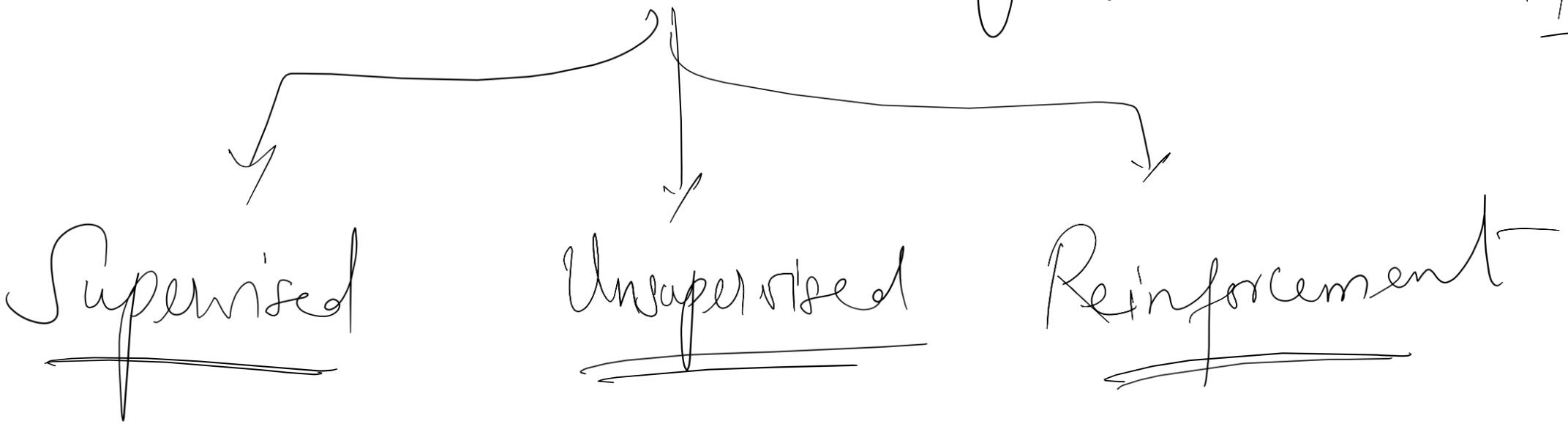
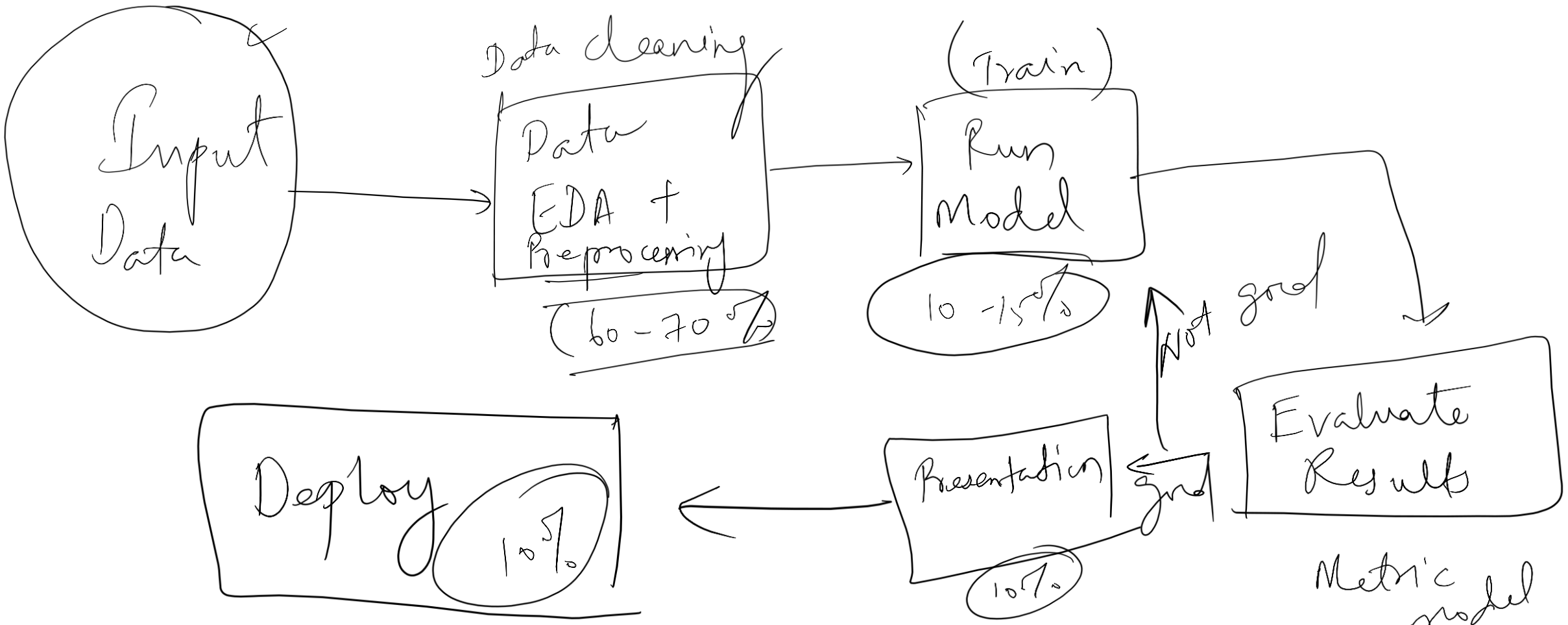
What is Machine Learning ?

