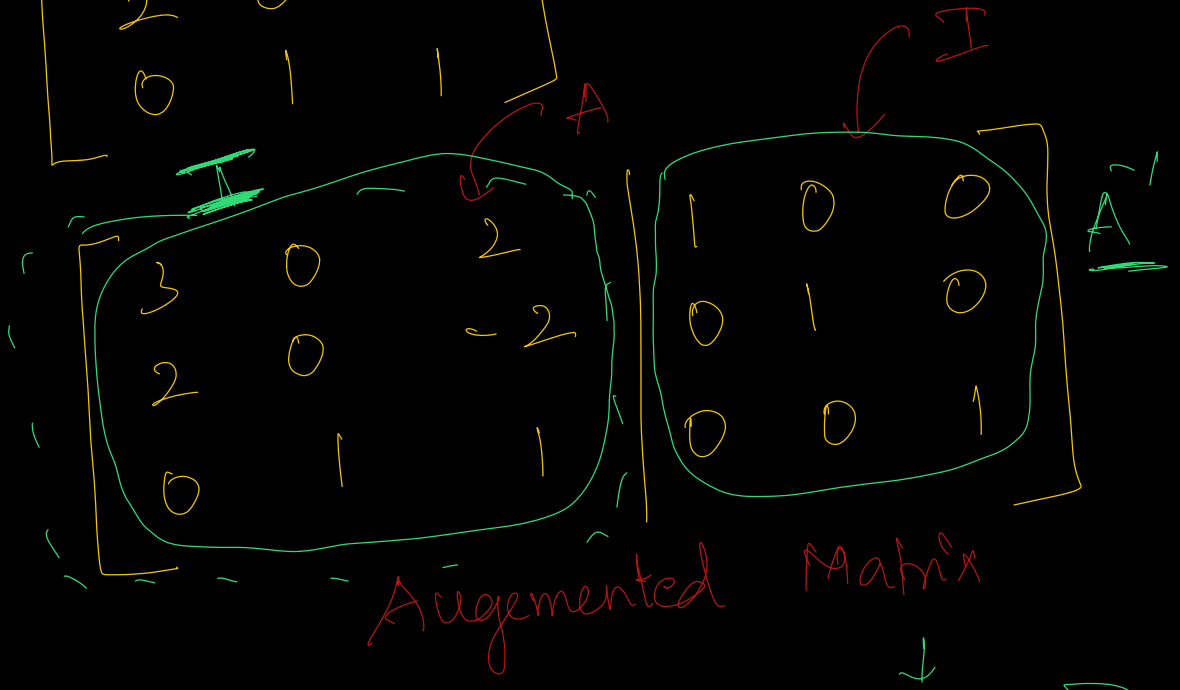
$$\begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 95 & 19 \\ 19 & 5 \end{bmatrix}^{-1} \begin{bmatrix} 138 \\ 28 \end{bmatrix}$$

Guassian Jordian

$$[A] \Rightarrow [A \mid I] \quad \text{(Identity matrix)}$$

$$[I \mid A^{-1}]$$

$$A = \begin{bmatrix} 3 & 0 & 2 \\ 2 & 0 & -2 \\ 0 & 1 & 1 \end{bmatrix}$$



$R1 + R2$

$$\left[\begin{array}{ccc|ccc} 5 & 0 & 0 & 1 & 1 & 0 \\ 2 & 0 & -2 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{array}\right]$$

$R1/5$

$$\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 1/5 & 1/5 & 0 \\ 2 & 0 & -2 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{array}\right]$$

$R2 = (R2 - 2)/2$

$$\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 1/5 & 1/5 & 0 \\ 0 & 1 & 2 & 1 & -1/2 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{array}\right]$$

$R3 \Rightarrow R2 - R3$

$$\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 1/5 & 1/5 & 0 \\ 0 & 1 & 2 & 1 & 1/2 & 1 \\ 0 & 0 & 1 & 1 & 1/2 & 0 \end{array}\right]$$