12/07



Supervised

GIGO →



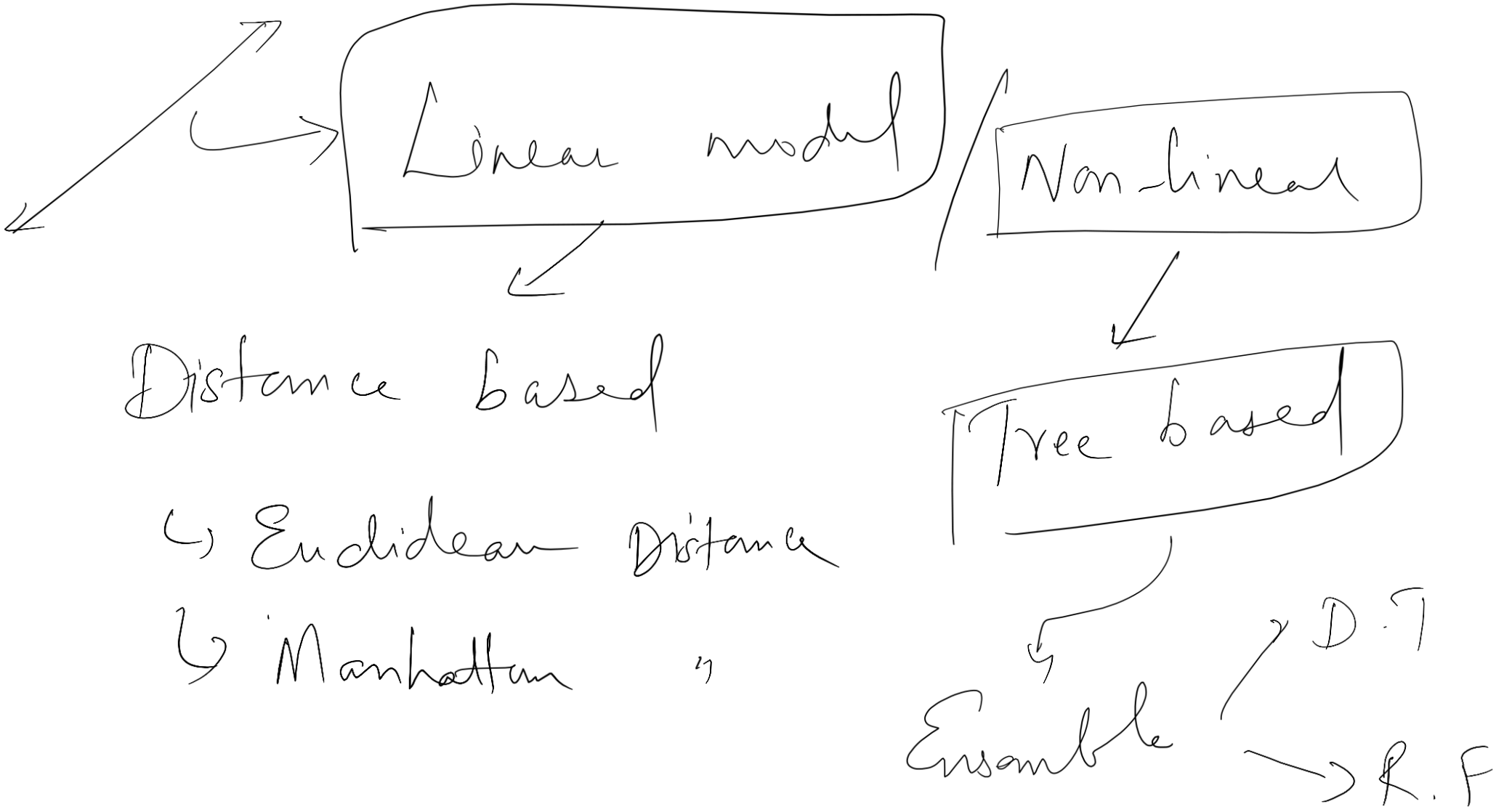
Data Input → Read → Sources

- → Flat, json
- → Excel, csv, delimited, pkl
- → DB → read_sql

Data cleaning:

'Move the better'

- EDA → Exploratory Data Analysis
- Pre-processing
  - null value → Imputation
  - Encoding
    - ① Label Encode
    - ② OHE
    - Pf should only contain 'numbers'
  - Scaling (Min Max scalar) ✗
  - Standardization (Std_scalar)


Linear model
Non-linear
Distance based
↳ Euclidean Distance
↳ Manhattan "
Tree based
Ensemble
D.T
R.F

Modeling:

Supervised Learning

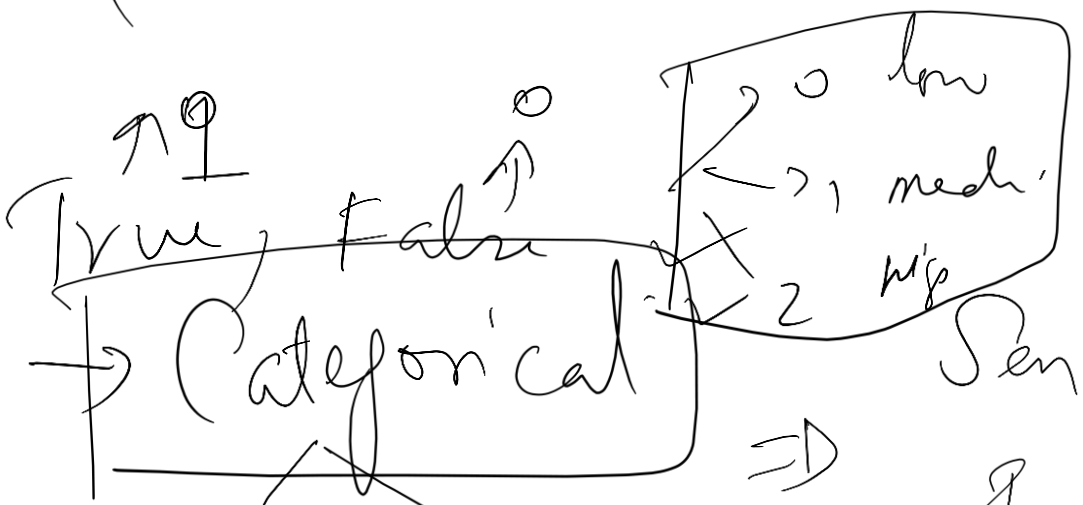
Target

→ Continuous (0 ..... ∞) ⇒

- Demand forecasting
- Weather forecasting
- Price prediction → House
  → Price elasticity

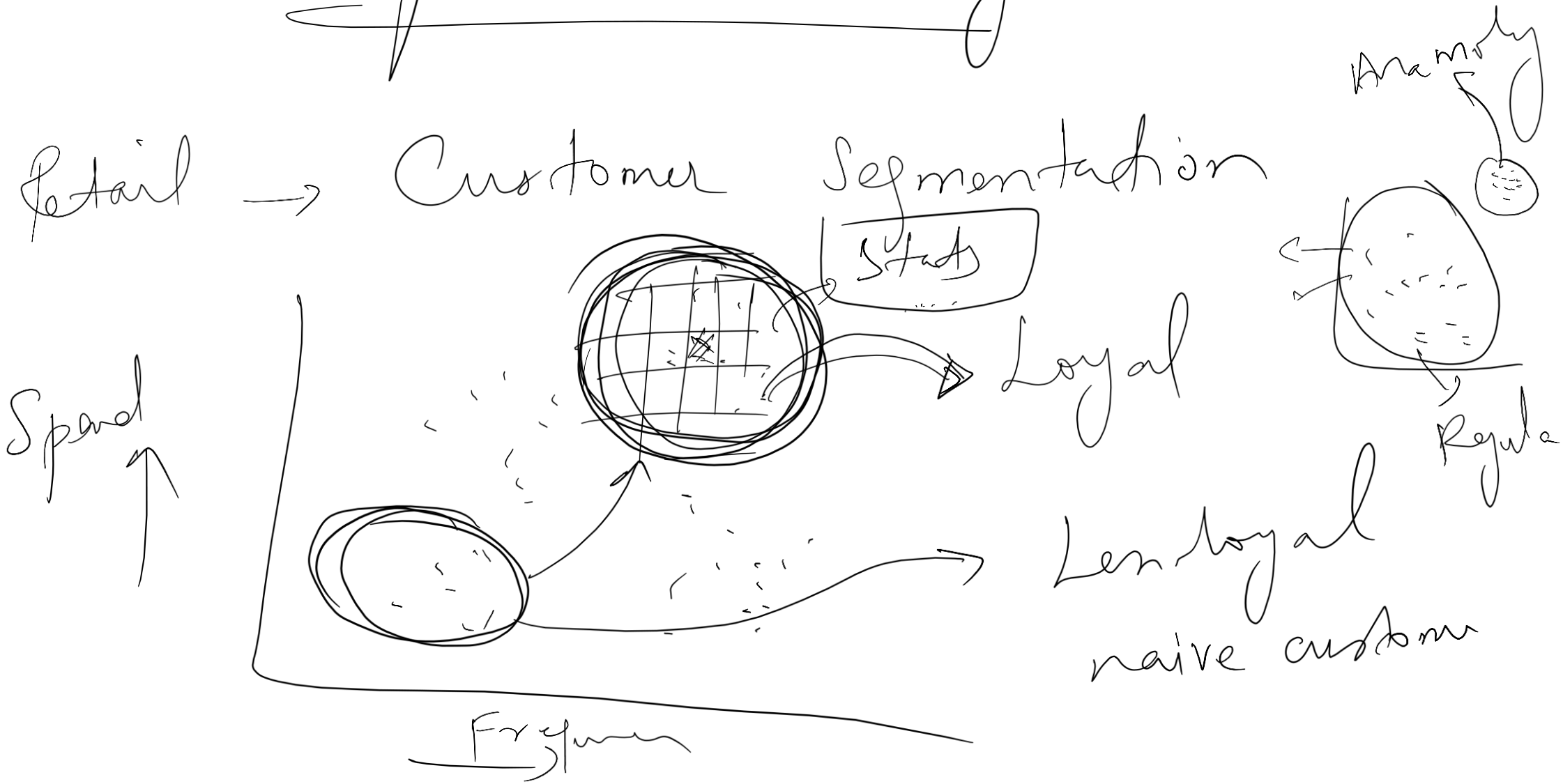
→ Categorical ⇒

- Sentiment Analysis
- Image classification → CV
- ⇒ Fraud detection, Spam filtering



Unsupervised Learning:

Retail → Customer Segmentation



Reinforcement Learning:

- State of Reward
- Learn & improve
- App:- Gaming & Robotics

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$Y = 3X + 2$

Y → Model

2 → Intercept (constant)

3 → Slope (Coeff.)

X → Input

X	Y
2	8
6	20
4	14
3	11
7	23
4	14
2	8
5	17
10	32
1	5

X → i/p variable

Y → Target variable

Y = ?

70%

.fit

$$y = mx + b$$

$$= mx + c \rightarrow \text{Slope (Coeff of } x\text{)}$$

$$= \boxed{b_0} + b_1 x \rightarrow \text{Input variable}$$

$\rightarrow$ Intercept

Equation of a straight line

Intercept → The point where the line meets/ cuts/ crosses the 'y' axis

Slope →
① If we increase the magnitude of slope, the slope gets steeper (vice versa)