$R2 = R2 - 2R3$

$$\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 1/5 & 1/5 & 0 \\ 0 & 1 & 0 & -1 & -1/2 & 1 \\ 0 & 0 & 1 & 1 & 1/2 & 0 \end{array}\right]$$

$$A^{-1} = \begin{bmatrix} 1/5 & 1/5 & 0 \\ -1 & -1/2 & 1 \\ 1 & 1/2 & 0 \end{bmatrix}$$

$$\begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 95 & 19 \\ 19 & 5 \end{bmatrix}^{-1} \begin{bmatrix} 138 \\ 28 \end{bmatrix}$$

$$A = \begin{bmatrix} 95 & 19 \\ 19 & 5 \end{bmatrix}$$

$$\left[\begin{array}{cc|cc} 95 & 19 & 1 & 0 \\ 19 & 5 & 0 & 1 \end{array}\right]$$

$$R2 = 95\,R2 - 19\,R1$$

$$\begin{bmatrix} 95 & 19 & 1 & 0 \\ 0 & 114 & -19 & 95 \end{bmatrix}$$

$$R1 = 114\,R1 - 19\,R2$$

$$\begin{bmatrix} 10830 & 0 & 475 & -1805 \\ 0 & 114 & -19 & 95 \end{bmatrix}$$

$$R1 = R1 / 10830$$

$$= \begin{bmatrix} 1 & 0 & 5/114 & -19/114 \\ 0 & 114 & -19 & 95 \end{bmatrix}$$

$$R2 = R2 / 114$$

$$\begin{bmatrix} 1 & 0 & 5/114 & -19/114 \\ 0 & 1 & -19/114 & 95/114 \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} 5/114 & -19/114 \\ -19/114 & 95/114 \end{bmatrix}$$

$$\begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 95 & 19 \\ 19 & 5 \end{bmatrix}^{-1} \begin{bmatrix} 138 \\ 28 \end{bmatrix}$$

$$\begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 5/114 & -19/114 \\ -19/114 & 95/114 \end{bmatrix} \begin{bmatrix} 138 \\ 28 \end{bmatrix}$$

$$= \begin{bmatrix} \frac{5}{114} \times 138 - \frac{19}{114} \times 28 \\ \frac{-19}{114} \times 138 + \frac{95}{114} \times 28 \end{bmatrix}$$

$$\begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 79/57 \\ 19/57 \end{bmatrix}$$

$$\begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 1.38 \\ 0.33 \end{bmatrix}$$

$$\hat{Y} = 1.38x + 0.33$$

$\Sigma |y-\hat{y}|$

SSE $\Sigma (y-\hat{y})^2$

X	Y	$\hat{Y} = 1.38x + 0.33$	$y-\hat{y}$ Error
1	2	1.71	0.29
2	3	3.09	−0.09
4	7	5.85	1.15
5	5	7.23	−2.23
7	11	9.9	1.1

$\Sigma \approx 0.2$

Error Metrics of Regression

Mean Squared Error (MSE)

range $0 - \infty$

$$= \frac{\Sigma (y - \hat{y})^2}{n}$$

Mean Absolute Error (MAE)

range $0 - \infty$

$$= \frac{\Sigma |y - \hat{y}|}{n}$$

Root Mean Squared Error (RMSE)

range $0 - \infty$

$$\sqrt{\frac{\Sigma (y - \hat{y})^2}{n}}$$

Mean Absolute Percentage Error (MAPE)

$$\frac{\sum \left| \frac{y - \hat{y}}{y} \right| \times 100\%}{n}$$

range 0 - 100

there an instance error may explode

1 ... 999 ... 1000

R^2 - Co-efficient of Determination

How much of the X is telling about Y

90 → x is telling 90% of Y

10 → x is telling 10% of Y

$$R^2 = 1 - \frac{\sum (y - \hat{y})^2}{\sum (y - \bar{y})^2}$$