② Changing the sign of the slope, changes the direction of slope

x_1 y_1 $\quad$ x_2 y_2

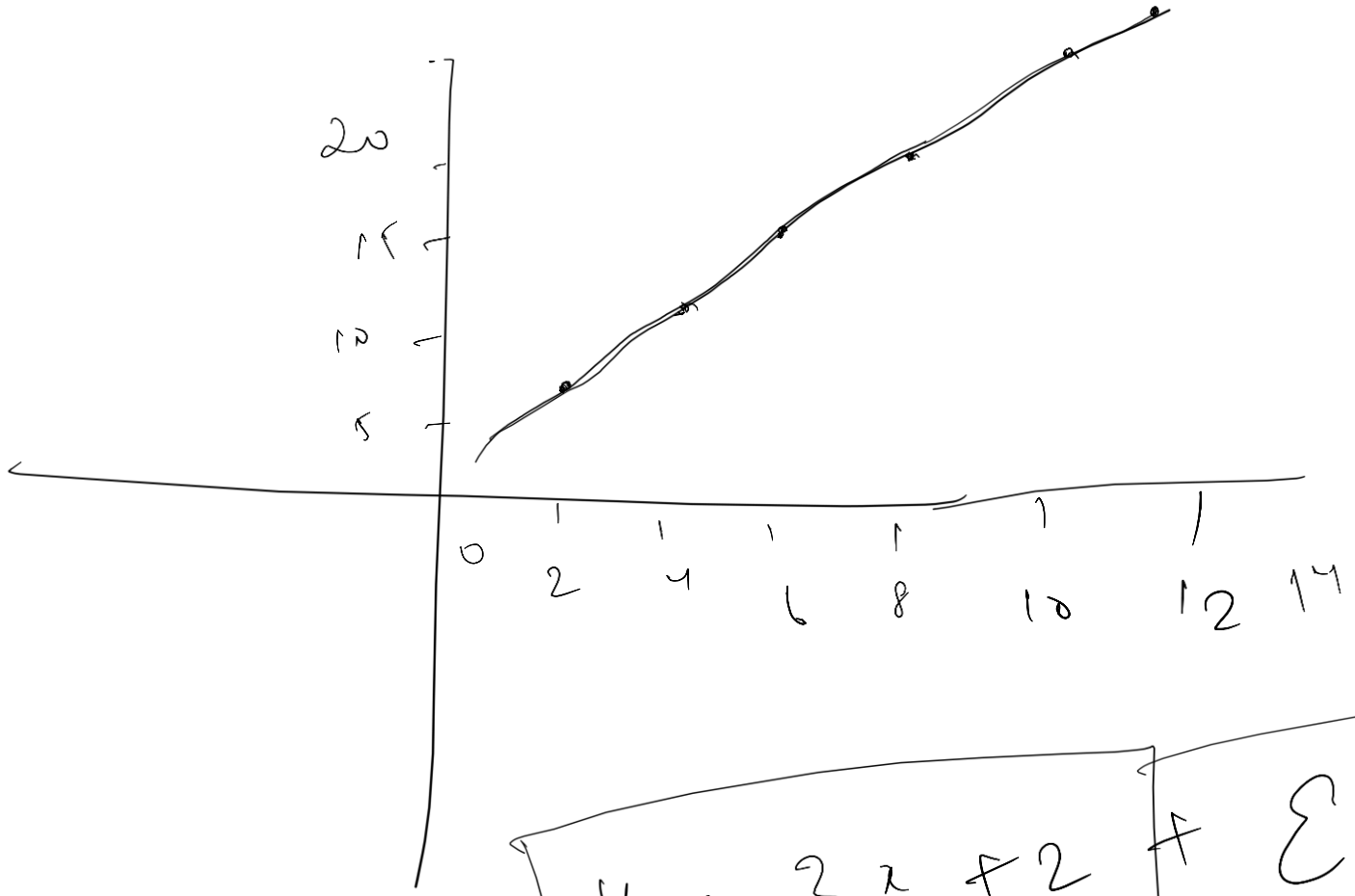
$(0, 2) \quad (-0.667, 0)$

$\Delta \rightarrow$ Delta

Slope : $\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 2}{-0.667 - 0}$

$= \frac{-2}{-0.667}$

$= \sim 3$

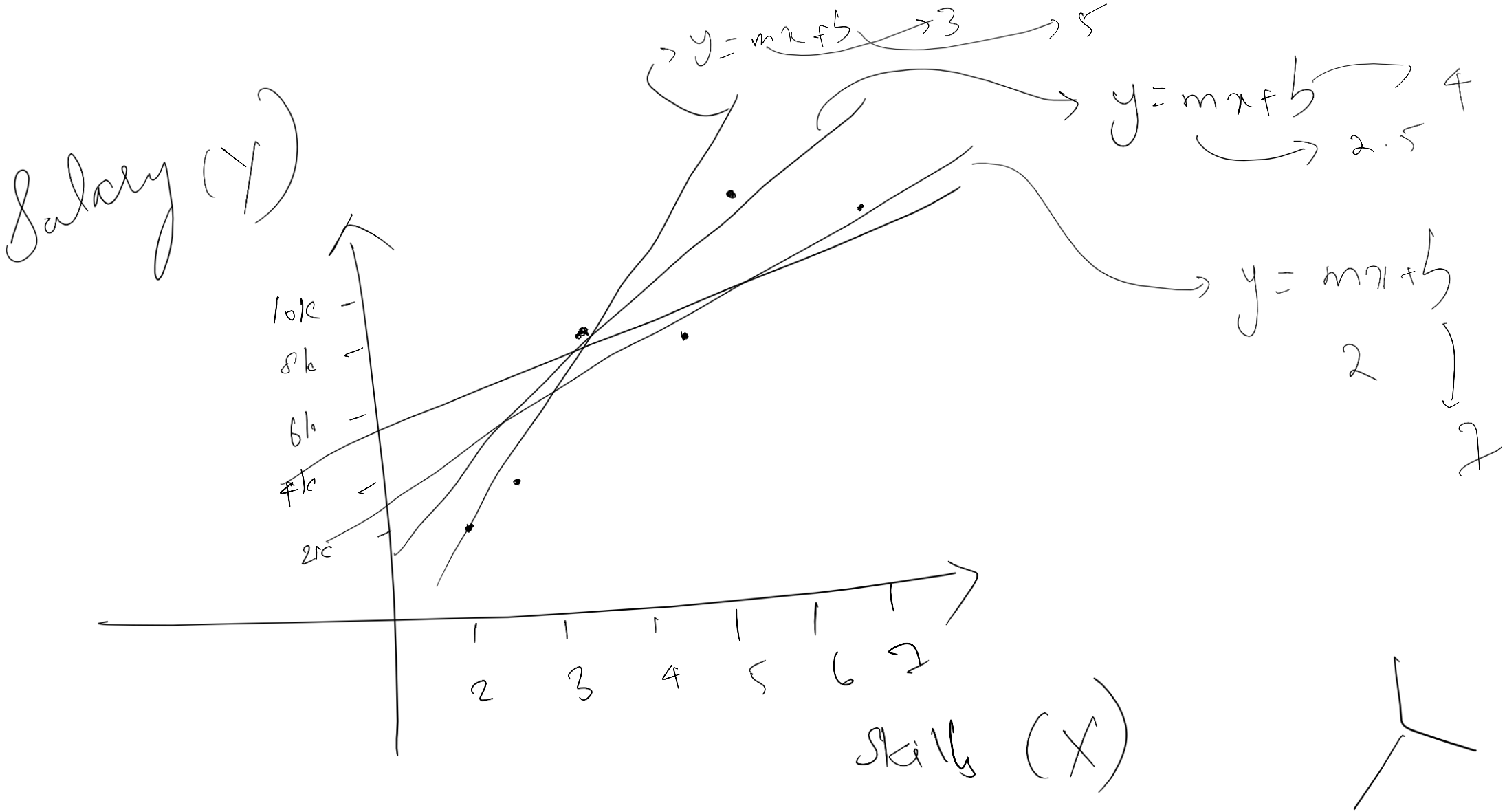


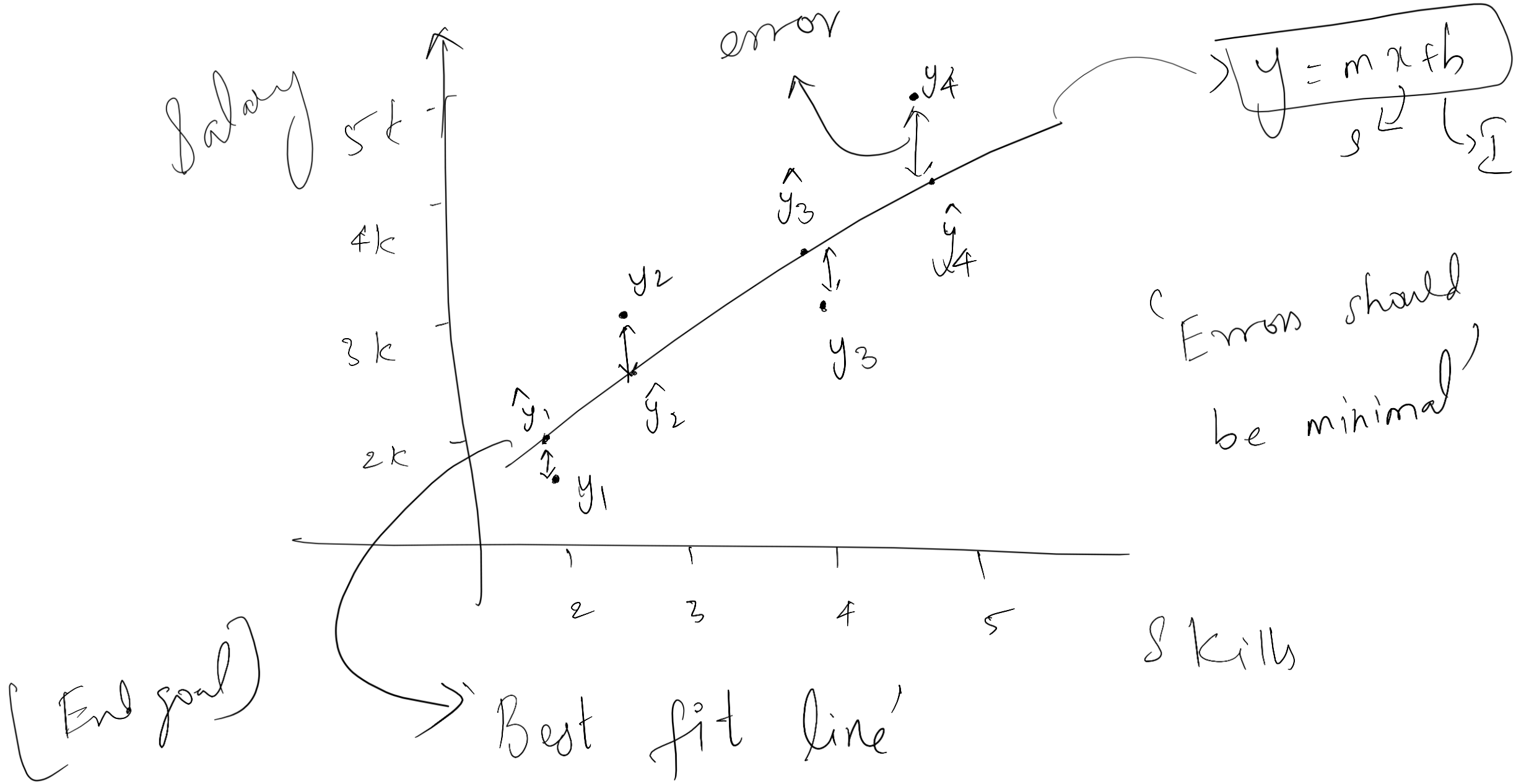
$y = 3x + 2 + \varepsilon$

ε → (0 zero)

ε → (Error)

MSE → Best fit Line


Salary (Y)
y = mx + b
3
5
y = mx + b
4
2.5
y = mx + b
2
7
10k
8k
6k
4k
2k
2
3
4
5
6
7
Skills (X)


Salary
5k
4k
3k
2k
error
y_4
$\hat{y}_3$
$\hat{y}_4$
y_2
$\hat{y}_2$
y_3
$\hat{y}_1$
y_1
1
2
3
4
5
Skills
$y = m x + b$
s
I
'Errors should be minimal'
(End goal)
'Best fit line'

$y_1, y_2, y_3, y_4 \dots y_n \longrightarrow$ Actual

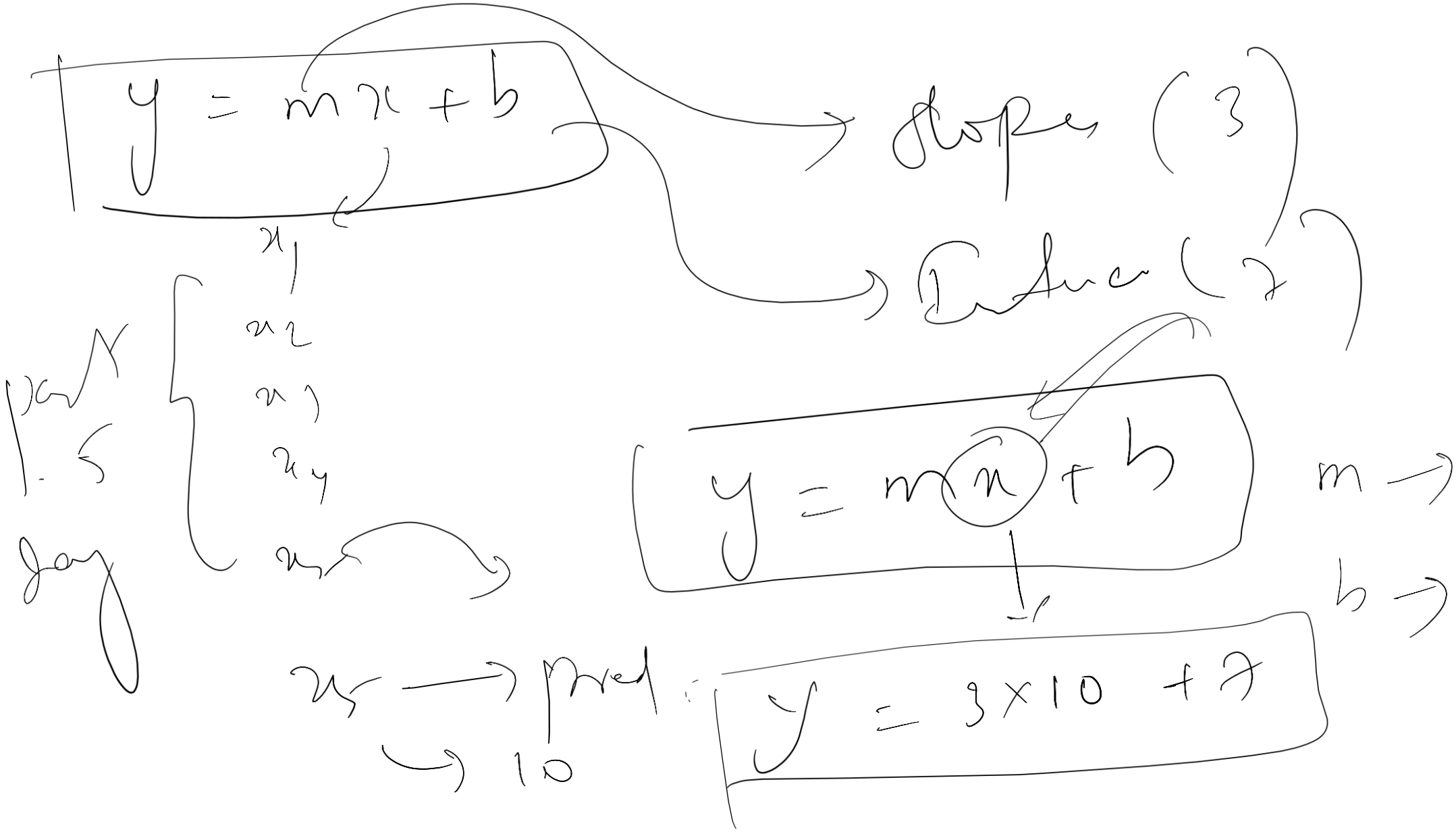
$\hat{y}_1, \hat{y}_2, \hat{y}_3 \dots \hat{y}_n \longrightarrow$ Pred

$$MSE \Rightarrow \frac{\sum_{i=1}^{n} (y_i - \hat{y}_i)^2}{n} \longrightarrow \text{Error}$$

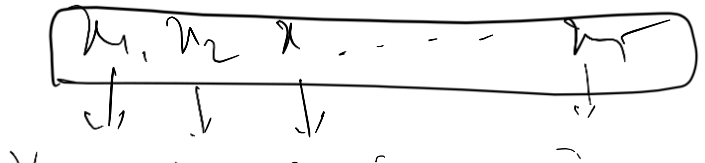
MAPE (0 - 100)

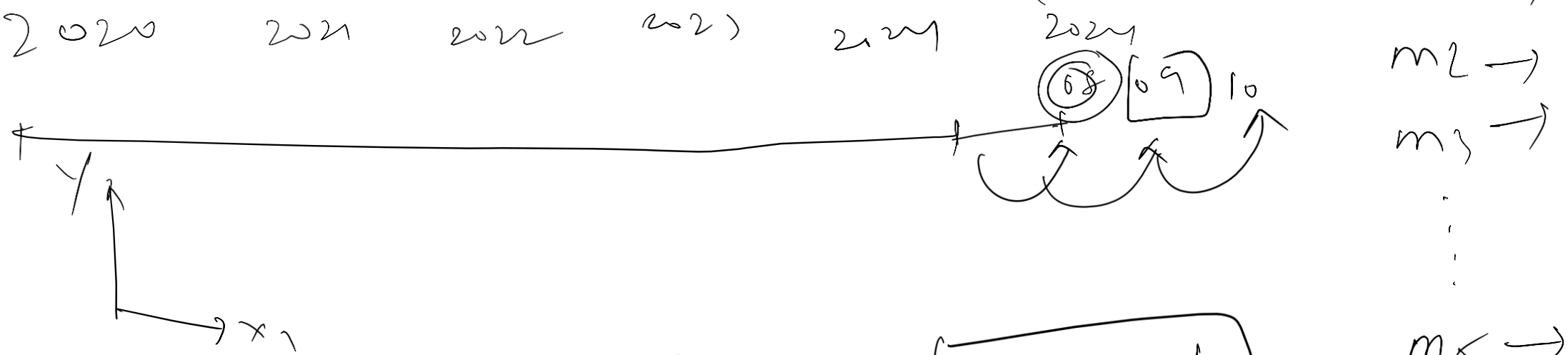
Mean Squared Error $\longrightarrow$ Minimal MSE

MAE $\longrightarrow$ Mean Absolute Error $\left[\frac{\sum |y_i - \hat{y}_i|}{n}\right] \times 100$


y = mx + b
slope (3
Intercept (7
x1
x2
x3
x4
x5
y = mx + b
m →
b →
y = 3x10 + 7
x5 → pred
→ 10

$12 \times 5 = 60$



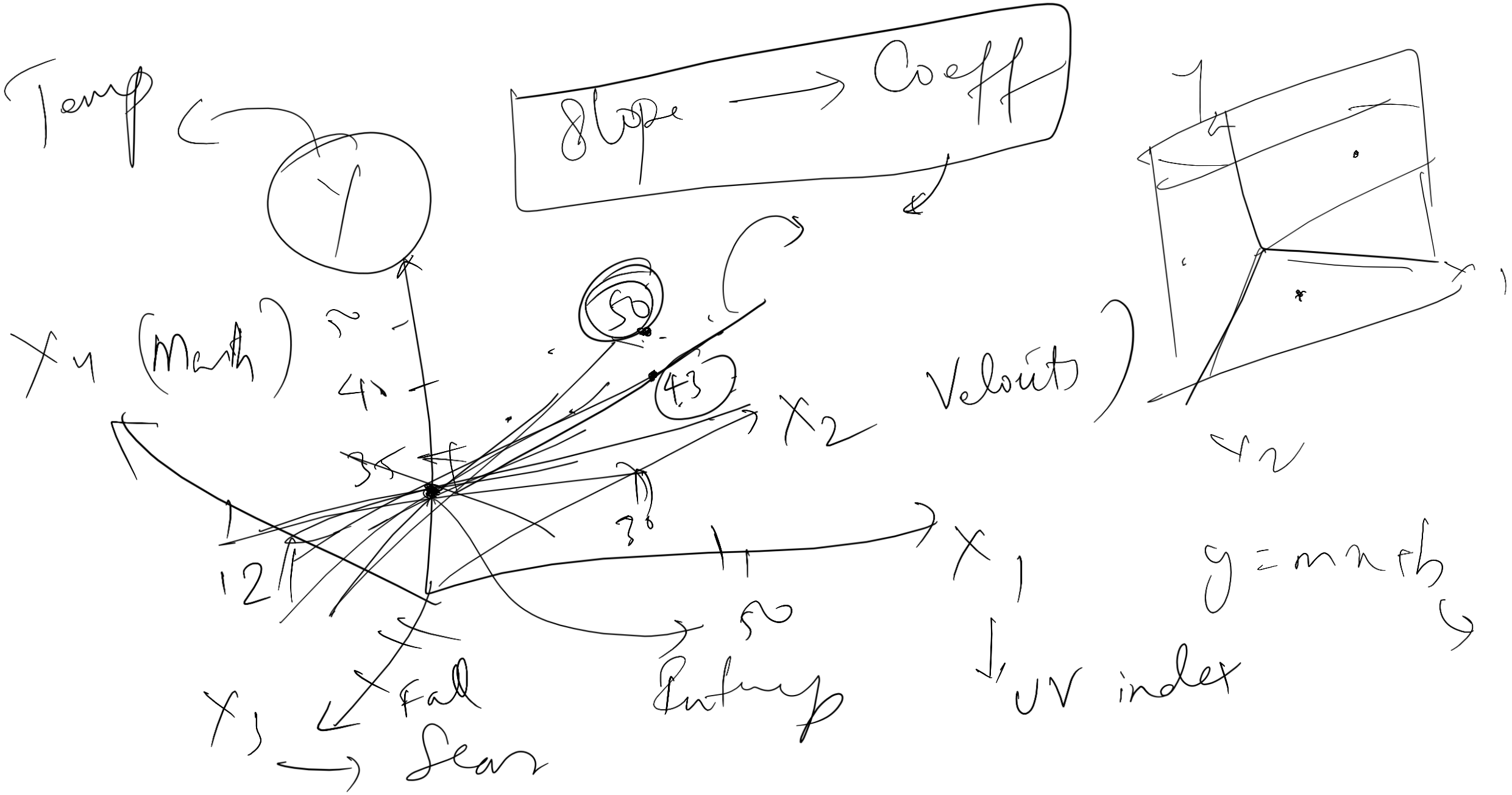


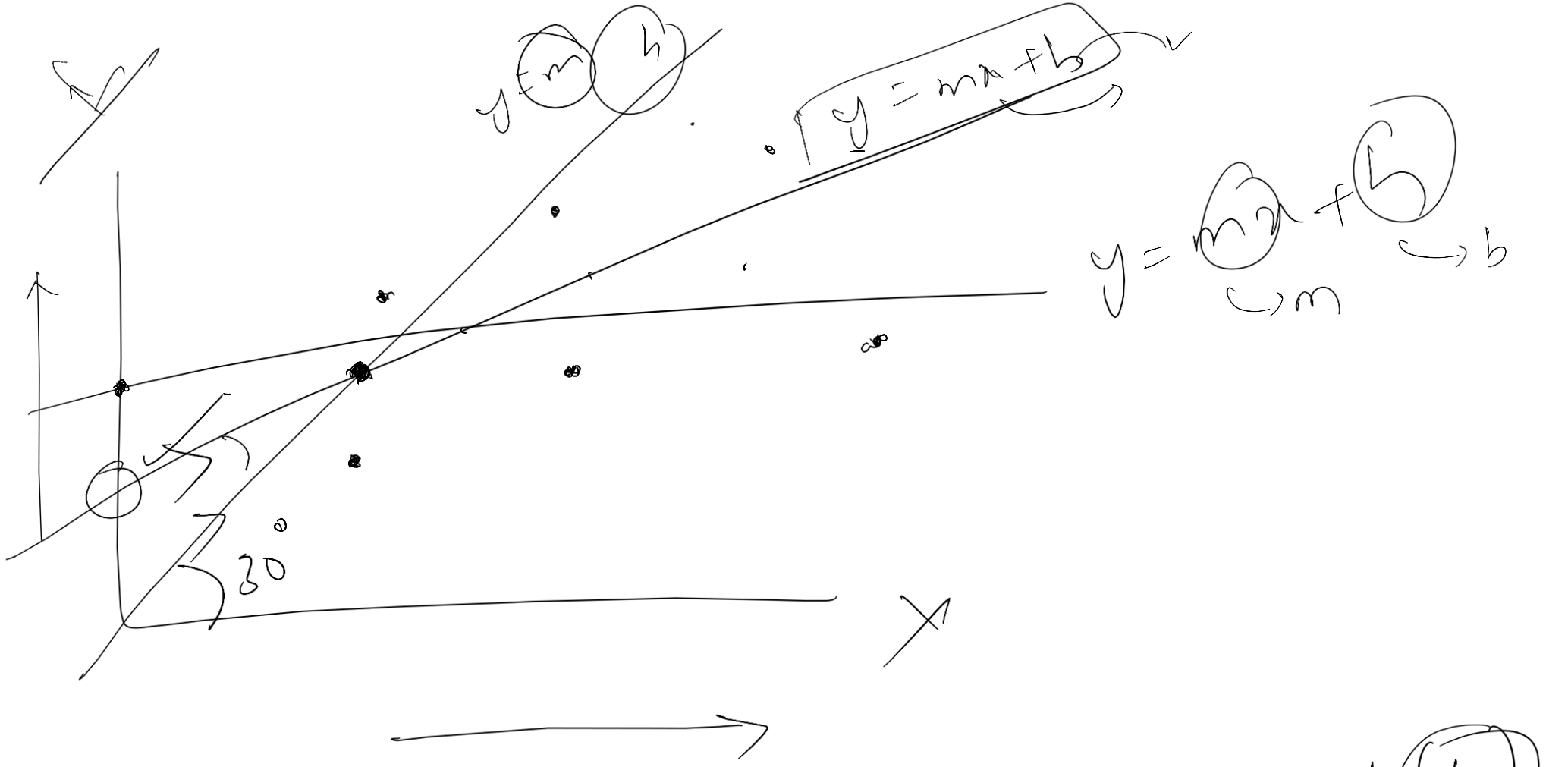
$y \rightarrow$ Temperature

$y = mx + b$

$y = m_1x_1 + m_2x_2 + m_3x_3 + m_4x_4 + m_5x_5 + b$ → Intercept

0.4 1.5 0.3 W 2.2


Temp
Slope → Coeff
X4 (Month)
X2
Velocity
X1
UV index
y = mx+b
X3
Fall
Season
Entropy
12
35
41
43
50
30



Objective: Find the slope (m) & Intercept (b)

hint: A Best fit line will cross the 'centroid'

(x_1, y_1) (x_2, y_2) (x_3, y_3) (x_4, y_4)

$$\left(\frac{x_1 + x_2 + x_3 + x_4}{4}, \frac{y_1 + y_2 + y_3 + y_4}{4} \right)$$

$(7, 4)$

$x + 2y = 5 \longrightarrow (1)$

$x + 3y = 10 \longrightarrow (2)$

$(-) \quad (-) \quad (-)$

$-y = -5$

$y = 5$

Find x & y ?

$x + 2y = 5$

$x + 2(5) = 5$

$x + 10 = 5$

$x = -5$

$1x + 2y = 5$

$2x + y = 10$

"Linear Algebra"

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

X $\quad$ θ $\quad$ Y

Mathematical adjustment

Apply X transpose on both side (LHS, RHS)

$$X\theta = Y$$

$$X^T \cdot X\theta = X^T \cdot Y$$

$$\theta = \frac{1}{X^T \cdot X} \cdot X^T Y$$

$\theta \rightarrow m$, b

Normal Eqn $\leftarrow$ $\theta = (X^T \cdot X)^{-1} \cdot X^T Y$

	X	Y
①	1	2
②	2	3
③	3	5

$$y = b \cdot 1 + m x$$

$$X = \begin{bmatrix} 1 & x_1 \\ 1 & x_2 \\ 1 & x_3 \end{bmatrix} \qquad y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix}$$

$$X \qquad \theta \qquad y$$

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

$$2 = 1b + 1m$$

$$3 = 1b + 2m$$

$$5 = 1b + 3m$$

$$X\theta = Y$$

$$X = \begin{bmatrix} 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{bmatrix} \quad X^T = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \end{bmatrix}$$

$$\theta = \begin{bmatrix} b \\ m \end{bmatrix} \quad Y = \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix}$$

$$\boxed{X^T \cdot X\theta = X^T \cdot Y}$$

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{bmatrix} \theta = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \end{bmatrix} \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix}$$

$$\begin{bmatrix} 1+1+1 & 1+2+3 \\ 1+2+3 & 1+4+9 \end{bmatrix} \theta = \begin{bmatrix} 2+3+5 \\ 2+6+15 \end{bmatrix}$$

$$\begin{bmatrix} 3 & 6 \\ 6 & 14 \end{bmatrix} \theta = \begin{bmatrix} 10 \\ 23 \end{bmatrix}$$

$$\theta = \begin{bmatrix} 3 & 6 \\ 6 & 14 \end{bmatrix}^{-1} \cdot \begin{bmatrix} 10 \\ 23 \end{bmatrix}$$

formula to convert the inverse =

$$\frac{1}{|A|} (\text{adj } A)$$

$|A| \rightarrow$ Difference of diagonal multiplication

$$\begin{bmatrix} 3 & 6 \\ 6 & 14 \end{bmatrix} = |A| \Rightarrow 42 - 36$$

$$|A| = 6$$

$$\begin{bmatrix} 3 & 6 \\ 6 & 14 \end{bmatrix} \Rightarrow \text{adj } A = \begin{bmatrix} 14 & -6 \\ -6 & 3 \end{bmatrix}$$

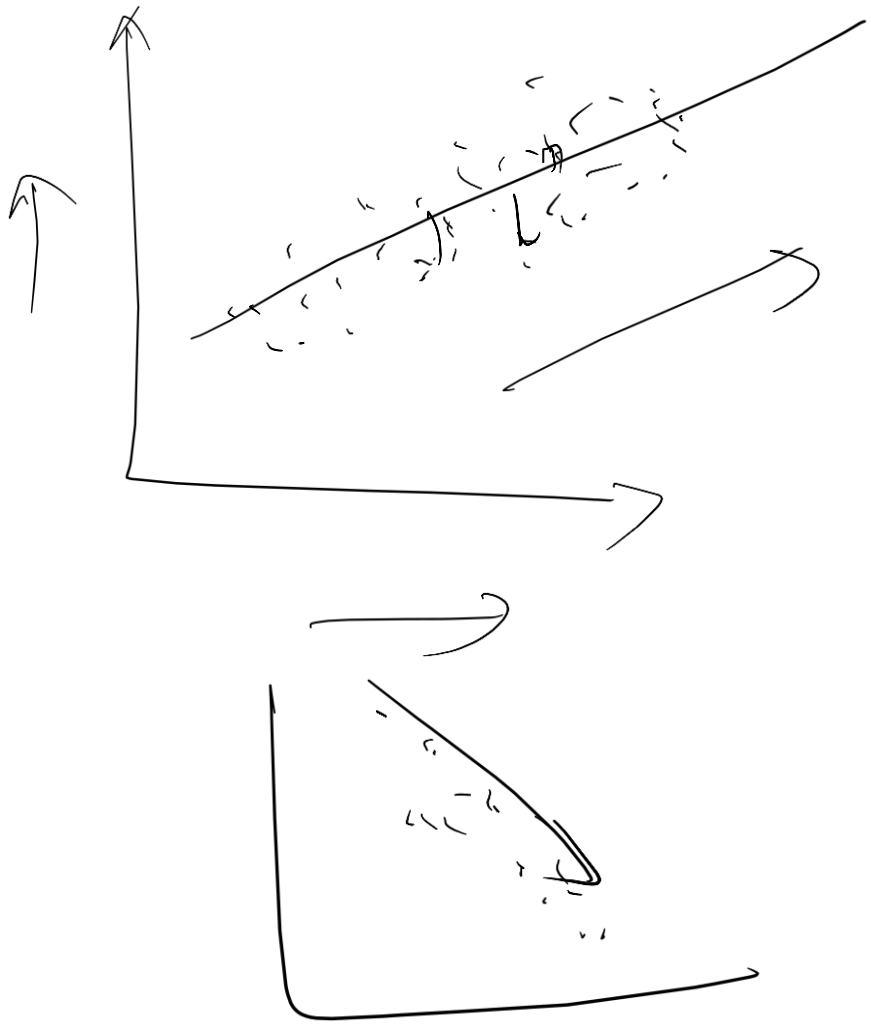
$$\frac{1}{6} \cdot \begin{bmatrix} 14 & -6 \\ -6 & 3 \end{bmatrix} = \begin{bmatrix} 14/6 & -6/6 \\ -6/6 & 3/6 \end{bmatrix} = \begin{bmatrix} 2.33 & -1 \\ -1 & 0.5 \end{bmatrix}$$

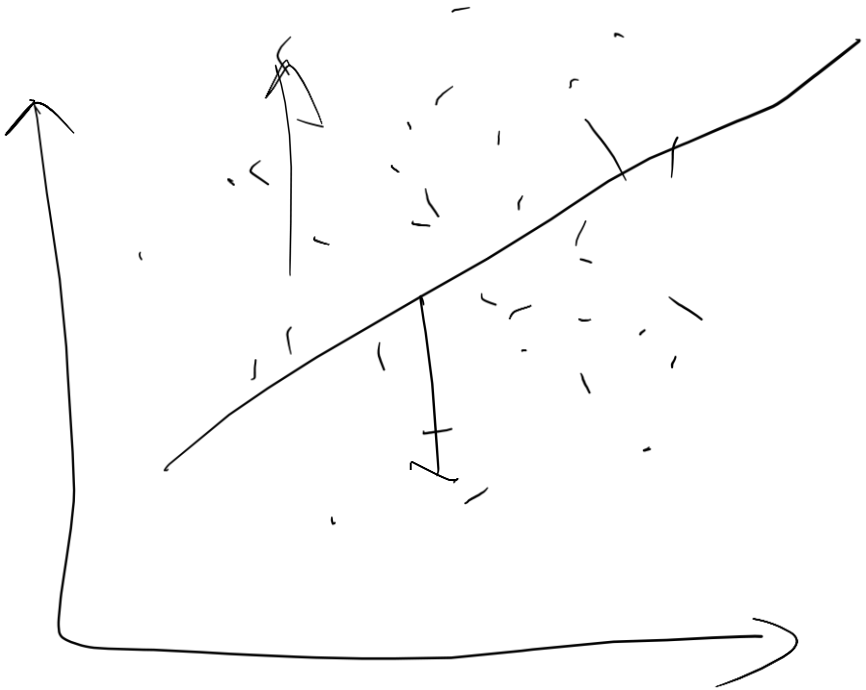
$$\theta = \begin{bmatrix} 2.33 & -1 \\ -1 & 0.5 \end{bmatrix} \begin{bmatrix} 10 \\ 23 \end{bmatrix}$$

$$= \begin{bmatrix} 23.33 - 23 \\ -10 + 11.5 \end{bmatrix} = \begin{bmatrix} 0.33 \\ 1.5 \end{bmatrix}$$

$$\boxed{b = 0.33 \quad ; \quad m = 1.5}$$

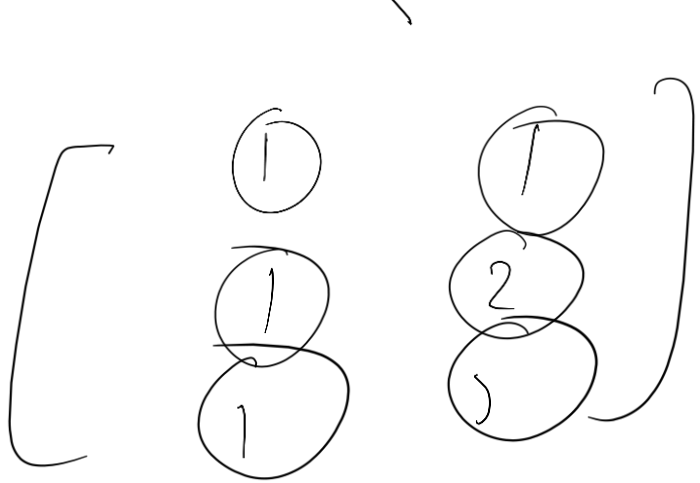
$$y = mx + b \Rightarrow 1.5x + 0.33$$

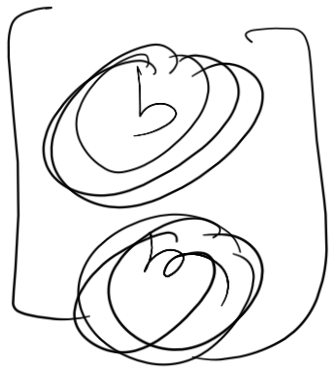




$$X \cdot \theta = Y$$

2D





→ 1D

$3 \times \boxed{2 \quad 2 \times 1}$

(3×1)

$$y = mx + b$$

$$m_1 \vec{x_1} + m_2 \vec{x_2} + b$$

$$\begin{bmatrix} 1 & 1 & 4 \\ 1 & 2 & 5 \\ 1 & 3 & 6 \end{bmatrix} \begin{bmatrix} b \\ m_1 \\ m_2 \end{bmatrix} = \begin{bmatrix} 5 \\ 7 \\ 9 \end{bmatrix}$$

x_1 x_2

(3×3) (3×1)

3×1